

UNIVERSITY OF MUMBAI



Revised syllabus (Rev- 2016) from Academic Year 2016 -17
Under

FACULTY OF TECHNOLOGY

Mechanical Engineering

Second Year with Effect from AY 2017-18

Third Year with Effect from AY 2018-19

Final Year with Effect from AY 2019-20

As per Choice Based Credit and Grading System
with effect from the AY 2016–17.

Co-ordinator, Faculty of Technology Preamble:

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEOs) and give freedom to affiliated Institutes to add few (PEOs). It is also resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Choice based Credit and Grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

Choice based Credit and grading system is implemented from the academic year 2016-17 through optional courses at department and institute level. This will be effective for SE, TE and BE from academic year 2017-18, 2018-19 and 2019-20 respectively.

Dr. S. K. Ukarande

Co-ordinator,

Faculty of Technology,

Member - Academic Council

University of Mumbai, Mumbai

Chairman's Preamble:

Engineering education in India is expanding and is set to increase manifold. The major challenge in the current scenario is to ensure quality to the stakeholders along with expansion. To meet this challenge, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education and reflects the fact that in achieving recognition, the institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of graduation from the program. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating the philosophy of outcome based education in the process of curriculum development.

As the Chairman, Board of Studies in Mechanical Engineering of the University of Mumbai, I am happy to state here that, the Program Educational Objectives for Undergraduate Program were finalized in a brainstorming sessions, which was attended by more than 40 members from different affiliated Institutes of the University. They are either Heads of Departments or their senior representatives from the Department of Mechanical Engineering. The Program Educational Objectives finalized for the undergraduate program in Mechanical Engineering are listed below;

1. To prepare the Learner with a sound foundation in the mathematical, scientific and engineering fundamentals
2. To motivate the Learner in the art of self-learning and to use modern tools for solving real life problems
3. To inculcate a professional and ethical attitude, good leadership qualities and commitment to social responsibilities in the Learner's thought process
4. To prepare the Learner for a successful career in Indian and Multinational Organisations

In addition to Program Educational Objectives, for each course of the program, objectives and expected outcomes from a learner's point of view are also included in the curriculum to support the philosophy of outcome based education. I strongly believe that even a small step taken in the right direction will definitely help in providing quality education to the major stakeholders.

Dr. S. M. Khot

Chairman, Board of Studies in Mechanical Engineering, University of Mumbai

**Program Structure for
B.E. in Mechanical Engineering
University of Mumbai
(With Effect from 2017-2018)**

Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned					
		Theory	Pract	Theory	Pract	Total			
MEC301	Applied Mathematics III**	04	--	04	--	04			
MEC302	Thermodynamics*	04	--	04	--	04			
MEC303	Strength of Materials*	04	--	04	--	04			
MEC304	Production Process I*	04	--	04	--	04			
MEC305	Material Technology*	03	--	03	--	03			
MEL301	Computer Aided Machine Drawing*	--	2 ^s +4	--	03	03			
MEL302	Strength of Material*	--	02	--	01	01			
MEL303	Material Technology*	--	02	--	01	01			
MEL304	Machine Shop Practice I*	--	04	--	02	02			
Total		19	14	19	07	26			
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
MEC301	Applied Mathematics III**	20	20	20	80	03	--	--	100
MEC302	Thermodynamics*	20	20	20	80	03	--	--	100
MEC303	Strength of Materials*	20	20	20	80	03	--	--	100
MEC304	Production Process I*	20	20	20	80	03	--	--	100
MEC305	Material Technology*	20	20	20	80	03	--	--	100
MEL301	Computer Aided Machine Drawing*	--	--	--	--	--	50	50	100
MEL302	Strength of Material*	--	--	--	--	--	25	25	50
MEL303	Material Technology*	--	--	--	--	--	25	--	25
MEL304	Machine Shop Practice I*	--	--	--	--	--	50	--	50
Total				100	400		150	75	725

* Common with Automobile Engineering

** Common with Automobile Engineering, Production Engineering and Civil Engineering

\$ Theory for entire class to be conducted

Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned						
		Theory	Pract	Theory	Pract	Total				
MEC401	Applied Mathematics IV**	04	--	04	--	04				
MEC402	Fluid Mechanics*	04	--	04	--	04				
MEC403	Industrial Electronics*	03	--	03	--	03				
MEC404	Production Process II*	04	--	04	--	04				
MEC405	Kinematics of Machinery*	04	--	04	--	04				
MEL401	Data Base and Information Retrieval*	--	2 ^{\$} +2	--	02	02				
MEL402	Fluid Mechanics*	--	02	--	01	01				
MEL403	Industrial Electronics*	--	02	--	01	01				
MEL404	Kinematics of Machinery*	--	02	--	01	01				
MEL405	Machine Shop Practice II*	--	04	--	02	02				
Total		19	14	19	07	26				
Course Code	Course Name	Examination Scheme								
		Theory					Exam Duration (Hrs)	Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam					
		Test1	Test 2	Avg						
MEC401	Applied Mathematics IV**	20	20	20	80	03	--	--	100	
MEC402	Fluid Mechanics*	20	20	20	80	03	--	--	100	
MEC403	Industrial Electronics*	20	20	20	80	03	--	--	100	
MEC404	Production Process II*	20	20	20	80	03	--	--	100	
MEC405	Kinematics of Machinery*	20	20	20	80	03	--	--	100	
MEL401	Data Base and Information Retrieval*	--	--	--	--	--	50	50	100	
MEL402	Fluid Mechanics*	--	--	--	--	--	25	25	50	
MEL403	Industrial Electronics*	--	--	--	--	--	25	25	50	
MEL404	Kinematics of Machinery*	--	--	--	--	--	25	--	25	
MEL405	Machine Shop Practice II*	--	--	--	--	--	50	50	100	
Total				100	400		175	150	825	

* Common with Automobile Engineering

** Common with Automobile Engineering, Production Engineering and Civil Engineering

\$ Theory for entire class to be conducted

Semester V

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned						
		Theory	Pract	Theory	Pract	Total				
MEC501	Internal Combustion Engines*	04	--	04	--	04				
MEC502	Mechanical Measurements and Control*	04	--	04	--	04				
MEC503	Heat Transfer*	04	--	04	--	04				
MEC504	Dynamics of Machinery	04	--	04	--	04				
MEDLO 501X	Department Level Optional Course I	04	--	04	--	04				
MEL501	Internal Combustion Engines	--	02	--	01	01				
MEL502	Mechanical Measurements and Control	--	02	--	01	01				
MEL503	Heat Transfer	--	02	--	01	01				
MEL504	Dynamics of Machinery	--	02	--	01	01				
MEL505	Manufacturing Sciences Lab	--	02	--	01	01				
MEL506	Business Communication and Ethics	--	02 ^s +02	--	02	02				
Total		20	14	20	07	27				
Course Code	Course Name	Examination Scheme								
		Theory					Exam Duration (Hrs)	Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam					
		Test1	Test 2	Avg						
MEC501	Internal Combustion Engines	20	20	20	80	03	--	--	100	
MEC502	Mechanical Measurements and Control	20	20	20	80	03	--	--	100	
MEC503	Heat Transfer	20	20	20	80	03	--	--	100	
MEC504	Dynamics of Machinery	20	20	20	80	03	--	--	100	
MEDLO 501X	Department Level Optional Course I	20	20	20	80	03	--	--	100	
MEL501	Internal Combustion Engines	--	--	--	--	--	25	25	50	
MEL502	Mechanical Measurements and Control	--	--	--	--	--	25	25	50	
MEL503	Heat Transfer	--	--	--	--	--	25	25	50	
MEL504	Dynamics of Machinery	--	--	--	--	--	25	25	50	
MEL505	Manufacturing Sciences Lab	--	--	--	--	--	25	--	25	
MEL506	Business Communication and Ethics	--	--	--	--	--	50	--	50	
Total				100	400		175	100	775	

[§]Theory classes shall be conducted for entire class

Course Code	Department Level Elective Course I
MEDLO5011	Press Tool Design
MEDLO5012	Machining Sciences and Tool Design
MEDLO5013	Design of Jigs and Fixtures

Semester VI

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract	Theory	Pract	Total
MEC601	Metrology and Quality engineering	04	--	04	--	04
MEC602	Machine Design I	04	--	04	--	04
MEC603	Finite Element analysis	04	--	04	--	04
MEC604	Refrigeration and Air Conditioning	04	--	04	--	04
MEDLO 602X	Department Level Optional Course II	04	--	04	--	04
MEL601	Metrology and Quality Engineering	--	02	--	01	01
MEL602	Machine Design I	--	02	--	01	01
MEL603	Finite Element Analysis	--	02	--	01	01
MEL604	Refrigeration and Air Conditioning	--	02	--	01	01
MEL605	Mechatronics Lab	--	02	--	01	01
Total		20	10	20	05	25

Course Code	Course Name	Examination Scheme								
		Theory					Exam Duration (Hrs)	Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam					
		Test1	Test 2	Avg						
MEC601	Metrology and Quality engineering	20	20	20	80	03	--	--	100	
MEC602	Machine Design I	20	20	20	80	03	--	--	100	
MEC603	Finite Element Analysis	20	20	20	80	03	--	--	100	
MEC604	Refrigeration and Air Conditioning	20	20	20	80	03	--	--	100	
MEDLO 602X	Department Level Optional Course II	20	20	20	80	03	--	--	100	
MEL601	Metrology and Quality engineering	--	--	--	--	--	25	25	50	
MEL602	Machine Design I	--	--	--	--	--	25	--	25	
MEL603	Finite Element analysis	--	--	--	--	--	25	25	50	
MEL604	Refrigeration and Air Conditioning	--	--	--	--	--	25	25	50	
MEL605	Mechatronics Lab	--	--	--	--	--	25	25	50	
Total				100	400		125	100	725	

Course Code	Department Level Optional Course II
MEDLO6021	Mechatronics
MEDLO6022	Robotics
MEDLO6023	Industrial Automation

Semester VII

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract	Theory	Pract	Total
MEC701	Machine Design II	04	--	04	--	04
MEC702	CAD/CAM/CAE	04	--	04	--	04
MEC703	Production Planning and Control	04	--	04	--	04
MEDLO 703X	Department Level Optional Course III	04	--	04	--	04
ILO701X	Institute Level Optional Course I [#]	03	--	03	--	03
MEL701	Machine Design II	--	02	--	01	01
MEL702	CAD/CAM/CAE	--	02	--	01	01
MEL703	Production Planning and Control	--	02	--	01	01
MEL704	Project I	--	06	--	03	03
Total		19	12	19	06	25

Course Code	Course Name	Examination Scheme								
		Theory					Exam Duration (Hrs)	Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam					
		Test1	Test 2	Avg						
MEC701	Machine Design II	20	20	20	80	03	--	--	100	
MEC702	CAD/CAM/CAE	20	20	20	80	03	--	--	100	
MEC703	Production Planning and Control	20	20	20	80	03	--	--	100	
MEDLO 703X	Department Level Optional Course III	20	20	20	80	03	--	--	100	
ILO701X	Institute Level Optional Course I [#]	20	20	20	80	03	--	--	100	
MEL701	Machine Design II	--	--	--	--	--	25	25	50	
MEL702	CAD/CAM/CAE	--	--	--	--	--	25	25	50	
MEL703	Production Planning and Control	--	--	--	--	--	25	25	50	
MEP701	Project I	--	--	--	--	--	50	--	50	
Total				100	400		125	75	700	

Course Code	Department Level Optional Course III	Course Code	Institute Level Optional Course I [#]
MEDLO7031	Mechanical Vibrations	ILO7011	Product Lifecycle Management
MEDLO7032	Automobile Engineering	ILO7012	Reliability Engineering
MEDLO7033	Pumps, Compressors and Fans	ILO7013	Management Information System
MEDLO7034	Computational Fluid Dynamics	ILO7014	Design of Experiments
		ILO7015	Operation Research
		ILO7016	Cyber Security and Laws
		ILO7017	Disaster Management and Mitigation Measures
		ILO7018	Energy Audit and Management
		ILO7019	Development Engineering

Common with all branches

Semester VIII

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract	Theory	Pract	Total
MEC801	Design of Mechanical Systems	04	--	04	--	04
MEC802	Industrial Engineering and Management	04	--	04	--	04
MEC803	Power Engineering	04	--	04	--	04
MEDLO 804X	Department Level Optional Course IV	04	--	04	--	04
ILO802X	Institute Level Optional Course II [#]	03	--	03	--	03
MEL801	Design of Mechanical Systems	--	02	--	01	01
MEL802	Power Engineering	--	02	--	01	01
MEP801	Project II	--	12	--	06	06
Total		19	16	19	08	27

Course Code	Course Name	Examination Scheme							
		Theory				Exam Duration (Hrs)	Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test 2	Avg					
MEC801	Design of Mechanical Systems	20	20	20	80	03	--	--	100
MEC802	Industrial Engineering and Management	20	20	20	80	03	--	--	100
MEC803	Power Engineering	20	20	20	80	03	--	--	100
MEDLO 804X	Department Level Optional Course IV	20	20	20	80	03	--	--	100
ILO802X	Institute Level Optional Course II [#]	20	20	20	80	03	--	--	100
MEL801	Design of Mechanical Systems	--	--	--	--	--	25	25	50
MEL802	Power Engineering	--	--	--	--	--	25	25	50
MEL803	Project II	--	--	--	--	--	50	100	150
Total				100	400		100	150	750

Course Code	Department Level Elective Course IV	Course Code	Institute Level Elective Course II [#]
MEDLO8041	Power Plant Engineering	ILO8021	Project Management
MEDLO8042	Rapid Prototyping	ILO8022	Finance Management
MEDLO8043	Renewable Energy Systems	ILO8023	Entrepreneurship Development and Management
MEDLO8044	Energy Management in Utility Systems	ILO8024	Human Resource Management
		ILO8025	Professional Ethics and CSR
		ILO8026	Research Methodology
		ILO8027	IPR and Patenting
		ILO8028	Digital Business Management
		ILO8029	Environmental Management

Common with all branches

Course Code	Course Name	Credits
MEC301	Applied Mathematics III**	04

Objectives

1. To provide sound foundation in the mathematical fundamentals necessary to formulate, solve and analyse engineering problems.
2. To study the basic principles of Laplace Transform, Fourier Series, Complex variables.

Outcomes: Learner will be able to...

1. Demonstrate the ability of using Laplace Transform in solving the Ordinary Differential Equations and Partial Differential Equations
2. Demonstrate the ability of using Fourier Series in solving the Ordinary Differential Equations and Partial Differential Equations
3. Solve initial and boundary value problems involving ordinary differential equations
4. Identify the analytic function, harmonic function, orthogonal trajectories
5. Apply bilinear transformations and conformal mappings
6. Identify the applicability of theorems and evaluate the contour integrals.

Module	Detailed Contents	Hrs
1	Laplace Transform 1.1 Function of bounded variation, Laplace Transform of standard functions such as $1, t^n, e^{at}, \sin at, \cos at, \sinh at, \cosh at$ 1.2 Linearity property of Laplace Transform, First Shifting property, Second Shifting property, Change of Scale property of L.T. (without proof) $L\{t^n f(t)\}, L\left\{\frac{f(t)}{t}\right\}, L\left\{\int_0^t f(u)du\right\}, L\left\{\frac{d^n f(t)}{dt^n}\right\}$ Laplace Transform. of Periodic functions 1.3 Inverse Laplace Transform: Linearity property, use of theorems to find inverse Laplace Transform, Partial fractions method and convolution theorem(without proof). 1.4 Applications to solve initial and boundary value problems involving ordinary differential equations with one dependent variable	12
2	Complex variables: 2.1 Functions of complex variable, Analytic function, necessary and sufficient conditions for $f(z)$ to be analytic (without proof), Cauchy-Riemann equations in polar coordinates. 2.2 Milne- Thomson method to determine analytic function $f(z)$ when it's real or imaginary or its combination is given. Harmonic function, orthogonal trajectories 2.3 Mapping: Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations such as Rotation and magnification, inversion and reflection, translation	08
3	Complex Integration: 3.1 Line integral of a function of a complex variable, Cauchy's theorem for analytic functions(without proof)Cauchy's integral formula (without proof))Singularities and poles: 3.2 Taylor's and Laurent's series development (without proof) 3.3 Residue at isolated singularity and its evaluation 3.4 Residue theorem, application to evaluate real integral of type $\int_0^{2\pi} f(\cos \theta, \sin \theta) d\theta, \quad \& \quad \int_{-\infty}^{\infty} f(x) dx$	08
4	Fourier Series: 4.1 Orthogonal and orthonormal functions, Expressions of a function in a series of orthogonal functions. Dirichlet's conditions. Fourier series of periodic function with period 2π and $2l$	10

	4.2 Dirichlet's theorem(only statement), even and odd functions, Half range sine and cosine series,Parseval's identities (without proof) 4.3 Complex form of Fourier series	
5	Partial Differential Equations: 5.1. Numerical Solution of Partial differential equations using Bender-Schmidt Explicit Method, Implicit method (Crank- Nicolson method). 5.2. Partial differential equations governing transverse vibrations of an elastic string its solution using Fourier series. 5.3. Heat equation, steady-state configuration for heat flow 5.4. Two and Three dimensional Laplace equations	09
6	Correlation and curve fitting 6.1. Correlation-Karl Pearson's coefficient of correlation- problems, Spearman's Rank correlation problems, Regression analysis- lines of regression (without proof) –problems 6.2. Curve Fitting: Curve fitting by the method of least squares- fitting of the curves of the form, $y = ax + b$, $y = ax^2 + bx + c$ and $y = ae^{bx}$	05

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

References:

1. Higher Engineering Mathematics, Dr B. S. Grewal, Khanna Publication
2. Advanced Engineering Mathematics, E Kreyszing, Wiley Eastern Limited
3. Higher Engineering Mathematics, B.V. Ramana, McGraw Hill Education, New Delhi
4. Complex Variables: Churchill, Mc-Graw Hill
5. Integral Transforms and their Engineering Applications, Dr B. B. Singh, Synergy Knowledgeware, Mumbai
6. Numerical Methods, Kandasamy, S. Chand & CO
7. Fundamentals of mathematical Statistics by S.C.. Gupta and Kapoor

Course Code	Course Name	Credits
MEC302	Thermodynamics*	04

Objectives

1. To familiarize the concepts of Energy in general and Heat and Work in particular
2. To study the fundamentals of quantification and grade of energy
3. To study the effect of energy transfer on properties of substances in the form of charts and diagrams
4. To familiarize application of the concepts of thermodynamics in vapour power, gas power cycles

Outcomes: Learner will be able to...

1. Demonstrate application of the laws of thermodynamics to wide range of systems.
2. Write steady flow energy equation for various flow and non-flow thermodynamic systems
3. Compute heat and work interactions in thermodynamics systems
4. Demonstrate the interrelations between thermodynamic functions to solve practical problems.
5. Use steam table and mollier chart to compute thermodynamics interactions
6. Compute efficiencies of heat engines, power cycles etc.

Module	Detailed Contents	Hrs
01	Basic Concepts & definitions: Thermodynamics and its importance, Macroscopic and Microscopic view point, Concept of Continuum, Thermodynamic System, Surrounding and Boundary, Control Volume approach and Systems approach, Equilibrium – Thermal, Chemical, Mechanical and thermodynamic, Pure Substance, Property – Intensive and Extensive, State, Path, Process and Cycle. Point Function and Path Function, Quasi Static Process and processes like Isobaric, Isochoric, Isothermal, Polytropic Process, Temperature and different scales, Zeroth Law of Thermodynamics, Energy, sources of energy; forms of energy, Energy transfer by work and forms of work ; free Expansion, Energy transfer by heat ; Adiabatic Process, Equations of state, Ideal gas Equation-; Specific gas constant and Universal Gas Constant	08
02	First Law of Thermodynamics: Relation between Heat and Work- Joules Constant, First law of thermodynamics for a cyclic process, First law of thermodynamics for a closed system undergoing a process, Conservation principle, First Law of Thermodynamics applied to open system – Steady Flow Energy Equation, Perpetual motion Machine of First kind, Application of first law of thermodynamics to closed system or Non flow Process, Application of first law of thermodynamics to Open Systems like Steam Nozzle, Boiler, Steam Turbine, Pump, Heat Exchanger, Throttling Process – Joules Thompson Coefficient and its significance	07
03	Second Law of Thermodynamics: Limitation of first law of thermodynamics, Thermal Reservoir – Source and Sink, Concept of Heat Engine, Heat Pump and Refrigerator, Second law of thermodynamics – Kelvin Planck and Clausius Statements. Equivalence of Clausius and Kelvin Planck Statement, Reversible and Irreversible Process. Causes of Irreversibility, Perpetual Motion Machine of Second Kind, Need of Carnot theorem and its corollaries, Carnot cycle, Thermodynamic Temperature Scale and its equivalence with Ideal Gas Scale Entropy: Clausius Inequality, Clausius Theorem, Entropy is Property of a system, Isentropic Process, Temperature Entropy Plot and its relationship with heat interactions, Entropy Principle, Entropy change During a Process. Interpretation of concept of entropy	07
04	Thermodynamic Relations: Reciprocal Relation, Cyclic Relation Property relations, Maxwell Relations, TdS equations, Heat capacity relations, Volume Expansivity, Isothermal Compressibility, Clausius-Clapeyron Equation Availability:	10

	High grade and Low Grade Energy, Available and Unavailable Energy, Dead State, Available energy with respect to a process and a cycle, Decrease of Available Energy When heat is transferred through a finite temperature Difference, Second Law efficiency Properties of Pure Substance: Pure substance and Phase changes: Phase change processes of pure substance, Property diagrams for phase change process (T-v, T-s and p-h diagrams), Understanding of Steam Table and Mollier chart with suitable examples.	
05	Compressors: Reciprocating Air Compressor, Single stage compressor – computation of work done, isothermal efficiency, effect of clearance volume, volumetric efficiency, Free air delivery, Theoretical and actual indicator diagram, Multistage compressors – Constructional details of multistage compressors, Need of multistage, Computation of work done, Volumetric efficiency, Condition for maximum efficiency, Inter cooling and after cooling (numerical), Theoretical and actual indicator diagram for multi stage compressors Rotary Air Compressors- Classification, Difference between compressors and blowers, Working and constructional details of roots blower, Screw type and vane type compressors	08
06	Vapour Power cycle: Carnot cycle and its limitations as a vapour cycle, Rankine cycle with different turbine inlet conditions, Mean temperature of heat addition, Methods to improve thermal efficiency of Rankine cycle – Reheat cycle and Regeneration Cycle. Gas Power cycles: Assumptions of Air Standard Cycle, Otto cycle, Diesel Cycle and Dual cycle, Brayton Cycle, Sterling Cycle and Ericsson Cycle and Lenoir cycle and Atkinson cycle	10

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

Reference Books:

1. Thermodynamics: An Engineering Approach by Yunus A. Cengel and Michael ABoles, 7th edition, TMH
2. Basic Engineering Thermodynamics by Rayner Joel, Longman Publishers Engineering
3. Engineering Thermodynamics by P Chattopadhyay, 2nd edition, Oxford University Press India
4. Thermodynamics by P K Nag, 5th edition, TMH
5. Thermodynamics by Onkar Singh, New Age International
6. Thermodynamics by C P Arora, TMH
7. Engineering Thermodynamics through Examples by Y V C Rao, Universities Press (India) Pvt Ltd
8. Fundamentals of Thermodynamics by Moran & Shapiro
9. Fundamentals of Classical Thermodynamics by Van Wylen G.H. & Sonntag R.E., JohnWiley & Sons
10. Thermodynamics by W.C. Reynolds, McGraw-Hill & Co
11. Thermodynamics by J P Holman, McGraw-Hill & Co

Course Code	Course Name	Credits
MEC303	Strength of Materials*	04

* Course common to Mechanical and Automobile Engineering

Objectives:

1. To study different types of stresses, strain and deformation induced in the mechanical components due to external loads.
2. To study distribution of various stresses in the mechanical elements or bodies of finite dimensions that deform under loads.
3. To study the effects of component dimensions, materials and shapes on stresses and deformations

Outcomes: Learner will be able to...

1. Demonstrate fundamental knowledge about various types of loading and stresses induced.
2. Draw the SFD and BMD for different types of loads and support conditions.
3. Analyse the stresses induced in basic mechanical components.
4. Estimate the strain energy in mechanical elements.
5. Analyse the deflection in beams.
6. Analyse buckling and bending phenomenon in columns, struts and beams.

Module	Detailed Contents	Hrs
1	Moment of Inertia: Area moment of Inertia, Principal Axes and Principal Moment of Inertia, , Parallel Axis theorem, Polar moment of Inertia. Stresses and Strains: Definition – Stress, Strain, Hooke’s law, elastic limit, uni-axial, bi-axial and tri-axial stresses, tensile & compressive stresses, shear stress, Principal stresses and strains, Mohr’s circle. Elastic Constants: Poisson’s ratio, Modulus of elasticity, Modulus of rigidity, Bulk Modulus, yield stress, Ultimate stress. Factor of safety, state of simple shear, relation between elastic constants, volumetric strain, volumetric strain for tri-axial loading, deformation of tapering members, deformation due to self –weight, bars of varying sections, composite sections, thermal stress and strain.	12
2	Shear Force and Bending Moment in Beams: Axial force, shear force and bending moment diagrams for statically determinate beams including beams with internal hinges for different types of loading, relationship between rates of loading, shear force and bending moment.	08
3	Stresses in Beams: Theory of pure bending, Assumptions, Flexural formula for straight beams, moment of resistance, bending stress distribution, section modulus for different sections, beams for uniform strength, Flitched beams. Direct and Bending Stresses: Core of sections, Chimneys subjected to wind pressure. Shear Stress in Beams: Distribution of shear stress, across plane sections used commonly for structural purposes, shear connectors.	08
4	Torsion: Torsion of circular shafts- solid and hollow, stresses in shafts when transmitting power, shafts in series and parallel. Strain Energy: Resilience, Proof Resilience, strain energy stored in the member due to gradual, sudden and impact loads, Strain energy due to shear, bending and torsion.	08

5	Deflection of Beams: Deflection of Cantilever, simply supported and overhang beams using double integration and Macaulay's Method for different types of loadings Thin Cylindrical and Spherical Shells: Cylinders and Spheres due to internal pressure, Cylindrical shell with hemi spherical ends	08
6	Columns and Struts: Buckling load, Types of end conditions for column, Euler's column theory and its limitations, Rankine and Johnson formula	04

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

References:

1. Strength of Materials by R. Subramanian, Oxford University Press, Third Edition 2016
2. Strength of Materials by Ryder, Macmillan
3. Mechanics of Materials by James M. Gere and Barry J. Goodno, Cengage Learning, 6thEd, 2009
4. Mechanics of Materials by Gere and Timoshenko, CBS 2nd Edition
5. Strength of Materials by Basavrajiah and Mahadevappa, Khanna Publishers, New Delhi
6. Elements of Strength of Materials by Timoshenko and Youngs, Affiliated East -West Press
7. Mechanics of Materials by Beer, Johnston, Dewolf and Mazurek, TMHPvt Ltd., New Delhi
8. Mechanics of Structures by S.B. Junnarkar, Charotar Publication
9. Mechanics of Materials by S.S. Ratan, Tata McGraw Hill Pvt. Ltd
10. Introduction to Solid Mechanics by Shames, PHI
11. Strength of Materials by Nag and Chandra, Wiley India
12. Strength of Materials by S. Ramamrutham, Dhanpat Rai Pvt. Ltd
13. Strength of Materials by W. Nash, Schaum's Outline Series, McGraw Hill Publication, Special Indian Edition

Course Code	Course Name	Credits
MEC304	Production Process*	04

Objectives

1. To study basic production processes.
2. To study how to select appropriate production processes for a specific application.
3. To study machine tools

Outcomes: Learner will be able to...

1. Demonstrate understanding of casting process
2. Illustrate principles of forming processes
3. Demonstrate applications of various types of welding processes.
4. Differentiate chip forming processes such as turning, milling, drilling, etc.
5. Illustrate the concept of producing polymer components and ceramic components.
6. Distinguish between the conventional and modern machine tools.

Module	Detailed Contents	Hrs
1	1.1 Metal casting: Classification of Production Processes: Examples and field of applications Pattern materials and allowances, Types of pattern, Sand properties, Sand moulding, Machine moulding Gating system :Types of riser, types of gates, solidification Melting- cupola& induction furnaces 1.2 Special casting processes : CO2 and shell moulding, Investment casting, Die casting, Vacuum casting, Inspection & casting defects and remedies	10
2	2.1 Joining processes: Welding: Classification of welding, Oxy-acetylene welding, types of flames, equipment used, welding methods & applications, Arc welding principle and working of metal arc welding, TIG & MIG welding, submerged arc welding, electro-slag welding & stud welding PAM welding. Applications merits & demerits of above welding processes, fluxes used, Thermit welding, Resistance welding, Friction welding, ultrasonic, explosive, LASER, electron beam welding, Welding defects and remedies Soldering and brazing techniques & applications Fastening processes	10
3	3.1 Forming processes: Principles and process characteristics, Rolling types, Rolling parameters: Draught, spread, elongation, roll pressure, torque, work and power in rolling. Effect of front and back tension on rolling load and capacities, Rolling defects, Thread rolling roll forging, production of seamless tubes, Forging, Extrusion and Wire Drawing processes	08
4	4.1 Moulding with polymers: Moulding with polymers: Basic concepts related to Injection Moulding, Compression moulding, Transfer moulding, Blow Moulding, Rotational Moulding, Thermoforming and Extrusion. Applications of plastics in Engineering field 4.2 Moulding with ceramics: Blow moulding and extrusion of glass.	06
5	Classification, Selection and application of Machine Tools: 5.1 Lathe Machines, Milling Machines, Drilling Machines, and Grinding Machines, Broaching machines, Lapping/Honing machines and shaping/slotting/planning Machines. 5.2 Gear Manufacturing -Gear milling, standard cutters and limitations, gear hobbing, gear shaping, gear shaving and gear grinding processes	10
6	5.1 Modern Machine Tools: CNC machines: Introduction, principles of operation, Types – Vertical machining centres and horizontal machining centres, major elements, functions, applications, controllers, open loop and closed loop systems 5.2 Types of automatic machines, Transfer machines	04

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

References

1. Workshop Technology By W. A. J. Chapman part I, II & III
2. A Textbook of Foundry Technology by M. Lal
3. Production Technology by R. C. Patel and C. G. Gupta Vol I, II.
4. Production Technology by Jain & Gupta
5. Manufacturing, Engineering and Technology SI by Serope Kalpakjian, Steven R. Schmid, Prentice Hall
6. Production Technology by HMT
7. Elements of Workshop Technology Hazra Chaudhary Vol I, II.
8. Foundry technology by P.L. Jain
9. Production Technology by P.C. Sharma
10. Manufacturing processes by P. N. Rao, Vol. 1 and 2

Course Code	Course Name	Credits
MEC305	Material Technology*	03

Objectives

1. To study basic engineering materials, their structure-property-performance
2. To study strengthening processes including heat treatment processes in order to enhance properties.
3. To study new materials and their applications

Outcomes: Learner will be able to...

1. Identify various crystal imperfections, deformation mechanisms, and strengthening mechanisms
2. Demonstrate understanding of various failure mechanisms of materials.
3. Interpret Iron-Iron carbide phase diagram, and different phases in microstructures of materials at different conditions.
4. Select appropriate heat treatment process for specific applications.
5. Identify effect of alloying elements on properties of steels
6. Illustrate basics of composite materials, Nano- materials and smart materials.

Module	Detailed Contents	Hrs
1	1.1 Classification of Materials: Metallic materials, Polymeric Materials, Ceramics and Composites: Definition, general properties, applications with examples 1.2 Lattice Imperfections: Definition, classification and significance of Imperfections Point defects: vacancy, interstitial and impurity atom defects, Their formation and effects, Dislocation - Edge and screw dislocations Burger's vector, Motion of dislocations and their significance, Surface defects - Grain boundary, sub-angle grain boundary and stacking faults, their significance, Generation of dislocation, Frank Reed source, conditions of multiplication and significance. 1.3 Deformation: Definition, elastic and plastic deformation, Mechanism of deformation and its significance in design and shaping, Critical Resolved shear stress, Deformation in single crystal and polycrystalline materials, Slip systems and deformability of FCC, BCC and HCP lattice systems. 1.4 Strain Hardening: Definition importance of strain hardening, Dislocation theory of strain hardening, Effect of strain hardening on engineering behaviour of materials, Recrystallization Annealing: stages of recrystallization annealing and factors affecting it	08
2	Failure mechanisms: 1.1 Fracture: Definition and types of fracture, Brittle fracture: Griffith's theory of fracture, Orowan's modification, Dislocation theory of fracture, Critical stress and crack propagation velocity for brittle fracture, Ductile fracture: Notch effect on fracture, Fracture toughness, Ductility transition, Definition and significance 1.2 Fatigue Failure: Definition of fatigue and significance of cyclic stress, Mechanism of fatigue and theories of fatigue failure, Fatigue testing, Test data presentation and statistical evolution, S-N Curve and its interpretation, Influence of important factors on fatigue, Notch effect, surface effect, Effect of pre-stressing, corrosion fatigue, Thermal fatigue. 1.3 Creep: Definition and significance of creep, Effect of temperature and creep on mechanical behaviours of materials, Creep testing and data presentation and analysis, Mechanism and types of creep, Analysis of classical creep curve and use of creep rate in designing of products for load bearing applications, Creep Resistant materials	08
3	3.1 Theory of Alloys & Alloys Diagrams : Significance of alloying, Definition, Classification and properties of different types of alloys, Solidification of pure metal, Different types of phase diagrams (Isomorphous, Eutectic,	08

	Peritectic, Eutectoid, Peritectoid) and their analysis, Importance of Iron as engineering material, Allotropic forms of Iron, Influence of carbon in Iron- Carbon alloying Iron-Iron carbide diagram and its analysis, TTT diagram, CCT diagram Hardenability concepts and tests, Graphitization of Iron- Grey iron, white iron, Nodular and malleable irons, their microstructures, properties and applications	
4	4.1 Heat treatment Process: Technology of heat treatment, Classification of heat treatment process, Annealing- Principle process, properties and applications of full annealing, Diffusion annealing, process annealing and Cyclic annealing, Normalizing, Hardening heat treatment, Tempering, Subzero treatment, Austempering, Martempering, Maraging and Ausforming process, Surface hardening: Hardening and surface Hardening methods. Carburizing, Nitriding, Cyaniding, Carbonitriding, induction hardening and flame hardening processes	06
5	5.1 Effect of Alloying Elements in Steels: Limitation of plain carbon steels, Significance of alloying elements, Effects of major and minor constituents, Effect of alloying elements on phase transformation Classification of tool steels and metallurgy of tool steels and stainless steel	04
6	Introduction to New materials: 6.1 Composites: Basic concepts of composites, Processing of composites, advantages over metallic materials, various types of composites and their applications 6.2 Nano Materials: Introduction, Concepts, synthesis of nanomaterials, examples, applications and Nano composites 6.3 An overview to Smart materials (e.g.: Rheological fluids)	04

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

References

1. Materials Science and Engineering by William D. Callister, Jr. – Adapted by R.Balasubramaniam, Wiley India (P) Ltd
2. Material Science and Metallurgy by V.D. Kodgire, Everest Publishing House
3. Mechanical Behaviour of Materials by Courtney, McGraw Hill International New Delhi
4. Introduction of Engineering Materials, by B.K. Agrawal, McGraw Hill Pub. Co. Ltd
5. Mechanical Metallurgy by G.E. Dieter, McGraw Hill International New Delhi
6. A text book of Metallurgy by A.R.Bailey, Macmillan & Co. Ltd., London
7. The Structure and Properties of Engineering Alloys by W.F. Smith, McGraw hill Int.
8. Engineering Physical Metallurgy, by Y. Lakhtin, Mir Publishers, Moscow
9. Introduction to Physical Metallurgy by SydneyAvner, McGraw Hill
10. Metallurgy for Engineers by E.C. Rollason - ELBS SOC and Edward Arnold, London

Course Code	Course Name	Credits
MEL301	Computer Aided Machine Drawing*	03

Objectives:

1. To familiarise conversion of an object into a drawing
2. To study conventional representation of various machining and mechanical details as per IS
3. To become conversant with 2-D and 3-D drafting

Outcomes: Learner will be able to...

1. Visualize and prepare detail drawing of a given object.
2. Read and interpret the drawing
3. Draw details and assembly of different mechanical systems.
4. Convert detailed drawing into assembly drawing using modelling software
5. Convert assembly drawing into detailed drawing using modelling software
6. Prepare detailed drawing of any given physical object/machine element with actual measurements

Module	Detailed Contents	Theory	Practical
1	1.1 Machine Elements: Preparation of 2-D drawings of standard machine elements (nuts, bolts, keys, cotter, screws, spring etc) 1.2 Conventional representation of threaded parts, Types of threads; thread designation, Conventional representation of machine components and materials, Designation of standard components 1.3 Solid Geometry: Intersection of surfaces and interpenetration of solids- Intersection of prism or cylinder with prism; cylinder or cone, both solids in simple position only. Primary auxiliary views	02 01 04	04 -- --
2	2.1 Geometric Dimensioning and Tolerancing (GD&T) : Dimensioning with tolerances indicating various types of fits, 2.2 Details and assembly drawing: Types of assembly drawings, part drawings, drawings for catalogues and instruction manuals, patent drawings, drawing standards, 2.3 Introduction to unit assembly drawing, steps involved in preparing assembly drawing from details and vice-versa, 2.4 Preparation of details and assembly drawings of <i>any three</i> from: Clapper block, Single tool post, Lathe and Milling tail stock, jigs and fixtures 2.5 Cotter, Knuckle joint, Keys: keys-sunk, parallel woodruff, saddle, feather etc. 2.6 Couplings: simple, muff, flanged Protected flange coupling, Oldham's coupling, Universal coupling	02 02 02 01 02	-- -- 08 -- 06
3	3.1 Preparation of details and assembly drawings of Bearings: Simple, solid, Bushed bearing, I.S. conventional representation of ball and roller bearing, Pedestal bearing, footstep bearing	02	06
4	4.1 Preparation of details and assembly drawings of pulleys, Pipe joints: Classification of Pulleys, pipe joints 4.2 Pulleys: Flat belt, V-belt, rope belt, Fast and loose pulleys. 4.3 Pipe joints(any two): Flanged joints, Socket and spigot joint, Gland and stuffing box, expansion joint	02 -- --	-- 06 06
5	5.2 Preparation of details and assembly drawings of Valves, I.C. Engine parts: Types of Valves, introduction to I.C. Engine 5.3 Preparation of details and assembly drawings(any three): Air cock; Blow off cock, Steam stop valve, Gate valve, Globe valve, Non return Valve, I.C. Engine parts: Piston, Connecting rod, Cross head, Crankshaft, Carburettor, Fuel pump, injector, and Spark plug	02 --	-- 08

6	6.1 Reverse Engineering of a physical model: disassembling of any physical model having not less than five parts, measure the required dimensions of each component, sketch the minimum views required for each component, convert these sketches into 3-D model and create an assembly drawing with actual dimensions	02	06

Assessment:

Term work

- A. Minimum two questions from theory part of each module should be solved as a home work in A-3 size sketch book.
- B. A-3 size Printouts/plots of the problems solved in practical class from the practical part of each module. Problems from practical parts of each module should be solved using any standard CAD packages like IDEAS, PRO-E, CATIA, Solid Works, Inventor etc.

The distribution of marks for Term work shall be as follows:

- Home work sketch book 20 marks
- Printouts/Plots 20 marks
- Attendance 10 marks

End Semester Practical/Oral examination:

To be conducted by pair of Internal and External Examiner

1. Practical examination duration is **three hours**, based on Part-B of the Term work, and should contain two sessions as follows:

Session-I: Preparation of 3-D models of parts, assembling parts and preparing views of assembly from given 2-D detailed drawing.

Session-II: Preparation of minimum five detailed 3-D part drawings from given 2-D assembly drawing.

Oral examination should also be conducted to check the knowledge of conventional and CAD drawing.

2. Questions provided for practical examination should contain minimum five and not more than ten parts.

3. The distribution of marks for practical examination shall be as follows:

- **Session-I** 20 marks
- **Session-II** 20 marks
- **Oral** 10 marks

4. Evaluation of practical examination to be done based on the printout of students work

5. Students work along with evaluation report to be preserved till the next examination

References:

1. Machine Drawing by N.D. Bhatt.
2. A textbook of Machine Drawing by Laxminarayan and M.L. Mathur, Jain brothers Delhi
3. Machine Drawing by Kamat and Rao
4. Machine Drawing by M. B. Shah
5. A text book of Machine Drawing by R. B. Gupta, Satyaprakashan, Tech. Publication
6. Machine Drawing by K.I.Narayana, P. Kannaiah, K.Venkata Reddy
7. Machine Drawing by Sidheshwar and Kanheya
8. Autodesk Inventor 2011 for Engineers and Designers by ShamTickoo and SurinderRaina, Dreamtech Press
9. Engineering Drawing by P J Shah
10. Engineering Drawing by N D Bhatt

Course Code	Course Name	Credits
MEL302	Strength of Materials*	01

Objectives:

1. To familiarise material behaviour under different loading conditions
2. To acquaint with surface hardness measurement method
3. To familiarise with impact test methods for different materials

Outcomes: Learner will be able to...

1. Analyse the stress - strain behaviour of materials
2. Measure ultimate tensile/compression strength of material
3. Measure torsional strength of material
4. Perform impact test using Izod and Charpy method
5. Measure the hardness of materials.
6. Perform flexural test with central and three point loading conditions

a) List of Experiments (Minimum Eight)

Module	Detailed Contents	Laboratory Sessions
1	Tension test on mild steel bar (stress-strain behaviour, determination of yield strength and modulus of elasticity)	2 Hrs
2	Bending test on UTM	2 Hrs
3	Torsion test on mild steel bar / cast iron bar	2 Hrs
4	Impact test on metal specimen (Izod test)	2 Hrs
5	Impact test on metal specimen (Charpy test)	2 Hrs
6	Hardness test on metals - Brinell Hardness Number	2 Hrs
7	Hardness test on metals - Rockwell Hardness Number	2 Hrs
8	Flexural test on beam (central loading)	2 Hrs
9	Flexural test on beam (three point loading)	2 Hrs

b) Assignments: Atleast one problem on each of the following topics:

1. Simple stress strain
2. SFD and BMD
3. Stresses in beams
4. Strain energy and deflection.
5. Torsion, Columns and struts

Note: Preferably, the assignments shall be based on live problems.**Project Based Learning may be incorporated by judiciously reducing number of assignments.**

Assessment:

Term Work:Including Part a and b both

Distribution of marks for Term Work shall be as follows:

Part a	:	15marks.
Part b	:	05 Marks
Attendance	:	05 marks.

End Semester Practical/Oral Examination:

Pair of Internal and External Examiner should conduct practical examination followed by Oral

Course Code	Course Name	Credits
MEL303	Materials Technology*	03

Objectives:

1. To familiarise with use of optical laboratory microscope
2. To acquaint with microstructures of ferrous (steel and cast iron) metals
3. To familiarise with microstructures of steel under different heat treated conditions
4. To study hardenability, fatigue test for fatigue strength and corrosion rate test

Outcomes: Learner will be able to...

1. Demonstrate the understanding of the procedure to prepare samples for studying microstructure using microscope (metallography)
2. Interpret different phases present in different plain carbon steels and cast irons.
3. Perform different heat treatment processes for a steel and observe microstructures in these conditions
4. Identify effects of Annealing, Normalizing and Hardening on microstructure of medium carbon steel
5. Determine hardenability of steel using Jominy end Quench test
6. Determine S-N curve by Fatigue Test.

Sr No	Details
1	Study of metallurgical microscope
2	Metallographic sample preparation and etching
3	Microstructures of plain carbon steels
4	Microstructures of cast irons
5	Annealing, Normalizing and Hardening of medium carbon steel and observation of microstructures
6	Study of tempering characteristics of hardened steel
7	Determination of hardenability of steel using Jominy end Quench Test
8	Fatigue test – to determine number of cycles to failure of a given material at a given stress

Assignments: Assignment on following topics

1. Crystal imperfections-deformation-strengthening mechanisms
2. Fracture-failure of metals
3. Iron –Iron carbide phase diagram/TTT diagram/CCT diagram.
4. Heat treatment processes
5. Alloy steels (e. g. alloy steels, tool steels)
6. New materials

Note: Preferably, the assignments shall be based on live problems. **Project Based Learning may be incorporated by judiciously reducing number of assignments**

Assessment:

Term Work: Including Laboratory Work and Assignments both

Distribution of marks for Term Work shall be as follows:

Laboratory work	15 marks
Assignments	05 Marks
Attendance	05 marks

Course Code	Course Name	Credits
MEL304	Machine Shop Practice I*	02

Objectives:

1. To study basic machining processes.
2. To familiarise various machining operations and machine protocols

Outcomes: Learner will be able to...

1. Operate various machines like lathe, shaper etc.
2. Perform plain turning, taper turning, and screw cutting etc. on lathe machine.
3. Perform machining operations on shaper.
4. Demonstrate metal joining process like compressive welding.
5. Perform forging operations
6. Perform shaping operations

Module	Details	Hrs
1	Introduction to Lathe Machine, demonstration of various machining processes performed on lathe machine. One Job on Plain and Taper Turning One job on Precision Turning, Taper Turning and Screw Cutting	18
2	Introduction to Shaping Machine and various machining processes performed on Shaping Machine One job on shaping machine to make horizontal and inclined surface	12
3	Introduction to various forging tools Two jobs on Forging of Cutting Tools used on Lathe Machine	12
4	One simple exercise on Welding, Preparation of a component using Compressive Welding Joint	6

Assessment:

Term Work:

1. All the jobs mentioned above
2. Complete Work-Shop Book giving details of drawing of the job and time sheet

The distribution of marks for Term work shall be as follows:

Job Work with complete workshop book	 40 marks
Attendance	 10 marks

Course Code	Course Name	Credits
MEC401	Applied Mathematics IV**	04

Objectives:

- 1 To inculcate an ability to relate engineering problems to mathematical context
- 2 To provide a solid foundation in mathematical fundamentals required to solve engineering problem
- 3 To study the basic principles of Vector analyses, complex integration, probability, test of hypothesis and correlation between data.
- 4 To prepare students for competitive exams

Outcomes: Learner will be able to...

- 1 Solve the system of linear equations using matrix algebra with its specific rules
- 2 Demonstrate basics of vector calculus
- 3 Apply the concept of probability distribution and sampling theory to engineering problems
- 4 Apply principles of vector calculus to the analysis of engineering problems
- 5 Identify, formulate and solve engineering problems
- 6 Illustrate basic theory of correlations and regression

Module	Details	Hrs
1	Matrices: 1.1 Brief revision of vectors over a real field, inner product, norm of a vector 1.2 Eigen values and Eigen vectors: Characteristic polynomial, characteristic equation, characteristic roots and characteristic vectors of a square matrix, properties of characteristic roots and vectors of different types of matrices such as orthogonal matrix, Hermitian matrix, Skew-Hermitian matrix, Cayley Hamilton theorem (without proof) . Similarity of matrices. Functions of a square matrix	08
2	Matrices: 2.1 Minimal polynomial and Derogatory matrix 2.2 Quadratic forms: Linear transformations of a quadratic form, congruence of a square matrix, reduction to Canonical form under congruent transformations, orthogonal transformations, determining the nature of a quadratic form, Applications of Eigen Values and Eigen Vectors Vector calculus 2.3 Brief revision of Scalar and vector point functions. Gradient of a scalar function, Divergence and curl of a vector function 2.4 Line integrals, circulation of a vector, condition for independence of the path in the line integral	09
3	Vector calculus: 3.1 Green's theorem(without proof) for plane regions and properties of line integrals, Stokes theorem (without proof), Gauss divergence theorem (without proof) related identities and deductions.(No verification problems on Stoke's Theorem and Gauss Divergence Theorem) Linear Programming problems 3.2 Types of solutions to linear programming problems, standard form of L.P.P. Simplex method to solve L.P.P	09
4	Linear Programming problems Probability Distributions: 4.1 Big M method (Penalty method) to solve L.P.P, Duality, Dual simplex method and Revised simplex method to solve L.P.P. Probability Distributions 4.2 Discrete and Continuous random variables, Probability mass and density function, Probability distribution for random variables, Expected value, Variance. 4.3 Probability Distributions: Binomial, Poisson and Normal Distributions	09

5	Sampling theory: 5.1. Sampling theory: Sampling distribution. Test of Hypothesis. Level of significance, critical region. One tailed and two tailed tests. Interval Estimation of population parameters. Large and small samples 5.3. Test of significance for Large samples: Test for significance of the difference between sample mean and population means, Test for significance of the difference between the means of two samples. 5.4. Student's t-distribution and its properties. Test of significance of small samples: Test for significance of the difference between sample mean and population means, Test for significance of the difference between the means of two Samples, paired t-test	09
6	Sampling theory and ANOVA 6.1. Chi-square test, Test for the Goodness of fit, Association of attributes and Yate's correction 6.2. Analysis of Variance(F-Test): One way classification, Two-way classification(short-cut method)	08

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

References:

1. Advanced Engineering Mathematics, E Kreyszing, Wiley Eastern Limited
2. Higher Engineering Mathematics, B. S. Grewal, Khanna Publication
3. Advanced Engineering Mathematics, H. K. Dass, S. Chand & co
4. Vector Analysis by Murray R. Spiegel, Schaum Series
5. Operations Research, S.D. Sharma, S. Chand & CO.
6. Fundamentals of Mathematical Statistics, S C Gupta & V K Kapoor, S. Chand & Co
7. Elements of Applied mathematics, P N & J N Wartikar, Pune Vidyarthi Gruha Prakashan
8. Advanced Engineering Mathematics, E Kreyszing, Wiley Eastern Limited
9. Operations Research, Kantiswearup, Manmohan, P K Gupta, S. Chand & CO

Course Code	Course Name	Credits
MEC402	Fluid Mechanics*	04

Objectives:

1. To study fluid statics and fluid dynamics
2. To study application of mass, momentum and energy equations in fluid flow.
3. To learn various flow measurement techniques.

Outcomes: Learner will be able to...

1. Define properties of fluids and classification of fluids
2. Evaluate hydrostatic forces on various surfaces and predict stability of floating bodies
3. Formulate and solve equations of the control volume for fluid flow systems
4. Apply Bernoulli's equation to various flow measuring devices
5. Calculate resistance to flow of incompressible fluids through closed conduits and over surfaces
6. Apply fundamentals of compressible fluid flows to relevant systems

Module	Detailed Contents	Hrs
1	1.1 Fluid Definition and properties, Newton's law of viscosity concept of continuum, Classification of fluids 1.2 Fluid Statics: Definition of body and surface forces, Pascal's law, Basic hydrostatic equation, Forces on surfaces due to hydrostatic pressure, Buoyancy and Archimedes' principle	06
2	2 Fluid Kinematics: 2.1 Eulerian and Lagrangian approach to solutions; Velocity and acceleration in an Eulerian flow field; Definition of streamlines, path lines and streak lines; Definition of steady/unsteady, uniform/non-uniform, one-two and three dimensional flows; Definition of control volume and control surface, Understanding of differential and integral methods of analysis 2.2 Definition and equations for stream function, velocity potential function in rectangular and cylindrical co-ordinates, rotational and irrotational flows; Definition and equations for source, sink, irrotational vortex, circulation	06
3	3 Fluid Dynamics: 3.1 Integral equations for the control volume: Reynold's Transport theorem, equations for conservation of mass, energy and momentum, Bernoulli's equation and its application in flow measurement, pitot tube, venture, orifice and nozzle meters. 3.2 Differential equations for the control volume: Mass conservation in 2 and 3 dimension in rectangular, Euler's equations in 2,3 dimensions and subsequent derivation of Bernoulli's equation; Navier-Stokes equations (without proof) in rectangular Cartesian co-ordinates; Exact solutions of Navier-Stokes Equations to viscous laminar flow between two parallel planes (Couette flow and plane Poiseuille flow)	12
4	4 Real fluid flows: 4.1 Definition of Reynold's number, Laminar flow through a pipe (Hagen-Poiseuille flow), velocity profile and head loss; Turbulent flows and theories of turbulence-Statistical theory, Eddy viscosity theory and Prandtl mixing length theory; velocity profiles for turbulent flows-universal velocity profile, $1/7^{\text{th}}$ power law; Velocity profiles for smooth and rough pipes 4.2 Darcy's equation for head loss in pipe (no derivation), Moody's diagram, pipes in series and parallel, major and minor losses in pipes	08
5	5 Boundary Layer Flows: 5.1 Concept of boundary layer and definition of boundary layer thickness, displacement, momentum and energy thickness; Growth of boundary layer,	08

	laminar and turbulent boundary layers, laminar sub-layer; Von Karman Momentum Integral equation for boundary layers (without proof), analysis of laminar and turbulent boundary layers, drag, boundary layer separation and methods to control it, streamlined and bluff bodies 5.2 Aerofoil theory: Definition of aerofoil, lift and drag, stalling of aerofoils, induced drag	
6	6 Compressible Fluid flow: 6.1 Propagation of sound waves through compressible fluids, Sonic velocity and Mach number; Application of continuity, momentum and energy equations for steady state conditions; steady flow through nozzle, isentropic flow through ducts of varying cross-sectional area, Effect of varying back pressure on nozzle performance, Critical pressure ratio 6.2 Normal shocks, basic equations of normal shock, change of properties across normal shock	08

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

Reference Books:

1. Fluid Mechanics by Yunus A Cengel and John M Cimbala, McGraw Hill Education, 3rd Edition
2. Fluid Mechanics and Machinery by C S P Ojha, Chandramouli and R Berndtsson, Oxford University Press
3. Introduction to Fluid Mechanics by Fox and McDonald
4. Fluid Mechanics by R K Bansal
5. Fluid Mechanics by Victor Streeter, Benjamin Wylie and K W Bedford, McGraw Hill Education, 9th Edition
6. Fluid Mechanics by K. L. Kumar
7. Introduction to Fluid Mechanics by James A. Fay
8. Fluid Mechanics by B. M. Massey
9. Mechanics of Fluids by Irving Shames
10. Fluid Mechanics and Hydraulics, S. K. Ukarande, Ane Books Pvt.Ltd

Course Code	Course Name	Credits
MEC 403	Industrial Electronics*	3

Objectives

- 1 To study power electronic switches and circuits and their applications
- 2 To familiarise Op amp and digital circuits and their applications
- 3 To acquaint with basics of microprocessor and microcontroller
- 4 To study structure, working and characteristics of different types of industrial electric motors and their selection for a particular application

Outcomes: Learner will be able to...

- 1 Illustrate construction, working principles and applications of power electronic switches
- 2 Identify rectifiers and inverters for dc and ac motor speed control
- 3 Develop circuits using OPAMP and timer IC555
- 4 Identify digital circuits for industrial applications
- 5 Illustrate the knowledge of basic functioning of microcontroller
- 6 Analyse speed-torque characteristics of electrical machines for speed control

Module	Detailed Contents	Hrs.
1	Semiconductor Devices: Diodes: Principles V-I characteristics and Application of: rectifier diode, zener diode, LED, photodiode, SCR V-I characteristics, UJT triggering circuit, turning-off of a SCR (preliminary discussion), basics of Gate Turn-off thyristor (GTO). Structure and V-I characteristics of Triac (modes of operation not needed) and Diac, Applications of Triac-Diac circuit. Characteristics and principle of Power BJT, power MOSFET, IGBT, comparison of devices, MOSFET/IGBT Gate driver circuit Comparison of SCR, Triac, Power BJT, power MOSFET, IGBT	08
2	Phase controlled rectifiers and Bridge inverters: Full wave controlled rectifier using SCR's(semi controlled, fully controlled) with R load only, Derivation of output voltage Block diagram of closed loop speed control of DC motors, Necessity of inner current control loop Basic principle of single phase and three phase bridge inverters , block diagrams including rectifier and inverter for speed control of AC motors (frequency control only)	07
3	Operational amplifiers and 555 Timer: Operational amplifier circuits, Ideal OPAMP behaviour, common OPAMP ICs; Basic OPAMP circuits- Inverting amplifier, Non-inverting amplifier, Voltage follower (Buffer), Instrumentation Amplifier, Active first order filter: Low pass and high pass filter; Power Op Amps, Optical Isolation amplifier; 555 timer-Operating modes: monostable, astable multivibrator	04
4	Digital logic and logic families: Digital signals, combinational and sequential logic circuits, clock signals, Boolean algebra and logic gates. Integrated circuits and logic families: Logic Levels, Noise Immunity, Fan Out, Propagation Delay, TTL logic family CMOS Logic family, comparison with TTL family Flip flops: Set Reset(SR),Trigger(T), clocked F/Fs; Registers, decoders and encoders, Multiplexer and Demultiplexer, applications	04
5	Microprocessor and Microcontrollers: Overview of generic microprocessor, architecture and functional block diagram, Comparison of microprocessor and microcontroller	08

	MSP430 architecture, assembly language programming, C compiler programming, basics of interfacing with external input / output devices (like reading external analog voltages, digital input output) Applications of microcontroller: Temperature measurement, Speed Measurement using Proximity Sensor, Piezoelectric Actuator Drive	
6	Motors: Review and comparison of DC motors and AC induction motors, Basic principles of speed control of AC induction motor Basics of BLDC motor, Linear Actuator motor, Servo Motor Motor Specifications, suitability of each motor for various industrial applications, Selection and sizing of motors for different applications. Applications for pumps, conveyors, machine tools, Microcontroller based speed control for Induction Motor.	05

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

Reference Books:

1. Power Electronics M.H. Rashid, Prentice-Hall of India
2. Power Electronics, P S Bhimbra
3. Power Electronics, Vedam Subramanyam, New Age International
4. Power Electronics, Ned Mohan, Undeland, Robbins, John Wiley Publication
5. Electronic Devices and Circuits, Robert Boylestad and Louis Nashelsky, Prentice-Hall
6. Industrial Electronics and Control by S K Bhattacharya, S Chatterjee, TTTI Chandigarh
7. Modern Digital Electronic, Jain R P, Tata McGraw Hill, 1984
8. Digital principal and Application, Malvino and Leach, Tata McGraw Hill, 1991
9. Fundamentals of Microcontrollers and Embedded System, Ramesh Gaonkar, PENRAM
10. MSP430 Microcontroller Basics, John H. Davies, Newnes; 1 edition 2008

Course Code	Course Name	Credits
MEC404	Production Process II*	04

Objectives

1. To study sheet metal forming as well as mechanical behavior of stress system in metal forming processes.
2. To Acquaint to basic principles of design of jigs and fixtures
3. To give exposure to Non-traditional machining operations.
4. To acquaint with fundamentals of metal cutting and tool engineering

Outcomes: Learner will be able to...

1. Demonstrate understanding of metal cutting principles and mechanism
2. Identify cutting tool geometry of single point and multipoint cutting tool
3. Demonstrate various concepts of sheet metal forming operations
4. Demonstrate concepts and use of jigs and fixtures
5. Illustrate various non-traditional machining techniques
6. Illustrate concepts and applications of additive manufacturing

Module	Details	Hrs
1	Metal Cutting: 1.1 Features of machining processes, concept of speed and cutting, mechanism of chip formation, concept of shear plane, chip reduction coefficient force analysis, Merchant's circle of cutting forces, expression for shear plane angle and coefficient of friction in terms of cutting forces and tool angles, Merchant's theory-original and modified, effect of various parameters on cutting forces 1.2 Different types of dynamometers and their operations, Tool life definition, mechanism of tool wear and measurement, preliminary and ultimate feature, factors influencing tool life such as speed, feed, depth of cut, tool material, cutting fluids etc., Machinability, factors affecting surface finish	16
2.	Tool Engineering: 2.1 Cutting Tool geometry and definition of principles tool angles of single point cutting tools, Types of milling cutters and their geometry, Geometry of drill, broach 2.2 Specification & Selection of grinding wheel, dressing & truing and balancing of grinding wheels	06
3.	Sheet Metal Forming: 3.1 Sheet metal operations, Classification of presses, Types of Dies:, compound, combination, progressive, bending, forming and drawing dies, scrap strip layout, centre of pressure, selection of die sets, stock guides, strippers	06
4.	Jigs and Fixtures: 4.1 Elements of Jigs and fixtures, principles of location, types of locating and clamping elements, Drill bushes-their types and applications indexing devices, auxiliary elements, Types of jigs, Milling fixture and turning fixture	06
5.	Non-traditional Machining: 5.1 Ultrasonic Machining (USM), Abrasive Jet Machining (AJM), Water Jet Machining, Electrochemical Machining (ECM), Chemical Machining (CHM) Electrical Discharge Machining (EDM), Plasma Arc Machining (PAM), Laser Beam Machining (LBM), Electron Beam Machining (EBM)	06

6.	Additive Manufacturing: 6.1 Historical Development , Fundamentals of Rapid Prototyping, Advantages of Rapid Prototyping ,Additive Manufacturing (AM) Definition, Applications of AM parts, The Generic AM process, Why use the term Additive Manufacturing, The Benefits of AM, Distinction Between AM and CNC Machining, Other Related Technologies: Reverse Engineering, CAE, Haptic based CAD, Classifications of AM / RP System: Liquid polymer Systems, Discrete Particle Systems, Molten Material Systems, Solid Sheet Systems 6.2 New AM Classification Schemes as per ASTM F42 and ISO TC 261: Vat photo polymerization, Powder bed fusion, Material extrusion, Material jetting, Binder jetting, Sheet lamination and Directed energy deposition 6.3 Vat Photo Polymerization based AM / RP Systems: Principle of operation, Process, materials advantages, disadvantages, and applications of 3D Systems' stereo lithography (SLA), CMET'S Solid Object Ultraviolet-Laser Printer (SOUP).	08

Assessment:

Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

References

1. Tool Design by Donaldson
2. Machining Process by H.L. Juneja
3. Production Technology - HMT
4. Manufacturing, Engineering and Technology SI by Serope Kalpakjian, Steven R Schmid, Prentice Hall
5. Fundamentals of Tool Design by ASTME
6. Metal cutting Theory & Cutting Tool Designing by V. Arshinov, G Alekseev
7. Principle of Metal cutting by Sen & Bhattacharya
8. Manufacturing science by Ghosh and Mallick
9. Production Engg by P.C.Sharma
10. Additive Manufacturing Technologies, Ian Gibson, D.W. Rosen, and B. Stucker, , 2nd Edition, Springer 2015

Course Code	Course Name	Credits
MEC405	Kinematics of Machinery*	04

Objectives:

1. To acquaint with basic concept of kinematics and kinetics of machine elements
2. To familiarise with various basic mechanisms and inversions
3. To study basics of power transmission

Outcomes: Learner will be able to...

1. Define various components of mechanisms
2. Develop mechanisms to provide specific motion
3. Draw velocity and acceleration diagrams of various mechanisms
4. Draw Cam profile for the specific follower motion
5. Analyse forces in various gears
6. Select appropriate power transmission for specific application

Module	Details	Hrs.
1	1.1 Kinetics of Rigid Bodies: Mass M.I. about centroidal axis and about any other axis, Radius of Gyration, D'Alembert's Principle of bodies under rotational motion about a fixed axis and plane motion, Application of motion of bars, cylinders and spheres only Kinetics of Rigid bodies: Work and Energy Kinetic energy in translating motion, Rotation about fixed axis and in general plane motion, Work Energy Principle and Conservation of energy 1.2 Basic Kinematics: Structure, Machine, Mechanism, Kinematic link & its types, Kinematic pairs, Types of constrained motions, Types of Kinematic pairs, Kinematic chains, Types of joints, Degree of freedom (mobility), Kutzbach mobility criterion, Grübler's criterion & its limitations Four bar chain and its inversions, Grashoff's law, Slider crank chain and its inversions, Double slider crank chain and its inversions	10
2	2.1 Special Mechanisms: Straight line generating mechanisms: Introduction to Exact straight line generating mechanisms - Peaucillier's and Hart's Mechanisms, Introduction to Approximate Straight line generating mechanisms- Watt's, Grasshopper mechanism, Tchebicheff's mechanisms Offset slider crank mechanisms - Pantograph, Hook-joint (single and double). Steering Gear Mechanism - Ackerman, Davis steering gears	06
3	3.1 Velocity Analysis of Mechanisms (mechanisms up to 6 links): Velocity analysis by instantaneous center of rotation method (Graphical approach), Velocity analysis by relative velocity method (Graphical approach) Analysis extended to find rubbing velocities at joints, mechanical advantage (Graphical approach) Velocity analysis of low degree complexity mechanism (Graphical approach), Auxiliary point method 3.2 Velocity and Acceleration Analysis of Mechanism: Velocity and Acceleration- analysis by relative method (mechanism up to 6 link) including pairs involving Coriolis acceleration (Graphical Approach)	10
4	4.1 Cam Mechanism: Cam and its Classification, Followers and its Classification, Motion analysis and plotting of displacement - time, velocity-time, acceleration-time, jerk-time graphs for uniform velocity, UARM, SHM, and Cycloid motions (combined motions during one stroke excluded), Motion analysis of simple cams - R-R cam, D-R-R and D-R-D-R Cam operating radial translating follower, Pressure angle	06

5	5.1 Belts, Chains and Brakes: Belts: Introduction, types and all other fundamentals of belting, Dynamic analysis –belt tensions, condition of maximum power transmission Chains: types of chains, chordal action, variation in velocity ratio, length of chain Brakes: Introduction, types and working principles, Introduction to braking of vehicles	06
6	6.1 Gears and Gear Trains: Gears- Introduction, types, Law of gearing, Construction of Involute and Cycloid gear tooth profile, Details of gear terminology, involutes and cycloidal tooth profile, Interference in involutes gears, Critical numbers of teeth for interference free motion Methods to control interference in involutes gears, Static force analysis in gears - spur, helical, bevel, worm & worm wheel Gear Trains: Kinematics and dynamic analysis of simple and compound gear trains, reverted gear trains, epi-cycle gear trains with spur or bevel gear combination	10

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of content and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the syllabus.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the syllabus**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

References:

1. Theory of Mechanisms and Machines by Amitabh Ghosh and A. Kumar Mallik
2. Theory of Machines and Mechanism by Uicker Jr, Garden Pennock & J.F. Shigley, OXFORD University Press
3. Theory of Machines by P L Ballaney
4. Theory of Machines by S S Ratan
5. Kinematics of Machines by R T Hinckle, Prentice Hall Inc
6. Kinematics by V M Fairs, McGraw Hill
7. Mechanism Design: Analysis and Synthesis Vol I by A. Erdman and G N Sander, Prentice Hall
8. Kinematics and Dynamics of Planer mechanisms by Jeremy Hirsihham, McGraw Hill
9. Theory of Machines by W. G. Green, Bluckie & Sons Ltd

Course Code	Course Name	Credits
MEL401	Data Base and Information Retrieval*	02

Objective:

1. To acquaint with data modelling/database design using the entity-relationship
2. To study use of Structured Query Language (SQL) and learn SQL syntax
3. To familiarise Graphical User Interface techniques to retrieve information from database
4. To study needs of database processing and controlling the consequences of concurrent data access

Outcomes: Learner will be able to...

1. Identify data models and schemes in DBMS
2. Demonstrate the features of database management systems and Relational database
3. Use SQL- the standard language of relational databases
4. Demonstrate understanding of functional dependencies and design of the database
5. Design graphical user Interface for specific application
6. Create visual software entities

Module	Detailed Contents	Hrs.
01	Introduction to Database Concept: What is a database?, Characteristics of database, Example of database, File system V/s Database system, What is DBMS?, Users of database system, Advantage of using an enterprise database, Concerns when using an enterprise database, Data independence, DBMS systems architecture, Database administrator	02
02	Entity-Relationship Data Model: Introduction, Benefits of Data Modelling, Types of Models, Phases of Database Modelling, The Entity-Relationship (ER) Model, Generalisation, Specialization and Aggregation, Extended Entity-Relationship (EER) Model	04
03	Rational Model and Algebra: Introduction, Mapping the ER and EER Model to the relational Model, Data Manipulation, Data Integrity, Advantages of Relational Model, Relational Algebra, Relational Algebra Queries, Relational Calculus	04
04	Structured Query Language (SQL): Overview of SQL, Data definition commands, set operations, aggregate functions, null values, Data manipulation commands, Data control commands, Views- using virtual tables in SQL, Nested and complex queries	04
05	Introduction to Transactions Management and Co-currency: Transaction concept, transaction states, ACID properties, Implementation of atomicity and durability, Concurrent Executions, Serializability, Recoverability, Co-currency Control: Lock-based, Timestamp-based, Validation-based protocols, Deadlock handling, Recovery system, Failure classification, Storage structure, Recovery and atomicity, Log based recovery, Shadow paging	04
06	Graphical User Interface: Murphy's law of GUI design, Features of GUI, Icons and graphics, Identifying visual cues, clear communication, colour selection, GUI standard, planning GUI Design Work Visual Programming: Sharing Data and Code: Working with projects, introduction to basic language, Using inbuilt controls and ActiveX controls, creating and using classes, introduction to collections, using and creating ActiveX components, dynamics data exchange, Object linking and embedding, Creating visual software entities: Working with text, graphics, working with files, file management, serial communication, multimedia control interfaces	06

Assessment:

Term Work:

Assign minimum two case studies for each student. On their case studies following exercises to be performed

1. Problem Definition and draw ER/EER diagram
2. Design Relational Model
3. Perform DDL operation
4. Perform DML and DCL operations
5. Design Forms using Visual programming
6. Retrieve the information through GUI.

Distribution of Term work Marks

Laboratory work	40 Marks

Attendance	10 Marks

End Semester Practical/Oral Examination:

1. Practical examination of 2 hours duration followed by viva to be conducted by Pair of Internal and External Examiner based on contents
2. Evaluation of practical examination to be done by examiner based on the printout of students work
3. Distribution of marks

Practical examination:	40 marks
Viva based on practical examination	10marks
4. Students work along with evaluation report to be preserved till the next examination

Reference Books:

1. Database Management Systems, G K Gupta, McGraw – Hill
2. Database System Concepts, Korth, Slberchatz, Sudarshan, 6thEdition, McGraw – Hill
3. GUI Design for dummies, IDG books
4. Visual Basic 2005, How to program, Deitel and Deitel, 3rdEdition, Pearson Education
5. SQL and PL/SQL for Oracle 10g, Black Book, Dr P S Deshpande, Dreamtech Press
6. Introduction to Database Management, Mark L Gillenson, Paulraj Ponniah, Wiley
7. Oracle for Professional, Sharaman Shah, SPD.
8. Database Management Systems, Raghu Ramkrishnan and Johannes Gehrke, TMH
9. Fundamentals of Database Management System, Mark L Gillenson, Wiley India

Course Code	Course/Subject Name	Credits
MEL402	Fluid Mechanics*	1

Objectives:

1. To study measurement as well as calibration principles
2. To practically verify the concepts learnt in theory course

Outcomes: Learner will be able to...

1. Calibrate different gauges
2. Measure hydrostatic forces
3. Verify the Archimedes Principle
4. Calibrate Venturimeter, Orificemeter and Pitot tube
5. Verify the Bernoulli's Principle
6. Read manometers and maintain them.

(a) List of Experiments: Any 6 experiments to be performed.

Expt no	Experiment	Hrs
1	Calibration of Pressure Gauges	2
2	Measurement of Hydrostatic Pressures	2
3	Verification of Archimedes' Principle	2
4	Calibration of Venturimeter/ Orificemeter/Nozzlemeter/ Pitot tube	2
5	Determine the friction factor for Pipes	2
6	Determination of major and minor losses in Pipe systems	2
7	Verification of Bernoulli's Equation	2
8	Experiment on Laminar flow in pipes	2
9	Calculation of Lift and Drag over an aerofoil	2
10	Determine the pressure profile over an aerofoil	2

- (b) Mini Project: A mini project along with a brief report in which a group of students (maximum 4) will design/ fabricate/ assemble a unit or software based simulation to demonstrate any principle in Fluid Mechanics.

Assessment:

Term work Mark distribution will be as follows:

Laboratory work	15 marks
Mini Project	05 marks
Attendance	05 marks

End Semester Practical/Oral Examination:

1. Pair of Internal and External Examiner should conduct practical/viva based on contents. Distribution of marks for practical/viva examination shall be as follows:

Practical performance	15 marks
Viva	10 marks
2. Evaluation of practical examination to be done based on the experiment performed and the output of the experiment during practical examination
3. Students work along with evaluation report to be preserved till the next examination

Course Code	Course Name	Credits
MEL403	Industrial Electronics*	01

Objectives

1. To study operational characteristics of various electrical and electronics components
2. To study microcontroller based applications and its programming

Outcomes: Learner will be able to...

1. Demonstrate characteristics of various electrical and electronics components
2. Develop simple applications built around these components
3. Identify use of different basic gates
4. Identify and use digital circuits for industrial applications
5. Built and demonstrate basic parameter measurement using microcontroller
6. Test and Analyse speed-torque characteristics of electrical machines for speed control.

List of Experiment: Minimum six from 1-9 and four from 10-15, in all minimum ten experiments need to be performed

Sr No	Detailed Contents
1	MOSFET / IGBT as a switch
2	V-I characteristics of SCR
3	Triggering circuit of SCR (UJT)
4	Full wave Rectifier using SCR
5	Single phase Bridge inverter with rectifier load
6	OPAMP as integrator
7	555 timer as astable multivibrator
8	Implementing study of gates and Logic Operations like, NOT, AND, OR
9	Realization of basic gates using universal gates
10	Light dimmer circuit using Diac-Triac
11	Speed control of DC motor
12	Speed control of induction motor
13	Simple programs using microcontroller
14	Simple microcontroller based application like Temp Measurement/ Speed Measurement using Proximity Sensor/ Piezoelectric Actuator Drive
15	Microcontroller based speed control for Induction Motor

Learners (in a group) may be encouraged for Project Based Learning. Appropriate Weightage may be given in term work assessment

Assessment:

Distribution of marks for term work

Laboratory work	20 Marks
Attendance	05 Marks

End Semester Practical/Oral Examination:

1. Pair of Internal and External Examiner should conduct practical/viva based on contents
2. Distribution of marks for practical/viva examination shall be as follows:

Practical performance	15 marks
Viva	10 marks
3. Evaluation of practical examination to be done based on the experiment performed and the output of the experiment during practical examination
4. Students work along with evaluation report to be preserved till the next examination

Course Code	Course Name	Credits
MEL 404	Kinematics of Machinery*	01

Objectives:

1. To familiarise with various mechanisms and inversions
2. To acquaint with basics of power transmission systems

Outcomes: Learner will be able to...

1. Draw velocity diagram by instantaneous center method
2. Draw velocity and acceleration diagrams for four bar mechanism by relative method.
3. Draw velocity and acceleration diagrams for Slider crank mechanism by relative method
4. Draw Cam profile for the specific follower motion
5. Plot displacement-time, velocity-time, acceleration-time cam profiles
6. Develop and build mechanisms to provide specific motion

Term Work: (Comprises a and b)

a) List of Experiments

Sr No	Details	Lab Session
1	Analysis of velocity of mechanisms by Instantaneous Center of Rotation – 3 to 5 problems	2 Hrs
2	Analysis of velocity of mechanism by Relative method – 3 to 5 problems	4 Hrs
3	Analysis of Velocity & Acceleration of mechanism by Relative method – 3 to 5 problems	4 Hrs
4	Motion analysis and plotting of displacement–time, velocity-time and acceleration-time, jerk-time and layout of cam profiles - 2 to 3 problems	4 Hrs
5	Mini project on design and fabrication of any one mechanism for a group of maximum 4 students	6 Hrs

b) Assignments: Minimum two problems on each of the following topics:

- i) Brakes
- ii) Chains and belts
- iii) Gear and gear trains

Distribution of marks for Term Work shall be as follows:

Laboratory work	:	15marks.
Assignments	:	05 Marks
Attendance	:	05 marks.

Course Code	Course/Subject Name	Credits
MEL405	Machine Shop Practice – II*	2

Objectives:

1. To familiarise with basic machining processes.
2. To Acquaint to various machining operations and machine protocols

Outcomes: Learner should be able to

1. Operate lathe machine,
2. Perform shaping operations
3. Perform finishing operations on grinding machine
4. Perform milling operations.
5. Perform precision turning
6. Perform drilling and threading operations.

Module	Details	Hrs
1	One composite job consisting minimum four parts employing operations on lathe like precision turning screw cutting, boring etc. This job shall involve use of shaping, milling and grinding operations	48

Term Work:

1. Composite job mentioned above
2. Complete Work-Shop Book giving details of drawing of the job and time sheet

The distribution of marks for Term work shall be as follows:

Job Work with complete workshop book	 40 marks
Attendance	 10 marks

End Semester Practical Examination:

Pair of Internal and External Examiner should conduct practical/viva based on contents.

Practical examination will be held for 4 hours.

Job shall consist of minimum four operations such as precision turning, boring, screw cutting, drilling, milling, shaping, grinding etc.

Course Code	Course/Subject Name	Credits
MEC501	Internal Combustion Engines*	4

Objectives

1. To familiarize with the working of S.I. and C.I. engines and its important systems
2. To acquaint with the various methods for measurement of engine performance
3. To provide insight into the harmful effects of engine pollutants and its control
4. To familiarise with the latest technological developments in engine technology

Outcomes: Learner will be able to...

1. Demonstrate the working of different systems and processes of S.I. engines
2. Demonstrate the working of different systems and processes of C.I. engines
3. Illustrate the working of lubrication, cooling and supercharging systems.
4. Analyse engine performance
5. Illustrate emission norms and emission control
6. Comprehend the different technological advances in engines and alternate fuels

Module	Detailed Contents	Hrs.
01	Introduction Classification of I.C. Engines; Parts of I.C. Engine and their materials, Cycle of operation in Four stroke and Two-stroke IC engines and their comparative study; Fuel air cycles and their analysis, Actual working cycle, Valve Timing Diagram. LHR Engines, Homogeneous charge compression Ignition, Rotary engine-Six stroke engine concept	06
02	S.I. Engines Fuel Supply System: Spark ignition Engine mixture requirements, Fuel-Air ratio, Simple carburettor and auxiliary circuits (excluding mathematical analysis of carburettors) Injection systems: Single-point and Multipoint injection, Gasoline Direct Injection Ignition System: Battery Ignition System, Magneto Ignition System, Functions and working of ignition coil, spark plug, contact breaker point, Requirements and working of Ignition advance mechanisms; mechanical and vacuum, Electronic Ignition Systems; Capacitor Discharge Ignition System, Transistorized Coil Assisted Ignition System, Transistor Ignition system with contactless breaker Combustion : Combustion phenomenon in SI Engines, Ignition delay, Flame propagation, Pressure-Crank angle diagram, Abnormal combustion, Auto ignition, Detonation and Knocking, Factors affecting combustion and detonation, Types of combustion chambers	12
03	Compression Ignition Engines Fuel Injection Systems: Air injection systems, Airless/solid injection systems, Common rail, individual pump, distributor and unit systems. Injection pumps, Fuel injector, Types of nozzle, Electronically controlled unit fuel injection system Combustion: Combustion phenomenon in C I engines, Stages of combustion, Delay period, Knocking, Pressure-Crank angle diagram, Factors affecting combustion and knocking, Types of combustion chambers	10
04	Engine lubrication: Types of lubricants and their properties, SAE rating of lubricants, Types of lubrication systems Engine Cooling: Necessity of engine cooling, disadvantages of overcooling, Cooling systems and their comparison: Air cooling, Liquid cooling Supercharging/Turbo-charging: Objectives, Limitations, Methods and Types, Different arrangements of turbochargers and superchargers	06

05	Engine Testing and Performance Measurement of Brake Power, Indicated Power, Frictional Power, Fuel Consumption, Air flow, BMEP, Performance characteristic of SI and CI Engine Effect of load and speed on Mechanical, Indicated Thermal, Brake Thermal and Volumetric efficiencies, Heat balance sheet. Engine Exhaust Emission and its control Constituents of exhaust emission at its harmful effect on environment and human health, Formation of NO _x , HC, CO and particulate emissions, Methods of controlling emissions; Catalytic convertors, particulate traps, Exhaust Gas Recirculation, EURO and BHARAT norms.	10
06	Alternative Fuels Alcohol - Hydrogen - Natural Gas and Liquefied Petroleum Gas – Biodiesel- Biogas - Producer Gas - Properties - Suitability - Engine Modifications - Merits and Demerits as fuels. Basics of Electronic Engine Controls: Electronic Control module (ECM), Inputs required and output signals from ECM, Sensors: Throttle Position, Inlet Air Temperature, Coolant Temperature, Crankshaft Position, Camshaft Position, Mass Air flow and Exhaust Gas Oxygen sensors, their construction and importance in ECM. Electronic Spark control, Air Management system, Idle speed control	04

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of content and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the syllabus.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the syllabus**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

References:

1. Internal Combustion Engines, Willard W.Pulkrabek, Pearson Education.
2. Internal Combustion Engines, Shyam Agrawal, New Age International
3. Internal Combustion Engine, Mathur and Sharma
4. Internal Combustion Engines, Mohanty, Standard Book House
5. Internal Combustion Engine, Gills and Smith
6. Internal Combustion Engines Fundamentals, John B. Heywood , TMH
7. Internal Combustion Engines, Gupta H N, 2nd ed, PHI
8. Internal Combustion Engine, V Ganesan, TMH
9. Introduction to Internal Combustion Engines, Richard Stone, Palgrave Publication, 4th Edition
10. Internal Combustion Engine, S.L. Beohar
11. Internal Combustion Engine, P.M Heldt.
12. Internal Combustion Engines, V.L. Maleeve
13. Internal Combustion Engine, E.F. Oberi.
14. Internal Combustion Engine by Domkundwar

Course Code	Course/Subject Name	Credits
MEC502	Mechanical Measurement and Control*	4

Objectives

1. To impart knowledge of architecture of the measurement system
2. To deliver working principle of mechanical measurement system
3. To study concept of mathematical modelling of the control system
4. To acquaint with control system under different time domain

Outcomes: Learner will be able to...

1. Classify various types of static characteristics and types of errors occurring in the system.
2. Classify and select proper measuring instrument for linear and angular displacement
3. Classify and select proper measuring instrument for pressure and temperature measurement
4. Design mathematical model of system/process for standard input responses
5. Analyse error and differentiate various types of control systems and time domain specifications
6. Analyse the problems associated with stability

Module	Contents	Hours
01	1.1 Significance of Mechanical Measurements, Classification of measuring instruments, generalized measurement system, types of inputs: Desired, interfering and modifying inputs. 1.2 Static characteristics: Static calibration, Linearity, Static Sensitivity, Accuracy, Static error, Precision, Reproducibility, Threshold, Resolution, Hysteresis, Drift, Span & Range etc. 1.3 Errors in measurement: Types of errors, Effect of component errors, Probable errors.	08
02	2.1 Displacement Measurement: Transducers for displacement, displacement measurement, potentiometer, LVDT, Capacitance Types, Digital Transducers (optical encoder) , Nozzle Flapper Transducer 2.2 Strain Measurement: Theory of Strain Gauges, gauge factor, temperature Compensation, Bridge circuit, orientation of strain gauges for force and torque, Strain gauge based load cells and torque sensors 2.3 Measurement of Angular Velocity: Tachometers, Tachogenerators, Digital tachometers and Stroboscopic Methods. 2.4 Acceleration Measurement: theory of accelerometer and vibrometers, practical accelerometers, strain gauge based and piezoelectric accelerometers	08
03	3.1 Pressure Measurement: Elastic pressure transducers viz. Bourdon tubes, diaphragm, bellows and piezoelectric pressure sensors, High Pressure Measurements, Bridge man gauge. Vacuum measurement: Vacuum gauges viz. McLeod gauge, Ionization and Thermal Conductivity gauges 3.2 Flow Measurement: Bernoulli flowmeters, Ultrasonic Flowmeter, Magnetic flow meter, rotameter 3.3 Temperature Measurement: Electrical methods of temperature measurement Resistance thermometers, Thermistors and thermocouples, Pyrometers 3.4 Sensitivity analysis of sensor -influence of component variation 3.5 Signal conditioning: Amplifier, Conversion, Filtering, Impedance Buffering, Modulation / Demodulation, Linearization, Grounding and Isolation	08
04	4.1 Introduction to control systems, Classification of control system. Open loop and closed loop systems. 4.2 Mathematical modelling of control systems, concept of transfer function, Block diagram algebra	06
05	5.1 Transient and steady state analysis of first and second order system. Time Domain specifications. Step response of second order system. Steady-state error, error coefficients, steady state analysis of different type of systems using step, ramp and parabolic inputs	06

06	Stability analysis 6.1 Introduction to concepts of stability, The Routh criteria for stability 6.2 Experimental determination of frequency response, Stability analysis using Root locus, Bode plot and Nyquist Plots 6.3 State space modeling 6.4 Process control systems, ON-OFF control. P-I-D Control	12

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of content and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the syllabus.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the syllabus**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

References

1. Measurement Systems: Applications and Design, by EO Doebelin, 5th Edition, *McGraw Hill*
2. Mechanical Engineering Measurements, A K Sawhney, *Dhanpat Rai & Sons, New Delhi*
3. Instrumentation & Mechanical Measurements, A K Thayal
4. Control System Engineering by Nagrath IJ and Gopal M, *Wiley Eastern Ltd.*
5. Modern Control engineering: by KOgata, *Prentice Hall*
6. Control systems by DhaneshManik, Cengage Learning
7. Engineering Metrology and Measurements by N V Raghavendra and L Krishnamurthy, Oxford University Press
8. Instrumentation and Control System, W. Bolton, Elsevier
9. Experimental Methods for Engineers by J P Holman, McGraw Hills Int. Edition
10. Engineering Experimentation by EO Doebelin, McGraw Hills Int. Edition
11. Mechanical Measurements by S P Venkateshan, Ane books, India

Course Code	Course/Subject Name	Credits
MEC 503	Heat Transfer*	04

Objectives

1. To Study basic heat transfer concepts applicable for steady state and transient conditions
2. To Study mathematical modelling and designing concepts of heat exchangers

Outcomes: Learner will be able to...

1. Identify the three modes of heat transfer (conduction, convection and radiation).
2. Illustrate basic modes of heat transfer
3. Develop mathematical model for each mode of heat transfer
4. Develop mathematical model for transient heat transfer
5. Demonstrate and explain mechanism of boiling and condensation
6. Analyse different heat exchangers and quantify their performance

Module	Detailed Contents	Hrs.
01	Basic concepts of heat transfer: Define heat transfer and its importance in engineering applications, Difference between heat transfer and Thermodynamics, Physical Mechanism of modes of heat transfer, Governing laws of heat transfer, Conduction mode: Thermal conductivity, Thermal diffusivity, Convection mode: Free and Forced convection, Heat transfer Coefficient, Radiation mode: Emissivity, transmissivity, reflectivity, absorptivity, Black body, Grey body, Opaque body, Steady and unsteady heat transfer, One dimensional, two dimensional and three dimensional heat transfer, Thermal resistance concept in heat transfer, Thermal contact resistance	04
02	Conduction: Assumptions in heat conduction, Generalized heat conduction equation in rectangular, cylindrical coordinates, Initial and boundary conditions, Steady state heat conduction through plane wall, Composite wall, cylinder, composite cylinder wall, sphere, Internal Heat generation concept, Heat conduction with heat generation in plane wall, solid cylinder and solid sphere, Critical radius of insulation in cylinder and sphere	08
03	Heat transfer from Extended Surface: Types of extended surface and its significance, Governing differential equation for fin and its solution, Fin performance: Fin effectiveness and Fin efficiency, Thermo Well Unsteady state heat transfer: Applications of unsteady state heat transfer, Lumped system Analysis, Criteria for lumped system analysis: characteristic length, Biot Number, Thermal time constant and Response of a thermocouple, Heisler Charts Numerical methods in heat transfer: Significance of numerical methods in heat transfer, Finite difference formulation of differential equations, One-dimensional heat conduction.	08
04	Convection: Determination of heat transfer coefficient, Dimensional Analysis, Dimensionless numbers in free and forced convection and their significance External Flow: Velocity Boundary layer and Thermal Boundary layer, Laminar and turbulent flow over a flat plate, Flow across cylinder and sphere, Flow across bank of tubes Internal Flow: Velocity Boundary layer and Thermal Boundary layer, Laminar and Turbulent flow in tubes, General thermal analysis: Constant heat flux and constant surface temperature	10
05	Radiation: Basic laws of radiation, Black body radiation, Planck's law, Kirchhoff's law, Wein displacement law, Lambert cosine law, Radiation intensity, Radiation heat exchange between black bodies, Shape factor algebra, Radiation heat exchange between nonblack bodies, Electrical network approach for radiation heat exchange: Radiosity and irradiation, Radiation shield	08
06	Boiling and Condensation: Boiling heat transfer, Pool boiling: different regimes and pool boiling curve, Flow boiling: Different Regimes and Boiling curve, Condensation heat transfer, Film condensation, Dropwise Condensation Heat Exchangers: Types of heat exchangers, Overall heat transfer coefficient, Fouling factor, Analysis of heat exchangers, LMTD, Effectiveness –NTU method, Correction factor, Effectiveness of heat exchangers Heat Pipe: Introduction and application	10

Assessment:**Internal Assessment for 20 marks:**

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of content and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the syllabus.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the syllabus**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

ReferenceBooks:

1. Introduction to thermodynamics and Heat transfer by Yunus A Cengel 2nd Edition, McGraw Hill International
2. Fundamentals of Heat and Mass Transfer by F P Incropera and D P deWitt, Wiley India
3. Heat Transfer by P S Ghoshdastidar, 2nd Edition, Oxford University Press
4. Heat and Mass Transfer, by R Rudramoorthy and L Malaysamy, 2nd Edition, PEARSON
5. Heat Transfer by J P Holman, McGraw Hill
6. Heat Transfer by S P Sukhatme, University Press
7. Heat and Mass Transfer by PK Nag, TMH
8. Heat and Mass Transfer by Mahesh Rathod, Laxmi Publications
9. Heat and Mass Transfer by R K Rajput, S Chand and company

Course Code	Course/Subject Name	Credits
MEC504	Dynamics of Machinery*	4

Objectives:

1. To acquaint with working principles and applications of Governors / Gyroscope
2. To study static and dynamic force analysis in the mechanisms
3. To familiarise with basics of mechanical vibrations
4. To study the balancing of mechanical systems

Outcomes: Learner will be able to...

1. Demonstrate working Principles of different types of governors and Gyroscopic effects on the mechanical systems
2. Illustrate basic of static and dynamic forces
3. Determine natural frequency of element/system
4. Determine vibration response of mechanical elements / systems
5. Design vibration isolation system for a specific application
6. Demonstrate basic concepts of balancing of forces and couples

Module	Details	Hrs.
1	Governors and Gyroscopes: 1.1 Governors: Introduction to Centrifugal and Inertia governors, Force analysis of governors- Porter and Hartnell governors, Performance characteristics of governors, Governors effort and power 1.2 Gyroscope: Introduction, Gyroscopic couple and its effect on spinning bodies, naval ships during steering, pitching, rolling and their stabilization. Effect of gyroscopic and centrifugal couples, permissible speeds on curve paths, gyroscopic effect due to lateral misalignment of rigid disc mounted on shaft.	09
2	2.1 Static and Dynamic force analysis, in slider crank mechanism (neglecting mass of connecting rod and crank), Engine force analysis, Turning moment on crank shaft 2.2 Dynamically equivalent systems, to convert rigid body in to two mass with and without correction couple	06
3	3.1 Basic Concepts of Vibration: Vibration and oscillation, causes and effects of vibrations, Vibration parameters - springs, mass, damper, damper models, Motion- periodic, non-periodic, degree of freedom, static equilibrium position, vibration classification, steps involved in vibration analysis 3.2 Free Undamped Single Degree of Freedom Vibration System: Longitudinal, transverse, torsional, vibration system, methods for formulation of differential equations by Newton, Energy, Lagrangian and Rayleigh's method	08
4	4.1 Free Damped Single Degree of Freedom Vibration System: Viscous damped system - under damped, critically damped, over damped; Logarithmic decrement; Coulomb's damping 4.2 Equivalent Single Degree of Freedom Vibration System: Conversion of multi-springs, multi masses, multi-dampers into a single spring and damper with linear or rotational co-ordinate system, Introduction to free multi-degree of freedom vibration systems	07
5	5.1 Forced Single Degree of Freedom Vibratory System: Analysis of linear and torsional systems subjected to harmonic force excitation and harmonic motion excitation (excluding elastic damper) 5.2 Vibration Isolation and Transmissibility: Force Transmissibility, motion transmissibility, typical isolators & mounts.	10

	5.3 Vibration Measuring instruments: Principle of seismic instruments, vibrometer, accelerometer - undamped and damped, Introduction to conditioning monitoring and fault diagnosis	
6	6.1 Rotor Dynamics: Critical speed of single rotor, undamped and damped 6.2 Balancing: Static and Dynamic balancing of multi rotor system, balancing of reciprocating masses in In-line engines, V-engines (excluding other radial engines)	08

Assessment:

Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests

First test based on approximately 40% of content and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the syllabus.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the syllabus**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

References:

1. Theory of Machines Thomas Bevan CSB Publishers & Distributors
2. Theory of Machines by Jagdishlal Metropolitan Book New Delhi, Company, Daryaganj, Delhi
3. Theory of Machines by S.S.Ratan Tata McGraw Hill , New Delhi
4. Theory of Machines by P.L.Bellaney Khanna publication, NewDelhi
5. Theory of Machines and Mechanisms by John J Uicker, Gordon R Pennock and Joseph E Shigley, Oxford University Press
6. Theory of Vibration with Applications, by W. Thomson, 2nd edition, Pearson Education
7. Mechanical Vibrations by S.S.Rao, fourth edition, Pearson Education
8. Mechanical Vibrations by G.K.Grover
9. Fundamentals of Mechanical Vibration by S.Graham Kelly, Tata McGraw Hill
10. Principles of Vibration by Benson H Tongue, 2nd Edition, Oxford University Press
11. Vibration Analysis by P. Srineevasan, TMH
12. Mechanical Vibrations- Schaum's outline series, William W.Seto, McGraw Hill
13. Theory and Practice of Mechanical Vibrations by J S Rao and K Gupta, New Age International
14. Elements of Vibration Analysis by Leonard Meirovitch, McGraw- Hill, New York

Course Code	Course/Subject Name	Credits
MEDLO5011	Press Tool Design	4

Objectives:

1. To acquaint with various press working operations for mass production of sheet metal components
2. To familiarise with sheet metal working techniques for design of press tools
3. To inculcate knowledge about scrap minimization, safety aspects and automation in press working

Outcomes: Learner will be able to....

1. Demonstrate various press working operations for mass production of sheet metal parts
2. Identify press tool requirements to build concepts pertaining to design of press tools
3. Prepare working drawings and setup for economic production of sheet metal components
4. Select suitable materials for different elements of press tools
5. Illustrate the principles and blank development in bent & drawn components
6. Elaborate failure mechanisms of pressed components, safety aspects and automation in press working

Module	Contents	Hours
1	Introduction to Press Working – 1.1 Classification of common Press working operations, Benefits and limitations of using Press tools. Applications of pressed parts/components. 1.2 Theory of Shearing in Press Working. Optimum Cutting clearance & its effect on tolerances of pressed components. Construction of Basic shearing die. Functions of different elements of a press tool. Methods of feeding the strip/coil material.	08
2	Design and Calculations of Piercing & Blanking Die– 2.1 Calculations for Economic Strip Layout, Calculations of Cutting force and Stripping force, Recommending minimum tonnage of a press. Centre of Pressure (its importance and calculation) 2.2 Design aspects of Press tool elements viz. Punches & methods of retaining punches, Die block, Stripper, Pilot, etc. Methods of reducing cutting loads on press tools 2.3 Different types Die sets and its selection	14
3	3.1 Selection of Material & Hardware – Selection and arrangement of Hardware used in Press tools. Selection of steels and its hardness for different elements of Press tools.	03
4	Bending and Drawing- 4.1 Theory of Bending, Spring back and measures to control it, Calculations for Blank development of Simple Bent components, Minimum bend radius, Types of Bending dies 4.2 Theory of Drawing, Metal flow in Drawing & forming operations; reduction ratio and redrawing limits, draw clearance, drawing and blank holding forces for cylindrical draws only. Blank development of Cup 4.3 Defects in drawn as well as bent parts, Presses selection for drawing/forming operations 4.4 Basic construction and working of Bending and Drawing dies	12
5	5.1 Miscellaneous Dies- Basic construction & working of Shaving dies, Trimming dies, Compound dies, Combination dies, Coining dies, Embossing dies, Simple Progressive & Compound Progressive dies	05
6	Selection of Presses and its setting – 6.1 Selection of Press and Press setting for Shearing, Bending, Progressive and Drawing dies, Equipment for Sheet metal operations (Basics only), Overloading of presses (load, energy considerations) 6.2 Introduction to Automation & Safety in Press shop	06

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
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3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

References

1. Die Design Fundamentals by J. R. Paquin, Industrial Press
2. Techniques of Press Working Sheet Metal by D F Eary and E A Reed
3. Press Tools Design and Construction by P H Joshi, S Chand Publishing
4. Tool Design by C. Donaldson and V C Goold, TMH
5. Production Engineering by P. C. Sharma, S Chand Publishing
6. Metal working ASM Handbook

Course Code	Course/Subject Name	Credits
MEDLO5012	Machining Sciences And Tool Design	4

Objectives

1. To familiarise with the basic concepts of machining science like mechanics of machining, tool wear, tool life and surface roughness.
2. To familiarise with various single and multipoint cutting tools designing processes
3. To study the economics of machining process

Outcomes: Learner will be able to...

1. Calculate the values of various forces involved in the machining operations
2. Design various single and multipoint cutting tools
3. Analyse heat generation in machining operation and coolant operations
4. Illustrate the properties of various cutting tool materials and hence select an appropriate tool material for particular machining application
5. Demonstrate the inter-relationship between cutting parameters and machining performance measures like power requirement, cutting time, tool life and surface finish
6. Analyse economics of machining operations

Module	Details	Hrs.
01	1.1 Metal Cutting Theory: Orthogonal and oblique cutting, various types of chips, Mechanics of orthogonal steady state metal cutting, shear plane and shear plane angle, Merchant's force circle, stresses, shear strain, velocity relations, rate of strain, energy considerations, Concept of specific power consumption in machining, Ernst and Merchant's model & modified model for orthogonal cutting, Lee and Shaffer model, Analytical modelling of machining operations, mechanistic modelling of machining, slip line field analysis, finite element analysis, modelling of material properties 1.2 Dynamometry: Dynamometer requirements, force measurement, electric transducers, strain gage lathe dynamometer, strain rings, milling dynamometer, drilling dynamometer, surface grinding dynamometer, piezoelectric dynamometry	10
02	2.1 Temperatures in metal cutting and cutting fluids: Heat generation in metal cutting, heat transfer in a moving material, temperature distribution in metal cutting, temperature in primary deformation zone, temperature in secondary deformation zone, effect of cutting speed on temperature, prediction of temperature distribution in machining, measurement of cutting temperature, work-tool thermocouple, direct thermocouple measurement, radiation methods, hardness and microstructure changes in steel tools Cutting fluid types, the action of coolants, the action of lubricants, characteristics of an efficient lubricant in metal cutting, application methods of cutting fluid, cutting fluid maintenance and environmental considerations, disposal of cutting fluids, dry cutting and minimum quantity lubrication, cryogenic cooling	06
03	Cutting tool materials and machining induced surface integrity 3.1 Properties of cutting tool materials, Major tool material types, Plain carbon steel, high speed steel, cast alloys, cemented tungsten carbide, titanium carbides, ceramic and cermet tools, synthetic diamond, polycrystalline diamond (PCD), cubic boron nitride (CBN), coated tools 3.2 Measurement and specification of surface finish, primary cutting edge finish, fracture roughness, BUE formation and its influence on finish, secondary cutting edge finish,	06

	geometrical contribution to roughness, edge finishing, residual stress and micro hardness	
04	4.1 Tool life and machining economics: Definition, flank wear and crater wear, criteria for tool failure, effect of cutting parameters and tool geometry on tool life, Taylor's tool life equation, Experimental methods to find Taylor exponents, Components of product cost, Optimum cutting velocity for minimum cost of production and maximum production rate	06
05	5.1 Design of single point cutting tools : Different systems of tool nomenclature like MRS, ORS and NRS, Interrelationship among different systems of nomenclature for tool angles, Constructional features of solid tool, tipped tools, mechanically held regrind able insert type tools and throw away tip type tools, Design of shanks, cutting tip and chip breakers for HSS and Carbide tools, ISO coding system for tipped tools and tool holders	08
06	6.1 Design of multi point cutting tools : Various types such as flat form tool, tangential form tool, circular form tool, constructional details and fields of application, Profile design of flat and circular form tools, Broach nomenclature, design steps for circular pull type, key way and spline broaches, Design of face and peripheral milling cutters	10

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

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1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

References

1. Fundamentals of Metal Machining and Machine Tools, Third Edition by Winston A. Knight, Geoffrey Boothroyd, CRC press Taylor and Francis group
2. Metal Cutting Principles by Milton Clayton Shaw, 2nd Edition, Oxford University Press
3. Cutting Tools by P H Joshi, A H Wheeler Publishing Co Ltd
4. ASM Handbook, Vol. 16: Machining by Joseph R. Davis, 9th Edition, ASM International
5. Fundamentals of Metal Cutting and Machine Tools by B. L. Juneja, G. S. Sekhon and Nitin Seth, 2nd Edition, New Age International
6. Metal Cutting Theory and Cutting Tool Design, by V. Arshinov and G. Alekseev, Mir publishers, Moscow
7. Typical Examples and Problems in Metal Cutting and Tool Design, by N. Nefedov and K. Osipov, Mir publishers, Moscow

Course Code	Course/Subject Name	Credits
MEDLO5013	Design of Jigs and Fixtures	4

Objectives

1. To acquaint with the concepts of planning and writing sequence of operations
2. To acquaint basics of identification and selection of location and clamping points on work-piece
3. To familiarise design principles in designing simple productive and cost effective jigs and fixtures

Outcomes: Learner will be able to...

1. Write methodically, the sequence of operations of simple work-piece
2. Identify and select locating and clamping points on work-piece
3. Demonstrate construction of drill jig
4. Illustrate construction of milling fixture
5. Identify appropriate combination of tools, jigs and fixture, suitable for a particular machining operation
6. Design assembly of jigs and fixtures on simple work-piece

Module	Details	Hrs
01	1.1 Introduction to Tool Design Production Tooling's Jigs, Fixtures and their difference, their requirement(accuracy, machinability, quantity modifications so as to assist production, Interchange ability, Simplicity, Swarf disposal, Handling, Ease of operation, Skill reduction, Cost reduction), Analysis for Operation planning, sequencing of operations.	08
02	Basic Construction of Jig & Fixture 1.1 Location & Locating Devices Locating principles: Degrees of freedom, Redundant location, Fool-proofing, nesting, Locators: locators that control work piece on flat surfaces, location of cylindrical surfaces, conical locators, centralizers. 1.2 Clamping & clamping Devices Requirement of clamping system, Position of clamps, Types of clamps, Clamping devices; examples of typical clamps(multiple clamping and equalizing devices, quick acting clamping mechanisms such as link, toggle, cam, eccentric, pneumatic, hydraulic and electric devices), Component distortion under clamping and cutting forces, Material used for different clamping devices of jigs/fixture and recommended hardness	10
03	3.1 Construction of Drill Jig Introduction, Selection of location, supporting and clamping faces /points, cutting tools and means of guiding and supporting Jigs, various types of Jig Bushes, Commonly used drill jigs, Case Study on Design of Drill Jig	10
04	4.1 Construction of Milling fixture Introduction, Selection of location, supporting and clamping faces /points choice, tool setting block and Tennon's, Case Study on Design of Milling Fixture	08
05	5.1 Introduction to Commonly used Fixtures Turning Fixture (Chucks, collets, Mandrels) Grinding Fixture, Broaching Fixture, and Welding Fixture	08
06	6.1 Indexing Jig & Fixture Introduction, Application of indexing, Essential features of an indexing jig /fixture, Indexing Devices	04

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

References

1. Jig and Fixture Design Manual, Erik K. Henrikson, Industrial Press
2. An introduction to jig and tool Design, MH A Kempster, 3rd Edition, ELBS
3. Jigs and Fixture, P. H. Joshi, TMH
4. Tool design, C. Donaldson, George H. Lecain, V.C. Goold, TMH
5. Jigs and Fixture Handbook, A.K. Goroshkin, Mir Publication
6. Jigs and Fixture, ASTME
7. Non- Standards Calming Devices, Hiran E. Grant TMH, New Delhi

Subject Code	Subject Name	Credits
MEL 501	Internal Combustion Engines Lab	01

Objectives:

1. To familiarise concept of thermal conductivity, heat transfer coefficient through experiments
2. To familiarise experimental verification of the concepts of heat transfer

Outcomes: Learner will be able to...

1. Dismantle engine assembly
2. Overhaul and Assemble engine components
3. Perform load test/speed test on engine setup
4. Calculate performance of multi cylinder engine
5. Analyse engine performance and draw heat balance sheet
6. Perform exhaust gas analysis

Part A: Dismantle, overhaul and assemble the following

1. 2 Stroke/ 4 Stroke Engines
2. Carburettor
3. Ignition system
4. Fuel injection system

Part B: Performing experiments on engine test rigs

1. Morse Test on petrol engine
2. Speed Test on petrol or/and diesel engine
3. Load Test on diesel engine (engines)
4. Heat Balance test on diesel or petrol engines
5. Experimental determination of Air fuel ratio and volumetric efficiency of the engine
6. Exhaust Gas/Smoke analysis of S.I./ C.I. engines
7. Effect of Supercharging on Performance Characteristics of an engine

Term Work

Term work shall consist of minimum 6 exercises, from the list, out of which minimum 4 must be actual experiments from Part B and 1 case study/report (in group of not more than 3 students) on latest trends/developments in IC Engines.

The distribution of marks for term work shall be as follows:

1. Laboratory work (Exercises) : **15 marks**
2. Case study: **05 marks**
3. Attendance: **05 marks**

End Semester Practical/Oral Examination:

1. Pair of Internal and External Examiner should conduct practical/viva based on contents
2. Distribution of marks for practical/viva examination shall be as follows:

Practical performance	15 marks
Oral	10 marks
3. Evaluation of practical examination to be done based on the experiment performed and the output of the experiment during practical examination
4. Students work along with evaluation report to be preserved till the next examination

Course Code	Course/Subject Name	Credits
MEL 502	Mechanical Measurement and Control	1

Objectives

1. To study calibration of different measuring instruments
2. To study working of mechanical measurement system
3. To familiarise with different types of control systems

Outcomes: Learner will be able to...

1. Calibrate displacement sensors
2. Calibrate pressure and vacuum gauges
3. Measure torque using strain gauges
4. Identify system/process characteristics for standard input responses
5. Identify various types of control systems and time domain specifications
6. Analyse the problems associated with stability

List of Experiments

Sr. No.	Topic
1	Calibration of Displacement sensors like LVDT, Potentiometers etc.
2	Calibration of Pressure Gauges
3	Calibration of Vacuum Gauges
4	Torque measurement using strain gauges
5	Calibration of tachometers
6	Vibration Measurement & Calibration of Accelerometers.
7	Experiments on feedback control systems and servomechanisms
8	System Identification of any one of the sensor
9	Experiment on frequency response system identification
10	Experiment on transient state response of a control system.
11	Experiment on design of PID controller for a system.

- (a) Design based experiments shall be encouraged using standard National Instrument/ texas instrument/ dSPACE GmbH/ Arduino or any other platform). **Learners (in a group) may be encouraged for Project Based Learning. Appropriate weightage may be given in term work assessment**

Term Work

Term work shall consist of minimum 8 experiments (04 from the measurement group and 4 from the control group),

The distribution of marks for term work shall be as follows:

- Laboratory work (Experiments) : **15 marks**
- Design based experiment: **05 marks**
- Attendance: **05 marks**

End Semester Practical/Oral Examination:

1. Pair of Internal and External Examiner should conduct practical/viva based on contents
2. Distribution of marks for practical/viva examination shall be as follows:

Practical performance	15 marks
Oral	10 marks
3. Evaluation of practical examination to be done based on the experiment performed and the output of the experiment during practical examination
4. Students work along with evaluation report to be preserved till the next examination

Subject Code	Subject Name	Credits
MEL 503	Heat Transfer Lab	01

Objectives:

1. To familiarise concept of thermal conductivity, heat transfer coefficient through experiments
2. To familiarise experimental verification of the concepts of heat transfer

Outcomes: Learner will be able to...

1. Estimate thermal conductivity of metals/non metals/liquids
2. Compute heat transfer coefficient in natural as well forced convection
3. Measure emissivity of grey body
4. Quantify fin effectiveness/efficiency
5. Analyse heat exchanger performance
6. Demonstrate energy balance for heat exchanger

The laboratory experiments should be based on the following:

Expt.No	Name of Experiments	Time
1	Conduction: (Any Two) 1. Measurement of thermal conductivity of metal rod 2. Measurement of thermal conductivity of insulating material 3. Measurement of thermal conductivity of liquid 4. Determination of contact resistance 5. Effect of area on heat transfer	2Hrs
2	Convection: (Any One) 1. Measurement of heat transfer coefficient in natural convection 2. Measurement of heat transfer coefficient in forced convection 3. Comparison of heat transfer coefficient of free and forced convection	2Hrs
3	Radiation: (Any One) 1. Verification of Stefan Boltzmann Law 2. Measurement of Emissivity of Grey surface	2Hrs
4	Transient Conduction: 1. Unsteady state heat transfer in cylinder/rod/wall	2Hrs
5	Fins: (Any One) 1. Determination of fin efficiency and fin effectiveness 2. Comparison of fin performance of Various type of fins	2Hrs
6.	Boiling and Condensation: (Any One) 1. Measurement of heat transfer coefficient in boiling process of water. 2. Measurement of heat transfer coefficient in condensation of saturated steam.	2Hrs
7	Heat Exchangers: (Any One) 1. Estimation of overall heat transfer coefficient and effectiveness of double pipe heat exchanger (parallel flow and Counter flow arrangement) 2. Estimation of overall heat transfer coefficient and effectiveness of shell and tube heat exchanger (parallel flow and Counter flow arrangement) 3. Estimation of overall heat transfer coefficient and effectiveness of plate type heat exchanger.	2Hrs

Assignments: Assignment consisting of at least 3 numerical on each of the following topics

1. Steady state conduction
2. Fins and unsteady state conduction
3. Convection and dimensional analysis

4. Radiation
5. Heat Exchangers

Note: Preferably, the assignments shall be based on live problems. **Project Based Learning may be incorporated by judiciously reducing number of assignments.**

Assessment:

Term work Mark distribution will be as follows:

Laboratory work	15 marks
Assignments	05 marks
Attendance	05 marks

End Semester Practical/Oral Examination:

1. Pair of Internal and External Examiner should conduct practical/viva based on contents Distribution of marks for practical/viva examination shall be as follows:

Practical performance	15 marks
Oral	10 marks
2. Evaluation of practical examination to be done based on the experiment performed and the output of the experiment during practical examination
3. Students work along with evaluation report to be preserved till the next examination

Course Code	Course Name	Credits
MEL504	Dynamics of Machinery*	1

Objectives:

1. To acquaint with working principles and applications of gyroscope and governors
2. To acquaint with the principles of vibration measuring instruments
3. To study balancing of mechanical systems

Outcomes: Learner will be able to...

1. Plot and analyse governor characteristics
2. Analyse gyroscopic effect on laboratory model
3. Estimate natural frequency of mechanical systems
4. Analyse vibration response of mechanical systems
5. Determine damping coefficient of a system
6. Balance rotating mass

Term Work: (Comprises part a and b)

a) List of Experiments: (Minimum Eight)

Sr. No.	Title of Experiment	Laboratory Sessions
1	Experiments on Governors- Porter Governor, Hartnell Governor	2 hrs
2	Experiments on Gyroscope	2 hrs
3	Determine natural frequency of compound pendulum, equivalent simple pendulum system.	2 Hrs.
4	Determine natural frequency for longitudinal vibrations of helical springs, and springs in series and parallel	2 Hrs
5	Determine natural frequency and nodal points for single rotor and two-rotor vibratory system	2 Hrs
6	Experiment on whirling of shaft	2 Hrs
7	Determination of damping coefficient of any system/media	2 Hrs
8	Experimental balancing of single and multi-rotor system	2 Hrs
9	Measurement of vibration response of a system	2 Hrs
10	Vibration analysis of mechanical system using MATLAB/SCILAB/GNU Octave	2 Hrs

b) Assignment: Minimum two problems on each of the following topics:

1. Governors and Gyroscope
2. Static and dynamic force analysis
3. Vibration, isolation and control
4. Vibration measuring instruments
5. Rotor dynamics

Project Based Learning may be incorporated by judiciously reducing number of assignments

Term Work

The distribution of marks for term work shall be as follows:

- Laboratory work : 15 marks.
- Assignments : 05 marks.
- Attendance : 05 Marks.

Course Code	Course/Subject Name	Credits
MEL 505	Manufacturing Sciences Lab	1

Objectives:

1. To study conventional machining operations
2. To familiarise with CNC machining operation
3. To acquaint with Non Traditional machining operations

Outcomes: Learner will be able to...

1. Estimate machining time for simple and taper turning operations on lathe
2. Estimate machining time for threading/knurling operations on lathe
3. Estimate machining time for various machining operations on shaper
4. Perform NC, CNC and DNC machining operations
5. Write CNC program for different operations
6. Identify machining parameters for various Non Traditional machining operations

Sr No.	Details
1	Introduction to machining operations
2	Introduction to lathe machine (other than plain turning operation) and shaping machine
3	Machining and machining time estimation for taper turning
4	Machining and machining time estimation for thread cutting
5	Machining and machining time estimation for internal thread cutting
6	Machining and machining time estimation for knurling
7	Machining and machining time estimation for eccentric turning
8	Machining of hexagon and square in shaping machine
9	NC, CNC, DNC machining operations
10	CNC programming for Turning and Drilling operations
11	Different Non Traditional machining operations with process parameters

Term Work:

All the assignments mentioned above with relevant sketches.

Distribution of marks for Term work shall be as follows:

All the above listed assignments:	20 marks
Attendance:	05 marks

Subject Code	Subject Name	Credits
MEL506	Business Communication & Ethics	02

Objectives:

1. To inculcate professional and ethical attitude at the workplace
2. To enhance effective communication and interpersonal skills
3. To build multidisciplinary approach towards all life tasks
4. To hone analytical and logical skills for problem-solving

Outcomes: Learner will be able to...

1. Design a technical document using precise language, suitable vocabulary and apt style.
2. Develop the life skills/ interpersonal skills to progress professionally by building stronger relationships.
3. Demonstrate awareness of contemporary issues knowledge of professional and ethical responsibilities.
4. Apply the traits of a suitable candidate for a job/higher education, upon being trained in the techniques of holding a group discussion, facing interviews and writing resume/SOP.
5. Deliver formal presentations effectively implementing the verbal and non-verbal skills

Module	Detailed Contents	Hrs.
01	Report Writing	05
1.1	Objectives of Report Writing	
1.2	Language and Style in a report	
1.3	Types : Informative and Interpretative (Analytical, Survey and Feasibility) and Formats of reports (Memo, Letter, Short and Long Report)	
02	Technical Writing	03
2.1	Technical Paper Writing (IEEE Format)	
2.2	Proposal Writing	
03	Introduction to Interpersonal Skills	09
3.1	Emotional Intelligence	
3.2	Leadership and Motivation	
3.3	Team Building	
3.4	Assertiveness	
3.5	Conflict Resolution and Negotiation Skills	
3.6	Time Management	
3.7	Decision Making	
04	Meetings and Documentation	02
4.1	Strategies for conducting effective meetings	
4.2	Notice, Agenda and Minutes of a meeting	
4.3	Business meeting etiquettes	
05	Introduction to Corporate Ethics	02
5.1	Professional and work ethics (responsible use of social media - Facebook, WA, Twitter etc.	
5.2	Introduction to Intellectual Property Rights	
5.4	Ethical codes of conduct in business and corporate activities (Personal ethics, conflicting values, choosing a moral response and making ethical decisions)	
06	Employment Skills	07
6.1	Group Discussion	

6.2	Resume Writing	
6.3	Interview Skills	
6.4	Presentation Skills	
6.5	Statement of Purpose	
		28

Assessment:

List of Assignments

1. Report Writing (Theory)
2. Technical Proposal
3. Technical Paper Writing (Paraphrasing a published IEEE Technical Paper)
4. Interpersonal Skills (Group activities and Role plays)
5. Interpersonal Skills (Documentation in the form of soft copy or hard copy)
6. Meetings and Documentation (Notice, Agenda, Minutes of Mock Meetings)
7. Corporate ethics (Case studies, Role plays)
8. Writing Resume and Statement of Purpose

Term Work

Term work shall consist of all assignments from the list.

The distribution of marks for term work shall be as follows:

Book Report	10 marks
Assignments:	10 marks
Project Report Presentation:	15 marks
Group Discussion:	10 marks
Attendance:	05 marks

References:

1. Fred Luthans, "Organizational Behavior", Mc Graw Hill,
2. Lesiker and Petit, "Report Writing for Business", Mc Graw Hill
3. R.Subramaniam, "Professional Ethics" Oxford University Press
4. Huckin and Olsen, "Technical Writing and Professional Communication", McGraw
5. Raman and Sharma, Fundamentals of Technical Communication, Oxford University Press
6. Hill Wallace and Masters, "Personal Development for Life and Work", Thomson Learning, 12th Edition
7. Heta Murphy, "*Effective Business Communication*", Mc Graw Hill, edition
8. R.C Sharma and Krishna Mohan, "*Business Correspondence and Report Writing*",
9. Raman Sharma, *Communication Skills*, Oxford University Press
10. B N Ghosh, "*Managing Soft Skills for Personality Development*", Tata McGraw Hill Lehman,
11. Dufrene, Sinha, "*BCOM*", Cengage Learning, 2nd edition
12. Bell . Smith, "Management Communication" Wiley India Edition, 3rd edition.
13. Dr. K. Alex , "Soft Skills", S Chand and Company
14. Robbins Stephens P., "Organizational Behavior", Pearson Education
15. <https://grad.ucla.edu/asis/agep/advsopestem.pdf>

Course Code	Course/Subject Name	Credits
MEC 601	Metrology and Quality Engineering	4

Objectives:

1. To acquaint with measuring equipment used for linear and angular measurements.
2. To familiarize with different classes of measuring instruments and scope of measurement in industry and research
3. To acquaint with operations of precision measurement, instrument/equipment for measurement
4. To inculcate the fundamentals of quality concepts and statistics in metrology

Outcomes: Learner will be able to...

1. Demonstrate inspection methods and different gauges
2. Illustrate working principle of measuring instruments and calibration methodology
3. Illustrate basic concepts and statistical methods in quality control
4. Demonstrate characteristics of screw threads, gear profile, and tool profile
5. Illustrate the different sampling techniques in quality control
6. Illustrate different nondestructive techniques used for quality evaluation

Module	Details	Hours
1	1.1 Introduction to Metrology: Fundamental Definitions, Types of Standards, Precision and Accuracy, Measurement Errors, linear measurements by Vernier calliper, micrometer, slip gauges, Angular Measurement: Universal bevel protractor, clinometers, sine bar, angle gauges case studies on Industrial and Research Applications and Scope 1.2 Introduction to Nano-Metrology	06
2	1.3 Design of Gauges : Limits, Fits, Tolerances, Types of Gauges, Taylor's Principle of Limit Gauges, IS 919 for design of gauges 1.4 Comparators : Definition, Classification, Working principle of Mechanical, Opto-mechanical, Pneumatic and Electrical/Electronic comparators with advantages, limitations and uses 1.5 Surface Texture measurement: Surface roughness, Waviness, Roughness Parameter Ra, Rz, RMS etc., working of Tomlinson surface meter, Taly-surf surface roughness tester, Surface roughness symbols 1.6 Flatness Test measurement by Interference principle: Concept of Flatness, Interferometer principle for measurement, Optical Flats – study of Surface textures under monochromatic light source, fingertip test technique	14
3	3.1 Screw Thread Measurement : Screw threads Terminology, screw thread errors, Effective diameter measurement of screw thread by Floating Carriage micrometer 3.2 Gear Measurement : Gear Terminology, Gear errors, Measurement by Parkinson Gear tester and Gear tooth Vernier Calliper 3.3 Special Measuring Instruments : Measurement by Tool Maker's Microscope, Optical Profile Projector, CMM and Autocollimator	12

4	4.1 Quality Engineering Introduction to Quality, Classification of Quality Tools, Quality of Design, Quality of Conformance, Compromise between Quality and Cost, Introduction to Six Sigma 4.2 SQC & SQC tools Statistics in Quality control, Variables and Attributes data, Process Capability, Control charts for variables and for attribute data($\bar{X}$ and R-Chart, p-chart np-chart, c-chart, U-chart), Applications of SQC in engineering – case studies	08
5	5.1 Sampling Techniques Advantages of Sampling Inspection, operating characteristic (OC) curve. Choosing OC curve for appropriate sampling plan, acceptance sampling 5.2 Role of computers in metrology	04
6	6.1 Non-destructive Testing Visual, Dye Penetrant, Magnetic Particle, X ray Radiography, Ultrasonic Testing, Eddy Current testing methods.	04

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

References

1. Engineering Metrology, K.J. Hume, Kalyani Publications
2. Mechanical Measurements and Metrology by RKJain, Khanna Publishers
3. A text book of Engineering Metrology by IC Gupta, Dhanpat Rai Publications
4. Metrology and Measurement by Anand, Bewoor and Vinay Kulkarni, McGraw Hill
5. Engineering Metrology and Measurement by N V Raghavendra and Krishnamurthy, Oxford University Press
6. Engineering Metrology and Measurements, Bentley, Pearson Education
7. Statistical Quality Control by AL Grant, McGraw Hill, New York
8. Statistical Quality Control by R C Gupta, Khanna Publishers
9. Juran on Planning for Quality, Juran J M, The Free Press, 1988.
10. Statistical Quality Control by M Mahajan, Dhanpat Rai and Sons

Course Code	Course Name	Credits
MEC602	MACHINE DESIGN – I*	4

Objective:

1. To study basic principles of machine design
2. To acquaint with the concepts of design based on strength & rigidity
3. To familiarize with use of design data books & various codes of practice
4. To make conversant with preparation of working drawings based on designs

Outcomes: Learner will be able to...

1. Demonstrate understanding of various design considerations
2. Illustrate basic principles of machine design
3. Design machine elements for static as well as dynamic loading
4. Design machine elements on the basis of strength/ rigidity concepts
5. Use design data books in designing various components
6. Acquire skill in preparing production drawings pertaining to various designs

Modules	Details	Hrs.
1	Mechanical Engineering Design, Design methods, Aesthetic and Ergonomics consideration in design, Material properties and their uses in design, Manufacturing consideration in design, Design consideration of casting and forging, Basic principle of Machine Design, Modes of failures, Factor of safety, Design stresses, Theories of failures (Selection in the process of designing), Standards, I.S. Codes, Preferred Series and Numbers	06
2	Curved Beams: Assumptions made in the analysis of curved beams, Design of curved beams: Bending stresses in curved beams, such as crane hook, C-frame, etc. Thick Cylinders: Design of thick cylinders subjected to an internal pressure using Lamé's equation	06
3	Design against static loads: Cotter joint, Knuckle joint, Turn buckle, Bolted and welded joints under eccentric loading; Power Screw – screw presses, C-clamps along with the Frame, Screw Jack	12
4	Design against fluctuating loads: variables stresses, reversed, repeated, fluctuating stresses. Fatigue failure: static and fatigue stress concentration factors, Endurance limit- estimation of endurance limit, Design for finite and infinite life, Soderberg and Goodman design criteria, Fatigue design under combined stresses	06
5	Design of Shaft: power transmitting, power distribution shafts, Module (excluding crank shaft) under static and fatigue criteria Keys: Types of Keys and their selection based on shafting condition Couplings: Classification of coupling, Design of Flange couplings, Bush pin type flexible couplings	11
6	Design of Springs: Helical compression, Tension Springs under Static and Variable loads, Leaf springs	07

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

References:

1. Design of Machine Elements - V.B. Banadari, Tata McGraw Hill Publication
2. Design of Machine Elements - Sharma, Purohil. Prentice Hall India Publication
3. Machine Design -An Integrated Approach - Robert L. Norton, Pearson Education
4. Machine Design by Pandya & Shah, Charotar Publishing
5. Mechanical Engineering Design by J.E.Shigley, McGraw Hill
6. Recommended Data Books - PSG
7. Machine Design by Reshetov, Mir Publication
8. Machine Design by Black Adams, McGraw Hill
9. Fundamentals of Machine Elements by Hawrock, Jacobson McGraw Hill
10. Machine Design by R.C.Patel, Pandya, Sikh, Vol-I & II C. Jamnadas & Co
11. Design of Machine Elements by V.M.Faires
12. Design of Machine Elements by Spotts

Course Code	Course Name	Credits
MEC603	Finite Element Analysis	4

Objectives:

1. To familiarise with concepts of FEM
2. To study the applicability of FEM to engineering problems
3. To acquaint with application of numerical techniques for solving problems

Outcomes: Learner will be able to...

1. Solve differential equations using weighted residual methods
2. Develop the finite element equations to model engineering problems governed by second order differential equations
3. Apply the basic finite element formulation techniques to solve engineering problems by using one dimensional elements
4. Apply the basic finite element formulation techniques to solve engineering problems by using two dimensional elements
5. Apply the basic finite element formulation techniques to find natural frequency of single degree of vibration system
6. Use commercial FEA software, to solve problems related to mechanical engineering

Module	Details	Hrs.
01	Introduction: 1.1 Introductory Concepts: Introduction to FEM, Historical Background, General FEM procedure, Applications of FEM in various fields Advantages and disadvantages of FEM 1.2 Mathematical Modelling of field problems in engineering, Governing equations, Differential equations in different fields 1.3 Approximate solution of differential equations, Weighted residual techniques, Boundary value problems	08
02	FEA Procedure: 2.1 Discrete and Continuous Models, Weighted Residual Methods - Ritz Technique- Basic Concepts of the, Finite Element Method 2.2 Definitions of various terms used in FEM like element, order of the element, internal and external node/s, degree of freedom, primary and secondary variables, boundary conditions. 2.3 Minimization of a functional, Principle of minimum total potential, Piecewise Rayleigh-Ritz method, Formulation of 'stiffness matrix', transformation and assembly concepts	08
03	One Dimensional Problems: 3.1 One dimensional second order equations - discretization-element types - linear and higher order elements -derivation of shape functions and stiffness matrices and force vectors 3.2 Assembly of Matrices- solution of problems in one dimensional structural analysis, heat transfer and fluid flow (stepped and taper bars, fluid network, spring-Cart Systems) 3.3 Analysis of Plane trusses, Analysis of Beams 3.4 Solution of one dimensional structural and thermal problems using FE Software, Selection of suitable element type, modelling, meshing, boundary condition, convergence of solution, result analysis, case studies	10
04	Two Dimensional Finite Element Formulations: 4.1 Introduction, three node triangular element, four node rectangular element, four node quadrilateral element, eight node quadrilateral element 4.2 Natural coordinates and coordinates transformations: serendipity and Lagrange's methods for deriving shape functions for triangular and quadrilateral element 4.3 Sub parametric, Isoparametric, super parametric elements, Compatibility, Patch test, Convergence criterion, sources of errors	08

05	Two Dimensional Vector Variable Problems: 5.1 Equations of elasticity - Plane stress, plane strain and axisymmetric problems 5.2 Jacobian matrix, stress analysis of CST and four node Quadratic element	08
06	Finite Element Formulation of Dynamics and Numerical Techniques: 6.1 Applications to free vibration problems of rod and beam, Lumped and consistent mass matrices 6.2 Solutions techniques to Dynamic problems, longitudinal vibration frequencies and mode shapes, Fourth order beam equation, transverse deflections and natural frequencies of beams	06

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

References:

1. Text book of Finite Element Analysis by Seshu P, Prentice Hall of India
2. Finite Element Method by JNReddy, TMH
3. 'Introduction to Finite Elements in Engineering, Chandrupatla and Belegundu, Pearson Education
4. Finite Element Methods by R Dhanraj and K Prabhakaran Nair, Oxford University Press
5. A first course in Finite Element Method by Logan D L, Thomson Asia PvtLtd
6. 'Concepts and Applications of Finite Element Analysis by Cook R D, Malkus D S, Plesha ME, John-Wiley Sons
7. The Finite Element Method in Engineering by SSRao, Butter WorthHeinemann
8. Fundamental Finite Element Analysis and Application with Mathematica and MATLAB Computations by M. Asghar Bhatti, Wiley India Pvt. Ltd.

Course Code	Course/Subject Name	Credits
MEC604	Refrigeration and Air Conditioning	4

Objectives

1. To study working and operating principles of Air Refrigeration, Vapour Compression and Vapour Absorption system
2. To study components of refrigeration and air conditioning systems
3. To study controls and applications of refrigeration and air conditioning

Outcomes: Learner will be able to...

1. Demonstrate fundamental principles of refrigeration and air conditioning
2. Identify and locate various important components of the refrigeration and air conditioning system
3. Illustrate various refrigeration and air conditioning processes using psychometric chart
4. Design Air Conditioning system using cooling load calculations.
5. Estimate air conditioning system parameters
6. Demonstrate understanding of duct design concepts

Module	Detailed Contents	Hrs.
01	Introduction to Refrigeration: Methods of refrigeration, First and Second Law applied to refrigerating machines, Carnot refrigerator, Carnot heat pump, unit of refrigeration, Co-efficient of Performance, Energy Efficiency Ratio (EER), and BEE star rating Air refrigeration systems: Bell Coleman cycle, applications Aircraft air refrigeration systems: Need for aircraft refrigeration, Simple, Bootstrap including evaporative cooling, Reduced ambient, Regenerative air cooling system, Comparison of these systems based on DART rating.	08
02	Vapour Compression Refrigeration System: Simple vapour compression cycle, Effect of liquid sub cooling & superheating, effect of evaporator and condenser pressures, methods of subcooling, use of P-h charts, Actual VCR cycle, Use of P-h Charts, Comparison between air-cooled and water-cooled condenser based air conditioning systems, Types of condensers, evaporators, expansion devices and Compressors Cooling tower: Types of cooling towers, tower approach, tower range, tower efficiency, tower losses, tower maintenance Refrigerants: Desirable properties of refrigerants, ASHRAE numbering system for refrigerants. Thermodynamic, Chemical and Physical properties, Secondary refrigerants, ODP and GWP, Montreal protocol and India's commitment, Recent substitutes for refrigerants	12
03	Other Refrigeration Systems: Vapour Absorption Refrigeration, Importance of VAR system, COP of ideal VAR system, Ammonia-water VAR system, Lithium Bromide – Water VAR system, Single and double effect, Electrolux refrigeration system, Non-Conventional Refrigeration Systems: Thermoelectric Refrigeration, Thermo-acoustic Refrigeration, Vortex Tube Refrigeration	06
04	Psychrometry: Need for air conditioning, Principle of psychrometry, Psychrometric properties, chart and processes, air washers, requirements of comfort air conditioning, summer and Winter Air conditioning	05
05	Design of Air Conditioning Systems: Different Heat sources,- Adiabatic mixing of two air streams, Bypass factor, sensible heat factor, RSHE, GSHE, ERSHE, Room apparatus dew point and coil apparatus dew point, Ventilation and infiltration, Inside and Outside Design condition, Cooling Load estimation, Introduction to Unitary Products viz. Room/Split and Packaged Air Conditioners, Introduction to recent developments viz. Variable Refrigerant Flow systems, VAV control systems, Inverter Units. Human Comfort, Thermal exchange of body with environment, Effective temperature, Comfort chart, Comfort zone, Indoor Air Quality, Green Buildings	12

	Duct Design Friction chart for circular ducts, Equivalent diameter of a circular duct for rectangular ducts, Static pressure regain and equal pressure drop methods of duct design, Factors considered in air distribution system, Air distribution systems for cooling and heating	
06	Controls and Applications: Controls – LP/HP cutoff, Thermostats, Humidistats, Interlocking control, Electronic Controllers Applications Refrigeration & A/C Ice plant – food storage plants – dairy and food processing plants, Food preservation, Freeze Drying, A/c in textile, printing pharmaceutical industry and Hospitals, Liquefaction of LNG, Liquefaction of gases (cryogenics), Deep sea water air-conditioning	05

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

References

- 1 Refrigeration and air-conditioning – C P Arora, TMH
- 2 Principles of refrigeration – R J Dossat, Willey Eastern Publication
- 3 Refrigeration and air-conditioning – W F Stoeker and J W Jones, TMH
- 4 Modern Air-conditioning practice – C P Arora, TMH
- 5 Refrigeration and air-conditioning- Manohar Prasad, New Age Int (P) Ltd
- 6 Basic Refrigeration and air-conditioning- P. Ananthanarayana, TMH
- 7 ASHRAE Handbook of Fundamentals
- 8 ASHRAE Handbook of Systems
- 9 ASHRAE Handbook of Equipment
- 10 ISHRAE Air Conditioning Handbook
- 11 ISHRAE Refrigeration Handbook

Course Code	Course Name	Credits
MEDLO6021	Mechatronics	4

Objectives

1. To study key elements of Mechatronics system and its integration
2. To familiarise concepts of sensors characterization and its interfacing with microcontrollers
3. To acquaint with concepts of actuators and its interfacing with microcontrollers
4. To study continuous control logics i.e. P, PI, PD and PID
5. To study discrete control logics in PLC systems and its industrial applications

Outcomes: Learner will be able to...

1. Identify the suitable sensor and actuator for a mechatronics system
2. Select suitable logic controls
3. Analyse continuous control logics for standard input conditions
4. Develop ladder logic programming
5. Design hydraulic/pneumatic circuits
6. Design a mechatronic system

Module	Detailed Contents	Hrs.
1	Introduction of Mechatronics and its block diagram representation Key elements of mechatronics, Applications of Mechatronics domestic, industrial etc. Representation of mechatronic system in block diagram and concept of transfer function for each element of mechatronic system, Reduction methods and its numerical treatment for represented block diagram	08
2	Selection of Sensors & Actuators Sensors: Criteria for selection of sensors based on requirements, principle of measurement, sensing method, performance chart etc. (Displacement, temperature, acceleration, force/pressure) based on static and dynamic characteristics. Actuators: Selection of actuators based on principle of operation, performance characteristics, maximum loading conditions, safety etc. Principle and selection of mechano-electrical actuators (1) DC motors (2) Stepper Motors (3) Solenoid Actuators (4) Servo Motors (5) BLDC	08
3	Data Acquisition, Signal Conditioning & Microcontroller System Theory: Concept of Bit accuracy/width and Sampling speed, sampling theorem, aliasing, Nyquist criteria, ADC (Analog to Digital Convertor) Successive approximation method and sample and hold circuitry, DAC (Digital to Analog Convertor) R-2R circuit and DAC resolution Signal Filters: Low pass, High Pass and Band Pass with circuit diagrams for simple cases	08
4	Pneumatics and hydraulics: Hydraulic and pneumatic devices: Different types of valves, Actuators and auxiliary elements in Pneumatics and hydraulics, their applications and use of their ISO symbols, Synthesis and design of circuits (up to 2 cylinders)–pneumatic, electro- pneumatics and hydraulics, electro-hydraulics	08
5	Control System Control system design and analysis by Root Locus Method, Control system Design by Frequency response method, stability margin, Nyquist diagram, Bode diagram P, I and D control actions, P, PI, PD and PID control systems, Transient response:- Percentage overshoot, Rise time, Delay time, Steady state error, PID tuning (manual), Zigler Method	08
6	Discrete Control System PLC (Programming Logic Control) Theory: Introduction to PLC, Architecture, Ladder Logic programming for different types of logic gates, Latching, Timers, Counter, Practical Examples of Ladder Programming	08

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

References

1. Mechatronics, Kenji Uchino and Jayne R. Giniewicz, publication: Marcel Dekker, Inc
2. Applied Mechatronics- A. Smaili and F. Mrad, OXFORD university press
3. Mechatronics System Design , Shetty and Kolk, Cengage Learning, India Edition
4. Introduction to Mechatronics and Measurement Systems, Alciatore and HistanTata McGraw-Hill
5. Mechatronics, Necsulescu, Pearson education
6. Mechatronics - Electromechanics and Control Mechanics , Mill Springer-Verlag
7. Mechatronics - Electronic Control Systems in Mechanical Engineering , Bolton Pearson education
8. Mechatronics - Electronics in products and processes , Bradley, et al. Chapman and Hall
9. Mechatronics - Mechanical System Interfacing , Auslander and Kempf, Prentice Hall
10. Introduction to Mechatronics, AppuKuttan K.K., OXFORD Higher Education
11. Pneumatic Circuits and Low Cost Automation by Fawcett JR
12. The Art of Electronics, Horowitz and Hill Cambridge, University Press
13. Electromechanical Design Handbook , Walsh, McGraw-Hill
14. Electro-mechanical Engineering - An Integrated Approach , Fraser and Milne
15. Handbook of Electromechanical Product Design , Hurricks Longman, John Wiley, Addison Wesley
16. Principles and Applications of Electrical Engineering , Rizzoni, Irwin Publishing
17. Understanding Electro-Mechanical Engineering - An Introduction to Mechatronics , KammIEEE
18. Modeling and control of Dynamic Systems, Macia and Thaler, Cengage Learning, India Edition
19. Mechatronics, A. Smaili, F. Mrad, OXFORD Higher Education.
20. Pneumatic and Hydraulic Control Systems: Aizerman. M.A.
21. Industrial Hydraulics: Pippenger
22. Vickers Manual on Hydraulics
23. Computer Numerical Control of Machine Tools: Thyer. G.R.
24. Pneumatic Applications: Deppert Warner & Stoll Kurt
25. Mechanization by Pneumatic Control: Vol. 1 & 2 Deppert Warner & Stoll kurt
26. Hydraulics and Pneumatics for Production: Stewart
27. Hydraulic Valves and Controls: Pippenger
28. Fundamentals of pneumatics: Festo series
29. Automatic Control Engineering: Francis. H. Raven.
30. Mechatronics, NitaigourMahalik, Tata McGraw-Hill
31. Mechatronics, HMT
32. System Identification: Theory for the User (2nd Edition) , Lennart Ljung
33. Design with Microprocessors for Mechanical Engineers, StifflerMcGraw-Hill

Course Code	Course/Subject Name	Credits
MEDLO6022	Robotics	04

Objectives:

1. To study the basics of robotics and its control
2. To study various design principles of robotics through kinematic analysis, workspace analysis, and trajectory planning
3. To study applications of robots in industrial inspection and material handling
4. To study the role of a robot as a humanoid

Outcomes: Learner will be able to...

1. Demonstrate the basic functioning of a robot
2. Identify various components of robots
3. Carryout kinematic analysis, workspace analysis, and trajectory planning for a robot
4. Identify suitable sensors/actuators for robot
5. Select an appropriate robot for given industrial inspection and material handling systems.
6. Illustrate various aspects of a robot as a humanoid

Module	Details	Hrs.
01	Introduction Definition of robot, Evolution of robots, Laws of robots, International Robotic Standards, Types of robots, Selection of robots, Robot Classifications, Degrees of freedom, Robot configuration, Accuracy and repeatability, Specification of a robot, Robot feedback controls: Point to point control and Continuous path control, Control system for robot joint, Adaptive control, Actuators and sensors, Drives and transmission systems, End effectors, Applications of robots	08
02	Kinematics of Robots Direct: Link coordinates D-H Representation, The ARM equation, Direct kinematic analysis for Four axis, SCARA Robot and three, five, and six axis Articulated Robots. Inverse: The inverse kinematics problem, General properties of solutions, Tool configuration, Inverse kinematics of four axis SCARA robot and three and five axis Articulated robot. Mobile Robot Kinematics Introduction, Kinematic models and constraints, Representing robot position, Forward kinematic models, Wheel kinematic constraints, Robot kinematic constraints, Mobile robot maneuverability, Degree of mobility, Degree of steerability, Mobile robot workspace, Degree of freedom, Holonomic robots, Path and trajectory considerations, Motion control, Open loop control, Feedback control.	10
03	Workspace Analysis and Trajectory Planning Workspace Analysis, work envelope of a Four axis SCARA robot and five axis articulated robot workspace fixtures, the pick and place operations, Joint space technique - Continuous path motion, Interpolated motion, Straight line motion and Cartesian space technique in trajectory planning.	10
04	Sensors & Actuators Sensors: Selection of sensors (Displacement, temperature, acceleration ,force/pressure) based on static and dynamic charecterstics, Interfacing: Concept of interfacing, bit accuracy and sampling speed, amplifying electronics, and microcontroller Actuators: Principle and selection of mechano-electrical actuators (1) DC motors (2) Stepper Motors (3) Solenoid Actuators (4) Servo Motors (5) BLDC	08

05	Robots for Inspection and Material Handling Robotic vision systems, Image representation, Object recognition and categorization, Depth measurement, Image data compression, Visual inspection, Software considerations Concepts of material handling, Principles and considerations in material handling systems design, Conventional material handling systems - Industrial trucks, Monorails, Rail guided vehicles, Conveyor systems, Cranes and Hoists, Advanced material handling systems, Automated guided vehicle systems, Automated storage and retrieval systems, Bar code technology, Radio frequency identification technology	08
06	Humanoids Wheeled and legged, Legged locomotion and balance, Arm movement, Gaze and auditory orientation control, Facial expression, Hands and manipulation, Sound and speech generation, Motion capture/Learning from demonstration, Human activity recognition using vision, touch, and sound, Vision, Tactile Sensing, Models of emotion and motivation, Performance, Interaction, Safety and robustness, Applications, Case studies	08

Assessment:

Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

References

1. Yoram Korean, "Robotics for engineers", McGraw Hill Co.
2. M.P. Groover, M. Weiss, R.N. Nagel, and N.G. Odrey, "Industrial Robotics Technology programming and Applications", McGraw-Hill,
3. Robotics: Fundamental Concepts and Analysis by Ashitava Ghosal, Oxford University Press
4. R.K. Mittal and I.J. Nagrath, "Robotics and Control", TMH Publications
5. Robert J. Schilling, "Fundamentals of Robotics Analysis and Control", PHI Learning
6. Bijay K. Ghosh, Ning Xi, T.J. Tarn, Control in Robotics and Automation Sensor – Based integration, Academic Press
7. K.S.Fu, R.C.Gonzalez, and C.S.G.Lee, "Robotics Control Sensing, Vision and Intelligence", McGraw hill Book co.
8. Hartenberg and Denavit, "Kinematics and Synthesis of linkages", McGraw Hill Book Co.
9. A.S. Hall, "Kinematics and Linkage Design", Prentice Hall
10. J.Hirchhorn, "Kinematics and Dynamics of Machinery", McGraw Hill Book Company

11. P.A. Janaki Raman, “Robotics and Image Processing An Introduction”, Tata McGraw Hill Publishing company Ltd.
12. Richard D Klafter, Thomas A Chmielewski, and Michael Negin, “Robotics Engineering – An Integrated Approach”, Eastern Economy Edition, Prentice Hall of India P Ltd.
13. Roland Siegwart, Illah Reza Nourbakhsh, and Davide Scaramuzza, “Introduction to Autonomous Mobile Robots”, Bradford Company Scituate, USA
14. Alonzo Kelly, Karl Iagnemma, and Andrew Howard, “Field and Service Robotics”, Springer
15. Riyadh Siaer, “The future of Humanoid Robots- Research and applications”, Intech Publications

Course Code	Course Name	Credits
MEDLO6023	Industrial Automation	4

Objectives:

1. To study the need for the automation, its advantages and limitations
2. To study the basic functional elements of automation
3. To familiarise with the levels of automation and strategies of automation
4. To acquaint with control of mechanical operations involving pneumatic, electric, hydraulic and electronic systems

Outcomes: Learner will be able to...

1. Demonstrate basics of industrial automation
2. Identify various types of automation
3. Demonstrate use of automated controls using pneumatic and hydraulic systems.
4. Illustrate the control systems in automated system.
5. Demonstrate applicability of PLC in process industry
6. Design electro-pneumatic circuits

Module	Detailed Contents	Hrs.
01	Introduction to Automation: Definition and fundamentals of automation, reasons for Automating, basic elements of an automated system: Power, Program and control system Advanced automation functions: safety, maintenance & repair diagnosis, error detection and recovery Levels of automation Automation principles and strategies: USA principle, ten strategies of automation and production system, automation migration strategy	06
02	Mechanization and Automation: Mechanization and automation, product cycle, hard Vs flexible automation, Capital- intensive Vs low cost automation Types of systems-mechanical, electrical, hydraulic, pneumatic and hybrid systems Automation using CAMS, Geneva mechanisms, gears etc. Assembly line Automation: automated assembly systems, transfer systems, vibratory bowl feeders, non-vibratory feeders, part orienting, feed track, part placing & part escapement systems Introduction to Material storage/ handling and transport systems, and its automation using AS/RS, AGVS and conveyors etc.	08
03	Pneumatics and hydraulics: Hydraulic and pneumatic devices-Different types of valves , Actuators and auxiliary elements in Pneumatics & hydraulics , their applications and use of their ISO symbols Synthesis and design of circuits (up to 3 cylinders)–pneumatic, electro pneumatics and hydraulics Design of Electro-Pneumatic Circuits using single solenoid and double solenoid valves; with and without grouping	14
04	Sensors & Actuators Sensors: Selection of sensors (Displacement, temperature, acceleration, force /pressure) based on static and dynamic characteristics Interfacing: Concept of interfacing, bit accuracy and sampling speed, amplifying electronics, and microcontroller Actuators: Principle and selection of mechano-electrical actuators (1) DC motors (2) Stepper Motors (3) Solenoid Actuators (4) Servo Motors (5) BLDC	06

05	Industrial control systems: Process industries versus discrete manufacturing industries, Continuous versus discrete control, Computer process control, Forms of computer process control Discrete control using PLC- discrete process control, Programmable logic controller, its architecture, ladder logic, Ladder Logic Programming for different types of logic gates, Latching, Timers, Counter, Practical Examples of Ladder Programming	10
06	Robots and their applications: Introduction to robots, Types, Classifications, Selection of robots, Robot Degrees of freedom, Robot configuration, Accuracy and repeatability, Specification of a robot, Robot feedback controls: Point to point control and Continuous path control, Control system for robot joint, Adaptive control, Drives and transmission systems, End effectors, Industrial robot applications of robots	08

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

Reference Books:

1. M.P. Groover "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education, New Delhi
2. Jeffrey Boothroyd, Peter Dewhurst and Winston A. Knight, "Product Design for manufacture and Assembly", CRC Press
3. M.P. Groover, M. Weiss, R.N. Nagel, and N.G. Odrey, "Industrial Robotics Technology programming and Applications", McGraw-Hill,
4. Yoram Koren, "Robotics for engineers", McGraw Hill Co
5. John W Webb and Reis, Ronald A., "Programmable Logic Controllers: Principles & Applications", Prentice Hall.
6. Frank Petruzella, "Programmable Logic Controllers", McGraw-Hill Education; 4 edition
7. Industrial Hydraulics: Pippenger
8. Mechatronics - Mechanical System Interfacing, Auslander and Kempf, Prentice Hall
9. Pneumatic Circuits and Low Cost Automation: by Fawcett J.R.
10. Fundamentals of pneumatics: Festo series

Course Code	Course/Subject Name	Credits
MEL601	Metrology and Quality Engineering	1

Objectives:

1. To familiarise with working of gauges
2. To acquaint with gear parameter measurement
3. To acquaint with operations of precision measurement, instrument/equipment for measurement
4. To inculcate the fundamentals of quality concepts and statistics in metrology

Outcomes: Learner will be able to...

1. Measure linear and angular dimensions
2. Measure surface roughness
3. Measure various parameters of gear tooth profile
4. Use optical profile projector for measurement
5. Use various instruments for measurement of screw threads
6. Measure flatness by Autocollimator / Interferometry method

Six Experiments need to be performed on the below mentioned topics:

Sr. No.	Topic
1	Vernier Calliper, Micrometer and Bevel Protractor for linear and angular measurement
2	Surface measurement by Surface roughness tester
3	Gear measurement – Gear tooth Vernier calliper / Parkinson gear tester
4	Screw Thread Measurement – screw thread Micrometer, Floating carriage micrometer /bench micrometer
5	Optical profile projector for miniature linear / angular measurements of screw / gear or components
6	Tool maker's microscope for linear / angular measurement of single point tools
7	Comparator – Mechanical / Pneumatic type
8	Flatness measurement by Autocollimator / Interferometry method
9	QC charts for 50 sample readings of OD / ID of specimen and printouts

Term-Work

Consists of minimum six experiments from the above list and presented with Aim, Apparatus/equipment's, and Introduction, Working principle, Diagram, method, observation table, Analysis, Results and conclusion/inferences.

Also, minimum 5 assignments to help smooth conducting of laboratory exercises and one case study relevant to contents

Project Based Learning may be incorporated by judiciously reducing number of assignments

Distribution of marks for term work shall be as follows:

Laboratory work:	15 marks
Assignments:	05 marks
Attendance:	05 marks

End Semester Practical/Oral examination

1. Pair of Internal and External Examiner should conduct practical/viva based on contents
2. Distribution of marks for practical/viva examination shall be as follows:
 - a) Practical performance**15 marks**
 - b) Oral **10 marks**
3. Evaluation of practical examination to be done based on the experiment performed and the output of the experiments during practical examination.
4. Students work along with evaluation report to be preserved till the next examination

Course Code	Course Name	Credits
MEL602	Machine Design –I *	1

Objectives:

1. To study the basic design principles
2. To familiarize with use of design data books & various codes of practice
3. To make conversant with preparation of working drawings based on designs

Outcomes: Learner will be able to...

1. Design shaft under various conditions
2. Design Knuckle Joint / cotter joint
3. Design Screw Jack/C-clamp along with frame
4. Design Flexible flange couplings/ Leaf spring
5. Convert design dimensions into working/manufacturing drawing
6. Use design data book/standard codes to standardise the designed dimensions

Term Work: (Comprises a & b)

a) Term work - Shall consist of (minimum 3) design exercises from the list which may include computer aided drawing on **A3 size sheets**.

- 1) Knuckle Joint / cotter joint
- 2) Screw Jack
- 3) Flexible flange couplings
- 4) Leaf springs
- 5) C-clamps along with the Frame

b) Assignment: Design exercises in the form of design calculations with sketches and/ or drawings on following machine elements.

- 1) Bolted and welded joints
- 2) Combined stresses problem using theory of failure.
- 3) Shaft design (solid and hollow shaft)
- 4) Design against fluctuating loads (finite and infinite life)

The distribution of marks for term work shall be as follows:

- Part - a : 15 marks.
- Part--b : 05 marks.
- Attendance: 05 Marks.

Course Code	Course Name	Credits
MEL603	Finite Element Analysis	1

Objectives:

1. To familiarise FEA concept for practical implementation
2. To acquaint with FEA application software

Outcomes: Learner will be able to...

1. Select appropriate element for given problem
2. Select suitable meshing and perform convergence test
3. Select appropriate solver for given problem
4. Interpret the result
5. Apply basic aspects of FEA to solve engineering problems
6. Validate FEA solution

Term Work: (Comprises a and b)

a) List of Experiments: Students should use the commercial software or programmes from the text-books or self-developed programs, to verify the results obtained by manual calculations. The input data and output results of the problem solved using the computer programs should be included in the Journal. The proposed list is given below:

1. Any two problems using bar element
2. Any two problems using truss element
3. Any two problems using CST element
4. Any two problem using axisymmetric element
5. Any one problem of free vibration analysis using bar element
6. Any one problem on steady state heat conduction

While performing the analysis the students should understand the concepts of selection of element type, meshing and convergence of solution.

b) Course Project:

A group of not more than four students, shall do Finite Element Analysis of any mechanical engineering element /system, which involves element selection, assigning properties, meshing, assigning loads, and boundary conditions, analysis and result interpretation.

The distribution of marks for term work shall be as follows:

Part a:	15 marks.
Part b:	05 marks.
Attendance:	05 Marks.

End Semester Practical/Oral examination

1. Pair of Internal and External Examiner should conduct practical/viva based on contents
2. Duration of practical examination is 2 hour
3. Distribution of marks for practical/viva examination shall be as follows:
 - a) Practical performance**15** marks
 - b) Oral **10** marks
4. Evaluation of practical examination to be done based on the experiment performed and the output of the experiments during practical examination.
5. Students work along with evaluation report to be preserved till the next examination

Course Code	Course/Subject Name	Credits
MEL604	Refrigeration and Air Conditioning TW/Practical	1

Objectives

1. To study operating principles of Vapour Compression system
2. To study components of refrigeration and air conditioning systems
3. To study controls and applications of refrigeration and air conditioning

Outcomes: Learner will be able to...

1. Demonstrate fundamental principles of refrigeration and air conditioning
2. Identify and locate various important components of the refrigeration and air conditioning system
3. Represent various refrigeration and air conditioning processes using psychometric chart
4. Operate and maintain refrigeration system
5. Operate and maintain air conditioning system
6. Simulate VCRS

Part A: List of Experiments

Trial on window air conditioner or Air Conditioning Test Rig

Trial on water cooler/Refrigeration Test Rig

Trial on Ice Plant

Trial on cooling tower

Part B: Demonstrations/Reports/Assignments/Simulations

Demonstration of domestic refrigerator along with wiring diagram

Demonstration of leak detection, evacuation and charging of refrigerant

Report on different protocols to regulate global warming

Visit report of Refrigeration establishment like Cold storage plant or ice plant or air-conditioning plant

Assignment on humidification and dehumidification, heating and cooling, mixing of two air streams

Steady state Simulation of VCR system with developed code or any analytical software

Term work

Term work shall consists of minimum Three Laboratory Experiments, at least one demonstration exercise, Industrial Visit Report, at least one assignment consisting of numerical based on Refrigeration and Air Conditioning and one simulation exercise on VCR

The distribution of marks for term work shall be as follows:

Part a:	15 marks.
Part b:	05 marks.
Attendance:	05 Marks.

End Semester Practical/Oral examination:

1. Pair of Internal and External Examiner should conduct practical/viva based on contents
2. Practical examination (in a group of not more than 5 students) duration is 2 hours
3. Distribution of marks for practical/viva examination shall be as follows:
 - a. Practical performance 15 marks
 - b. Oral 10 marks
4. Evaluation of practical examination to be done based on the experiment performed and the output of the experiments during practical examination.
5. Students work along with evaluation report to be preserved till the next examination

Subject Code	Subject Name	Credits
MEL 605	Mechatronics Lab	01

Objectives

1. To study sensors and actuators
2. To study control systems
3. To study automation

Outcomes: Learner will be able to...

1. Demonstrate implementation of interfacing sensors and actuators using microcontrollers
2. Demonstrate of interfacing various utilities with microcontrollers
3. Demonstrate discrete control system using PLC microcontroller
4. Design and develop a control system for specific use
5. Implement program to PLC system and demonstrate its application
6. Develop pneumatic circuits for a specific system

The laboratory experiments should be based on the following

Group 1: Sensors & Actuators

1. Theoretical & Experimental Implementation of Interfacing of Sensors using microcontroller and determination of sensor characteristics such as Static Characteristics (Sensitivity, Accuracy, Range, Resolution etc.), Dynamic Characteristics (Transient Response and Frequency Response)
2. Measurement and Calibration of Load / Force (*It is suggested to determine all characteristics of sensor mentioned in previous experiments*)
3. Measurement, Calibration and Comparison of Temperature Sensors (Thermocouple, RTD and Thermistor) (*It is suggested to determine all characteristics of sensor mentioned in previous experiments*)
4. Interfacing of Stepper Motor with microcontroller and its programming for Rotational or XY table (*It is suggested to program to vary the position of rotary or XY table and compare the positioning accuracy using standard calibrated angular or linear sensor*)
5. Interfacing of DC Motor with microcontroller and its programming for characterization of DC motor setup (*It is suggested to program to vary the speed of DC motor and determine its load-speed characteristics*)
6. Interfacing of Water Heater with microcontroller and its programming for determination of its transient and steady state characteristics (*It is suggested to program to vary the input current to heater and determine its transient and steady state characteristics*)

Group 2: Control Systems

1. Experimental demonstration of Discrete control system using PLC microcontroller using standard PLC demo setup (Bottle filling Machine, Traffic Light Signal, Water heater and its stirring System etc.). *(here it is suggested to carry out ladder programming and demonstrate its operation)*
2. System Identification of Spring Mass Damper System for step input & harmonic input and determination of poles and zeros of system. *(Spring Mass Damper setup with all required position sensors mounted is to be characterized for step input, it is suggested to determine transfer function (i.e. input output relation) of the setup and plotting its transient and frequency response (Bode plot))*
3. Design & Experimental Implementation of PID control strategy for Spring Mass Damper Setup to control precisely position of mass. *(it is suggested to conduct experimental study on effect of variation of controller parameters on its transient characteristics also to study the changes in poles and zeros of system).*
4. Design & Experimental Implementation of PID control strategy for DC motor speed control under varying loading conditions and effect of variation of load is to be studied.
5. Design & Experimental implementation of PID control strategy for Real Time Temperature Control of furnace *(it is suggested to conduct experimental study on effect of variation of controller parameters on its transient characteristics also to study the changes in poles and zeros of system).*
6. Modeling and design of control system for quarter car suspension model using any suitable modeling and analysis software.

Group 3: Automation

1. Real time Logic implementation for traffic Control demo setup and it is necessary to carry out ladder programming and implement program to PLC system and demonstrate its operations
2. IOT: Real time interfacing of sensors (temperature, humidity, position, level etc.) and actuator (stepper motor, dc motor, servo motor etc.) with microcontroller and Ethernet shield and controlling the actuator and monitoring of sensor output remotely using internet.
3. Robotics: Real Time demonstration of line following robot using standard robotic kit
4. Demonstration and study of functions of components of robotics arm.
5. Visualization of DH parameters in Roboanalyzer. (*Roboanalyzer is free software developed by IIT Delhi, available on www.roboanalyzer.com)
6. Designing sequential operation for two cylinders using electro-hydraulic circuits
7. Designing sequential operation for two cylinders using electro- pneumatic circuits
8. Development of pneumatic circuits to understand pneumatic components and their working

Term work

Term work shall consists of minimum Nine Experiments, Three from each group mentioned above

The distribution of marks for term work shall be as follows:

Laboratory Work:	20 marks.
Attendance:	05 Marks.

End Semester Practical/Oral examination:

1. Pair of Internal and External Examiner should conduct practical/oral based on contents
2. Practical examination (in a group of not more than 4 students) duration is 2 hours
3. Distribution of marks for practical/Oral examination shall be as follows:
 - a. Practical performance**15** marks
 - b. Oral **10** marks
4. Evaluation of practical examination to be done based on the experiment performed and the output of the experiments during practical examination.
5. Students work along with evaluation report to be preserved till the next examination

Course Code	Course/Subject Name	Credits
MEC701	Machine Design – II	4

Objective:

1. To acquaint with functional and strength design principles of important machine elements
2. To familiarise selection of standard elements such as rolling element bearings, belts etc.

Outcomes: Learner will be able to...

1. Select appropriate gears for power transmission on the basis of given load and speed
2. Design gears based on the given conditions.
3. Select bearings for a given applications from the manufacturers catalogue.
4. Select and/or design belts and flywheel for given applications
5. Design cam and follower mechanisms.
6. Design clutches and brakes

Module	Details	Hrs.
01	Design of Gears: 1.1 Gears: Design of spur, helical, bevel and worm gears with strength, wear and thermal considerations 1.2 Gear Box: Two stage Gear box with fixed ratio consisting of spur, helical and bevel gear pairs: gear box housing layout and housing design	14
02	2.1 Rolling Contact Bearings: Types of bearing and designation, selection of rolling contact bearings based on constant / variable load & speed conditions (includes deep groove ball bearing, cylindrical roller, spherical roller, taper roller, self-aligning bearing and thrust bearing)	05
03	1.1 Sliding Contact Bearings: Design of hydro dynamically lubricated bearings (self-contained), Introduction to hydro static bearings, Types and selection of Mechanical seals	05
04	4.1 Design of Cams and Followers: Design of Cam and Roller follower mechanisms with spring and shaft	06
05	5.1 Design and selection of Belts: Flat and V-belts with pulley construction 5.2 Design of Flywheel – Introduction, Fluctuation of energy and speed, turning moment diagram, estimating inertia of flywheel for reciprocating prime movers and machines, Weight of the flywheel, flywheel for punches, rim constructions, stresses in rims and arms, Construction of flywheel 5.3 Design and selection of standard roller chains	10
06	6.1 Design of Clutches: Introduction, types, Basic theory of plate and cone type clutches, Design of single plate, multi-plate and cone clutches, with spring, lever design and thermal, wear considerations. 6.2 Design of Brakes: Design of single shoe brake	08

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

References:

1. Design of Machine Elements - V.B. Banadari, Tata McGraw Hill Publication
2. Design of Machine Elements - Sharma, Purohil. Prentice Hall India Publication
3. Machine Design -An Integrated Approach - Robert L. Norton, Pearson Education
4. Machine Design by Pandya & Shah, Charotar Publishing
5. Mechanical Engineering Design by J.E.Shigley, McGraw Hill
6. Recommended Data Books - PSG
7. Machine Design by Reshetov, Mir Publication
8. Machine Design by Black Adams, McGraw Hill
9. Fundamentals of Machine Elements by Hawrock, Jacobson McGraw Hill
10. Machine Design by R.C.Patel, Pandya, Sikh, Vol-I & II C. Jamnadas & Co
11. Design of Machine Elements by V.M.Faires
12. Design of Machine Elements by Spotts

Course Code	Course/Subject Name	Credits
MEC702	CAD/CAM/CAE	04

Objectives

1. To introduce new and exciting field of Intelligent CAD/CAM/CAE with particular focus on engineering product design and manufacturing.
2. To develop a holistic view of initial competency in engineering design by modern computational methods.
3. To develop New API for CAD

Outcomes: Learner will be able to...

1. Identify proper computer graphics techniques for geometric modelling.
2. Transform, manipulate objects & store and manage data.
3. CAM Toolpath Creation and NC- G code output.
4. Use rapid prototyping and tooling concepts in any real life applications.
5. Identify the tools for Analysis of a complex engineering component.

Modules	Details	Hrs.
01	Computer Graphics and Techniques for Geometric Modeling Computer Graphics: Two dimensional computer graphics, vector generation, the windowing transformation, Three dimensional Computer graphics, viewing transformation, Homogeneous coordinates, Perspective projection, Hidden line removal & hidden surface removal algorithm, light & shade ray tracing. The parametric representation of geometry, Bezier curves, Cubic Spline curve, B-Spline curve, parametric representation of line, circle, ellipse & parabola. Constructive solid geometry (CSG), Boundary Representation (B-Rep), Wire Frame Modeling, Solid Modeling, Surface Modeling, Parametric Modeling, feature based modeling, Feature recognition, Design by feature.	08
02	Transformation, Manipulation & Data Storage 2D & 3D Transformations (Translation, Rotation, & Scaling & Magnification), Concatenations, Matrix representation, Problems & object oriented programming on Transformations. Object transformation, mirror transformation, Artificial Intelligence in Design & Manufacturing, Representation of Knowledge, and Knowledge base Engineering. Application Programming Interface (API) Concept of customizing applications by writing programs, Fusion Object Model, Creating Scripts and Add-Ins, Document and assembly structure, Attributes, Creating Programs for Assemblies, Joint, B- Rep & Geometry.	08
03	Design to Manufacturing (CAM) 2D Machining Strategies, 3D Machining Strategies, Fixture Component Terminology, Work Coordinate System Terminology, Create setups, Apply 2D operations, Facing, 2D adaptive clearing, 2D contour. Chamfer milling, Bore ,Tool simulation and stock material removal , Produce setup sheets , Product NC code via post processing,	08
04	Computer Aided Engineering (CAE) Fundamentals of computer aided engineering, CAE includes mass property calculations, kinematic analysis and animation (movement, visualization, simulation and FEA). Case study based on modeling and analysis of structural, thermal/fluid, and dynamic (vibration analysis) system. Parameter optimization.	08
05	Computer Integrated Manufacturing & Technology Driven Practices Introduction, Evolution, Objectives, CIM Hardware and Software, CIM Benefits, Nature and role of the elements of CIM, Identifying CIM needs, Data base requirements of CIM, Role of CAD/CAM in CIM, Obstacles to Computer Integrated Manufacturing, Concept of the future CIM systems, Socio -techno- economic aspects of CIM.	08

06	Rapid Prototyping and Tooling Introduction to RP, Technology Description, Overview of RP, Benefits and Application. RP Processes: Process overviews, STL file Generation, Classes of RP systems: Stereolithography Approach (SLA), SLA with photo-polymerization (mathematical modelling of the process), SLA with liquid thermal polymerization, Selective Laser Sintering (SLS), Fused deposition modelling, Laminated object manufacturing, Laser powder forming. Prototype properties: Material properties, colour, dimensional accuracy, stability, surface finish, machinability, environmental resistance, operational properties. RP Applications: Design, Concept Models, Form & fit checking, Functional testing, CAD data verification, Rapid Tooling, Rapid manufacturing, Science & Medicine, RP processes for MEMS, Photolithography, Direct Laser Writer, Bulk Lithography for 3D micro fabrication (Modelling of beam propagation and curing in resin system).	08

Assessment:

Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

References:

1. "CAD/CAM Computer Aided and Manufacturing" by Mikell P. Groover and Emory W. Zimmers, Jr., *Eastern Economy Edition*
2. "CAD/ CAM , Theory & Practice" by Ibrahim Zeid, R. Sivasubramanian, *Tata McGraw Hill Publications*
3. "Computer Graphics" by Donald Hearn and M. Pauline Baker, *Eastern Economy Edition*
4. "CAD/CAM Principles, Practice and Manufacturing Management" by Chris McMahon, Jimmie Browne, *Pearson Education*
5. "CAD/CAM/CIM" by P. Radhakrishnan, S. Subramanyan, V. Raju, *New Age International Publishers*
6. "CAD/CAM Principles and Applications" by P.N. Rao, *Tata McGraw Hill Publications*
7. "Principle of Computer Graphics" by William .M. Neumann and Robert .F. Sproul, *McGraw Hill Book Co. Singapore.*
8. David L. Goetsch, Fundamental of CIM technology ,Delmar publication
9. David Bedworth, Computer Integrated Design and Manufacturing, *McGraw Hill.*
10. "CNC Machines" by B.S. Pabla and M. Adithan, *New Age International Publishers.*
11. "Numerical Control and Computer Aided Manufacturing" , T.K. Kundra, P.N. Rao, N.K. Tiwari, *Tata McGraw Hill*
12. "CNC Technology and Programming", Krar, S., and Gill, A., *McGraw Hill publishers*
13. "Computer Integrated Manufacturing- An Introduction with Case Studies" by Paul G. Ranky, *Prentice Hall International*

14. "Flexible Manufacturing Systems" by H.K. Shivanand, M.M. Benal, V.Koti, *New Age International Publishers*
15. "Automation, Production Systems and Computer Integrated Manufacturing ", Groover M.P., *Prentice-Hall of India Pvt. Ltd*
16. "Mathematical Elements for Computer Graphics", Rogers D F I and Adams J A, McGraw-Hill.
17. "Computer Integrated Manufacturing Hand Book" by Eric Teicholz, Joel N. Orr, McGraw Hill International Editions
18. "Rapid Prototyping" Chee Kai ChuaWorld Scientific Publishing
19. "Rapid Prototyping:Principles and Applications" RafiqNoorani, Wiley
20. "Rapid Prototyping:Principles and Applications" C.K. Chua,K.F.Leong, C.S. Lim World Scientific Publishing
21. "Rapid Prototyping and Manufacturing" P. F. Jacobs, Society of Manufacturing Engineers.

Course Code	Course/Subject Name	Credits
MEC703	Production Planning and Control	4

Objectives:

1. To provide an exposure to Production Planning & Control (PPC) and its significance in Manufacturing Industries
2. To give insight into the ongoing & futuristic trends in the control of inventory
3. To appraise about need and benefits of planning functions related to products and processes
4. To give exposure to production scheduling and sequencing so as to optimise resources

Outcomes: Learner will be able to...

1. Illustrate production planning functions and manage manufacturing functions in a better way
2. Develop competency in scheduling and sequencing of manufacturing operations
3. Forecast the demand of the product and prepare an aggregate plan
4. Develop the skills of Inventory Management and cost effectiveness
5. Create a logical approach to Line Balancing in various production systems
6. Implement techniques of manufacturing planning and control

Module	Details	Hrs
1	Concepts of PPC: 1.1. Manufacturing systems- components and types, need for PPC, functions of PPC, relationship of PPC with other functions 1.2. Factors influencing PPC in the organization, manufacturing methods- projects & jobbing products, batch, mass / flow production, continuous / process production. 1.3. Organization of PPC- status of PPC department, internal structure, degree of centralization, PPC as an integrated approach 1.4. Prerequisites of PPC – data pertaining to design, equipment, raw materials, tooling, performance standards, labour and operating systems	06
2	Forecasting, Aggregate planning, Capacity planning 2.1. Forecasting: Need for forecasting, role of forecasting in PPC, forecasting methods of qualitative type like judgment techniques. Forecasting methods of quantitative types like time series analysis, least square method, moving averagemethod, exponential smoothing method. Forecasting Errors and Forecasting Bias 2.2. Aggregate planning : Concept of aggregate planning, decision rules, strategies and methods 2.3. Capacity Planning: Measurement of capacity, Measures of capacity, Factors influencing effective capacity, short range, medium range and long range capacity planning, Rough cut capacity planning.	08
3	Inventory Control: 3.1. Basic concepts of inventory, Types of inventory, purpose of holding stock and influence of demand on inventory, Costs associated with Inventory management. 3.2. Inventory Models: Deterministic models - instantaneous stock replenishment model, Production model, planned shortages and price discount model, Probabilistic models- fixed quantity system(Q-system) and Fixed period system (p-system) 3.3. Selective Inventory Control techniques - ABC analysis, HML analysis and VED analysis	08
4	Process Planning and Line Balancing 4.1 Process planning: Prerequisite information requirement, steps in process planning, process planning in different situations, documents in process planning, machine / process selection & Computer Aided Process Planning 4.2 Line Balancing: objectives, constraints, terminology in assembly line, heuristic methods like Kilbridge-Wester, Largest Candidate rule, Rank positional weight	08
5	Production Scheduling and Sequencing 5.1 Scheduling: Inputs for scheduling, loading and scheduling devices, factors influencing scheduling, scheduling techniques, use of Gantt Charts and basic scheduling problems.	10

	Project scheduling by using elements of network analysis –PERT & CPM, cost analysis & crashing, resource leveling 5.2 Sequencing: Product sequencing, dispatching, progress report & expediting and control. Johnson's Rule for optimal sequence of N jobs on 2 machine. Process n Jobs on 3 Machines (n/3 problem) and Jackson Algorithm. Processing of 2 Jobs on m Machine (2/m) problem	
6	MRP, MRP II, ERP 6.1. Material Requirement planning(MRP) and Manufacturing Resource Planning (MRP-II) - general concepts, types of demands, Inputs to MRP, MRP objectives, outputs of MRP, Estimation of planned order releases. Benefits and Limitations of MRP II 6.2. Enterprise Resource Planning (ERP): Evolution, features, purpose of modeling an enterprise, information mapping, generic model of ERP, Modules in ERP, Methodology of implementation, critical success factors of ERP, Case studies of success and failure of ERP implementations, ERP packages	08

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

References

1. Production Planning and Control – Samuel Eilon.
2. Production Planning and Control – L C Jamb
3. Production Planning and Control, W. Boltan-Longman Scientific & Technical
4. Production Systems- Planning, Analysis& Control, James. L. Riggs-John Wiley & Sons
5. Manufacturing Planning and Control Systems, Thomas E. Vollman, William L. Berry & Others- Galgotia Publishers
6. Manufacturing Process Planning and Systems Engineering, Anand Bewoor-Dreamtech Press
7. Production and Operations Management, S.N.Chary- TMH publishing company
8. Modernization & Manufacturing Management, L.C. Jhamb - Everest Publishing House

Course Code	Course/Subject Name	Credits
MEDLO7031	MECHANICAL VIBRATION	4

Objectives:

1. To study basic concepts of vibration analysis
2. To acquaint with the principles of vibration measuring instruments
3. To acquaint with the practices of monitoring health conditions of the systems

Outcomes: Learner will be able to...

1. Develop mathematical model to represent dynamic system.
2. Estimate natural frequency of mechanical element / system.
3. Analyse vibratory response of mechanical element / system.
4. Estimate the parameters of vibration isolation system and
5. Control the vibrations to the acceptable level using basic vibration principles
6. Handle the vibration measuring instruments

Module	Details	Hrs.
1	1.1 Basic Concepts of Vibration: Introduction, classification, terminology, modelling vibration analysis 1.2 Free Undamped Single Degree of Freedom Vibration System: Longitudinal, transverse, torsional, vibration system, methods for formulation of differential equations by D'Alembert's Principle, Newton, Energy, Lagrangian and Rayleigh's method	08
2	Multi Degree of Freedom System: 2.1 Undamped free vibration: Free vibration equation of motion, Influence coefficients (stiffness and flexibility), Reciprocity theorem, Generalized Coordinates, and Coordinate Coupling, Lagrangian equations, Rayleigh and Dunkerley method, two rotor and geared systems 2.2 Eigen Values and Eigen vectors: for translatory and torsional two d.o.f. systems, Matrix method, Holzer's method (translatory and torsional unbranched systems)	10
3	Free Damped Single Degree of Freedom Vibration System: Types of dampers, Viscous damped system- translatory and rotary systems, Coulomb's damping- final rest position of body in coulomb damping, motion with negative damping factor,	06
4	4.1 Forced Single Degree of Freedom Vibratory System: Analysis of linear and torsional systems subjected to harmonic force excitation and harmonic motion excitation 4.2 Vibration Isolation and Control: Conventional Methods: By mass /Inertia, stiffness, damping (vibration isolation principles) Force Transmissibility, motion transmissibility, typical isolators & mounts. Introduction to Semi-Active and Active Vibration control.	10
5	5.1 Vibration Measuring Instruments: Principle of seismic instruments, vibrometer, accelerometer- undamped, damped 5.2 Introduction to Conditioning Monitoring and Fault Diagnosis: Introduction to conditioning monitoring and fault diagnosis, Condition & Vibration Monitoring Techniques, Condition / vibration monitoring data collection. Signature analysis	07
6	Non-Linear Vibration: Basics of Non-linear vibration, systems with non-linear elastic properties, free vibrations of system with non-linear elasticity and damping, phase -plane technique, Duffing's equation, Jump phenomenon, Limit Cycle, Perturbation method.	07

Assessment:

Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

References:

1. Mechanical Vibrations by S.S.Rao, fourth edition, Pearson Education
2. Mechanical Vibrations by G. K. Grover
3. Fundamentals of Mechanical Vibration by S.Graham Kelly, Tata McGraw Hill
4. Vibration Analysis by P. Srinivasan, Tata McGraw Hill
5. Mechanical Vibrations- Schaum's outline series, William W.Seto, McGraw Hill
6. Theory and Practice of Mechanical Vibrations by J.S.Rao, K. Gupta, New Age International Publications
7. Mechanical Vibrations by Den, Chabril, Hinckle
8. Mechanical Vibrations by J.P.Den Hartog, McGraw Hill Book Company Inc
9. Introduction to Dynamics and Control by Leonard Meirovitch, Wiley, New York
10. Elements of Vibration Analysis by Leonard Meirovitch, McGraw-Hill, New York
11. Dynamics and Control of Structures by Leonard Meirovitch, Wiley, New York
12. Matrices and Transformations by Antony J. Pettifrezzo, Dover, New York
13. Principles of Vibration by Benson H. Tongue, Oxford University Press
14. Theory of Vibration with Applications, by W. Thomson, 2nd edition, Pearson Education
15. Vibrations by Balakumar Balachandran, Edward Magrab, Cengage Learning

Course Code	Course/Subject Name	Credits
MEDLO7032	AUTOMOBILE ENGINEERING	04

Objectives:

1. To impart the understanding of important mechanical systems of an automobile
2. To provide insight into the electrical systems of an automobile
3. To familiarize with the latest technological developments in automotive technology

Outcomes: Learner will be able to...

1. Illustrate the types and working of clutch and transmission system.
2. Demonstrate the working of different types of final drives, steering gears and braking systems
3. Illustrate the constructional features of wheels, tyres and suspension systems
4. Demonstrate the understanding of types of storage, charging and starting systems
5. Identify the type of body and chassis of an automobile
6. Comprehend the different technological advances in automobile

Module	Details	Hrs
1	Clutch : Requirements of Clutches, Types of Clutches; Single Plate, Multi-plate, Wet Clutch, Semi-centrifugal, Centrifugal. Clutch materials. Clutch operating mechanisms; Mechanical, Electric, Hydraulic and Vacuum. Free Pedal Play. Transmission: Necessity of gear box. Sliding mesh, Constant mesh, and Synchromesh Gear selector mechanisms. Overdrives and hydrodynamic torque converter, Trouble shooting and remedies. Propeller Shaft and Axle: Propeller shafts and universal joints: Types and construction, Different types of universal joints and constant velocity joints Types of live axles; semi, three quarter and full floating axles Types of Front Stub Axles; Elliot, Reverse Elliot, Lamoine and Reverse Lamoine	09
2	Final Drive and Differential : Types of Final drive; spiral, bevel, Hypoid and worm drives. Necessity of differential, Working of differential, Conventional and non-slip differential, Trouble shooting and remedies Steering System : Steering geometry, Steering requirements, Steering linkages and steering gears. Over steer and under steer, Cornering power, Reversibility of steering gears. Braking System: Requirement of brake, Classification of brakes, Brake Actuation Methods; Mechanical, Hydraulic, Pneumatic, Electro and vacuum brakes. Types of Disc brakes and Drum Brakes, Brake trouble shooting, Introduction to antilock braking system (ABS)	08
3	Suspension System Objects of suspension, Basic requirements, Sprung and un-sprung mass, Types of Independent and rigid axle suspension. Air suspension and its features. Pitching, rolling and bouncing. Shock absorbers and its types Wheels and Tyres: Requirements of wheels and tyres. Types of wheels, types of tyres and types of carcass	07
4	Automotive Electrical System : Storage System: Lead-Acid Battery; construction, working, ratings, types of charging methods, Alkaline, ZEBRA, Sodium Sulphur and Swing batteries Charging System:	06

	Dynamo: Principle of operation, Construction and Working. Regulators, combined current and voltage regulator. Alternator: Principle of operation, Construction, Working. Rectification from AC to DC Starting system: Requirements, Various torque terms used, Starter motor drives; Bendix, Rubber compression, Compression Spring, Overrunning Clutch. Starter motor solenoids and switches	
5	Body Engineering: Importance of Body design, Materials for body construction-Styling forms-Coach and bus body style, layouts of passenger cars, Bus and truck bodies. Chassis types and structure types: Open, Semi integral and integral bus structure Frames: functions and types of frames, Loads on frames, Load distribution of structure, Location of power plant	06
6	Recent trends in Automobiles : Intelligent Vehicle Systems : Cruise Control, Adaptive Cruise Control (ACC), Electronic Stability Program (ESP), Electronic Brake Distribution (EBD), Traction Control System (TCS). Integrated Starter Alternator (ISA)	04

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

Reference Books:

1. Automobile Engineering, Kirpal Singh, Vol I & II, Standard publishers Distributors ,Delhi
2. The Automobile by Harbans Singh Reyat
3. The Automobile Engineering by T.R. Banga and Nathu Singh
4. Automotive Engineering Fundamentals by Richard Stone, Jeffrey K. Ball,SAE International
5. Vehicle body engineering by J Powlowski
6. Automobile Mechanics, N. K. Giri, 8thEdition, Khanna Publishers
7. Bosch Automotive Hand Book, 6thEdition, SAE Publications
8. Automotive Mechanics by William H. Crouse and Donald L. Anglin, 10th Edition, McGraw Hill
9. Motor vehicles by T. K. Garrett, K. Newton and W. Steeds
10. Automotive Mechanics by Joseph Heitner
11. Automobile Electrical and Electronics by Tom Denton
12. Automotive Electrical Equipment by P. L. Kohli
13. Computerised Engine Control by Dick H. King

Course Code	Course/Subject Name	Credits
MEDLO7033	Pumps, Compressors and Fans	4

Objectives

1. To study of Different types of Pumps, Compressors & Fans
2. To familiarise design aspects of Pumps, Compressors & Fans

Outcomes: Learner will be able to...

1. Select suitable Pump
2. Design a reciprocating pump and analyse its performance
3. Design a centrifugal pump and analyse its performance
4. Demonstrate basic principles of fans and blowers
5. Design fan/blower and analyse its performance
6. Design a compressor and analyse its performance

Module	Detailed Contents	Hrs.
01	Introduction to Fluid Machinery: Introduction to pumps, Introduction to blowers and compressors, Basic equations of energy transfer between fluid and rotor, Performance characteristics, Dimensionless parameters, Specific speed, stage velocity triangles, work and efficiency.	04
02	Reciprocating Pumps and Centrifugal Pumps: Introduction: Types, Component and Working of Reciprocating pump and Centrifugal Pumps, Discharge, Work done and power required to drive for single acting and double acting, Coefficient of discharge, slip, Effect of acceleration of piston on velocity and pressure, indicator diagram, Air Vessel, Operating characteristics.	06
03	Design & Analysis of Pumps: Design procedure and design optimization of Pumps, selection of pumps, Thermal design- Selection of materials for high temperature and corrosive fluids, Hydraulic design- Selection of impeller and casing dimension using industrial manuals	08
04	Introduction to Fans, Blowers and Compressors: Classification of blowers, Basics of stationary and moving air, Eulers characteristics, velocity triangles and operating pressure conditions, Equations for blowers, Losses and hydraulic efficiency, flow through impeller casing, inlet nozzle, Volute, diffusers, leakage, mechanical losses, surge and stall, Applications of blowers and fans Compressors: Basic theory, classification and application, Working with enthalpy-entropy diagram	06
05	Design and Analysis of Fans and Blowers: Rotor design airfoil theory, vortex theory, cascade effects, degree of reaction, Design procedure for selection and optimization of Blowers. Stage pressure rise, stage parameters and design parameters, Design of impeller and casing dimension in aerodynamic design	06
06	Design & Analysis of Compressors: Construction and approximate calculation of centrifugal compressors, impeller flow losses, slip factor, diffuser analysis, performance curves of centrifugal compressors, Basic design features of axial flow compressors; velocity triangles, enthalpy-entropy diagrams, stage losses and efficiency, work done factor, simple stage of axial flow compressors	06

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

Reference Books:

1. Principles of Turbo machinery by Shepherd, D.G., Macmillan
2. Centrifugal Pump Design by John Tuzson, John Wiley
3. Blowers and Pumps by Stepanff, A.J., John Wiley and Sons Inc.
4. Centrifugal pumps and blowers by Austin H. Chruch, John Wiley and Sons
5. Centrifugal Pumps Design and Applications by Val S.Labanoff and Robert Ross, Jaico P House
6. Pump Hand Book by Igori Karassik, McGraw-Hill International Edition
7. Pumps by G.K.Sahu, New age international
8. Turbine, Compressors and Fans by S.M.Yahya, Tata Mc-Graw Hill Publishing Company
9. Fluid Mechanics and Hydraulic Machines by R. K. Bansal, Laxmi Publication
10. Gas Turbines by V. Ganeshan, Tata Mc-Graw Hill Publishing Company
11. Steam and Gas Turbine by R. Yadav, Central Publishing House, Allahabad

Course Code	Course/subject Name	Credits
MEDLO7034	Computational Fluid Dynamics	4

Objectives:

1. To study basic principles of Computational Fluid Dynamics
2. To study grid generation and discretization methods

Outcomes: Learner will be able to...

1. Demonstrate methodology to work with CFD
2. Illustrate principles of grid generation and discretisation methods
3. Identify and apply specific boundary conditions relevant to specific application
4. Decide solution parameters relevant to specific application
5. Analyze the results and draw the appropriate inferences
6. Demonstrate basic principles of FVM

Module	Detailed Contents	Hrs.
01	Introduction: What is CFD, Scope and Application of CFD, Methods of Predictions like Experimental and theoretical, Working of Commercial CFD Software, Solution methodology-Preprocessing, Solver, Post processing.	04
02	Mathematical description of Physical Phenomenon: Governing Differential Equations, Meaning of Differential equation, The Continuity Equation, A Momentum equation, The Energy Equation, The General Differential Equation, Boundary Conditions, Initial and Boundary Conditions, Initial and Boundary Value problems.	06
03	Grid Generation and Discretization Methods: Structured and unstructured Grids: O-type, H-type, C-type of Structured Grid Generation, Mesh Adaptation. The Nature of Numerical Methods: The Discretization Concept, The Structure of the Discretization Equation. Basic discretization techniques applied to model equations and systems of equations: finite difference, finite volume and finite element methods. Methods of Deriving the Discretization Equations, Taylor-Series Formulation, Variational Formulation, Method of Weighted Residuals, Control Volume Formulation	08
04	Heat Conduction, Convection and Diffusion: Steady One-dimensional Conduction, Unsteady One-dimensional Conduction, Two and Three-dimensional Situations, Over relaxation and Under relaxation, Steady One-dimensional and Two Dimensional Convection-Diffusion, Unsteady One-dimensional Convection.	
05	Incompressible Fluid Flow: Governing Equations, Stream Function-Vorticity Method, Determination of Pressure for Viscous Flow, The SIMPLE, SIMPLER Algorithm, Introduction to Turbulence Modeling, Basic Theories of Turbulence, The Time-Averaged Equations for Turbulent Flow.	
06	Finite Volume Methods: FVM solutions to steady one, two and three dimensional diffusion problems and unsteady one and two dimensional diffusion problems, FVM solutions to convection-diffusion problems - one and two dimensional, steady and unsteady; Advection schemes; Pressure velocity coupling	08

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

References:

1. An introduction to computational fluid dynamics-The finite volume method, Versteeg.H.K. , Malalasekera.W., Prentice Hall
2. Computational Fluid Mechanics and Heat Transfer, Anderson, D.A., Tannehill, I.I., and Pletcher, R.H., Hemisphere Publishing Corporation, New York, USA, 1984
3. Introduction to Computational Fluid Dynamics, Niyogi P. ,Laha M.K., Chakrabarty S.K., Pearson Education, India
4. Computational Fluid Flow and Heat Transfer, Muralidhar, K.,andSundararajan,T., Narosa Publishing House ,New Delhi
5. Computer Simulation of flow and heat transfer, Ghoshdasdar, P. S., Tata McGraw-Hill Publishing Company Ltd
6. Finite Element Programming of the Navier Stock Equation, Taylor, C and Hughes J.B., Pineridge Press Ltd.U.K.
7. Computational Techniques for Fluid Dynamics: Fundamental and General Techniques, Fletcher, C.A.J., Springer-Verlag
8. Numerical Fluid Dynamics, Bose, T. K., Narosa Publishing House
9. T. J. Chung, Computational Fluid Dynamics, Cambridge University Press
10. Anderson, J.D. Computational Fluid Dynamics, McGraw Hill

Course Code	Course Name	Credits
ILO 7011	Product Life Cycle Management	03

Objectives:

1. To familiarize the students with the need, benefits and components of PLM
2. To acquaint students with Product Data Management & PLM strategies
3. To give insights into new product development program and guidelines for designing and developing a product
4. To familiarize the students with Virtual Product Development

Outcomes: Learner will be able to...

1. Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
2. Illustrate various approaches and techniques for designing and developing products.
3. Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
4. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

Module	Detailed Contents	Hrs
01	Introduction to Product Lifecycle Management (PLM): Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications PLM Strategies: Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	10
02	Product Design: Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	09
03	Product Data Management (PDM): Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	05
04	Virtual Product Development Tools: For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	05
05	Integration of Environmental Aspects in Product Design: Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life	05

	Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	
06	Life Cycle Assessment and Life Cycle Cost Analysis: Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	05

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

REFERENCES:

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, Antonino Risitano, "Product Design for the environment-A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229
3. Saaksvuori Antti, Immonen Anselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265

Course Code	Course Name	Credits
ILO 7012	Reliability Engineering	03

Objectives:

1. To familiarize the students with various aspects of probability theory
2. To acquaint the students with reliability and its concepts
3. To introduce the students to methods of estimating the system reliability of simple and complex systems
4. To understand the various aspects of Maintainability, Availability and FMEA procedure

Outcomes: Learner will be able to...

1. Understand and apply the concept of Probability to engineering problems
2. Apply various reliability concepts to calculate different reliability parameters
3. Estimate the system reliability of simple and complex systems
4. Carry out a Failure Mode Effect and Criticality Analysis

Module	Detailed Contents	Hrs
01	Probability theory: Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. Probability Distributions: Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. Measures of Dispersion: Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	08
02	Reliability Concepts: Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. Failure Data Analysis: Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. Reliability Hazard Models: Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	08
03	System Reliability: System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	05
04	Reliability Improvement: Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	08
05	Maintainability and Availability: System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	05
06	Failure Mode, Effects and Criticality Analysis: Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fault tree analysis and Event tree Analysis	05

Assessment:

Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

REFERENCES:

1. L.S. Srinath, "Reliability Engineering", Affiliated East-West Press (P) Ltd., 1985.
2. Charles E. Ebeling, "Reliability and Maintainability Engineering", Tata McGraw Hill.
3. B.S. Dhillon, C. Singh, "Engineering Reliability", John Wiley & Sons, 1980.
4. P.D.T. Connor, "Practical Reliability Engg.", John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, "Reliability in Engineering Design", John Wiley & Sons.
6. Murray R. Spiegel, "Probability and Statistics", Tata McGraw-Hill Publishing Co. Ltd.

Course Code	Course Name	Credits
ILO 7013	Management Information System	03

Objectives:

1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
4. Identify the basic steps in systems development

Outcomes: Learner will be able to...

1. Explain how information systems Transform Business
2. Identify the impact information systems have on an organization
3. Describe IT infrastructure and its components and its current trends
4. Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
5. Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

Module	Detailed Contents	Hrs
01	Introduction To Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS	4
02	Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results	7
03	Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls	7
04	Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	7
05	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	6
06	Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	8

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

REFERENCES:

1. Kelly Rainer, Brad Prince, Management Information Systems, Wiley
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

Course Code	Course Name	Credits
ILO 7014	Design of Experiments	03

Objectives:

1. To understand the issues and principles of Design of Experiments (DOE)
2. To list the guidelines for designing experiments
3. To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

Outcomes: Learner will be able to...

1. Plan data collection, to turn data into information and to make decisions that lead to appropriate action
2. Apply the methods taught to real life situations
3. Plan, analyze, and interpret the results of experiments

Module	Detailed Contents	Hrs
01	Introduction 1.1 Strategy of Experimentation 1.2 Typical Applications of Experimental Design 1.3 Guidelines for Designing Experiments 1.4 Response Surface Methodology	06
02	Fitting Regression Models 2.1 Linear Regression Models 2.2 Estimation of the Parameters in Linear Regression Models 2.3 Hypothesis Testing in Multiple Regression 2.4 Confidence Intervals in Multiple Regression 2.5 Prediction of new response observation 2.6 Regression model diagnostics 2.7 Testing for lack of fit	08
03	Two-Level Factorial Designs 3.1 The 2^2 Design 3.2 The 2^3 Design 3.3 The General 2^k Design 3.4 A Single Replicate of the 2^k Design 3.5 The Addition of Center Points to the 2^k Design, 3.6 Blocking in the 2^k Factorial Design 3.7 Split-Plot Designs	07
04	Two-Level Fractional Factorial Designs 4.1 The One-Half Fraction of the 2^k Design 4.2 The One-Quarter Fraction of the 2^k Design 4.3 The General 2^{k-p} Fractional Factorial Design 4.4 Resolution III Designs 4.5 Resolution IV and V Designs 4.6 Fractional Factorial Split-Plot Designs	07
05	Response Surface Methods and Designs 5.1 Introduction to Response Surface Methodology 5.2 The Method of Steepest Ascent 5.3 Analysis of a Second-Order Response Surface 5.4 Experimental Designs for Fitting Response Surfaces	07

06	Taguchi Approach 6.1 Crossed Array Designs and Signal-to-Noise Ratios 6.2 Analysis Methods 6.3 Robust design examples	04

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

REFERENCES:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition, John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss

Course Code	Course Name	Credits
ILO 7015	Operations Research	03

Objectives:

1. Formulate a real-world problem as a mathematical programming model.
2. Understand the mathematical tools that are needed to solve optimization problems.
3. Use mathematical software to solve the proposed models.

Outcomes: Learner will be able to...

1. Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.
2. Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
3. Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
4. Understand the applications of integer programming and a queuing model and compute important performance measures

Module	Detailed Contents	Hrs
01	Introduction to Operations Research: Introduction, , Structure of the Mathematical Model, Limitations of Operations Research Linear Programming: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, Duality, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis Transportation Problem: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method. Assignment Problem: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem Integer Programming Problem: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.	14
02	Queuing models: queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	05
03	Simulation: Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	05
04	Dynamic programming. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	05

05	Game Theory. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	05
06	Inventory Models: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	05

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

REFERENCES:

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009
3. Hiller, F. S. and Lieberman, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons

Course Code	Course Name	Credits
ILO 7016	Cyber Security and Laws	03

Objectives:

1. To understand and identify different types cybercrime and cyber law
2. To recognized Indian IT Act 2008 and its latest amendments
3. To learn various types of security standards compliances

Outcomes: Learner will be able to...

1. Understand the concept of cybercrime and its effect on outside world
2. Interpret and apply IT law in various legal issues
3. Distinguish different aspects of cyber law
4. Apply Information Security Standards compliance during software design and development

Module	Detailed Contents	Hrs
01	Introduction to Cybercrime: Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	4
02	Cyber offenses & Cybercrime: How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	9
03	Tools and Methods Used in Cyberline Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	6
04	The Concept of Cyberspace E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law , The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	8
05	Indian IT Act. Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	6
06	Information Security Standard compliances SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	6

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

REFERENCES:

1. Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, *Information Systems Security*, Wiley India, New Delhi
6. Kenneth J. Knapp, *Cyber Security & Global Information Assurance* Information Science Publishing.
7. William Stallings, *Cryptography and Network Security*, Pearson Publication
8. Websites for more information is available on : The Information Technology ACT, 2008- TIFR : <https://www.tifrh.res.in>
9. Website for more information , A Compliance Primer for IT professional : <https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538>

Course Code	Course Name	Credits
ILO 7017	Disaster Management and Mitigation Measures	03

Objectives:

1. To understand physics and various types of disaster occurring around the world
2. To identify extent and damaging capacity of a disaster
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand role of individual and various organization during and after disaster
5. To understand application of GIS in the field of disaster management
6. To understand the emergency government response structures before, during and after disaster

Outcomes: Learner will be able to...

1. Get to know natural as well as manmade disaster and their extent and possible effects on the economy.
2. Plan of national importance structures based upon the previous history.
3. Get acquainted with government policies, acts and various organizational structure associated with an emergency.
4. Get to know the simple do's and don'ts in such extreme events and act accordingly.

Module	Detailed Contents	Hrs
01	Introduction 1.1 Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	03
02	Natural Disaster and Manmade disasters: 2.1 Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion 2.2 Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	09
03	Disaster Management, Policy and Administration 3.1 Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. 3.2 Policy and administration: Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	06
04	Institutional Framework for Disaster Management in India: 4.1 Importance of public awareness, Preparation and execution of emergency management program. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. 4.2 Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	06
05	Financing Relief Measures: 5.1 Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams.	09

	5.2 International relief aid agencies and their role in extreme events.	
06	Preventive and Mitigation Measures: 6.1 Pre-disaster, during disaster and post-disaster measures in some events in general 6.2 Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication 6.3 Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. 6.4 Do's and don'ts in case of disasters and effective implementation of relief aids.	06

Assessment:

Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

REFERENCES:

1. 'Disaster Management' by Harsh K.Gupta, Universities Press Publications.
 2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.
 3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elsevier Publications.
 4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
 5. 'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
 6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
 7. Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications.
- (Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

Course Code	Course Name	Credits
ILO 7018	Energy Audit and Management	03

Objectives:

1. To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
2. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
3. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Outcomes: Learner will be able to...

1. To identify and describe present state of energy security and its importance.
2. To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
3. To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
4. To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
5. To analyze the data collected during performance evaluation and recommend energy saving measures

Module	Detailed Contents	Hrs
01	Energy Scenario: Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	04
02	Energy Audit Principles: Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	08
03	Energy Management and Energy Conservation in Electrical System: Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. Energy efficiency measures in lighting system, Lighting control: Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	10
04	Energy Management and Energy Conservation in Thermal Systems: Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	10

05	Energy Performance Assessment: On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	04
06	Energy conservation in Buildings: Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	03

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

REFERENCES:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. www.energymanagertraining.com
9. www.bee-india.nic.in

Course Code	Course Name	Credits
ILO7019	Development Engineering	03

Objectives:

1. To understand the characteristics of rural Society and the Scope, Nature and Constraints of rural Development
2. To study Implications of 73rd CAA on Planning, Development and Governance of Rural Areas
3. An exploration of human values, which go into making a 'good' human being, a 'good' professional, a 'good' society and a 'good life' in the context of work life and the personal life of modern Indian professionals
4. To understand the Nature and Type of Human Values relevant to Planning Institutions

Outcomes: Learner will be able to...

1. Apply knowledge for Rural Development.
2. Apply knowledge for Management Issues.
3. Apply knowledge for Initiatives and Strategies
4. Develop acumen for higher education and research.
5. Master the art of working in group of different nature.
6. Develop confidence to take up rural project activities independently

Module	Contents	Hrs
1	Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services.	08
2	Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee - linkage between Panchayati Raj, participation and rural development.	04
3	Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development.	06
4	Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.	04
5	Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education. Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom.	10
6	Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education	04

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

Reference

1. ITPI, Village Planning and Rural Development, ITPI, New Delhi
2. Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai
3. GoI, Constitution (73rd GoI, New Delhi Amendment) Act, GoI, New Delhi
4. Planning Commission, Five Year Plans, Planning Commission
5. Planning Commission, Manual of Integrated District Planning, 2006, Planning Commission New Delhi
6. Planning Guide to Beginners
7. Weaver, R.C., The Urban Complex, Doubleday.
8. Farmer, W.P. et al, Ethics in Planning, American Planning Association, Washington.
9. How, E., Normative Ethics in Planning, Journal of Planning Literature, Vol.5, No.2, pp. 123-150.
10. Watson, V. , Conflicting Rationalities: -- Implications for Planning Theory and Ethics, Planning Theory and Practice, Vol. 4, No.4, pp.395 – 407

Course Code	Course Name	Credits
MEL701	Machine Design –II	1

Objectives:

1. To familiarise applications of strength design principles for various machine elements
2. To make conversant with preparation of working drawings

Outcomes: Learner will be able to...

1. Design gears based on the given conditions
2. Design gearbox for a given application
3. Design cam & followers for a given condition
4. Design clutches for a given application
5. Design brakes for given condition
6. Select bearings for a given applications from the manufacturers catalogue

Term Work: (Comprises a and b)

a)

1. **Term work** - Shall consist of design and detailed assembly drawing of minimum two design problems from the mentioned list (computer aided drawing on **A3 size sheets**):
 1. Design of Gears and gear box
 2. Design of cam and followers
 3. Design of clutches
 4. Design of brakes
2. **Course Project:** Students in a group of two to four will be able to design and prepare working drawings of any system having minimum 5 to 6 components by applying the knowledge gained during the course.

b) Assignment : Each assignment containing at least 2- numerical based on following topics. These design exercises should be in the form of design calculations with sketches and/ or drawings.

1. Rolling contact bearings
2. Sliding contact bearing
3. Design of belt, chain and flywheel

The distribution of marks for term work shall be as follows:

Exercises & Drawing sheets:	15 Marks
Course Project:	05 Marks
Attendance:	05 Marks

End Semester Practical/Oral examination:

1. Each student will be given a small task of design, based on syllabus, which will be assessed by pair of examiners during the oral examination.
2. Distribution of marks for practical-oral examination shall be as follows:

Design Task:	15 marks
Oral:	10 marks
3. Evaluation of practical/oral examination to be done based on the performance of design task.
4. Students work along with evaluation report to be preserved till the next examination

Course Code	Course Name	Credits
MEL702	CAD/CAM/CAE	01

Objectives

1. To introduce new and exciting field of Intelligent CAD/CAM/CAE with particular focus on engineering product design and manufacturing.
2. To develop a holistic view of initial competency in engineering design by modern computational methods.
3. To develop New API for CAD

Outcomes: Learner will be able to...

1. Identify proper computer graphics techniques for geometric modelling.
2. Transform, manipulate objects as well as store and manage data.
3. Create CAM Toolpath and prepare NC- G code
4. Apply rapid prototyping and tooling concepts in any real life applications.
5. Identify the tools for Analysis of a complex engineering component.

List of Exercises

1. Programming for transformations,
2. API on Creating As built joints, Slider Joint Motion
3. Get the physical Properties API
4. Get the circle and arc data from the edge
5. Sketch spline through points creation : API
6. Solid modeling using any 3D modeling software
7. Part programming and part fabrication on CNC trainer (Turning / Milling)
8. Geometrical optimization of any mechanical component using computer aided engineering concepts. (Shape optimization)
9. Development of physical 3D mechanical structure using any one of the rapid prototyping processes.

Term Work

Term work shall consist of

- a. Any four exercises from 1 to 6 of above list
- b. Part programming and part fabrication on CNC trainer
- c. A course project in a group of not more than four students based on 8 and 9 of above list

The distribution of marks for term work shall be as follows:

- Exercises : 15 Marks
- Course Project : 05 Marks
- Attendance : 05 Marks

Assessment:

End Semester Practical/Oral Examination:

1. Each student will be given a small task of design based on syllabus, which will be assessed by pair of examiners during the oral examination.
2. Distribution of marks for practical-oral examination shall be as follows:

Design Task:	15 marks
Oral:	10 marks
3. Evaluation of practical/oral examination to be done based on the performance of design task
4. Students work along with evaluation report to be preserved till the next examination

Course Code	Course Name	Credits
MEL703	Production Planning and Control	01

Objectives:

1. To provide an exposure related to Production Planning & Control (PPC)
2. To give exposure to production scheduling and sequencing

Outcomes: Learner will be able to...

1. Prepare a process sheet
2. Prepare a Gantt Chart
3. Forecast the demand of the product and prepare an aggregate plan.
4. Perform ABC analysis of a given problem
5. Develop the skills of Inventory Management and cost effectiveness.
6. Create a logical approach to Line Balancing for various production systems.

Term Work

The Term work shall comprise of the following:

At least six laboratory exercises/assignments comprising questions/problems

Sr No	List of Laboratory Exercises (Any Six)
1	Preparation of a Process sheet of a simple turned/milled component
2	Numerical example on Johnson's Algorithm
3	An example on network crashing
4	Preparation of a Gantt Chart
5	A real life example on ABC analysis
6	An example on MRP for planned released orders
7	An example on line balancing
8	Preparation of organization charts with functional relationship for any SME.

Project Based Learning may be incorporated by judiciously reducing number of laboratory exercises

The distribution of marks for term work shall be as follows:

- Lab work/assignments/exercise : **20** marks
- Attendance : **05** marks

Practical/Oral examination

1. Each student will be given a small task based on laboratory exercises, which will be assessed by pair of examiners during the oral examination.
2. Distribution of marks for practical-oral examination shall be as follows:

Exercise:	15 marks
Oral:	10 marks
3. Evaluation of practical/oral examination to be done based on the performance of design task
4. Students work along with evaluation report to be preserved till the next examination

Course Code	Course/Subject Name	Credits
MEC801	Design of Mechanical Systems	4

Objectives:

1. To familiarise with the concept of system and methodology of system design
2. To study system design of various systems such as snatch block, belt conveyors, engine system, pumps and machine tool gearbox

Outcomes: Learner will be able to...

1. Apply the concept of system design.
2. Design material handling systems such as hoisting mechanism of EOT crane,
3. Design belt conveyor systems
4. Design engine components such as cylinder, piston, connecting rod and crankshaft
5. Design pumps for the given applications
6. Prepare layout of machine tool gear box and select number of teeth on each gear

Module	Details	Hrs.
01	Methodology & Morphology of design, Optimum design, system concepts in design.	04
02	Design of Hoisting mechanism: Design of Snatch Block Assembly including Rope Selection, Sheave, Hook, Bearing for hook, cross piece, Axle for sheave and shackle plate, Design of rope drum, selection motor with transmission system.	10
03	Design of belt Conveyors- Power requirement, selection of belt, design of tension take up unit, idler pulley	06
04	Engine Design (Petrol and Diesel): Design of cylinder, Piston with pin and rings, connecting rod & crank shaft with bearings	10
05	Design of Pump: 5.1 Design of main components of gear pump. 1 Motor selection 2 Gear design 3 Shaft design and bearing selection 4 Casing and bolt design 5 Suction and delivery pipe 5.2 Design of main components of Centrifugal Pump: 1 Motor selection 2 Suction and Delivery pipe 3 Design of Impeller, Impeller shaft 4 Design of Volute Casing	10
06	Design of Gear Box: Design of gear boxes for machine tool applications(Maximum three stages and twelve speeds), Requirements of gear box, determination of variable speed range, graphical representation of speeds, structure diagram, ray diagram, selection of optimum ray diagram, estimation of numbers of teeth on gears, deviation diagram, layout of gear box	08

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

Use of standard design data books like PSG Data Book, Machine Design Data Book- design of engine parts by Khandare S.S and Kale A.V. are permitted at the examination and shall be supplied by the college.

References:

1. Machine Design Exercises by S.N.Trikha, Khanna Publications, Delhi
2. Mechanical Engineering Design by Shigley J E and Mischke C R, McGraw Hill
3. Mechanical design analysis by M F Spotts, Prentice Hall Inc
4. Design of Machine Elements, Bhandari VB, TMH
5. Machine Design by Black PH and O Eugene Adams, McGraw Hill
6. Design Data by P.S.G. College of Technology, Coimbatore.
7. I S: 2825 Code for unfired pressure vessels
8. Mechanical Design Synthesis with Optimisation Applications by Johnson R C, Von Nostrand-Reynold Pub
9. Engineering Design by Dieter G E, McGraw Hill Inc
10. Design of machine tools by S K Basu and D K Pal, Oxford and IBH Pub. Co.
11. Machine tool design by NK Mehta, TMH
12. Mechanical System Design by SP Patil, JAICO students Ed., JAICO Publishing House
13. Material Handling Equipment by Rudenko, M.I.R. publishers, Moscow
14. Machine Design-An Integrated Approach by Robert L. Norton, Pearson Education
15. Material Handling Equipments by N. Rudenko, Peace Publication
16. Material Handling Equipments by Alexandrov, Mir Publication
17. Machine Design by Reshetov, Mir Publication
18. Machine Design by R.C.Patel, Pandya, Sikh, Vol -I & II, C. Jamnadas & Co
19. Design of Machine Elements by V. M. Faires
20. Pumps: Theory, Design and Applications by G K Sahu, New Age International
21. Gear Design Handbook by Gitin Maitra
22. Design Data Book- Design of engine parts by Khandare S.S & Kale A.V

Course Code	Course/Subject Name	Credits
MEC802	Industrial Engineering and Management	04

Objectives

1. To familiarise with concept of integration of various resources and the significance of optimizing them in manufacturing and allied Industries
2. To acquaint with various productivity enhancement techniques

Outcomes: Learner will be able to...

1. Illustrate the need for optimization of resources and its significance
2. Develop ability in integrating knowledge of design along with other aspects of value addition in the conceptualization and manufacturing stage of various products.
3. Demonstrate the concept of value analysis and its relevance.
4. Manage and implement different concepts involved in method study and understanding of work content in different situations.
5. Describe different aspects of work system design and facilities design pertinent to manufacturing industries.
6. Illustrate concepts of Agile manufacturing, Lean manufacturing and Flexible manufacturing

Modules	Detailed contents	Hrs.
01	Introduction to Industrial Engineering History and contribution, Industrial engineering approach, techniques of industrial engineering, objectives of industrial engineering, system approach to industrial engineering, definition and concept of productivity, productivity measurements, factors influencing productivity and productivity improvement techniques.	06
	Value Engineering and Value Analysis: Distinction between value engineering & value analysis and their Significance. Steps in value engineering & analysis and Check lists.	05
03	Work study: Method study, micro-motion study and principles of motion economy, Work measurement: time study, work sampling, standard data, PMTS; MOST	10
04	Work system design: Introduction to ergonomics and its scope in relation to work. Outline of discipline of anatomy, physiology and psychology, with respect to ergonomics building blocks such as anthropometry and biomechanics Job evaluation, merit rating, incentive schemes, wage administration and business process reengineering	08
05	Facility Design: Facility location factors and evaluation of alternate locations; types of plant layout and their evaluation; computer aided layout design techniques; assembly line balancing; materials handling systems Concepts of Group Technology and cellular manufacturing	09
06	Agile manufacturing: Introduction, Developing agile manufacturing, Integration of Product/Process Development, Application of IT/IS concepts, Agile supply chain management, Design of skill and knowledge and Computer control of Agile manufacturing. Flexible manufacturing, Lean Manufacturing, Value Stream Mapping	10

Assessment:

Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

References

1. Introduction to Work study, ILO, Geneva, and Oxford & IBH Pub Co. Pvt. Ltd.
2. Ergonomics at Work, Murrell
3. Plant Layout and Material Handling, James M. Apple, John Wiley & Sons
4. Facility Layout and Location – An Analytical Approach, Richard L. Francis & John A. White, Prentice Hall
5. Production Planning and Control, Samuel Elion
6. Production and Operations Management, Joseph G. Monks
7. Quality planning and analysis, J M Juran, FM Gryana, TMH
8. Total Quality Management, D. H. Bester Field et al. prentice hall
9. TQM in new product manufacturing, HG Menon; TMH
10. Industrial Engineering and Management by Dr Ravi Shankar

Course Code	Course Name	Credits
MEC803	Power Engineering	4

Objectives

1. To study boilers, boiler mountings and accessories
2. To study utilization of thermal and hydraulic energy
3. To study gas turbine and its applications

Outcomes: Learner will be able to...

1. Compute heat interactions in combustion of reactive mixtures
2. Differentiate boilers, boiler mountings and accessories
3. Calculate boiler efficiency and assess boiler performance
4. Demonstrate working cycles of gas turbines
5. Draw velocity triangles of impulse/reaction turbines and calculate performance parameters/efficiency
6. Demonstrate basic working of pumps

Module	Detailed Contents	Hrs.
01	Combustion of Reactive Mixtures Combustion reactions, Stoichiometric A/F ratio, Actual A/F ratio, Heat of combustion, Enthalpy of formation, First law of reactive system, Adiabatic flame temperature.	04
02	Steam Generators Fire tube and Water tube boiler, Low pressure and high pressure boilers, once through boiler, examples, and important features of HP boilers, Mountings and accessories, Equivalent evaporation of boilers, Boiler performance, Boiler efficiency Steam Turbine- Basic of steam turbine, Classification, compounding of turbine, Impulse turbine – velocity diagram, Condition for max efficiency Reaction turbine - velocity diagram, degree of reaction, Parson's turbine, Condition for maximum efficiency	12
03	Gas Turbines Applications of gas turbine, Actual Brayton cycle, open and closed cycle gas turbine, methods to improve efficiency and specific output, open cycle with intercooling, reheat, and regeneration, Effect of operating variable on thermal efficiency and work ratio	05
04	Jet Propulsion Engines Classification of jet propulsion engines, Thrust, Thrust power, Propulsive efficiency and thermal efficiency, Afterburner, Introduction to Turbojet, Turbofan, Ram jet, Turboprop and Rocket engine	05
05	Impact of Jets: Impact of jet on flat and curved plates Water Turbines: Types of hydro turbines - impulse and reaction, definition of various turbine parameters like gross head, discharge, work done, input power, output power, efficiencies etc., Eulers' equation applied to a turbine, turbine velocities and velocity triangles, expression for work done. Impulse Turbine: Components of Pelton turbine, definition of design parameters like speed ratio, jet ratio, and estimation of various parameters like head, discharge, and efficiency etc., determination of number of buckets. Reaction Turbines: Types of reaction turbines - inward and outward flow, radial mixed and axial; elements of the turbine, estimation of various parameters	12
06	Pumps Classification of pumps - positive displacement and non - positive displacement Positive Displacement pumps: Types and applications, general features of rotary pumps, general feature of reciprocating pumps, definition of head, discharge, work done and efficiency, types of reciprocating pumps, indicator diagram, use of air vessel. Centrifugal Pumps	10

	Types - radial flow, mixed flow and axial flow, Priming of pumps, components of the pump, Euler's equation and velocity triangles, correction factors for the head, design constant e.g., head constant, flow constant etc., self-priming pumps, series and parallel operation of pumps, system curve for branch network, determination of operating point, Cavitation in pumps, Determination of available and required NPSH	

Assessment:

Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

Reference Books:

1. Thermal Engineering, R K. Rajput, Laxmi Publication
2. Thermal Engineering, Kothandraman, Domkundwar, Khajuria, Arora, Dhanpatrai & Sons
3. Steam and gas turbine, R Yadav.
4. Fluid Mechancis and Machinery, C P S Ojha, Chandramouli and R Berndtsson, Oxford University Press
5. Fluid Mechanics and Hydraulic Machinery, Modi and Seth, Standard Book House
6. Hydraulic Machinery, Jagdish Lal
7. Hydraulic Machines, R K Rajput, S.Chand Publication

Course Code	Course/Subject Name	Credits
MEDLO8041	Power Plant Engineering	4

Objectives

1. Study basic working principles of different power plants
2. Study power plant economics

Outcomes: Learner will be able to...

1. Comprehend various equipment/systems utilized in power plants
2. Demonstrate site selection methodology, construction and operation of Hydro Electric Power Plants
3. Discuss working, site selection, advantages, disadvantages of steam power plants
4. Discuss operation of Combined Cycle Power Plants
5. Discuss types of reactors, waste disposal issues in nuclear power plants
6. Illustrate power plant economics

Module	Detailed Contents	Hrs.
01	Introduction: Energy resources and their availability, types of power plants, selection of the plants, review of basic thermodynamic cycles used in power plants	06
02	Hydro Electric Power Plants : Rainfall and run-off measurements and plotting of various curves for estimating stream flow and size of reservoir, power plants design, construction and operation of different components of hydro-electric power plants, site selection, comparison with other types of power plants	10
03	Steam Power Plants: Flow sheet and working of modern-thermal power plants, super critical pressure steam stations, site selection, coal storage, preparation, coal handling systems, feeding and burning of pulverized fuel, ash handling systems, dust collection-mechanical dust collector and electrostatic precipitator	08
04	Combined Cycles: Constant pressure gas turbine power plants, Arrangements of combined plants (steam & gas turbine power plants), re-powering systems with gas production from coal, using PFBC systems, with organic fluids, parameters affecting thermodynamic efficiency of combined cycles, Problems	08
05	Nuclear Power Plants: Principles of nuclear energy, basic nuclear reactions, nuclear reactors- PWR, BWR, CANDU, Sodium graphite, fast breeder, homogeneous; gas cooled, Advantages and limitations, nuclear power station, waste disposal.	08
06	Power Plant Economics: Load curve, different terms and definitions, cost of electrical energy, tariffs methods of electrical energy, performance & operating characteristics of power plants- incremental rate theory, input-output curves, efficiency, heat rate, economic load sharing, Problems.	08

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

References

1. Power Plant Engineering, A K Raja, Amit Praksh Shrivastava, Manish Dwivedi, New Age International Publishers
2. Power Plant Familiarization, Manual of Central Training Resources Unit of NTPC India, 1991
3. Power Plant Engineering, P.K. Nag, 2nd Edition, TMH, New Delhi
4. A Text Book of Power Plant Engineering, R.K. Rajput, Laxmi Publications
5. Hydro-Electric and Pumped Storage Plants, M G Jog, New Age International Publishers
6. A Course in Power Plant Engineering, Arora, Domkundwar, DhanpatRai & Co
7. Power Plant Engineering, P.C. Sharma, S.K. Kataria& Sons
8. Power Plant Engineering, G.R. Nagpal, Khanna Publishers
9. Power station Engineering and Economy by Bernhardt G.A. Skrotzki and William A. Vopat, TMH
10. Power Plant Engineering, Manoj Kumar Gupta, PHI Learning
11. Nuclear Power Plant Engineering, James Rust, Haralson Publishing Company
12. Nuclear Power Plants, Edited by Soon Heung Chang, InTech Publishers

Course Code	Course/Subject Name	Credits
MEDLO8042	Rapid Prototyping	04

Objectives

1. To familiarise with importance of Rapid Prototyping in Product Development.
2. To acquaint with the Synergic Integration Technologies

Outcomes: Learner will be able to...

1. Select the feasible RP process
2. Select the feasible RP material
3. Gauge and Hybridize the ever-evolving Prototyping Technologies
4. Contribute towards the Product Development at the respective domain in the industry
5. Apply RP to build working prototypes
6. Demonstrate basics of virtual reality

Module	Detailed Contents	Hrs.
01	Introduction: Product Development Cycle and the product Life Cycle. Problems in Product Development and the use of Synergic Integration Technologies. Relationship between Product Development Cost and the Selling Price. Where does RP stand. Classification of RP systems, advantages and limitations of RP, Applications and scope of RP, supported file formats and introduction to Solid Modelling.	10
02	Laminated Object Manufacturing (LOM), principle of operation, possible approaches, steps, advantages and limitations. Standard Machine Specifications. Fused Deposition Modelling (FDM), principle of operation, process steps, advantages and limitations. Standard Machine Specifications. Stereolithography Apparatus (SLA): Principle, process steps, advantages and limitations, Standard Machine Specifications. Selective Laser Sintering (SLS): Principle, process steps, advantages and limitations, Standard Machine Specifications.	12
03	Solid Ground Curing (SGC): Principle, process steps, advantages and limitations, PhotoMasking comparative with SLA and LOM Objet: Principle, process steps, advantages and limitations, applications, Standard Machine Specifications. 3D Printing: Principle, process steps, advantages and limitations, classification of printer family, Standard Machine Specifications, DIY procedures.	12
04	Rapid Tooling: Need for metallic tooling, approaches, RP Processes for Tooling, Silicon Rubber Molding, Epoxy Tooling, Spray Metal Tooling, Cast Kirksite Tooling, 3D KelTool, QuickCast.	05
05	Materials for Rapid Prototyping Systems: Nature of material, types of material; polymers, metals, ceramics and composites, liquid based materials; photo polymer development, solid based materials; powder based materials.	05
06	Reverse Engineering: Introduction to Digitizing Methods; contact type and non-contact type, brief introduction to the types of medical imaging. Virtual reality: Definition, features of VR, Technologies used in VR, Introduction to Augmented reality.	04

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

References:

1. Rapid Prototyping, Principles and Applications by Rafiq I. Noorani, Wiley & Sons
2. Rapid Prototyping: Principles and Applications by Chua C.K, Leong K.F and Lim C.S, 2nd Edition, World Scientific
3. Rapid Manufacturing – An Industrial revolution for the digital age by N.Hopkinson, R.J. M. Hauge, P M, Dickens, Wiley
4. Advanced Manufacturing Technology for Medical applications: Reverse Engineering, Software conversion and Rapid Prototyping by Ian Gibson, Wiley
5. Rapid Prototyping and Manufacturing: Fundamentals of Stereolithography by Paul F.Jacobs, McGraw Hill
6. Rapid Manufacturing by Pham D T and Dimov S S, Springer Verlag

Course Code	Course Name	Credits
MEDLO8043	Renewable Energy Sources	4

Objectives:

1. To study working principles of various renewable energy sources and their utilities.
2. To study economics of harnessing energy from renewable energy sources

Outcomes: Learner will be able to...

1. Demonstrate need of different renewable energy sources
2. Discuss importance of renewable energy sources
3. Discuss various renewable energy sources in Indian context
4. Calculate and analyse utilization of solar and wind energy
5. Illustrate design of biogas plant
6. Demonstrate basics of hydrogen energy

Module	Detailed Contents	Hrs.
01	Introduction to Energy Sources: Renewable and non-renewable energy sources, Need for Renewable Energy Sources, Energy Consumption as a measure of Nation's development; Strategy for meeting the future energy requirements, Global and National scenarios, Prospects of renewable energy sources, Present status and current installations, Introduction to Hybrid Energy Systems.	07
02	Solar Energy: Merits and demerits, Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length, Methods of Solar Radiation estimation. Solar Energy collection devices and Classification: Flat plate collectors, concentrating collectors, Solar air heaters-types, solar driers, storage of solar energy-thermal storage, solar pond, solar water heaters, solar distillation, solar still, solar cooker, solar heating & cooling of buildings, Solar Photovoltaic systems & applications.	12
03	Wind Energy: Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of Aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations.	10
04	Energy from Biomass: Biomass conversion technologies, Biogas generation plants, classification, advantages and disadvantages, constructional details, site selection, digester design consideration, filling a digester for starting, maintaining biogas production, Fuel properties of bio gas, utilization of biogas.	06
05	Geothermal Energy: Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India. Energy from the ocean: Ocean Thermal Electric Conversion (OTEC) systems like open cycle, closed cycle, Hybrid cycle, prospects of OTEC in India. Energy from tides, basic principle of tidal power, single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy. Wave energy and power from wave, wave energy conversion devices, advantages and disadvantages of wave energy	08
06	Hydrogen Energy: Methods of Hydrogen production, Hydrogen Storage, Fuel Cells and Types of Fuel Cells.	05

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- 1 Question paper will comprise of total **six questions, each carrying 20 marks**
- 2 **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
- 3 **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
- 4 Only **Four questions need to be solved**

Reference Books:

- 1 Non-conventional energy sources by G.D. Rai, Khanna Publishers
- 2 Renewable Energy: Power for a Sustainable Future, Edited by Godfrey Boyle, 3rd Edition, Oxford University Press
- 3 Solar Energy: Principles of Thermal Collection and Storage by SP Sukhatme and J K Nayak, TMH
- 4 Solar Energy: Fundamentals and Applications by H.P. Garg & Jai Prakash, Tata McGraw Hill.
- 5 Wind Power Technology, Joshua Earnest, PHI Learning, 2014
- 6 Renewable Energy Sources, J W Twidell & Anthony D. Weir. ELBS Pub.
- 7 Energy Conversion Systems, R D Begamudre, New Age International (P) Ltd., Publishers, New Delhi, 2000.
- 8 Solar Photovoltaics: Fundamentals, Technologies and Applications, C S Solanki, 2nd Edition, PHI Learning
- 9 Biomass Regenerable Energy, D. D. Hall and R. P. Grover, John Wiley, New York
- 10 Wind and Solar Power Systems, Mukund R Patel, CRC Press
- 11 Wind Energy Explained: Theory, Design and Application, J F Manwell, J.C. McGowan, A.L. Rogers, John Wiley and Sons
- 12 Magneto Hydrodynamics by Kuliovsky and Lyubimov, Addison

Course Code	Course Name	Credits
MEDLO8044	Energy Management in Utility Systems	4

Objectives:

1. To familiarise principles of energy management and concept of energy management in utility systems
2. To study energy economics and auditing
3. To study electrical energy management, cogeneration and waste heat recovery.

Outcomes: Learner will be able to...

1. Demonstrate general aspects of energy management
2. Summarize and explain need for energy management, economics and auditing
3. Illustrate basics of energy economics and financial analysis techniques
4. Describe importance of thermal and electrical utilities' maintenance
5. Assess potential and summarise benefits of waste heat recovery and cogeneration
6. Illustrate waste heat recovery and cogeneration methods

Module	Detailed Contents	Hrs.
01	General Aspects of Energy Management: Introduction to utility systems (Types) Current energy scenario: India and World, Current energy consumption pattern in global and Indian industry, Principles of Energy management, Energy policy, Energy action planning, Energy security and reliability, Energy and environment, Need of Renewable and energy efficiency, Energy Conservation Act	08
02	Energy Auditing : Need of Energy Audit, Types of energy audit, Components of energy audit, Energy audit methodology, Instruments, equipment used in energy audit, Analysis and recommendations of energy audit - examples for different applications, Energy audit reporting, Energy audit software. Material & Energy Balance	08
03	Energy Economics: Costing of Utilities - Determination of cost of steam, natural gas, compressed air and electricity. Financial Analysis Techniques - Simple payback, Time value of money, Net Present Value (NPV), Return on Investment (ROI), Internal Rate of Return (IRR), Risk and Sensitivity analysis	09
04	Energy Efficiency in Thermal Utilities: Energy performance assessment and efficiency improvement of Boilers, Furnaces, Heat exchangers, Fans and blowers, pumps, Compressors and HVAC systems. Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system	08
05	Electrical Energy Management and Lighting: Distribution and transformer losses. Electrical motors - types, efficiency and selection. Speed control, Energy efficient motors. Electricity Act 2003. Lighting - Lamp types and their features, recommended illumination levels, lighting system energy efficiency.	07
06	Cogeneration and Waste Heat Recovery, Cogeneration- Need, applications, advantages, classification, the cogeneration design process. Waste heat recovery- Classification and application, Potential for waste-heat recovery in Industry, Commercial WHR devices, saving potential. CDM projects and carbon credit calculations	08

Assessment:

Internal Assessment for 20 marks:

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End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
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3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

References:

1. Energy engineering and management, Amlan Chakrabarti, PHI Learning, New Delhi 2012
2. Handbook of Energy Audit, Albert Thumann P.E. CEM, William J. Younger CEM, 7th Edition, The Fairmont Press Inc
3. Energy management Handbook, Wayne C. Turner, 5th Edition, The Fairmont Press Inc., Georgia.
4. Handbook on Energy Audit and Environment management, Abbi Y. A., Jain Shashank, TERI, New Delhi
5. Energy Performance assessment for equipment and Utility Systems Vol. 1 to 4, Bureau of Energy Efficiency, Govt. of India
6. General Aspects of Energy Management and Energy Audit, Bureau of Energy Efficiency, Govt of India
7. Boiler Operators Guide, 4th Edition, Anthony L Kohan, McGraw Hill
8. Energy Hand book, Robert L. Loftness, 2nd Edition, Von Nostrand Reinhold Company
9. Sustainable Energy Management, Mirjana Golusin, Sinisa Dodic, Stevan Popov, Academic Press
10. Energy Management, Trivedi P R, Jolka K R, Commonwealth Publications, New Delhi
11. www.enrgymanagertraining.com
12. www.bee-india.nic.in

Course Code	Course Name	Credits
ILO 8021	Project Management	03

Objectives:

1. To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Outcomes: Learner will be able to...

1. Apply selection criteria and select an appropriate project from different options.
2. Write work break down structure for a project and develop a schedule based on it.
3. Identify opportunities and threats to the project and decide an approach to deal with them strategically.
4. Use Earned value technique and determine & predict status of the project.
5. Capture lessons learned during project phases and document them for future reference

Module	Detailed Contents	Hrs
01	Project Management Foundation: Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager, Negotiations and resolving conflicts, Project management in various organization structures, PM knowledge areas as per Project Management Institute (PMI)	5
02	Initiating Projects: How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	6
03	Project Planning and Scheduling: Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart, Introduction to Project Management Information System (PMIS).	8
04	Planning Projects: Crashing project time, Resource loading and levelling, Goldratt's critical chain, Project Stakeholders and Communication plan Risk Management in projects: Risk management planning, Risk identification and risk register, Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	6
05	5.1 Executing Projects: Planning monitoring and controlling cycle, Information needs and reporting, engaging with all stakeholders of the projects, Team management, communication and project meetings 5.2 Monitoring and Controlling Projects: Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep, Project audit 5.3 Project Contracting Project procurement management, contracting and outsourcing,	8
06	6.1 Project Leadership and Ethics: Introduction to project leadership, ethics in projects, Multicultural and virtual projects 6.2 Closing the Project:	6

	Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	

Assessment:

Internal Assessment for 20 marks:

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End Semester Examination:

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3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

REFERENCES:

1. Project Management: A managerial approach, Jack Meredith & Samuel Mantel, 7th Edition, Wiley India
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Project Management, Gido Clements, Cengage Learning
4. Project Management, Gopalan, Wiley India
5. Project Management, Dennis Lock, 9th Edition, Gower Publishing England

Course Code	Course Name	Credits
ILO 8022	Finance Management	03

Objectives:

1. Overview of Indian financial system, instruments and market
2. Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
3. Knowledge about sources of finance, capital structure, dividend policy

Outcomes: Learner will be able to...

1. Understand Indian finance system and corporate finance
2. Take investment, finance as well as dividend decisions

Module	Detailed Contents	Hrs
01	Overview of Indian Financial System: Characteristics, Components and Functions of Financial System. Financial Instruments: Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. Financial Markets: Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market Financial Institutions: Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	06
02	Concepts of Returns and Risks: Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. Time Value of Money: Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	06
03	Overview of Corporate Finance: Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. Financial Ratio Analysis: Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	09
04	Capital Budgeting: Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) Working Capital Management: Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	10
05	Sources of Finance: Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance.	05

	Capital Structure: Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure	
06	Dividend Policy: Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches— Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	03

Assessment:

Internal Assessment for 20 marks:

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End Semester Examination:

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4. Only **Four questions need to be solved.**

REFERENCES:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Course Code	Course Name	Credits
ILO8023	Entrepreneurship Development and Management	03

Objectives:

1. To acquaint with entrepreneurship and management of business
2. Understand Indian environment for entrepreneurship
3. Idea of EDP, MSME

Outcomes: Learner will be able to...

1. Understand the concept of business plan and ownerships
2. Interpret key regulations and legal aspects of entrepreneurship in India
3. Understand government policies for entrepreneurs

Module	Detailed Contents	Hrs
01	Overview Of Entrepreneurship: Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	04
02	Business Plans And Importance Of Capital To Entrepreneurship: Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur Entrepreneurship And Business Development: Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	09
03	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	05
04	Indian Environment for Entrepreneurship: key regulations and legal aspects , MSME Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	08
05	Effective Management of Business: Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	08
06	Achieving Success In The Small Business: Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	05

Assessment:

Internal Assessment for 20 marks:

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End Semester Examination:

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4. Only **Four questions need to be solved.**

REFERENCES:

1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
6. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. Laghu Udyog Samachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

Course Code	Course Name	Credits
ILO8024	Human Resource Management	03

Objectives:

1. To introduce the students with basic concepts, techniques and practices of the human resource management
2. To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations
3. To familiarize the students about the latest developments, trends & different aspects of HRM
4. To acquaint the student with the importance of inter-personal & inter-group behavioural skills in an organizational setting required for future stable engineers, leaders and managers

Outcomes: Learner will be able to...

1. Understand the concepts, aspects, techniques and practices of the human resource management.
2. Understand the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.
3. Gain knowledge about the latest developments and trends in HRM.
4. Apply the knowledge of behavioural skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

Module	Detailed Contents	Hrs
01	Introduction to HR • Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions • Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues	5
02	Organizational Behaviour (OB) • Introduction to OB Origin, Nature and Scope of Organizational Behaviour, Relevance to Organizational Effectiveness and Contemporary issues • Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness • Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behaviour • Motivation: Theories of Motivation and their Applications for Behavioural Change (Maslow, Herzberg, McGregor); • Group Behaviour and Group Dynamics: Work groups formal and informal groups and stages of group development, Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. • Case study	7
03	Organizational Structure & Design • Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress. • Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership. • Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.	6
04	Human resource Planning	5

	- Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale - Performance Appraisal Systems: Traditional & modern methods, Performance Counselling, Career Planning - Training & Development: Identification of Training Needs, Training Methods	
05	Emerging Trends in HR - Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes & transformation in HR. Organizational Change, Culture, Environment - Cross Cultural Leadership and Decision Making: Cross Cultural Communication and diversity at work, Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation	6
06	HR & MIS: Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries) Strategic HRM: Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals Labor Laws & Industrial Relations: Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act	10

Assessment:

Internal Assessment for 20 marks:

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End Semester Examination:

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3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

REFERENCES:

1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15th edition, 2015
5. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

Course Code	Course Name	Credits
ILO8025	Professional Ethics and Corporate Social Responsibility (CSR)	03

Objectives:

1. To understand professional ethics in business
2. To recognized corporate social responsibility

Outcomes: Learner will be able to...

1. Understand rights and duties of business
2. Distinguish different aspects of corporate social responsibility
3. Demonstrate professional ethics
4. Understand legal aspects of corporate social responsibility

Module	Detailed Contents	Hrs
01	Professional Ethics and Business: The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	04
02	Professional Ethics in the Marketplace: Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy Professional Ethics and the Environment: Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	08
03	Professional Ethics of Consumer Protection: Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy Professional Ethics of Job Discrimination: Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	06
04	Introduction to Corporate Social Responsibility: Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	05
05	Corporate Social Responsibility: Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	08
06	Corporate Social Responsibility in Globalizing India: Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	08

Assessment:

Internal Assessment for 20 marks:

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End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
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4. Only **Four questions need to be solved.**

REFERENCES:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
4. Corporate Social Responsibility in India (2015) by Bidyut Chakrabarty, Routledge, New Delhi.

Course Code	Course Name	Credits
ILO8026	Research Methodology	03

Objectives:

1. To understand Research and Research Process
2. To acquaint students with identifying problems for research and develop research strategies
3. To familiarize students with the techniques of data collection, analysis of data and interpretation

Outcomes: Learner will be able to...

1. Prepare a preliminary research design for projects in their subject matter areas
2. Accurately collect, analyze and report data
3. Present complex data or situations clearly
4. Review and analyze research findings

Module	Detailed Contents	Hrs
01	Introduction and Basic Research Concepts 1.1 Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology 1.2 Need of Research in Business and Social Sciences 1.3 Objectives of Research 1.4 Issues and Problems in Research 1.5 Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	09
02	Types of Research 2.1. Basic Research 2.2. Applied Research 2.3. Descriptive Research 2.4. Analytical Research 2.5. Empirical Research 2.6 Qualitative and Quantitative Approaches	07
03	Research Design and Sample Design 3.1 Research Design – Meaning, Types and Significance 3.2 Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	07
04	Research Methodology 4.1 Meaning of Research Methodology 4.2. Stages in Scientific Research Process: a. Identification and Selection of Research Problem b. Formulation of Research Problem c. Review of Literature d. Formulation of Hypothesis e. Formulation of research Design f. Sample Design g. Data Collection h. Data Analysis i. Hypothesis testing and Interpretation of Data j. Preparation of Research Report	08
05	Formulating Research Problem 5.1 Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	04
06	Outcome of Research 6.1 Preparation of the report on conclusion reached	04

	6.2 Validity Testing & Ethical Issues 6.3 Suggestions and Recommendation	

Assessment:

Internal Assessment for 20 marks:

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End Semester Examination:

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4. Only **Four questions need to be solved.**

REFERENCES:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R., 1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nded), Singapore, Pearson Education

Course Code	Course Name	Credits
ILO8027	IPR and Patenting	03

Objectives:

1. To understand intellectual property rights protection system
2. To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
3. To get acquaintance with Patent search and patent filing procedure and applications

Outcomes: Learner will be able to...

1. understand Intellectual Property assets
2. assist individuals and organizations in capacity building
3. work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

Module	Detailed Contents	Hr
01	Introduction to Intellectual Property Rights (IPR): Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc. Importance of IPR in Modern Global Economic Environment: Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	05
02	Enforcement of Intellectual Property Rights: Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement Indian Scenario of IPR: Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	07
03	Emerging Issues in IPR: Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	05
04	Basics of Patents: Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	07
05	Patent Rules: Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	08
06	Procedure for Filing a Patent (National and International): Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication, Time frame and cost, Patent Licensing, Patent Infringement Patent databases: Important websites, Searching international databases	07

Assessment:

Internal Assessment for 20 marks:

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End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

REFERENCE BOOKS:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. Lous Harns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi, IPR: Drafting, Interpretation of Patent Specifications and Claims, New India Publishing Agency
14. Vivien Irish, 2005, Intellectual Property Rights for Engineers, IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

Course Code	Course Name	Credits
ILO 8028	Digital Business Management	03

Objectives:

1. To familiarize with digital business concept
2. To acquaint with E-commerce
3. To give insights into E-business and its strategies

Outcomes: The learner will be able to

1. Identify drivers of digital business
2. Illustrate various approaches and techniques for E-business and management
3. Prepare E-business plan

Module	Detailed content	Hours
1	Introduction to Digital Business- Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy, Drivers of digital business- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) Opportunities and Challenges in Digital Business,	09
2	Overview of E-Commerce E-Commerce- Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	06
3	Digital Business Support services: ERP as e –business backbone, knowledge Tope Apps, Information and referral system Application Development: Building Digital business Applications and Infrastructure	06
4	Managing E-Business- Managing Knowledge, Management skills for e-business, Managing Risks in e –business Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	06
5	E-Business Strategy- E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	04
6	Materializing e-business: From Idea to Realization- Business plan preparation Case Studies and presentations	08

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

References:

1. A textbook on E-commerce, Er Arunrajan Mishra, Dr W K Sarwade, Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, Vinocenzo Morabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective- DoI:10.1787/9789264221796-en OECD Publishing

Course Code	Course Name	Credits
ILO8029	Environmental Management	03

Objectives:

1. Understand and identify environmental issues relevant to India and global concerns
2. Learn concepts of ecology
3. Familiarise environment related legislations

Outcomes: Learner will be able to...

1. Understand the concept of environmental management
2. Understand ecosystem and interdependence, food chain etc.
3. Understand and interpret environment related legislations

Module	Detailed Contents	Hrs
01	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities, Environmental issues relevant to India, Sustainable Development, the Energy scenario	10
02	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	06
03	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	05
04	Scope of Environment Management, Role and functions of Government as a planning and regulating agency Environment Quality Management and Corporate Environmental Responsibility	10
05	Total Quality Environmental Management, ISO-14000, EMS certification.	05
06	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	03

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

REFERENCES:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management, **T V Ramachandra and Vijay Kulkarni, TERI Press**
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Macmillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing, 2015

Course Code	Course Name	Credits
MEL801	Design of Mechanical Systems	1

Objectives:

1. To familiarise with the concept of system and methodology of system design
2. To study system design of various systems such as snatch block, belt conveyors, engine system, pumps and machine tool gearbox
3. To familiarise with the standard codes of professional practices in designing the various systems

Outcomes: Learner will be able to...

1. Apply the concept of system design.
2. Design of hoisting mechanism of EOT crane,
3. Design belt conveyor systems
4. Design pumps for the given applications
5. Design engine components such as cylinder, piston, connecting rod and crankshaft
6. Design of machine tool gearbox

Term Work:Comprises a& b

a) Term work - Shall consist of

1. Design and detailed assembly drawing (computer aided drawing on **A3 size sheets**) of minimum two design problems, from the following:
 - i) Design of hoisting mechanisms
 - ii) Design of belt conveyors
 - iii) Design of pumps
2. **Course Project:**Students in a group of two to four should be able to apply and integrate the knowledge gained during the course. Design and preparation of working drawings of any system having minimum 5 to 6 components is expected.

b) **Assignment:** Exercises on following topics in the form of design calculations with sketches and / or drawings.

1. Engine design
2. Design of gearbox

The distribution of marks for term work shall be as follows:

- Exercises and Drawing sheets : 10 marks.
- Assignments : 05 marks
- Course Project : 05 marks.
- Attendance : 05 Marks.

Assessment:

End Semester Practical/Oral examination:

1. Each student will be given a small task of design based on syllabus, which will be assessed by pair of examiners during the oral examination.
2. Distribution of marks for practical-oral examination shall be as follows:

Design Task:	15 marks
Oral:	10 marks
3. Evaluation of practical/oral examination to be done based on the performance of design task
4. Students work along with evaluation report to be preserved till the next examination

Subject Code	Subject Name	Credits
MEL 802	Power Engineering	01

Objectives

1. To familiarise with boilers, boiler mountings and accessories using models/cut sections
2. To familiarise with hydraulic energy conversion devices

Outcomes: Learner will be able to...

1. Differentiate boilers
2. Differentiate boiler mountings and accessories
3. Conduct a trial on impulse turbine and analyse its performance
4. Conduct a trial on reaction turbine and analyse its performance
5. Conduct a trial on Centrifugal pump and analyse its performance
6. Conduct a trial on Reciprocating pump and analyse its performance

List of Experiments

1. Demonstration of Boilers
2. Demonstration of Boiler mountings and accessories
3. Trial on Impulse turbine
5. Trial on Reaction turbine
6. Trial on centrifugal pump (Single stage/Multistage)
7. Trial on reciprocating pump
8. Visit to Thermal Power Plant/Hydroelectric Power Plant/Gas Turbine Power Plant

Assessment:

Term Work

Term work shall consist of all the experiments from the list, 3 assignments containing numerical based on maximum contents of the syllabus and a visit report

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments): **10 marks**

Assignments: **05 marks**

Visit report: **05 Marks**

Attendance: **05 marks**

End Semester Practical/Oral Examination:

1. Students in a group (4 to 6) have to perform trial either on Impulse turbine, Reaction turbine, Centrifugal Pump or Reciprocating Pump and the same will be assessed by pair of examiners during the oral examination.
2. Distribution of marks for practical-oral examination shall be as follows:

Trial:	15 marks
Oral:	10 marks
3. Evaluation of practical/oral examination to be done based on the performance
4. Students work along with evaluation report to be preserved till the next examination

Course Code	Course Name	Credits
MEP701/ MEP801	Project (I and II)	03 + 06

Objectives:

1. To acquaint with the process of undertaking literature survey/industrial visit and identifying the problem
2. To familiarize the process of problem solving in a group
3. To acquaint with the process of applying basic engineering fundamental in the domain of practical applications
4. To inculcate the process of research

Outcomes: Learner will be able to...

1. Do literature survey/industrial visit and identify the problem
2. Apply basic engineering fundamental in the domain of practical applications
3. Cultivate the habit of working in a team
4. Attempt a problem solution in a right approach
5. Correlate the theoretical and experimental/simulations results and draw the proper inferences
6. Prepare report as per the standard guidelines.

Guidelines for Project

Students should do literature survey/visit industry/analyse current trends and identify the problem for Project and finalize in consultation with Guide/Supervisor

Students should use multiple literatures and understand the problem.

Students should attempt solution to the problem by experimental/simulation methods.

The solution to be validated with proper justification and report to be compiled in standard format.

Guidelines for Assessment of Project I

Project I should be assessed based on following points

1. Quality of problem selected
2. Clarity of Problem definition and Feasibility of problem solution
3. Relevance to the specialization
4. Clarity of objective and scope
5. Breadth and depth of literature survey

Project I should be assessed through a presentation by the student project group to a panel of Internal examiners appointed by the Head of the Department/Institute of respective Programme.

Guidelines for Assessment of Project II

Project II should be assessed based on following points

1. Quality of problem selected
2. Clarity of Problem definition and Feasibility of problem solution
3. Relevance to the specialization / Industrial trends
4. Clarity of objective and scope
5. Quality of work attempted
6. Validation of results
7. Quality of Written and Oral Presentation

Project Report has to be prepared strictly as per University of Mumbai report writing guidelines.

Project II should be assessed through a presentation by the student project group to a panel of Internal and External Examiner approved by the University of Mumbai

Students should be motivated to publish a paper in Conferences/students competitions based on the work

AC – 11.05.2017

Item No. 4.193

UNIVERSITY OF MUMBAI



Revised syllabus (Rev- 2016) from Academic Year 2016 -17

Under

FACULTY OF TECHNOLOGY

Computer Engineering

Second Year with Effect from **AY 2017-18**

Third Year with Effect from **AY 2018-19**

Final Year with Effect from **AY 2019-20**

As per **Choice Based Credit and Grading System**

with effect from the AY 2016–17

Co-ordinator, Faculty of Technology's Preamble:

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's). It is also resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Choice based Credit and Grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

Choice based Credit and grading system is implemented from the academic year 2016-17 through optional courses at department and institute level. This will be effective for SE, TE and BE from academic year 2017-18, 2018-19 and 2019-20 respectively.

Dr. S. K. Ukarande

Co-ordinator,

Faculty of Technology,

Member - Academic Council

University of Mumbai, Mumbai

Chairman's Preamble:

Engineering education in India is expanding and is set to increase manifold. The major challenge in the current scenario is to ensure quality to the stakeholders along with expansion. To meet this challenge, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education and reflects the fact that in achieving recognition, the institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of graduation from the program. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating the philosophy of outcome based education in the process of curriculum development.

As the Chairman, Board of Studies in Computer Engineering of the University of Mumbai, I am happy to state here that, the Program Educational Objectives for Undergraduate Program were finalized in a brainstorming session, which was attended by more than 85 members from different affiliated Institutes of the University. They are either Heads of Departments or their senior representatives from the Department of Computer Engineering. The Program Educational Objectives finalized for the undergraduate program in Computer Engineering are listed below;

1. To prepare the Learner with a sound foundation in the mathematical, scientific and engineering fundamentals.
2. To motivate the Learner in the art of self-learning and to use modern tools for solving real life problems.
3. To equip the Learner with broad education necessary to understand the impact of Computer Science and Engineering in a global and social context.
4. To encourage, motivate and prepare the Learner's for Lifelong- learning.
5. To inculcate professional and ethical attitude, good leadership qualities and commitment to social responsibilities in the Learner's thought process.

In addition to Program Educational Objectives, for each course of the program, objectives and expected outcomes from a learner's point of view are also included in the curriculum to support the philosophy of outcome based education. I strongly believe that even a small step taken in the right direction will definitely help in providing quality education to the major stakeholders.

Dr. Subhash K. Shinde

**Chairman, Board of Studies in Computer Engineering,
University of Mumbai, Mumbai.**

Program Structure B.E. Computer Engineering, (Rev. 2016) w.e.f. AY 2017-18

S. E. Computer Engineering (Semester-III)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
CSC301	Applied Mathematics -III	4+1@	-	-	5	-	-	5
CSC302	Digital Logic Design and Analysis	4	-	-	4	-	-	4
CSC303	Discrete Mathematics	3+1@	-	-	4	-	-	4
CSC304	Electronic Circuits and Communication Fundamentals	4	-	-	4	-	-	4
CSC305	Data Structures	4	-	-	4	-	-	4
CSL301	Digital System Lab	-	2	-	-	1	-	1
CSL302	Basic Electronics Lab	-	2	-	-	1	-	1
CSL303	Data structure Lab	-	2	-	-	1	-	1
CSL304	OOPM(Java) Lab	-	2+2*	-	-	2	-	2
	Total	21	10	-	21	5	-	26

@ 1 hour to be taken tutorial as class wise.

*2 hours shown as practical's to be taken class wise and other 2 hours to be taken as batch wise

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)				
		Test 1	Test 2	Avg.						
CSC301	Applied Mathematics -III	20	20	20	80	3	-	-	-	100
CSC302	Digital Logic Design and Analysis	20	20	20	80	3	-	-	-	100
CSC303	Discrete Structures	20	20	20	80	3	-	-	-	100
CSC304	Electronic Circuits and Communication Fundamentals	20	20	20	80	3	-	-	-	100
CSC305	Data Structures	20	20	20	80	3	--	-	-	100
CSL301	Digital System Lab	-	-	-	-	-	25	--	25	50
CSL302	Basic Electronics Lab	-	-	-	-	-	25	25	---	50
CSL303	Data structure Lab	-	-	-	-	-	25	-	25	50
CSL304	OOPM(Java) Lab	-	-	-	-	-	50	--	50	100
Total		100	100	100	400	-	125	25	100	750

Program Structure B.E. Computer Engineering, (Rev. 2016) w.e.f. AY 2017-18

S. E. Computer Engineering (Semester-IV)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
CSC401	Applied Mathematics- IV	4+1@	-	-	5	-	-	5
CSC402	Analysis of Algorithms	4	-	-	4	-	-	4
CSC403	Computer Organization and Architecture	4	-	-	4	-	-	4
CSC404	Computer Graphics	4	-	-	4	-	-	4
CSC405	Operating System	4	-	-	4	-	-	4
CSL401	Analysis of Algorithms Lab	-	2	-	-	1	-	1
CSL402	Computer Graphics Lab	-	2	-	-	1	-	1
CSL403	Processor Architecture Lab	-	2	-	-	1	-	1
CSL404	Operating System Lab	-	2	-	-	1	-	1
CSL405	Open Source Tech Lab	-	2+2*	-	-	2	-	2
Total		21	12	-	21	6	-	27

@ 1 hour to be taken tutorial as class wise .

*2 hours shown as Practical's to be taken class wise and other 2 hours to be taken as batch wise

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)				
		Test 1	Test 2	Avg.						
CSC401	Applied Mathematics- IV	20	20	20	80	3	-	-	-	100
CSC402	Analysis of Algorithms	20	20	20	80	3	-	-	-	100
CSC403	Computer Organization and Architecture	20	20	20	80	3	-	-	-	100
CSC404	Computer Graphics	20	20	20	80	3	-	-	-	100
CSC405	Operating System	20	20	20	80	3	--	-	-	100
CSL401	Analysis of Algorithms Lab	-	-	-	-	-	25	--	25	50
CSL402	Computer Graphics Lab	-	-	-	-	-	25	--	25	50
CSL403	Processor Architecture Lab	-	-	-	-	-	25	25	-	50
CSL404	Operating System Lab	-	-	-	-	-	25	-	25	50
CSL405	Open Source Tech Lab	-	-	-	-	-	25	---	25	50
Total		100	100	100	400	-	125	25	100	750

Program Structure B.E. Computer Engineering, (Rev. 2016) w.e.f. AY 2018-19

T. E. Computer Engineering (Semester-V)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
CSC501	Microprocessor	4	-	-	4	-	-	4
CSC502	Database Management System	4	-	-	4	-	-	4
CSC503	Computer Network	4	-	-	4	-	-	4
CSC504	Theory of Computer Science	3+1@	-	-	4	-	-	4
CSDLO 501X	Department Level Optional Course -I	4	-	-	4	-	-	4
CSL501	Microprocessor Lab	-	2	-	-	1	-	1
CSL502	Computer Network Lab	-	2	-	-	1	-	1
CSL503	Database & Info. System Lab	-	2	-	-	1	-	1
CSL504	Web Design Lab	-	2+2*	-	-	2	-	2
CSL505	Business Comm. & Ethics	-	2+2*	-	-	2	-	2
Total		20	14	-	20	7	-	27

@ 1 hour to be taken tutorial as class wise.

*2 hours shown as Practical's to be taken class wise and other 2 hours to be taken as batch wise

Course Code	Course Name	Examination Scheme							
		Theory					TW	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Avg.					
CSC501	Microprocessor	20	20	20	80	3	-	-	100
CSC502	Database Management System	20	20	20	80	3	-	-	100
CSC503	Computer Network	20	20	20	80	3	-	-	100
CSC504	Theory of Computer Science	20	20	20	80	3	-	-	100
CSDLO 501X	Department Level Optional Course -I	20	20	20	80	3	--	-	100
CSL501	Microprocessor Lab	-	-	-	-	-	25	25	50
CSL502	Computer Network Lab	-	-	-	-	-	25	25	50
CSL503	Database & Info. System Lab	-	-	-	-	-	25	25	50
CSL504	Web Design Lab	-	-	-	-	-	25	25	50
CSL505	Business Comm. & Ethics	-	-	-	-	-	50	-	50
Total		100	100	100	400	-	150	100	750

Program Structure B.E. Computer Engineering, (Rev. 2016) w.e.f. AY 2018-19

T. E. Computer Engineering (Semester-VI)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
CSC601	Software Engineering	4	-	-	4	-	-	4
CSC602	System Programming & Compiler Construction	4	-	-	4	-	-	4
CSC603	Data Warehousing & Mining	4	-	-	4	-	-	4
CSC604	Cryptography & System Security	4	-	-	4	-	-	4
CSDLO 601X	Department Level Optional Course -II	4	-	-	4	-	-	4
CSL601	Software Engineering Lab	-	2	-	-	1	-	1
CSL602	System software Lab	-	2	-	-	1	-	1
CSL603	Data Warehousing & Mining Lab	-	2	-	-	1	-	1
CSL604	System Security Lab	-	2	-	-	1	-	1
CSP605	Mini-Project	-	4	-	-	2	-	2
	Total	20	12	-	20	6	-	26

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)				
		Test 1	Test 2	Avg.						
CSC601	Software Engineering	20	20	20	80	3	-	-	-	100
CSC602	System Programming & Compiler Construction	20	20	20	80	3	-	-	-	100
CSC603	Data Warehousing & Mining	20	20	20	80	3	-	-	-	100
CSC604	Cryptography & System Security	20	20	20	80	3	-	-	-	100
CSDLO 601X	Department Level Optional Course -II	20	20	20	80	3	-	-	-	100
CSL601	Software Engineering Lab	-	-	-	-	-	25	25	--	50
CSL602	System Software Lab	-	-	-	-	-	25	--	25	50
CSL603	Data Warehousing & Mining Lab	-	-	-	-	-	25	--	25	50
CSL604	System Security Lab	-	-	-	-	-	25	---	25	50
CSP605	Mini-Project	-	-	-	-	-	25	---	25	50
Total		100	100	100	400	-	150	25	100	750

Program Structure B.E. Computer Engineering, (Rev. 2016) w.e.f. AY 2019-20
B. E. Computer Engineering (Semester-VII)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
CSC701	Digital Signal & Image Processing	4	-	-	4	-	-	4
CSC702	Mobile Communication & Computing	4	-	-	4	-	-	4
CSC703	Artificial Intelligence & Soft Computing	4	-	-	4	-	-	4
CSDLO 701X	Department Level Optional Course -III	4	-	-	4	-	-	4
ILO701X	Institute Level Optional Course-I	3	-	-	3	-	-	3
CSL701	Digital Signal & Image Processing Lab	-	2	-	-	1	-	1
CSL702	Mobile App. Development. Tech. Lab	-	2	-	-	1	-	1
CSL703	Artificial Intelligence & Soft Computing Lab	-	2	-	-	1	-	1
CSL704	Computational Lab-I	-	2	-	-	1	-	1
CSP705	Major Project-I	-	6	-	-	3	-	3
	Total	19	14	-	19	7	-	26

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)				
		Test 1	Test 2	Avg.						
CSC701	Digital Signal & Image Processing	20	20	20	80	3	-	--	-	100
CSC702	Mobile Communication & Computing	20	20	20	80	3	-	--	-	100
CSC703	Artificial Intelligence & Soft Computing	20	20	20	80	3	-	--	-	100
CSDLO 701X	Department Level Optional Course -III	20	20	20	80	3	-	--	-	100
ILO701X	Institute Level Optional Course-I	20	20	20	80	3	--	--	-	100
CSL701	Digital Signal & Image Processing Lab	-	-	-	-	-	25	--	--	25
CSL702	Mobile App. Development. Tech. Lab	-	-	-	-	-	25	--	25	50
CSL703	Artificial Intelligence & Soft Computing Lab	--	-	-	-	--	25	25	--	50
CSL704	Computational Lab-I						25	--	25	50
CSP705	Major Project-I	-	-	-	-	-	50	-	25	75
Total		100	100	100	400		150	25	75	750

Program Structure B.E. Computer Engineering, (Rev. 2016) w.e.f. AY 2019-20

B. E. Computer Engineering (Semester-VIII)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
CSC801	Human Machine Interaction	4	-	-	4	-	-	4
CSC802	Distributed Computing	4	-	-	4	-	-	4
CSDLO 801X	Department Level Optional Course -IV	4	-	-	4	-	-	4
ILO801X	Institute Level Optional Course-II	3	-	-	3	-	-	3
CSL801	Human Machine Interaction Lab	-	2	-	-	1		1
CSL802	Distributed Computing Lab		2			1		1
CSL803	Cloud Computing Lab	-	4	-	-	2		2
CSL804	Computational Lab-II	-	2	-		1		1
CSP805	Major Project-II	-	12			6	-	6
	Total	15	22	-	15	11	-	26

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in				
		Test 1	Test 2	Avg.						
CSC801	Human Machine Interaction	20	20	20	80	3	-	-	-	100
CSC802	Distributed Computing	20	20	20	80	3	-	-	-	100
CSDLO 801X	Department Level Optional Course -IV	20	20	20	80	3	-	-	-	100
ILO801X	Institute Level Optional Course-II	20	20	20	80	3	-	-	-	100
CSC801	Human Machine Interaction Lab						25	25	-	50
CSL802	Distributed Computing Lab	-	-	-	-	-	25	25		50
CSL803	Cloud Computing Lab	-	-	-	-	-	50	--	25	75
CSL804	Computational Lab-II	-	-	-	-	-	50	--	25	75
CSP805	Major Project-II						50		50	100
Total		100	100	100	400	--	150		100	750

Sem.	Department Level Optional Course (DLOC)	Institute Level Optional Course (ILOC)
V	CSDLO5011: Multimedia System CSDLO5012: Advance Operating System CSDLO5013: Advance Algorithm	-----
VI	CSDLO6021: Machine Learning CSDLO6022: Advance Database System CSDLO6023: Enterprise Resource Planning CSDLO6024: Advance Computer Network	-----
VII	CSDLO7031: Advance System Security & Digital Forensics CSDLO7032: Big Data & Analytics CSDLO7033: Robotics	ILO7011. Product Lifecycle Management ILO7012. Reliability Engineering ILO7013. Management Information System ILO7014. Design of Experiments ILO7015. Operation Research ILO7016. Cyber Security and Laws ILO7017. Disaster Management & Mitigation Measures ILO7018. Energy Audit and Management ILO7019. Development Engineering
VIII	DLO8011: High Performance Computing DLO8012: Natural Language Processing DLO8013: Adhoc Wireless Network	ILO8021. Project Management ILO8022. Finance Management ILO8023. Entrepreneurship Development and Management ILO8024. Human Resource Management ILO8025. Professional Ethics and CSR ILO8026. Research Methodology ILO8027. IPR and Patenting ILO8028. Digital Business Management ILO8029. Environmental Management

Course Code	Course Name	Credits
CSC301	Applied Mathematics-III	5

Course objectives:

1. To understand the concept of complex variables, C-R equations, harmonic functions and its conjugate and mapping in complex plane.
2. To learn the complex mapping, standard mappings, cross ratios and fixed point.
3. To learn the Laplace Transform, Inverse Laplace Transform of various functions, its application and Z-transform.
4. To understand the concept of Fourier Series, its complex form and enhance the problem solving skill.

Course outcomes: On successful completion of course learner will be able to:

1. Understand complex variable theory, application of harmonic conjugate to get orthogonal trajectories and analytic function.
2. Plot the image of the curve by a complex transformation from z-plane to w-plane.
3. Expand the periodic function by using Fourier series and complex form of Fourier series.
4. Understand the concept of Laplace transform and inverse Laplace transform of various functions and its application to solve ordinary differential equations.
5. Apply the concept of Z- transformation and its inverse of the given sequence.
6. Apply the concept of Correlation and Regression to the engineering problems.

Module No.	Unit No.	Topics	Hrs.
1.0		Laplace Transform	09
	1.1	Laplace Transform of Standard Functions: Introduction, Definition of Laplace transform, Laplace transform of $1, e^{at} \sin(at), \cos(at), \sinh(at), \cosh(at), t^n \operatorname{erf}(t)$, Heavi-side unit step, dirac-delta function, LT of periodic function.	
	1.2	Properties of Laplace Transform: Linearity, first shifting property, second shifting property, multiplication by t^n , division by t , Laplace Transform of derivatives and integrals, change of scale property. (without proof)	
2.0		Inverse Laplace Transform	08
	2.1	Inverse Laplace Transform by Partial fraction method, Convolution theorem	
	2.2	Application to solve initial and boundary value problem involving	

		ordinary differential equations with one dependent variable and constant coefficients.	
3.0		Fourier Series	10
	3.1	Dirichlet's conditions, Fourier series of periodic functions with period 2π and $2L$, Fourier series for even and odd functions.	
	3.2	Half range sine and cosine Fourier series, Parseval's identities (without proof)	
	3.3	Complex form of Fourier series, Orthogonal and Orthonormal set of functions.	
4.0		Complex Variable & mapping	09
	4.1	Functions of a complex variable, Analytic functions, Cauchy-Riemann equations in Cartesian co-ordinates & Polar co-ordinates.	
	4.2	Harmonic functions, Analytic method and Milne Thomson methods to find $f(z)$, Orthogonal trajectories.	
	4.3	Mapping: Conformal mapping, bilinear transformations, cross ratio, fixed points, bilinear transformation of straight lines and circles.	
5.0		Z-transform	06
	5.1	Z-transform of standard functions such as $Z(a^n)$, $Z(n^p)$.	
	5.2	Properties of Z-transform :Linearity, Change of scale, Shifting property, Multiplication of K, Initial and final value, Convolution theorem (without proof)	
	5.3	Inverse Z transform: Binomial Expansion and Method of Partial fraction	
6.0		Correlation & regression, Curve Fitting	10
	6.1	Scattered diagrams, Karl Pearson's coefficient of correlation, covariance, Spearman's Rank correlation(non-repeated and repeated ranks)	
	6.2	Regression coefficient & Lines of Regression.	
	6.3	Fitting of curves: Least square method. Fitting of the straight line $y = a + bx$, parabolic curve $y = a + bx + cx^2$, & exponential curve $y = ab^x$	
		Total	52

Text Books:

1. Higher Engineering Mathematics by Grewal B. S. 38th edition, Khanna Publication 2005.
2. Advanced Engineering Mathematics by Kreyszig E. 9th edition, John Wiley.
3. A Text Book of Applied Mathematics Vol. I & II by P.N.Wartilar &
4. J.N.Wartikar, Pune, Vidyarthi Griha Prakashan., Pune.

Reference Books:

1. Advanced Engg. Mathematics by C. Ray Wylie & Louis Barrett.TMH International Edition.
2. Mathematical Methods of Science and Engineering by Kanti B. Datta, Cengage Learning.
3. Integral Transforms and their Engineering Applications by Dr. B. B. Singh, Synergy Knowledgewar.
4. Laplace Transforms by Murry R. Spieget, Schaun's out line series-McGraw Hill Publication.

Assessment:**Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

- 1 Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Credits
CSC302	Digital Logic Design and Analysis	4

Course Objectives:

1. To introduce the fundamental concepts and methods for design of digital circuits and a pre-requisite for computer organization and architecture, microprocessor systems.
2. To provide the concept of designing Combinational and sequential circuits.
3. To provide basic knowledge of how digital building blocks are described in VHDL.

Course Outcomes: At the end of the course student should be able-

1. To understand different number systems and their conversions.
2. To analyze and minimize Boolean expressions.
3. To design and analyze combinational circuits.
4. To design and analyze sequential circuits
5. To understand the basic concepts of VHDL.
6. To study basics of TTL and CMOS Logic families.

Module	Detailed Content	Hours
1	Number Systems and Codes Introduction to number system and conversions: Binary, Octal, Decimal and Hexadecimal number Systems, Binary arithmetic: addition, subtraction (1's and 2's complement), multiplication and division. Octal and Hexadecimal arithmetic: Addition and Subtraction (7's and 8's complement method for octal) and (15's and 16's complement method for Hexadecimal). Codes: Gray Code, BCD Code, Excess-3 code, ASCII Code. Error Detection and Correction: Hamming codes.	8
2	Boolean Algebra and Logic Gates: Theorems and Properties of Boolean Algebra, Boolean functions, Boolean function reduction using Boolean laws, Canonical forms, Standard SOP and POS form. Basic Digital gates: NOT , AND , OR , NAND , NOR , EXOR , EX-NOR, positive and negative logic, K-map method 2 variable, 3 variable, 4 variable, Don't care condition, Quine-McClusky Method, NAND-NOR Realization.	8
3	Combinational Logic Design: Introduction, Half and Full Adder, Half subtractor Full Subtractor, Four Bit Ripple adder, look ahead carry adder, 4 bit adder subtractor, one digit BCD Adder, Multiplexer, Multiplexer tree, Demultiplexer, Demultiplexer tree, Encoders Priority encoder, Decoders, One bit, Two bit , 4-bit Magnitude Comparator, ALU IC 74181.	8

4	Sequential Logic Design: Introduction: SR latch, Concepts of Flip Flops: SR, D, J-K, T, Truth Tables and Excitation Tables of all types, Race around condition, Master Slave J-K Flip Flops, Timing Diagram, Flip-flop conversion, State machines, state diagrams, State table, concept of Moore and Mealy machine. Counters : Design of Asynchronous and Synchronous Counters, Modulus of the Counters, UP- DOWN counter, Shift Registers: SISO, SIPO, PIPO, PISO Bidirectional Shift Register, Universal Shift Register, Ring and twisted ring/Johnson Counter, sequence generator.	15
5	Introduction to VHDL: Introduction: Fundamental building blocks Library, Entity, Architecture, Modeling Styles, Concurrent and sequential statements, simple design examples for combinational circuits and sequential circuits.	6
6	Digital Logic Families: Introduction: Terminologies like Propagation Delay, Power Consumption, Fan in and Fan out , current and voltage parameters, noise margin, with respect to TTL and CMOS Logic and their comparison	3

Text Books:

1. R. P. Jain, "Modern Digital Electronics", Tata McGraw Hill.
2. M. Morris Mano, "Digital Logic and computer Design", PHI.
3. Norman Balabanian, "Digital Logic Design Principles", Wiley.
4. J. Bhasker. "VHDL Primer", Pearson Education.

Reference Books:

1. Donald p Leach, Albert Paul Malvino, "Digital principles and Applications", Tata McGraw
2. Yarbrough John M. , "Digital Logic Applications and Design ", Cengage Learning.
3. Douglas L. Perry, "VHDL Programming by Example", Tata McGraw Hill.

Internal Assessment: Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Credits
CSC303	Discrete Mathematics	4

Course Objectives:

1. Cultivate clear thinking and creative problem solving.
2. Thoroughly train in the construction and understanding of mathematical proofs. Exercise common mathematical arguments and proof strategies.
3. Thoroughly prepare for the mathematical aspects of other Computer Engineering courses

Course Outcomes: At the end of the course student will be able to

1. Understand the notion of mathematical thinking, mathematical proofs and to apply them in problem solving.
2. Ability to reason logically.
3. Ability to understand relations, Diagraph and lattice..
4. Ability to understand use of functions, graphs and their use in programming applications.
5. Understand use of groups and codes in Encoding-Decoding
6. Apply discrete structures into other computing problems such as formal specification, verification, artificial intelligence, cryptography, Data Analysis and Data Mining etc.

Prerequisite: Basic Mathematics

Sr. No.	Module	Detailed Content	Hours
1	Set Theory	• Sets, Venn diagrams, Operations on Sets • Laws of set theory, Power set and Products • Partitions of sets, The Principle of Inclusion and Exclusion	4
2	Logic	• Propositions and logical operations, Truth tables • Equivalence, Implications • Laws of logic, Normal Forms • Predicates and Quantifiers • Mathematical Induction	8
3	Relations and Functions	• Relations, Paths and Digraphs • Properties and types of binary relations • Operations on relations, Closures, Warshall's algorithm • Equivalence and partial ordered relations, • Poset, Hasse diagram and Lattice • Functions: Types of functions - Injective, Surjective and Bijective	12

		• Composition of functions , Identity and Inverse function • Pigeon-hole principle	
4	Counting	• Permutations , Combinations • Elements of Probability, Discrete Probability and Conditional Probability • Generating Functions and Recurrence Relations • Recursive Functions • Introduction to Functional Programming	6
5	Graphs	• Definitions, Paths and circuits: Eulerian and Hamiltonian • Types of graphs, Sub Graphs • Isomorphism of graphs	6
6	Algebraic Structures and Coding Theory	• Algebraic structures with one binary operation: semigroup, monoid and group, Abelian group • Isomorphism, Homomorphism and Automorphism • Cyclic groups, Normal subgroups, • Codes and group codes	8

Text Books:

1. BernadKolman, Robert Busby, Sharon Cutler Ross, Nadeem-ur-Rehman, “Discrete Mathematical Structures”, Pearson Education.
2. C.L.Liu, Elements of Discrete Mathematics, second edition 1985, McGraw-Hill BookCompany. Reprinted 2000.
3. K.H.Rosen, Discrete Mathematics and applications, fifth edition 2003, TataMcGraw Hill publishing Company.
4. D.E. Rydeheard University of Manchester , R.M. Burstall, University of Edinburgh “Computational Category Theory”.

Reference Books:

1. Y N Singh, “Discrete Mathematical Structures”, Wiley-India.
2. J .L.Mott, A.Kandel, T.P .Baker, Discrete Mathematics for Computer Scientists and Mathematicians, second edition 1986, Prentice Hall of India.
3. J. P. Trembley, R. Manohar “Discrete Mathematical Structures with Applications to Computer Science”, TataMcgraw-Hill.
4. Seymour Lipschutz , Marc Lars Lipson,“ Discrete Mathematics” Schaum’sOutline, McGraw Hill Education.

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

**** Tutorial lecture can be conducted for each unit and min 10 problems on the covered unit can be given to the students for practice.**

Course Code	Course Name	Credits
CSC304	Electronic Circuits and Communication Fundamentals	4

Course Objectives:

1. To develop the knowledge of semiconductor devices and circuits, and explain their use in communication applications.
2. To inculcate circuit analysis capabilities in students.
3. To gain knowledge in electronic devices and circuits that is useful in real life applications.
4. To understand the fundamental concepts of electronic communication and their use in computer applications.

Course Outcomes: At the end of the course student should be able

1. To understand the use of semiconductor devices in circuits and analyze them.
2. To understand importance of oscillators and power amplifiers in communication system.
3. To understand basic concepts of operational amplifier and their applications.
4. To understand the fundamental concepts of electronic communication
5. To apply knowledge of electronic devices and circuits to communication applications.
6. To study basic concepts of information theory.

Prerequisite: Basic electrical engineering

Module	Detailed Content	Hours
1	Electronic Circuits: Bipolar junction transistor. Input and Output characteristics, Types of Biasing - Fixed bias, self-bias, voltage divider bias, DC load line and significance, CE amplifier using re model, (Analysis based Numericals)	08
2	Power Amplifiers: Introduction, Class A and Class C power amplifier. Oscillators: Introduction, Barkhausen criteria, Colpitts oscillator and Crystal oscillator	04
3	Electronic Circuits : Operational Amplifier and its applications Op-amp – block diagram, parameters and characteristics, applications- Inverting and Non inverting amplifier, Summing Amplifier(Numerical), Difference amplifier, Basic Integrator and Differentiator, Comparator, Zero Crossing Detector (only theory)	10

4	Communication Fundamentals: Analog Communication Block diagram and elements of analog communication systems, Theory of amplitude modulation and types of AM (Numerical) Generation of DSB SC using diode based balanced modulator, Generation of SSB using phase shift method, Introduction of FM, and its mathematical representation, Statement of Carson's Rule Comparison of AM, FM, Block diagram of AM transmitter (HLM and LLM) Block diagram of AM Superheterodyne receiver.	10
5	Pulse Modulation and Multiplexing. Statement of Sampling Theorem, Generation and detection of PAM, PWM, PPM, PCM, DM and ADM. Principle of TDM using PCM and FDM	10
6	Communication Fundamentals: Information theory. Amount of information, average information, information rate, Statement of Shannon's theorem, channel capacity (Numericals)	06

Text Books:

1. Robert Boylestad, 'Electronic Devices and circuit Theory', Prentice Hall.
2. D Roy Choudhury, 'Linear integrated Circuits' New Age International Ltd
3. G. Kennedy, B. Davis, S R M Prasanna, 'Electronic Communication Systems', McGraw Hill, 5th Edition.
4. Wayne Tomasi, 'Electronic Communication Systems (fundamentals through advanced)', Pearson Education, 4th Edition.
5. K. Sam Shanmugam, 'Digital and analog communication systems', Wiley.

Reference Books:

1. Donald Neamen, 'Electronic Circuit Analysis and Design', Tata McGraw Hill, 2nd Edition.
2. K. R. Botkar, 'Integrated Circuits', Khanna Publishers, 9th Edition
3. Simon Haykin, 'Digital Communication systems', Wiley.
4. David Bell, 'Electronic Devices and Circuits', Oxford, 5th Edition.
5. Ramakant A. Gayakwad, 'Op-amp and linear integrated circuits', PHI, 3rd edition.

Internal Assessment

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

Theory Examination:

2. Question paper will comprise of 6 questions, each carrying 20 marks.
5. The students need to solve total 4 questions.
6. Question No.1 will be compulsory and based on entire syllabus.
7. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Credits
CSC305	Data Structures	4

Course Objectives:

1. To teach various storage mechanisms of data.
2. To design and implement various data structures.
3. To introduce various techniques for representation of the data in the real world.
4. To teach different sorting techniques.
5. To teach different searching techniques.

Course Outcomes:

1. Students will be able to implement various linear and nonlinear data structures.
2. Students will be able to handle operations like insertion, deletion, searching and traversing on various data structures.
3. Students will be able to select appropriate sorting technique for given problem.
4. Students will be able to select appropriate searching technique for given problem.
5. Students will be able to apply the learned concepts in various domains like DBMS and Compiler Construction.
6. Students will be able to choose appropriate data structure for specified problem domain.

Prerequisite: C Programming

Module	Detailed Content	Hours
01	Introduction to Data Structures	03
	Introduction, Types of Data Structures – Linear and Nonlinear, Operations on Data Structures, Concept of ADT, Arrays.	
02	Stack and Queues	10
	Introduction, ADT of Stack, Operations on Stack, Array Implementation of Stack, Applications of Stack – Well form-ness of Parenthesis, Infix to Postfix Conversion and Postfix Evaluation, Recursion. ADT of Queue, Operations on Queue, Array Implementation of Queue, Circular Queue, Priority Queue, Double Ended Queue, Applications of Queue.	
03	Linked List	10
	Introduction, Representation of Linked List, Linked List v/s Array, Implementation of Linked List, Linked Implementation of Stack and Queue, Circular Linked List, Doubly Linked List, Application – Polynomial Representation and Addition.	
04	Trees	12
	Introduction, Tree Terminologies, Binary Tree, Representation, Types of Binary Tree, Binary Tree Traversals, Binary Search Tree, Implementation of Binary Search Tree, Applications – Expression Tree, Huffman Encoding. Search Trees – AVL, B Tree, B+ Tree, Splay Tree and Trie.	

05	Graphs	06
	Introduction, Graph Terminologies, Representation, Graph Traversals – Depth First Search (DFS) and Breadth First Search (BFS), Application – Topological Sorting	
06	Sorting and Searching	07
	Introduction, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort. Linear Search, Binary Search, Hashing – Concept, Hash Functions, Collision Handling Techniques.	

Text Books:

1. Data Structures using C, Reema Thareja, Oxford
2. Data Structures using C and C++, Rajesh K Shukla, Wiley - India
3. Data Structures Using C, Aaron M Tenenbaum, Yedidyah Langsam, Moshe J Augenstein, Pearson
4. Data Structures: A Pseudocode Approach with C, Richard F. Gilberg & Behrouz A., Forouzan, Second Edition, CENGAGE Learning
5. Introduction to Data Structure and Its Applications, JeanPaul Tremblay, P. G. Sorenson

Reference Books:

1. C & Data Structures, Prof. P.S. Deshpande, Prof. O.G. Kakde, DreamTech press.
2. Data Structure Using C, Balagurusamy.
3. Data Structures Using C, ISRD Group, Second Edition, Tata McGraw-Hill.
4. Data Structures, Adapted by: GAV PAI, Schaum's Outlines.

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

- 1 Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules

Lab Code	Lab Name	Credits
CSL301	Digital System Lab	1

Lab Outcome:

1. Understand the basics of various digital components.
2. Understand the principles of design of combinational logic and sequential logic circuits using basic components.
3. Recognize the importance of digital systems in computer architecture.
4. Design and simulate the basic digital circuit.

Description

Experiments with Logic Building Blocks using SSI/MSI, Experiments on Design and/or use Minimization tools. Use of VHDL and simulation in Logic Design. Experiment on design using MSI and/or PLDs tools.

Suggested List of Experiments:

Sr. No.	Title of Experiments
1	To study and verify the truth table of various logic gates using ICs and realize Boolean expressions using gates
2	To realize basic gates using universal gates
4	To realize binary to gray code and gray code to binary converter.
5	To realize parity generator and detector.
6	To realize arithmetic circuits i) Half adder ii) Full adder iii) Half subtractor iv) Full subtractor
7	To realize 2 bit magnitude comparator.
8	To Study multiplexer IC and realization of full adder using multiplexer IC
9	To Study decoder IC and realization of combinational logic using decoder IC
10	Study of flip-flops using IC's
11	To realize asynchronous 3 bit up counter.
12	To realize shift registers using flip flops
13	To realize basic gates using VHDL

14	To realize 4:1 multiplexer using VHDL
15	To realize 4 bit counter using VHDL

Term Work:

Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated.

Oral & Practical exam will be based on the above and CSC302: Digital Logic Design and Analysis syllabus.

Lab Code	Lab Name	Credits
CSL302	Basic Electronics Lab	1

Lab Outcome:

1. Understand the basics of various semiconductor devices, electronic components and instruments.
2. Understand the working of electronic circuits using components
3. Recognize the importance of electronic circuits in electronic communications.
4. Study the fundamental concepts of various modulation methods.

Description

Experiments with semiconductor devices, ICs, electronic component and various measuring instruments. Study experiments on various modulation methods.

Suggested List of Experiments:

Sr. No.	List Experiments
1	Study of electronic components and measuring instruments.
2	Implementation of single stage BJT amplifier.
3	Implementation of oscillators.
4	Implementation of inverting, non inverting amplifier using IC741.
5	Implementation of adder and subtractor using IC 741.
6	Implementation of differentiator using IC741.
7	Implementation of integrator using IC741.
8	Modulation and Demodulation of AM.
9	Study of super heterodyne receiver
10	Modulation and Demodulation PAM.
11	Modulation and Demodulation PWM.
12	Modulation and Demodulation PPM.
13	Modulation and Demodulation PCM.
14	Study of TDM.

15	Study of FDM.
16	SPICE based simulation.

Term Work:

Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated.

Oral exam will be based on the above mentioned experiment list and CSC304: Electronic circuits and communication fundamentals syllabus.

Lab Code	Lab Name	Credits
CSL303	Data Structures Lab	1

Lab outcomes:

1. Students will be able to implement various linear and nonlinear data structures.
2. Students will be able to handle operations like insertion, deletion, searching and traversing on various data structures.

Description: Experiments based on creating and manipulating various data structures.

Suggested Experiments:

Students are required to complete at least 12 experiments.

Star (*) marked experiments are compulsory.

- *1) Array Implementation of Stack.
- *2) Conversion of Infix to Postfix.
- 3) Evaluation of Postfix Expression.
- 4) Check continuity of different types of parenthesis using stack.
- 5) Array Implementation of Queue.
- *6) Array Implementation of Circular Queue.
- 7) Array Implementation of Priority Queue
- *8) Implementation of Singly Linked List
- 9) Linked Implementation of Stack
- 10) Linked Implementation of Queue.
- 11) Implementation of Circular Linked List.
- 12) Implementation of Doubly Linked List.
- *13) Implement Binary Search Tree.
- 14) Implementation of Bubble Sort.
- 15) Implementation of Insertion Sort.
- 16) Implementation of Merge Sort.
- *17) Implementation of Quick Sort.
- *18) Implementation of Binary Search.
- 19) Implementation of Hashing.
- 20) Implementation of Depth First Search and Breadth First Search.

Term Work:

1. Term work should consist of at least 10 experiments.
2. Journal must include at least 2 assignments.
3. A case study should be conducted using a Mini Project by taking a good problem definition and complete the following phases.
 - a. Decomposing the problem into modules
 - b. Identifying the best suited data structure for solving the sub problems with justification
 - c. Define algorithms for various identified functions
 - d. Implement the modules
4. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
5. Term Work:
Total 25 Marks = (Experiments: 10 mark + Mini Project: 05 mark + Assignments: 05 mark)

Practical and oral examination will be based on the above syllabus.

Lab Code	Lab Name	Credits
CSL304	OOPM (JAVA) Lab	2

Course Objective:

1. To learn the object oriented programming concepts.
2. To study various java programming concept like multithreading, exception handling, packages etc.
3. To explain components of GUI based programming.

Course Outcomes: At the end of the course Student should be able:

1. To apply fundamental programming constructs.
2. To illustrate the concept of packages, classes and objects.
3. To elaborate the concept of strings, arrays and vectors.
4. To implement the concept of inheritance and interfaces.
5. To implement the notion of exception handling and multithreading.
6. To develop GUI based application.

Prerequisite: Structured Programming Approach

Sr. No.	Module	Detailed Content	Hours
1	Introduction to Object Oriented Programming	1.1 OOP Concepts: Object, Class, Encapsulation, Abstraction, Inheritance, Polymorphism. 1.2 Features of Java, JVM 1.3 Basic Constructs/Notions: Constants, variables and data types, Operators and Expressions, Revision of Branching and looping	02
2	Classes, Object and Packages	2.1 Class, Object, Method. 2.2 Constructor, Static members and methods 2.3 Passing and returning Objects 2.4 Method Overloading 2.5 Packages in java, creating user defined packages, access specifiers.	05
3	Array, String and Vector	3.1 Arrays, Strings, String Buffer 3.2 Wrapper classes, Vector	04
4	Inheritance and Interface	4.1 Types of Inheritance, super keyword, Method Overriding, abstract class and abstract method, final keyword, 4.2 Implementing interfaces, extending interfaces	03
5	Exception Handling and Multithreading	5.1 Error vs Exception, try, catch, finally, throw, throws, creating own exception 5.2 Thread lifecycle, Thread class methods, creating threads, Synchronization	04
6	GUI programming in JAVA	6.1 Applet: Applet life cycle, Creating applets, Graphics class methods, Font and Color class, parameter passing.	08

		6.2 Event Handling: Event classes and event listener 6.3 Introduction to AWT: Working with windows, Using AWT controls- push Buttons, Label, Text Fields, Text Area, Check Box, and Radio Buttons. 6.4 Programming using JDBC: Introduction to JDBC, JDBC Drivers & Architecture.	

Text books:

1. Herbert Schildt, 'JAVA: The Complete Reference', Ninth Edition, Oracle Press.
2. Sachin Malhotra and Saurabh Chaudhary, "Programming in Java", Oxford University Press, 2010

Reference Books:

1. Ivor Horton, 'Beginning JAVA', Wiley India.
2. DietalandDietal, 'Java: How to Program', 8/e, PHI
3. 'JAVA Programming', Black Book, Dreamtech Press.
4. 'Learn to Master Java programming', Staredusolutions

Digital Material:

1. www.nptelvideos.in
2. www.w3schools.com
3. <http://spoken-tutorial.org>
4. www.staredusolutions.org

Suggested List of Programming Assignments/Laboratory Work:

1.	Program on various ways to accept data through keyboard and unsigned right shift operator.
2.	Program on branching, looping, labelled break and labelled continue.
3.	Program to create class with members and methods, accept and display details for single object.
4.	Program on constructor and constructor overloading
5.	Program on method overloading
6.	Program on passing object as argument and returning object
7.	Program on creating user defined package
8.	Program on 1D array
9.	Program on 2D array

10.	Program on String
11.	Program on StringBuffer
12.	Program on Vector
13.	Program on single and multilevel inheritance (Use super keyword)
14.	Program on abstract class
15.	Program on interface demonstrating concept of multiple inheritance
16.	Program on dynamic method dispatch using base class and interface reference.
17.	Program to demonstrate try, catch, throw, throws and finally.
18.	Program to demonstrate user defined exception
19.	Program on multithreading
20.	Program on concept of synchronization
21.	Program on Applet to demonstrate Graphics, Font and Color class.
22.	Program on passing parameters to applets
23.	Program to create GUI application without event handling using AWT controls
24.	Program to create GUI application with event handling using AWT controls
25.	Mini Project based on content of the syllabus. (Group of 2-3 students)

Term Work:

Students will submit term work in the form of journal that will include:

1. At least 16-18 programs and mini project
2. Two assignments covering whole syllabus

Term Work: 50 Marks (Total Marks) = 20 marks (Experiments) +
20 marks (Mini Project) +
05 marks (Assignments) +
05 marks (Attendance)

Practical and oral examination will be based on suggested practical list and entire syllabus.

Course Code	Course Name	Credits
CSC401	Applied Mathematics-IV	5

Course Objectives: The objectives of this course are to teach the students:

1. Matrix theory, and it's application to find the matrix function. Present methods of computing and using Eigen values and Eigen vectors.
2. Set up and directly evaluate contour integrals Cauchy's integral theorem and formula in basic and extended form. Present Taylor and Laurent's series to find singularities zero's and poles also presents residues theory
3. Theory of probability, Baye's Theorem, Expectation and Moments and it's application.
4. Probability distribution such as Binomial, Poisson and Normal distribution with their properties.
5. Sampling theory and it's application for small and large sample and Optimization techniques.

Course Outcomes:

1. Students in this course will be able to apply the method of solving complex integration, computing residues & evaluate various contour integrals.
2. Demonstrate ability to manipulate matrices and compute Eigen values and Eigen vectors.
3. Apply the concept of probability distribution to the engineering problems.
4. Apply the concept of sampling theory to the engineering problems.
5. Use matrix algebra with its specific rules to solve the system of linear equation, using concept of Eigen value and Eigen vector to the engineering problems.
6. Apply the concept of Linear & Non-Linear Programming Problem to the engineering problems.

Module No.	Unit No.	Topics	Hrs.
1.0		Complex Integration	10
	1.1	Complex Integration – Line Integral, Cauchy's Integral theorem for simply connected regions, Cauchy's Integral formula(without proof)	
	1.2	Taylor's and Laurent's series (without proof)	
	1.3	Zeros, poles of f(z), Residues, Cauchy's Residue theorem.	
	1.4	Applications of Residue theorem to evaluate Integrals of the type $\int_0^{2\pi} f(\cos\theta, \sin\theta)d\theta, \int_{-\infty}^{\infty} f(x)dx$	
2.0		Matrices	10
	2.1	Eigen values and Eigen vectors.	
	2.2	Cayley-Hamilton theorem(without proof)	
	2.3	Similar matrices, diagonalisable matrix.	
	2.4	Derogatory and non-derogatory matrices, Functions of square matrix.	

3.0		Probability	10
	3.1	Baye's Theorem	
	3.2	Random Variables: Discrete & continuous random variables, expectation, Variance, Probability Density Function & Cumulative Density Function.	
	3.3	Moments & Moment generating function.	
	3.4	Probability distribution: Binomial distribution, Poisson & Normal distribution. (For detail study)	
4.0		Sampling Theory (Large Sample test)	06
	4.1	Sampling Distribution, Test of Hypothesis, Level of significance, Critical region, One Tailed and Two Tailed test,	
	4.2	Test of significant for Large Samples:-Means of the samples and test of significant of means of two large samples.	
5.0		Sampling Theory (Small Sample test)	06
	5.1	Test of significant for small samples:- Students t- distribution for dependent and independent samples	
	5.2	Chi square test:- Test of goodness of fit and independence of attributes,Contingency table.	
6.0		Mathematical Programming	10
	6.1	Types of solution, Standard and Canonical form of LPP, Basic and feasible solutions, simplex method.	
	6.2	Artificial variables, Big –M method (method of penalty).	
	6.3	Duality and Dual simplex method.	
	6.4	Non Linear Programming Problems with equality constrains and inequality Constrains (two or three variables with one constrains) (No formulation, No Graphical method).	
		Total	52

Text Books:

1. Higher Engineering Mathematics by Grewal B. S. 38th edition, Khanna Publication 2005.
2. Operation Research by Hira & Gupta,S Chand.
3. A Text Book of Applied Mathematics Vol. I & II by P.N.Wartilar &
4. J.N.Wartikar, Pune, Vidyarthi Griha Prakashan., Pune.
5. Probability and Statistics for Engineering, Dr. J Ravichandran, Wiley-India.

Reference Books:

1. Probability & Statistics with reliability by Kishor s. Trivedi, Wiley India.
2. Advanced Engg. Mathematics by C. Ray Wylie & Louis Barrett.TMH International Edition.
3. Mathematical Methods of Science and Engineering by Kanti B. Datta, Cengage Learning.
4. Advanced Engineering Mathematics by Kreyszig E. 9th edition, John Wiley.
5. Operations Research by S.D. Sharma Kedar Nath, Ram Nath & Co. Meerat.
6. Engineering optimization (Theory and Practice) by Singiresu S.Rao, New Age International publication.

Assessment:**Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

In question paper, weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name	Credits
CSC402	Analysis of Algorithms	4

Course Objectives:

4. To provide mathematical approach for Analysis of Algorithms
5. To solve problems using various strategies
6. To analyse strategies for solving problems not solvable in polynomial time.

Course Outcomes: At the end of the course student will be able to

1. Analyze the running time and space complexity of algorithms.
2. Describe, apply and analyze the complexity of divide and conquer strategy.
3. Describe, apply and analyze the complexity of greedy strategy.
4. Describe, apply and analyze the complexity of dynamic programming strategy.
5. Explain and apply backtracking, branch and bound and string matching techniques to deal with some hard problems.
6. Describe the classes P, NP, and NP-Complete and be able to prove that a certain problem is NP-Complete.

Prerequisites: Students should be familiar with concepts of Data structure and discrete structures.

Module	Detailed Content	Hours
1	Introduction to analysis of algorithm Performance analysis , space and time complexity Growth of function – Big –Oh ,Omega , Theta notation Mathematical background for algorithm analysis, Analysis of selection sort , insertion sort. Recurrences: -The substitution method -Recursion tree method -Master method Divide and Conquer Approach: General method Analysis of Merge sort, Analysis of Quick sort, Analysis of Binary search, Finding minimum and maximum algorithm and analysis, Strassen's matrix multiplication	12
2	Dynamic Programming Approach: General Method Multistage graphs single source shortest path all pair shortest path Assembly-line scheduling 0/1 knapsack Travelling salesman problem Longest common subsequence	08
3	Greedy Method Approach:	06

	General Method Single source shortest path Knapsack problem Job sequencing with deadlines Minimum cost spanning trees-Kruskal and prim's algorithm Optimal storage on tapes	
4	Backtracking and Branch-and-bound: General Method 8 queen problem(N-queen problem) Sum of subsets Graph coloring 15 puzzle problem, Travelling salesman problem.	08
5	String Matching Algorithms: The naïve string matching Algorithms The Rabin Karp algorithm String matching with finite automata The knuth-Morris-Pratt algorithm	06
6	Non-deterministic polynomial algorithms: Polynomial time, Polynomial time verification NP Completeness and reducibility NP Completeness proofs Vertex Cover Problems Clique Problems	08

Text Books:

1. T.H.coreman , C.E. Leiserson,R.L. Rivest, and C. Stein, "Introduction to algorithms", 2nd edition , PHI publication 2005.
2. Ellis horowitz , Sartaj Sahni , S. Rajsekaran. "Fundamentals of computer algorithms" University Press

Reference Books:

1. Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, "Algorithms", Tata McGraw- Hill Edition.
2. S. K. Basu, "Design Methods and Analysis of Algorithm", PHI.
3. John Kleinberg, Eva Tardos, "Algorithm Design", Pearson.
4. Michael T. Goodrich, Roberto Tamassia, "Algorithm Design", Wiley Publication.

Assessment:**Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules..

Course Code	Course Name	Credit
CSC403	Computer Organization and Architecture	4

Course Objectives:

1. To have a thorough understanding of the basic structure and operation of a digital computer.
2. To discuss in detail the operation of the arithmetic unit including the algorithms & implementation of fixed-point and floating-point addition, subtraction, multiplication & division.
3. To study the different ways of communicating with I/O devices and standard I/O interfaces.
4. To study the hierarchical memory system including cache memories and virtual memory.

Course Outcomes: At the end of the course student should be able-

1. To describe basic structure of the computer system.
2. To demonstrate the arithmetic algorithms for solving ALU operations.
3. To describe instruction level parallelism and hazards in typical processor pipelines.
4. To describe superscalar architectures, multi-core architecture and their advantages
5. To demonstrate the memory mapping techniques.
6. To Identify various types of buses, interrupts and I/O operations in a computer system

Prerequisite: Digital Logic Design and Application

Sr. No.	Module	Detailed Content	Hours
1	<u>Introduction</u>	<u>Overview of Computer Architecture & Organization</u> • Introduction • Basic organization of computer • Block level description of the functional units. <u>Data Representation and Arithmetic Algorithms:</u> • Integer Data computation: Addition, Subtraction. Multiplication: unsigned multiplication, Booth's algorithm. • Division of integers: Restoring and non restoring division • Floating point representation. IEEE 754 floating point number representation. • Floating point arithmetic: Addition, Subtraction, Multiplication, Division	08
2	<u>Processor Organization and Architecture</u>	• Von Neumann model, Harvard Architecture • Register Organization, Instruction formats, addressing modes, instruction cycle. Instruction interpretation and sequencing. • ALU and Shifters • Basic pipelined datapath and control, Data dependences, data hazards, Branch hazards, delayed branches, branch prediction • Performance measures – CPI, speedup, efficiency, throughput and Amdahl's law	10

3	<u>Control Unit Design</u>	• Hardwired control unit design methods: State table, delay element, sequence counter with examples like control unit for multiplication and division • Microprogrammed control Unit: Microinstruction sequencing and execution. Micro operations, Wilkie's microprogrammed Control Unit, Examples on microprograms	08
4	<u>Memory Organization</u>	• Classifications of primary and secondary memories. Types of RAM (SRAM, DRAM, SDRAM, DDR, SSD) and ROM, Characteristics of memory, Memory hierarchy: cost and performance measurement. • Virtual Memory: Concept, Segmentation and Paging, Address translation mechanism. • Interleaved and Associative memory. • Cache memory Concepts, Locality of reference, design problems based on mapping techniques. Cache Coherency, Write Policies	12
5	<u>I/O Organization and Peripherals</u>	• Common I/O device types and characteristics • Types of data transfer techniques: Programmed I/O, Interrupt driven I/O and DMA. • Introduction to buses, Bus arbitration and multiple bus hierarchy • Interrupt types, Interrupts handling	06
6	<u>Advanced Processor Principles</u>	• Introduction to parallel processing, Flynn's Classification • Concepts of superscalar architecture, out-of-order execution, speculative execution, multithreaded processor, VLIW, data flow computing. • Introduction to Multi-core processor architecture	08

Text Books:

1. William Stallings, "Computer Organization and Architecture: Designing for Performance", Pearson Publication, 10th Edition, 2013
2. John P. Hayes, "Computer Architecture and Organization", McGraw-Hill, 1988
3. B. Govindarajulu, "Computer Architecture and Organization: Design Principles and Applications", Second Edition, McGraw-Hill (India),

Reference Books:

1. Andrew S. Tanenbaum "Structured Computer Organization", Pearson, Sixth Edition
2. Morris Mano. "Computer System Architecture" Pearson Publication, 3rd Edition, 2007
3. Kai Hwang, Fayé Alayé Briggs. "Computer architecture and parallel processing", McGraw-Hill
4. P. Pal Chaudhuri. "Computer Organization and Design" Prentice Hall India, 2004
5. Dr. M. Usha, T.S. Shrikant. "Computer System Architecture and Organization" Wiley India, 2014.

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Credits
CSC404	Computer Graphics	4

Course Objectives

- 1 To equip students with the fundamental knowledge and basic technical competence in the field of computer graphics.
- 2 To emphasize on implementation aspect of Computer Graphics Algorithms.
- 3 To prepare the student for advance areas like Image Processing or Computer Vision or Virtual Reality and professional avenues in the field of Computer Graphics.

Course Outcomes : At the end of the course , the students should be able to

- 1 Understand the basic concepts of Computer Graphics.
- 2 Demonstrate various algorithms for scan conversion and filling of basic objects and their comparative analysis.
- 3 Apply geometric transformations, viewing and clipping on graphical objects.
- 4 Explore solid model representation techniques and projections.
- 5 Understand visible surface detection techniques and illumination models.

Prerequisite: Knowledge of C Programming, Basic Data Structures and Mathematics.

Module No	Detail Syllabus	Hours
1	Introduction and Overview of Graphics System: • Definition and Representative uses of computer graphics, classification of application areas, Overview of coordinate systems ,definition of scan conversion, rasterization and rendering. • Raster scan & random scan displays, Flat Panel displays like LCD and LED , architecture of raster graphics system with display processor, architecture of random scan systems.	03
2	Output Primitives : • Scan conversions of point,line, circle and ellipse : DDA algorithm and Bresenham algorithm for line drawing, midpoint algorithm for circle, midpoint algorithm for ellipse drawing (Mathematical derivation for above algorithms is expected) • Aliasing , Antialiasing techniques like Pre and post filtering , super sampling , and pixel phasing). • Filled Area Primitive: Scan line Polygon Fill algorithm, Inside outside tests, Boundary Fill and Flood fill algorithm.	12
3	Two Dimensional Geometric Transformations • Basic transformations : Translation , Scaling , Rotation • Matrix representation and Homogeneous Coordinates • Composite transformation • Other transformations : Reflection and Shear • Raster method for transformation.	06

4	Two Dimensional Viewing and Clipping - Viewing transformation pipeline and Window to Viewport coordinate transformation - Clipping operations – Point clipping , Line clipping algorithms : Cohen – Sutherland , Midpoint subdivision , Liang – Barsky , Polygon Clipping Algorithms : Sutherland – Hodgeman, Weiler – Atherton.	08
5	Three Dimensional Object Representations , Geometric Transformations and 3D Viewing - Boundary Representation and Space partitioning representation: Polygon Surfaces , Bezier Curve , Bezier Surface , B-Spline Curve , Sweep Representation, Constructive Solid Geometry ,Octree, Fractal-Geometry : Fractal Dimension, Koch Curve. 3D Transformations :Translation, Rotation , Scaling and Reflection. - Composite transformations :Rotation about an arbitrary axis 3D transformation pipeline - Projections – Parallel , Perspective.(Matrix Representation) 3D clipping.	12
6	Visible Surface Detection - Classification of Visible Surface Detection algorithm - Back Surface detection method - Depth Buffer method - Depth Sorting method - Scan line method - Area Subdivision method	04
7	Illumination Models and Surface Rendering - Basic Illumination Models : Diffused reflection, Phong Specular reflection Model - Halftone and Dithering techniques - Polygon Rendering :Constant shading , Gouraud Shading , Phong Shading.	03

Text Books:

1. “Computer Graphics” C version by Hearn & Baker, 2nd Edition, Pearson
2. “Computer Graphics Principles and Practice in C , 2nd Edition ,James D. Foley, Andries van Dam, Steven K Feiner, John F. Hughes, Pearson .
3. “Computer Graphics”, by Rajesh K. Maurya, Wiley India Publication.
4. “Computer Graphics “ , by Samit Bhattacharya , Oxford Publication.

Reference Books:

1. “Procedural Elements for Computer Graphics “ by D. Rogers , Tata McGraw-Hill Publications.
2. “Computer Graphics” , by Zhigang Xiang , Roy Plastock , Schaum’s Outlines McGraw-Hill Education
3. “Computer Graphics using OpenGL” , by F.S.Hill , Jr. ,Third edition, Pearson Publications.

Assessment:**Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Credits
CSC405	Operating System	4

Course Objectives:

1. To introduce basic concepts and functions of operating systems.
2. To understand the concept of process, thread and resource management.
3. To understand the concepts of process synchronization and deadlock.
4. To understand various Memory, I/O and File management techniques.

Course Outcomes: At the end of the course student should be able to

1. Understand role of Operating System in terms of process, memory, file and I/O management.
2. Apply and analyse the concept of a process, thread, mutual exclusion and deadlock.
3. Evaluate performance of process scheduling algorithms and IPC.
4. Apply and analyse the concepts of memory management techniques.
5. Evaluate the performance of memory allocation and replacement techniques.
6. Apply and analyze different techniques of file and I/O management.

Prerequisite: Computer Organization & Architecture

Sr No	Module	Detailed Content	Hours
1	Operating System Overview	Operating System Objectives and Functions, The Evolution of Operating Systems, OS Design Considerations for Multiprocessor and Multicore architectures, Operating system structures, System Calls, Linux Kernel and Shell.	8 hrs
2	Process Concept and Scheduling	Process: Concept of a Process, Process States, Process Description, Process Control Block, Operations on Processes. Threads: Definition and Types, Concept of Multithreading, Multicore processors and threads. Scheduling: Uniprocessor Scheduling - Types of Scheduling: Preemptive and, Non-preemptive, Scheduling Algorithms: FCFS, SJF, SRTN, Priority based, Round Robin, Multilevel Queue scheduling. Introduction to Thread Scheduling, Multiprocessor Scheduling and Linux Scheduling.	8 hrs

3	Synchronization and Deadlocks	Concurrency: Principles of Concurrency, Inter-Process Communication, Process/Thread Synchronization. Mutual Exclusion: Requirements, Hardware Support, Operating System Support (Semaphores and Mutex), Programming Language Support (Monitors), Classical synchronization problems: Readers/Writers Problem, Producer and Consumer problem. Principles of Deadlock: Conditions and Resource Allocation Graphs, Deadlock Prevention, Deadlock Avoidance: Banker's Algorithm for Single & Multiple Resources, Deadlock Detection and Recovery. Dining Philosophers Problem.	12 hrs
4	Memory Management	Memory Management: Memory Management Requirements, Memory Partitioning: Fixed Partitioning, Dynamic Partitioning, Memory Allocation Strategies: Best-Fit, First Fit, Worst Fit, Next Fit, Buddy System, Relocation. Paging, Segmentation. Virtual Memory: Hardware and Control Structures, Demand Paging, Structure of Page Tables, Copy on Write, Page Replacement Strategies: FIFO, Optimal, LRU, LFU, Approximation, Counting Based. Allocation of frames, Thrashing.	8 hrs
5	File Management	File Management: Overview, File Organization and Access, File Directories, File Sharing, Secondary Storage Management, Linux Virtual File System.	6 hrs
6	Input /Output Management	I/O Management and Disk Scheduling: I/O Devices, Organization of the I/O Function, Operating System Design Issues, I/O Buffering, Disk Scheduling algorithm: FCFS, SSTF, SCAN, CSCAN, LOOK, C-LOOK. Disk Management, Disk Cache, Linux I/O.	6 hrs

Text Books:

1. William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 8th Edition, 2014, ISBN-10: 0133805913 • ISBN-13: 9780133805918 .
2. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley & Sons , Inc., 9th Edition, 2016, ISBN 978-81-265-5427-0
3. Andrew Tannenbaum, Operating System Design and Implementation, Pearson, 3rd Edition.
4. D.M Dhamdhere, Operating Systems: A Concept Based Approach, Mc-Graw Hill

Reference Books:

1. Maurice J. Bach, “Design of UNIX Operating System”, PHI
2. Achyut Godbole and Atul Kahate, Operating Systems, Mc Graw Hill Education, 3rd Edition
3. The Linux Kernel Book, Remy Card, Eric Dumas, Frank Mevel, Wiley Publications.

Assessment:**Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Lab Code	Lab Name	Credit
CSL401	Analysis of Algorithms Lab	1

Lab outcomes: At the end of the course student will be able to

1. Analyze the complexities of various problems in different domains.
2. Prove the correctness and analyze the running time of the basic algorithms for those classic problems in various domains.
3. Develop the efficient algorithms for the new problem with suitable designing techniques.
4. Implement the algorithms using different strategies.

Prerequisites: Students should be familiar with concepts of Data structure and Discrete structures.

Description:

Minimum 2 experiments should be implemented using any language on each algorithm design strategy (Divide and conquer, dynamic programming, Greedy method, backtracking and branch & bound, string matching).

Suggested Laboratory Experiments:

Sr. No.	Module Name	Suggested Experiment List
1	Introduction to analysis of algorithm Divide and Conquer Approach	Selection sort , insertion sort. Merge sort, Quick sort, Binary search.
2	Dynamic Programming Approach	Multistage graphs, single source shortest path, all pair shortest path, 0/1 knapsack, Travelling salesman problem, Longest common subsequence.
3	Greedy Method Approach	Single source shortest path, Knapsack problem, Job sequencing with deadlines, Minimum cost spanning trees-Kruskal and prim's algorithm, Optimal storage on tapes.
4	Backtracking and Branch-and-bound	8 queen problem (N-queen problem), Sum of subsets, Graph coloring, 15 puzzle problem, Travelling salesman problem.

5	String Matching Algorithms	The naïve string matching Algorithms, The Rabin Karp algorithm, String matching with finite automata, The knuth-Morris-Pratt algorithm.
6	Any two Experiments	This will involve implementation of two algorithms for problems beyond the scope of syllabus. The exact set of algorithms to implement is to be decided by the course instructor.

Text Books:

1. T.H.Coreman , C.E. Leiserson,R.L. Rivest, and C. Stein, “Introduction to algorithms”, 2nd edition , PHI publication 2005.
2. Ellis horowitz , sartaj Sahni , s. Rajsekaran. “Fundamentals of computer algorithms” University Press

Reference Books:

1. Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, “Algorithms”, Tata McGraw- Hill Edition.
2. S. K. Basu, “Design Methods and Analysis of Algorithm”, PHI.
3. Dana Vrajitoru and William Knight, “Practical Analysis of Algorithms”, Springer 2014th Edition.

Term Work:

Laboratory work must contain implementation of minimum 10 experiments. The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing marks in term work. The 25 marks of the term work should be divided as below:

25 Marks (total marks) = 15 Marks Lab. Experiments + 05 Marks Assignments (based on theory syllabus) + 05 (Attendance: theory + practical)

Oral & Practical Exam will be based on the experiments implemented in the Laboratory.

Lab Code	Lab Title	Credit
CSL402	Computer Graphics Lab	1

Lab Objectives

- 1 To emphasize on implementation aspect of Computer Graphics Algorithm.
- 2 To prepare students for advanced areas like Animation, image processing ,virtual reality etc

Lab Outcomes : At the end of the course , the students should be able to

- 1 Explore the working principle, utility of various input/ output devices and graphical tools.
- 2 Implement various output and filled area primitive algorithms using C/ OpenGL
- 3 Apply transformation and clipping algorithms on graphical objects.
- 4 Implementation of curve and fractal generation.
- 5 Develop a Graphical application based on learned concept.

Content:

Scan conversions: lines, circles, ellipses. Filling algorithms, clipping algorithms. 2D and 3D transformation. Curves. Visible surface determination. Simple animations Application of these through exercises in C/C++/ Open GL

List of Desirable Experiments:

1. Study and apply basic opengl functions to draw basic primitives. (*)
2. Implement sierpinsky gasket using openGL.
3. Implement DDA Line Drawing algorithms and Bresenham algorithm(*)
4. Implement midpoint Circle algorithm(*)
5. Implement midpoint Ellipse algorithm
6. Implement Area Filling Algorithm: Boundary Fill, Flood Fill ,Scan line Polygon Fill (*)
7. Implement Curve : Bezier for n control points , B Spline (Uniform) (atleast one)(*)
8. Implement Fractal (Koch Curve)
9. Character Generation : Bit Map method and Stroke Method
10. Implement 2D Transformations: Translation, Scaling, Rotation, Reflection, Shear.(*)
11. Implement Line Clipping Algorithm: Cohen Sutherland / Liang Barsky.(*)
12. Implement polygon clipping algorithm(atleast one)
13. Program to represent a 3D object using polygon surfaces and then perform 3D transformation.
14. Program to perform projection of a 3D object on Projection Plane : Parallel and Perspective.(*)

Term Work

1. Term work should consist of at least 12 experiments. (*)→ Practical to be covered necessarily
2. Journal must include at least 2 assignments.
3. Mini Project to perform using C / OpenGL.

Possible Ideas:

- a. Animation using multiple object
- b. Graphics editor with following features :

*Draw basic geometrical entities; apply geometrical transformations, Area filling, Clipping against Clip window, displaying the text, displaying bar / line graphs , pie charts etc.

The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.

Term Work: 25 Marks (Total) = 10 Marks (Experiments)

+ 5 Marks (Mini Project)

+ 5 Marks (Assignments)

+ 5 Marks (Theory + Practical Attendance).

Oral & Practical exam will be based on the above content and CSC404: Computer Graphics.

Lab Code	Lab Name	Credit
CSL403	Processor Architecture Lab	1

Lab Objectives:

1. To implement the operation of the arithmetic unit including the algorithms & implementation of fixed-point and floating-point addition, subtraction, multiplication & division.
2. To study the different ways of communicating with I/O devices and standard I/O interfaces.
3. To design memory subsystem including cache memory
4. To have through understanding of various computer buses

Lab Outcomes: At the end of the course student should be

1. Assemble personal computer
2. Design the basic building blocks of a computer: arithmetic-logic unit, registers, central processing unit, and memory.
3. Implement various algorithms like Booth's algorithm for arithmetic operations
4. Describe various I/O buses with merits and demerits.

Prerequisite: Digital Logic Design and Applications

Content:

Sr. No.	Module	Detailed Content
1	Overview of Computer Architecture & Organization	• Computer Anatomy- Memory, Ports, Motherboard and add-on cards • Dismantling and assembling PC
2	Programs on Data Representation and Arithmetic	• Ripple carry adder, Carry look-ahead adder, registers, Multiplication • Booths Algorithm, Restoring and Non restoring Division
3	Processor Organization and Architecture	• ALU Design, CPU Design • Case Study on multi-core Processors
4	Memory Organization	• Memory design, Cache Memory design
5	I/O Organization and Interrupts	• Case study on buses like ISA, PCI, USB etc • Interrupt handling using C/Java Programming

Digital Material:

- **Manual to use the simulator for computer organization and architecture.** Developed by the Department of CSE, IIT kharagpur (<http://cse10-iitkgp.virtual-labs.ac.in/>)

Books:

1. William Stallings, “Computer Organization and Architecture: Designing for Performance”, Pearson Publication, 10th Edition, 2013
2. B. Govindarajulu, “Computer Architecture and Organization: Design Principles and Applications”, Second Edition, McGraw-Hill (India),
6. Andrew S. Tanenbaum “Structured Computer Organization”, Pearson, Sixth Edition
7. Morris Mano. “Computer System Architecture” Pearson Publication, 3rd Edition, 2007
8. Kai Hwang, Fayé Alayé Briggs. “Computer architecture and parallel processing”, McGraw-Hill
9. P. Pal Chaudhuri. “Computer Organization and Design” Prentice Hall India, 2004
10. Dr. M. Usha, T.S. Shrikant. “Computer System Architecture and Organization” Wiley India, 2014.

Term Work

Term work should consist of at least 10-12 experiments and 3-4 assignments based on above content and CSC403: Computer Organization and Architecture

The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.

Term Work: 25 Marks (Total) = 10 Marks (Experiments)
+ 5 Marks (Mini Project)
+ 5 Marks (Assignments)
+ 5 Marks (Theory + Practical Attendance).

Oral exam will be based on the above content and CSC403: Computer Organization and Architecture.

Lab Code	Lab Name	Credit
CSL404	Operating System Lab	1

Lab Outcome:

1. Understand basic operating system commands.
2. Understand and explore various system calls.
3. Write shell scripts and shell commands using kernel APIs.
4. Implement and analyze different process scheduling algorithms
5. Implement and analyze different memory management algorithms.
6. Evaluate process management techniques and deadlock handling using simulator.

Descriptions:

Sr. No	Contents
1	Explore the internal commands of linux like ls, chdir, mkdir, chown, chmod, chgrp, ps etc
2	Write shell scripts to do the following: ➤ Display top 10 processes in descending order ➤ Display processes with highest memory usage. ➤ Display current logged in user and logname. ➤ Display current shell, home directory, operating system type, current path setting, current working directory. ➤ Display OS version, release number, kernel version. ➤ Illustrate the use of sort, grep, awk, etc.
3	a) Create a child process in Linux using the fork system call. From the child process obtain the process ID of both child and parent by using getpid and getppid system call. Explore wait and waitpid before termination of process. b) Explore the following system calls: open, read, write, close, getpid, setpid, getuid, getgid, getegid, geteuid.
4	Implement basic commands of linux like ls, cp, mv and others using kernel APIs.
5	Write a program to implement any two CPU scheduling algorithms like FCFS, SJF, Round Robin etc.
6	Write a program to implement dynamic partitioning placement algorithms i.e Best Fit, First-Fit, Worst-Fit etc
7	Write a program to implement various page replacement policies.
8	Using the CPU-OS simulator analyze and synthesize the following: a. Process Scheduling algorithms. b. Thread creation and synchronization. c. Deadlock prevention and avoidance.

Digital Materials:

1. Download the CPU-OS simulator along with related tutorials from <http://www.teach-sim.com>
2. <http://www.teach-sim.com>

Books:

1. Linux Kernel Book, by Remy Card, Eric Dumas, Frank Mevel, Wiley India
2. Unix Concepts and Applications, Sumitabha Das, McGraw Hill.

Term Work:

- Term work should consist of at least 12 experiments and 2-3 assignments on above content.
- The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
- Term Work: 25 Marks (Total) = 10 Marks (Experiments)
+ 5 Marks (Mini Project)
+ 5 Marks (Assignments)
+ 5 Marks (Theory + Practical Attendance).

Oral & Practical exam will be based on the above content and CSC405: Operating system syllabus.

Lab Code	Lab Name	Credit
CSL405	Open Source Technology Lab	2

Course Outcomes:

1. To understand basic concepts in python and perl.
2. To explore contents of files, directories and text processing with python
3. To develop program for data structure using built in functions in python.
4. To explore django web framework for developing python based web application.
5. To understand file handling and database handling using perl.
6. To explore basics of two way communication between client and server using python and perl

Prerequisites: Knowledge of some programming language like C, Java

Content:

Sr. No	Module Name	Detailed Content
1	Python basics	Data types in python ,Operators in python, Input and Output, Control statement, Arrays in python, String and Character in python, Functions, List and Tuples, Dictionaries Exception, Introduction to OOP, Classes , Objects , Interfaces, Inheritance
2	Advanced Python	Files in Python, Directories, Building Modules, Packages, Text Processing, Regular expression in python.
3	Data Structure in Python	Link List, Stack, Queues, Dequeues
4	Python Integration Primer	Graphical User interface ,Networking in Python , Python database connectivity, Introduction to Django
5	Basics of Perl	Perl Overview, Variables, Control Statements, Subroutines, Objects, Packages and Modules
6	Perl advanced	Working with Files, Data manipulation, Database Systems, Networking

Text Books

1. Core Python Programming, Dr. R. Nageswara Rao, Dreamtech Press
2. Beginning Python: Using Python 2.6 and Python 3.1. James Payne, Wrox publication
3. Perl: The Complete Reference. Second Edition. Martin C. Brown, McGraw-Hill
4. Introduction to computing and problem solving using python , E Balagurusamy, McGraw Hill Education

Reference Book

1. Perl Black Book, 2nd Edition: Steven Holzner, Dreamtech Press
2. Learn Python the Hard Way: (3rd Edition) (Zed Shaw's Hard Way Series)
3. Python Projects, Laura Cassell, Alan Gauld, wrox publication

Digital Material:

1. "The Python Tutorial", <http://docs.python.org/release/3.0.1/tutorial/>
2. Beginning Perl, <https://www.perl.org/books/beginning-perl/>
3. <http://spoken-tutorial.org>
4. www.staredusolutions.org

Suggested experiments using Python:

1. Exploring basics of python like data types (strings, list, array, dictionaries, set, tuples) and control statements.
2. Creating functions, classes and objects using python. Demonstrate exception handling and inheritance.
3. Exploring Files and directories
 - a. Python program to append data to existing file and then display the entire file
 - b. Python program to count number of lines, words and characters in a file.
 - c. Python program to display file available in current directory
4. Creating GUI with python containing widgets such as labels, textbox, radio, checkboxes and custom dialog boxes.
5. Menu driven program for data structure using built in function for link list, stack and queues.
6. Program to demonstrate CRUD(**create, read, update and delete**) operations on database (SQLite/MySQL) using python.
7. Creation of simple socket for basic information exchange between server and client.
8. Creating web application using Django web framework to demonstrate functionality of user login and registration (also validating user detail using regular expression).

Suggested experiments using Perl:

10. Exploring various data type, loops and conditional statement in perl. And Creating functions, packages and modules in perl.
11. Program to demonstrate use of objects and classes in perl.
12. Program to demonstrate file handling, data manipulation and use of regular expression for text processing in perl
13. Program to send email and read content of URL.

Term Work:

Students will submit term work in the form of journal that will include:

1. At least 12-14 programs.
2. One mini-project in a group 2-3 student.
3. Two assignments covering whole syllabus.

Term Work (25) = 15 marks (Experiments & Assignments)
+ 10 marks (Mini Project)
+ 05 marks (Attendance)

Practical and oral examination will be based on suggested practical list and entire syllabus.

University of Mumbai



No. UG/44 of 2019-20

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges, Directors of the recognized Institutions in Science & Technology Faculty is invited to this office Circular No. UG/249 of 2010 dated 12th August, 2010 relating to the revised syllabus of Fourth Year (Sem.VII & VIII) of the B. E. Degree Course in branch of Civil Engineering.

They are hereby informed that the recommendations made by the Board of Studies in Civil Engineering at its meeting held on 11th April, 2019 have been accepted by the Academic Council at its meeting held on 15th April, 2019 vide item No. 4.51 and that in accordance therewith, the revised syllabus as per the (CBCGS) for the B.E. Civil Engineering (Sem. VII & VIII) has been brought into force with effect from the academic year 2019-20, accordingly. (The same is available on the University's website www.mu.ac.in).

MUMBAI - 400 032
9th July, 2019

dpmk
(Dr. Ajay Deshmukh)
REGISTRAR

To

The Principals of the affiliated Colleges, and Directors of the recognized Institutions in Science & Technology Faculty. (Circular No. UG/334 of 2017-18 dated 9th January, 2018.)

A.C/4.51/15/04/2019

No. UG/44 -A of 2018-19

MUMBAI-400 032

9th July, 2019

Copy forwarded with Compliments for information to:-

- 1) The I/c Dean, Faculty of Science & Technology,
- 2) The Chairman, Board of Studies in Civil Engineering,
- 3) The Director, Board of Examinations and Evaluation,
- 4) The Director, Board of Students Development,
- 5) The Co-ordinator, University Computerization Centre,

dpmk
(Dr. Ajay Deshmukh)
REGISTRAR

UNIVERSITY OF MUMBAI



Revised syllabus (Rev- 2016) from Academic Year 2016 -17

Under

FACULTY OF TECHNOLOGY

Civil Engineering

Second Year with Effect from A.Y. 2017-18

Third Year with Effect from A.Y. 2018-19

Final Year with Effect from A.Y. 2019-20

As per Choice Based Credit and Grading System

with effect from the A.Y. 2016–17

Dean, Faculty of Science and Technology

Preamble:

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome-based education in the process of curriculum development. Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEOs) and give freedom to affiliated Institutes to add few (PEOs). It is also resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology and developed curriculum accordingly. In addition to outcome-based education, semester-based credit and grading system is also introduced to ensure quality of engineering education. Choice based Credit and Grading system enables a much-required shift in focus from teacher-centric to learner centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scales to grade learner's performance. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc. Choice based Credit and grading system is implemented from the academic year 2016-17 through optional courses at department and institute level. This will be effective for SE, TE and BE from academic year 2017- 18, 2018-19 and 2019-20 respectively.

Dr. S. K. Ukarande

Dean(I/c) Faculty of Science and Technology,

Member - Academic Council,

University of Mumbai, Mumbai

Chairman

Preamble:

Engineering education in India is expanding and is set to increase manifold. The major challenge in the current scenario is to ensure quality to the stakeholders along with expansion. To meet this challenge, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education and reflects the fact that in achieving recognition, the institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of graduation from the program. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating the philosophy of outcome-based education in the process of curriculum development. As the Chairman, Board of Studies in Civil Engineering of the University of Mumbai, I am happy to state here that, the Program Educational Objectives for Undergraduate Program were finalized in a brain storming session, which was attended by more than 40 members from different affiliated Institutes of the University. They are either Heads of Departments or their senior representatives from the Department of Civil Engineering. The Program Educational Objectives finalized for the undergraduate program in Civil Engineering are listed below;

1. To prepare the Learner with a sound foundation in the mathematical, scientific and engineering fundamentals
 2. To motivate the Learner in the art of self-learning and to use modern tools for solving real life problems
 3. To inculcate a professional and ethical attitude, good leadership qualities and commitment to social responsibilities in the Learner's thought process
 4. To prepare the Learner for a successful career in Indian and Multinational Organisations
- In addition to Program Educational Objectives, for each course of the program, objectives and expected outcomes from a learner's point of view are also included in the curriculum to support the philosophy of outcome-based education.

I strongly believe that even a small step taken in the right direction will definitely help in providing quality education to the major stakeholders.

Dr. S. K. Ukarande

Chairman, Board of Studies in Civil Engineering,

University of Mumbai

University of Mumbai
Scheme of Instructions and Examination
Second Year Engineering (Civil Engineering)
(With effect from 2017- 2018)
(Semester-III)

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
CE-C301	Applied Mathematics -III*	4	-	1	4	-	1	5
CE-C302	Surveying- I	4	2	-	4	1	-	5
CE-C303	Strength of Materials	4	2	-	4	1	-	5
CE-C304	Engineering Geology	3	2	-	3	1	-	4
CE-C305	Fluid Mechanics-I	3	2	-	3	1	-	4
Total		18	8	1	18	4	1	23

Subject Code	Subject Name	Examination Scheme							
		Theory					TW	Oral & Practical	Total
		Internal Assessment			End Sem Exam	Exam Duration			
		Test1	Test2	Avg					
CE-C301	Applied Mathematics- III	20	20	20	80	3	25	-	125
CE-C302	Surveying- I	20	20	20	80	3	25	25**	150
CE-C303	Strength of Materials	20	20	20	80	3	25	25	150
CE-C304	Engineering Geology	20	20	20	80	3	25	25	150
CE-C305	Fluid Mechanics -I	20	20	20	80	3	25	25	150
Total		--	--	100	400	-	125	100	725

*Common with Mechanical/ Automobile/ Mechatronics

** For the course ‘Surveying-I (CE-C 302)’, the oral examination will be conducted in conjunction with practical/s

University of Mumbai
Scheme of Instructions and Examination
Second Year Engineering (Civil Engineering)
(With effect from 2017- 2018)
(Semester -IV)

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
CE-C401	Applied Mathematics-IV*	4	-	1	4	-	1	5
CE-C402	Surveying-II	3	3	-	3	1.5	-	4.5
CE-C403	Structural Analysis-I	4	2	-	4	1	-	5
CE-C404	Building Design & Drawing	2	3	-	2	1.5	-	3.5
CE-C405	Building Materials & Construction Technology	4	2	-	4	1	-	5
CE-C406	Fluid Mechanics-II	3	2	-	3	1	-	4
Total		20	12	1	20	6	1	27

Subject Code	Subject Name	Examination Scheme							
		Theory					TW	Oral & Practical	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test1	Test2	Avg.					
CE-C401	Applied Mathematics- IV*	20	20	20	80	3	25	--	125
CE-C402	Surveying-II	20	20	20	80	3	50	25**	175
CE-C403	Structural Analysis-I	20	20	20	80	3	25	25	150
CE-C404	Building Design & Drawing	20	20	20	80	4	25	25@	150
CE-C405	Building Materials & Construction Technology	20	20	20	80	3	25	25	150
CE-C406	Fluid Mechanics-II	20	20	20	80	3	25	25	150
Total		--	--	120	480	--	175	125	900

* Common with Mechanical/ Automobile/ Mechatronics

** For the course 'Surveying-II (CE-C 402), the oral examination will be conducted in conjunction with practical/s

@ For the course 'Building Design and Drawing (CE-C 404)', the oral examination shall be conducted in conjunction with the sketching examination.

University of Mumbai
Scheme of Instructions and Examination
Third Year Engineering (Civil Engineering)
(With effect from 2018- 2019)
(Semester -V)

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practs.	Tut.	Theory	Practs.	Tut.	Total
CE-C501	Structural Analysis – II	4	2	--	4	1	--	5
CE-C502	Geotechnical Engineering – I	3	2	--	3	1	--	4
CE-C503	Applied Hydraulics	3	2	--	3	1	--	4
CE-C504	Environmental Engineering -I	3	2	--	3	1	--	4
CE-C505	Transportation Engineering – I	3	2	--	3	1	--	4
CE-DLO506X	Department Level Optional Course – I	3	2	--	3	1	--	4
CE-C507	Business and Communication Ethics	--	4#	--	--	2	--	2
Total		19	16		19	8	-	27

Subject Code	Subject Name	Examination Scheme								
		Theory					Term Work	Practs .	Oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (In Hrs.)				
		Test 1	Test 2	Avg						
CE-C501	Structural Analysis-II	20	20	20	80	3	25	--	25	150
CE-C502	Geotechnical Engineering – I	20	20	20	80	3	25	--	25	150
CE-C503	Applied Hydraulics	20	20	20	80	3	25	--	25	150
CE-C504	Environmental Engineering -I	20	20	20	80	3	25	--	25	150
CE-C505	Transportation Engineering – I	20	20	20	80	3	25	--	25	150
CE-DLO506X	Department Level Optional Course -I	20	20	20	80	3	25	--	25	150
CE-C507	Business and Communication Ethics	--	--	--	--	--	50*	--	--	50
Total		--	--	120	480	--	200	--	150	950

University of Mumbai
Scheme of Instructions and Examination
Third Year Engineering (Civil Engineering)
(With effect from 2018- 2019)
(Semester -VI)

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut.	Theory	Practs	Tut.	Total
CE-C601	Geotechnical Engineering. – II	3	2	--	3	1	--	4
CE-C602	Design and Drawing of Steel Structures	4	2	--	4	1	--	5
CE-C603	Transportation Engineering. – II	3	2	--	3	1	--	4
CE-C604	Environmental Engineering. – II	3	2	--	3	1	--	4
CE-C605	Water Resource Engineering –I	3	2	--	3	1	--	4
CE-DLO606X	Department Level Optional Course – II	3	2	--	3	1	--	4
CE-C607	Software Applications in Civil Engineering	--	2	--	--	1	--	1
Total		19	14	--	19	7	--	26

Subject Code	Subject Name	Examination Scheme								
		Theory					Term Work	Pract.	Oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (InHrs.)				
		Test1	Test2	Avg						
CE-C601	Geotechnical Engineering-II	20	20	20	80	3	25	--	25	150
CE-C602	Design and Drawing of Steel Structures	20	20	20	80	4	25	--	25@	150
CE-C603	Transportation Engineering- II	20	20	20	80	3	25	--	--	125
CE-C604	Environmental Engineering-II	20	20	20	80	3	25	--	25	150
CE-C605	Water Resource Engineering-I	20	20	20	80	3	25	--	25	150
CE-DLO606X	Department Level Optional Course-II	20	20	20	80	3	25	--	25	150
CE-C607	Software Applications in Civil Engineering	--	--	--	--	--	25		25	50
Total		120	120	120	480		175	--	150	925

For the course ‘Business and Communication Ethics (CE- C507), although 04 (Four) clock hours are mentioned under the head of Practical, 02 (Two) clock hours out of these 04 (Four) clock hours may be utilized as the Theory at the Institute/ College Level so as to enable the instructor (teacher) to impart the theoretical aspects of the said course. Accordingly, the provision may be made in the Time Table.

* Further, the oral examination in respect of the course ‘Business and Communication Ethics (CE-C 507)’ will be an internal oral and will be conducted in conjunction with seminar/ presentation.

@ For the course, Design and Drawing of Steel Structures (CE-C 602), the oral examination will be conducted in conjunction with sketching.

Department Level Optional Course –I	Department Level Optional Course- II
CE-DLO5061: Advanced Surveying	CE-DLO6061: Advanced Construction Equipment
CE-DLO5062: Advanced Concrete Technology	CE-DLO6062: Traffic Engineering and Management
CE-DLO5063: Building Services and Repairs	CE-DLO6063: Ground Improvement Techniques
CE-DLO5064: Advanced Structural Mechanics	CE-DLO6064: Advanced Structural Analysis

University of Mumbai
Scheme of Instructions and Examination
Fourth Year Engineering (Civil Engineering)
(With effect from 2019-2020)
(Semester -VII)

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practs.	Tut.	Theory	Pract.	Tut.	Total
CE-C701	Quantity Survey Estimation and Valuation	4	2	--	4	1	-	5
CE-C702	Theory of Reinforced Concrete Structures	4	--	2	4		2	6
CE-C703	Water Resource Engineering -II	3	--	2	3	--	2	5
CE-DLO704X	Department Level Optional Course-III	3	--	2	3	--	2	5
ILO701X	Institute Level Optional Course-I	3	--		3	--		3
CE-C705	Project – Part I	--	6	--	--	3	--	3
Total		17	8	6	17	4	6	27

Subject Code	Subject Name	Examination Scheme								
		Theory					Term Work	Pract	Oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (InHrs.)				
		Test1	Test 2	Avg						
CE-C701	Quantity Survey Estimation and Valuation	20	20	20	80	4	25	--	25	150
CE-C702	Theory of Reinforced Concrete Structures	20	20	20	80	3	25	--	25	150
CE-C703	Water Resource Engineering-II	20	20	20	80	3	25	--	25	150
CE-DLO704X	Department Level Optional Course-III	20	20	20	80	3	25	--	25	150
ILO701X	Institute Level Optional Course I	20	20	20	80	3	--	--	-	100
CE-P705	Project – Part I	--	--	--	--	--	50	--	25@	75
Total		100	100	100	400		150	--	125	775

@ For Project Part-I (CE-P 705), the oral examination shall be based on the presentation/ seminar before the board of internal examiners to be appointed by the Head of the concerned Department.

University of Mumbai
Scheme of Instructions and Examination
Fourth Year Engineering (Civil Engineering)
(With effect from 2019-2020)
(Semester- VIII)

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practs	Tut.	Theory	Practs	Tut	Total
CE-C801	Design and Drawing of Reinforced Concrete Structures	4	2	--	4	1	-	5
CE-C802	Construction Management	4	2	--	4	1	-	5
CE-DLO803X	Department Level Optional Course- IV	4	2	--	4	1	--	5
ILO802X	Institute Level Optional Course- II	3	--	--	3	--	--	3
CE-P804	Project – Part II	--	12	--	--	6	--	6
Total		15	18	-	15	9	-	24

Subject Code	Subject Name	Examination Scheme								
		Theory					Term Work	Pract	Oral	Total
		Internal Assessment			End Sem Exam	Exam. Duration (In Hrs.)				
		Test1	Test 2	Avg						
CE-C801	Design and Drawing of Reinforced Concrete Structures	20	20	20	80	4	25	--	25	150
CE-C802	Construction Management	20	20	20	80	3	25	--	25	150
CE-DLO803X	Department Level Optional Course-IV	20	20	20	80	3	25	--	25	150
ILO802X	Institute Level Optional Course II	20	20	20	80	3	--	--	--	100
CE-P804	Project – Part II	--	--	--			50	--	50 [#]	100
Total		80	80	80	320		125		125	650

[#] The oral examination for the Project- Part II (CE-P 804) shall be based on the presentation/ seminar to be delivered by the projectee/s before the board of examiners. The board of internal examiners will comprise of the internal examiners and the external examiners to be approved by the University from the pool of eligible examiners.

Guidelines for Project, i.e., Dissertation (Part-I and II)

- (i) Students can form groups with minimum of 2 (Two) students and not more than 4 (Four) students.
- (ii) Faculty load: In Semester VII: 01 (One) clock hour per week per project group and in Semester VIII: 02 (Two) clock hours per week per project group.
- (iii) Each faculty member shall be permitted to guide maximum 04 (Four) project groups.

Department Level Optional Course – III (Semester – VII)	Department Level Optional Course – IV (Semester – VIII)
CE-DLO7041: Pre-stressed Concrete CE-DLO7042: Solid Waste management CE-DLO7043: Pavement Sub-grade and Materials CE-DLO7044: Structural Dynamics CE-DLO7045: Application of GIS and Remote Sensing CE-DLO7046: Foundation Analysis and Design	CE-DLO8031: Advanced Design of Steel Structures CE-DLO8032: Industrial Waste Treatment CE-DLO8033: Pavement Design and Construction CE-DLO8034: Bridge Engineering and Design CE-DLO8035: Appraisal and Implementation of Infrastructure Projects CE-DLO8036: Soil Dynamics CE-DLO8037: Applied Hydrology and Flood Control

Institute Level Optional Course – I (Semester –VII)	Institute Level Optional Course – II (Semester – VIII)
ILO7011: Product Lifecycle Management ILO7012: Reliability Engineering ILO7013: Management Information Systems ILO7014: Design of Experiments ILO7015: Operations Research ILO7016: Cyber Security and Laws ILO7017: Disaster Management and Mitigation Measures ILO7018: Energy Audit and Management ILO7019: Development Engineering	ILO8021: Project Management ILO8022: Finance Management ILO8023: Entrepreneurship Development and Management ILO8024: Human Resources Management ILO8025: Professional Ethics and Corporate Social Responsibility (CSR) ILO8026: Research Methodology ILO8027: Intellectual Property Rights and Patenting ILO8028: Digital Business Management ILO8029: Environment Management

Semester-VII

Semester VII		
Subject Code	Subject Name	Credits
CE-C 701	Quantity Survey, Estimation & Valuation	5

Teaching Scheme						
Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
04	02	--	04	01	--	05

Evaluation Scheme								
Theory					Term Work/ Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20						
			80	04 Hrs.	25	-	25	150

Rationale

Any structure, i.e., building, bridge, dam etc. consists of various building materials. Due to rise in the cost of materials, the structure has to be designed so that it is safe, serviceable and economical. Without proper design and estimation, it may lead to the increase in cost of construction and it further affects the economical aspect of the structure. A prior knowledge of various building materials is required for the construction and it controls the cost of the structure, save wastage of labour-hours and eventually helps in giving the correct amount required and quantity of various materials required. It also helps in scheduling of men, materials and machine to be used in the project at stages. The scope of the subject includes estimating, costing, analysis of rates, specification, valuation, tender and contracts etc.

Objectives

- To read, understand and interpret plans, sections, detailed drawings and specifications for a construction project.
- To study the various methods of detailed and approximate estimates.
- To emphasize the importance of relevant IS: 1200- 1964 codes and relevant Indian Standard specifications, taking out quantities from the given requirements of the work, and drafting specifications.
- To conduct a material and labour survey to understand the current market rates for the various materials required for construction and the different categories of labour required.
- To perform the rate analysis for various items: standard and non-standard and the use of DSR in this process.
- To study the process of tendering and its various stages, various types of contracts, its suitability and validity as per the Indian Contract Act of 1872 and draft various clauses and conditions of a contract.

Detailed Syllabus		
Module	Sub-Modules/ Contents	Hrs
I.	Introduction	04
	1.1 Importance of Course	
	1.2 Measurement systems for various items of civil engineering structures.	
	1.3 Units of measurement of various items of works	
	1.4 I.S1200	
II.	Specifications & Rate Analysis	09
	2.1 Types & importance of specifications, rules to be followed for drafting the specifications of various items of work etc	
	2.2 Rate analysis, its importance & necessity, Factors affecting rate analysis, Task work, sources of materials, Study of IS 7272 regarding labour output ,District Schedule of Rates(DSR) Rate analysis of important items of construction works.	
III.	Estimates	14
	3.1 Approximate Estimate Definition & Purposes of approximate estimates, Methods for preparing approximate estimates & numerical based on methods, Various terms such as administrative approval, Technical sanction, Contingencies, Work charged establishments etc.	
	3.2 Detailed Estimate Definition & purposes of detailed estimate, Data required for preparation of detailed estimate. Methods of taking out quantities such as long wall & short wall method, Centre line method etc Bar Bending Schedule & its necessity, preparation of bar bending schedule of various structural elements as per code IS2502.Preparation of detailed estimate of R.C.C framed structures	
IV.	Estimation of Earthwork for Roads & Canals	06
	4.1 Methods of computation of volume of earthwork such as mean area method, mid-sectional area method, Prismoidal formula, Trapezoidal formula, Spot level method etc. & numericals based on methods. Mass haul diagram & its necessity, Terms like lead & lift etc.	
V.	Tenders & Contracts	09
	5.1 Tenders Definition & types of tenders, Tender notice & its inclusions, Pre-qualification of contractors, Pre-bid meeting, Procedure for submission & Opening of tender, acceptance & rejection of tender, Tender validity period, E-Tendering	
	5.2 Contracts Definition, basic forms such as Valid, void & voidable contract. General types of contract with their suitability, conditions of contract	
	5.3 Dispute resolution methods Causes of disputes & disputes resolution methods such as litigation, mediation & arbitration	

VI.	Valuation		10
	6.1	Difference between cost, price & value. Types of value, Valuation & its purposes. Various terms such as depreciation, sinking fund, capitalized value, years purchase etc. Methods for calculating depreciation of building	
	6.2	Methods of valuation such as Rental method, land & building method, Belting method etc.	
	6.3	Freehold Properties, Leasehold Properties, Easement rights	
	6.4	Numericals based on valuation	

Contribution to Outcomes

On completion of the course, the learners will be able to:

- **Apply** the measurement systems to various civil engineering items of work.
- **Draft** the specifications for various items of work & determine unit rates of items of works
- **Estimate** approximate cost of the structures by using various methods & **prepare** detailed estimates of various civil engineering structures by referring drawings.
- **Assess** the quantities of earthwork & **construct** mass haul diagrams.
- **Draft** tender notice & **demonstrate** the significance of the tender as well as contract process.
- **Determine** the present fair value of any constructed building at stated time.

Theory examination:

- Question paper will comprise of **six** questions; each carrying 20 marks.
- The **first** question will be **compulsory** based on computation of quantities of various items of work by referring drawings.
- The remaining **five** questions will be based on all the modules of entire syllabus. For this, the modules shall be divided proportionately further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module or contents thereof.
- There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
- The students will have to attempt any **three** questions out of remaining five questions.
- Total **four** questions need to be attempted.

Oral Examination:

The oral examination will be based on the entire syllabus and the term work.

Term Work:

The term work shall consist of the following:

- At least **eight** assignments based on entire syllabus
- Detailed estimate of any **Three** of the following with the required material survey for the same.

- Single Storied building (RCC)
- Road work
- Load bearing structure
- Cross drainage work
- Valuation report in a standard format of the Government/ Private company/Firm.

The use of quantity survey software and the use of worksheets/databases while solving some of the afore-mentioned assignments is desirable.

Distribution of Term Work Marks:

The marks of the term-work shall be judiciously awarded depending upon the quality of the term work including that of the report on assignments. The final certification and acceptance of the term-work warrants the satisfactory and the appropriate completion of the assignments; and the minimum passing marks to be obtained by the students. The following weight age of marks shall be given for different components of the term work.

Assignments : 20 Marks

Attendance : 05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

75%- 80%: 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks

Recommended Books:

- 1) Estimating, Costing, Specifications and Valuation: *Chakraborty, M.*, Kolkata.
- 2) Building and Engineering Contracts: *Patil, B. S.*, University Press, Hyderabad.
- 3) Estimating and costing: *Datta, B. N.*, UBS Publications
- 4) Relevant Indian Standard Specifications, BIS Publications
- 5) World Bank approved contract documents

Semester VII		
Subject Code	Subject Name	Credits
CE-C 702	Theory of Reinforced Concrete Structures	06

Teaching Scheme						
Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
04	-	02	04	-	02	06

Evaluation Scheme								
Theory					Term Work/ Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20						

Rationale

Working stress Method (WSM) makes use of the concept of modular ratio based on the higher factor of safety in evaluating the stresses in two different materials of the RCC i.e. steel and the concrete. The limit state method (LSM) is based on the statistical probability which provides the rational solution to the design problem. The philosophy lies behind LSM uses multiple safety factors format which attempts to provide adequate safety at the ultimate load as well as adequate serviceability at service load by considering all possible limit states. The subject involves the application of working stress and limit state method in the analysis and design of various elements of the civil engineering structures.

Objectives

- To develop the clear understanding of design philosophy amongst the students for the design of reinforced concrete structure using (WSM) working stress method and (LSM) limit state method.
- To study the various clauses of IS: 456-2000 and its significance in the RCC design.
- To apply the concepts of LSM in the analysis and design of beams, slabs and columns.
- To study the concept of Serviceability and durability for deflection and crack width calculation in RCC structures.
- To study the concept of reinforced concrete footing design subjected to axial load and moment.
- To develop the concept of design using ready charts and curves for column subjected to axial load and moments.

Detailed Syllabus

Module	Contents	Hrs
I.	Working Stress Method Concept of reinforced concrete, Working Stress Method (WSM) of design for reinforced concrete, permissible stresses as per IS-456-2000; stress- strain curve of concrete and steel, characteristics of concrete steel reinforcement. Concept of balanced, under reinforced and over reinforced sections. Analysis design of singly reinforced and doubly reinforced rectangular beams for flexure, shear by WSM, Analysis and design of Cracked and un-cracked RCC column sections by WSM	12
II.	Limit State Method Introduction to limit state method of design as per IS-456-2000; concepts of probability and reliability, characteristic loads, characteristic strength, partial safety factors for loads and materials, introduction to various limit states.	03
III.	Limit State of Collapse – Flexure, Shear, Bond and Torsion Limit state of collapse in flexure, shear and Limit state of serviceability in deflection and cracking, design of singly and doubly reinforced rectangular and T sections for flexure, design of members in shear and bond, design of beam subjected to bending and torsion. Requirements governing reinforcement detailing. Deflection and crack width calculation for RCC members.	15
IV.	Design of Slabs using LSM: Design of one way, one way continuous slab and two way slabs with all end conditions as per IS-456-2000.	06
V.	Limit State of Collapse – Compression: Limit state of collapse compression for short and slender column. Members subjected to combined axial and uni-axial as well as biaxial bending. Development of interactive curves and their use in column design.	08
VI.	Design of Foundations: Isolated square and rectangular footings subjected to axial load and moments. Design of combined rectangular pad footings, slab beam type footing. Design of Raft foundations (No numerical to be asked on raft foundations in the exam)	08

Contribution to Outcomes

On successful completion of the course, the student shall be able to:

- Understand the pros and cons of the WSM and LSM.
- Understand the various clauses specified in IS: 456-2000 for designing structural members with the safety and economy.
- Carry out analysis and design of various elements of the reinforced concrete structures such as beam, slab, column, footings using the concept of Limit state method.
- Understand and the use of readymade design curves from Special publications of Bureau of Indian standards.

Theory Examination:-

- **Use of IS:456-2000 shall be allowed in the examination.**
- Question paper will comprise of **six** questions; each carrying 20 marks.
- The **first** question will be **compulsory** will have the short questions having weightage of 4-5 marks covering the entire syllabus.
- The remaining **five** questions will be based on all the modules of the entire syllabus. For this, the modules shall be divided proportionately further; and the weightage of marks shall be judiciously awarded in proportion to the importance of the sub-module contents thereof.
- There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
- The students will have to attempt any **three** questions out of remaining five questions.
- Total **four** questions need to be attempted.

Term Work:

The term-work shall comprise of the neatly written report of the assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least two problems on each modules/ sub-modules contents thereof. At least one numerical on raft foundation shall be included in assignments.

Distribution of Term-work Marks:

The marks of the term-work shall be judiciously awarded depending upon the quality of the term work including that of the report on assignments. The final certification acceptance of the term-work warrants the satisfactory and the appropriate completion of the assignments, the minimum passing marks to be obtained by the students. The following weightage of marks shall be given for different components of the term work.

- Assignments : 20 Marks
- Attendance : 05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

75%- 80%: 03 Marks; 81%- 90%: 04 Marks 91% onwards: 05 Mark

Recommended Books:-

1. Design of Reinforced Concrete Structures: *Dayaratnam, P*; Oxford and IBH.
2. Limit State Design – Reinforced Concrete: *Jain A. K*, Nemchand and Bros., Roorkee
3. Limit State Design – Reinforced Concrete: *Shah and Karve*, Structure Publications, Pune.
4. Ultimate Strength Design for Structural Concrete: *Arthur, P. D. and Ramakrishnan, V.*, Wheeler and Co. Pvt. Ltd.
5. Reinforced Concrete: *H.J. Shah*, Charotar Publishers, Anand.
6. Fundamentals of Reinforced Concrete: *Sinha& Roy*, S. Chand and Co. Ltd.
7. Illustrated Reinforced Concrete Design: *Dr. V. L. Shah and Dr. S. R. Karve*, Structure Publications, Pune.
8. Reinforced Concrete Design: *Wang, C. K., Salmon, C. G., and Pincheira, J. A.*, John Wiley (2007), 7th Edition.

9. Reinforced Concrete Fundamentals: *Ferguson, P. M., Breen, J. E., and Jirsa, J. O.*, John Wiley & Sons (1988) 5th Edition.
10. RCC Design (WSM and LSM): *Punmia, B. C., Jain, A. K., and Jain, Arun, K.*, Laxmi Publications.
11. Limit State Design of Reinforced Concrete (as per IS: 456-2000): *Punmia, B. C., Jain, A. K., and Jain, Arun, K.*, Laxmi Publications.
12. Design of RCC structural Elements (RCC Vol-I): *Bhavikatti, S. S.*, New Age International Publications.
13. Reinforced Concrete: *Syal and Goel*; Wheeler Publishers.
14. Relevant IS Codes: BIS Publications, New Delhi.
15. Reinforced Concrete Design: *Pillai, S. U. and Menon, Devdas*, Tata Mc-Graw Hill Publishing House, New Delhi.
16. Reinforced Concrete Design by S.N. Sinha, Tata Mc-Graw Hill Publishing House, New Delhi.
17. Theory of Reinforced concrete structures by N. Subramanian , Oxford University Press.

Semester VII		
Subject Code	Subject Name	Credits
CE-C 703	Water Resources Engineering II	05

Teaching Scheme						
Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
03	-	02	03	-	02	05

Evaluation Scheme								
Theory					Term Work/ Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03 Hrs.	25	-	25	150

Rationale

This subject provides necessary knowledge about design of gravity dams, earthen dams, energy dissipaters, canal headwork's, and canal structures. This subject is also useful with respect to facts, concepts, principles and procedures related to canal design, canal lining, cross drainage works and water logging. Further students will be able to plan and execute the construction of these structures.

Objectives

- To understand different types of dams and its suitability to a particular region.
- To study design consideration of earthen dams
- To study various types of Spillways
- To understand the importance of silt theories for design of irrigation channels
- To study the classification of canals and design of canal system.

Detailed Syllabus

Module	Topics	Hrs
I	Gravity dams	08
	Definition, typical cross section, forces acting on gravity dam, modes of failure and structural stability analysis, profile of dam- elementary and practical profile, low and high gravity dam, design consideration and fixing of section of dam, methods of design, construction of galleries in dams, types of joints, temperature control in concrete dams, foundation treatment, Arch dams, types of arch dams	
II	Earth and rock fill dams:	06
	Types of earth dams, method of construction, causes and failures of earth dams, design criteria, selecting suitable preliminary section, seepage line for different conditions and its location, seepage control through embankment and through foundations, Swedish circle method with pore pressure, details of	

	construction and maintenance, types of rock fill dams, stability analysis, advantages	
III	Spillways and flood control works:	06
	Introduction, location of spillway, design consideration of main spillway, controlled and uncontrolled spillway, types of spillways, design principles of ogee spillway. Chute spillway. Siphon spillway and shaft spillway, energy dissipation below overflow and other types of spillways, design of bucket type energy dissipater and stilling basin, flood mitigation reservoirs. Crest gates, types, advantages, design of radial gate, outlet works through dams, intake structures.	
IV	Irrigation Channels (Silt Theories)	07
	Kennedy's theory, Kennedy's methods of channel designs silt supporting capacity according to Kennedy's theory. Drawbacks in Kennedy's theory. Lacey's regime theory, Lacey's theory applied to channel design. Comparison of Kennedy's and Lacey's theory defects in Lacey's theory. Introduction to Sediment transport in channels.	
V	Canal Head works and Distribution System	06
	Canals: Classification, canal alignment, canal losses, estimation of discharge, cross sections of irrigation canals, maintenance of irrigation canal, canal lining, economics of canal lining, water logging, effect of water logging, remedial measures.	
VI	Canal structures	06
	Canal falls, types of canal falls, canal escapes, types, canal head regulators, cross regulators, canal outlets and its types cross drainage works and types of cross drainage works.	

Course Outcomes

On completion of this course the student will be able to:

- Design the section of gravity dams, earth and rockfill dams, arch dams and buttress dams.
- Design spillways and energy dissipaters.
- Apply silt theories to design irrigation canals.
- Explain various types of canals and its maintenance.
- Explain different cross drainage works of a canal system.

Theory examination:

1. The question paper will comprise of six questions; each carrying 20 marks.
2. The first question will be compulsory and will have short questions having weightage of 4-5 marks covering the entire syllabus.
3. The remaining five questions will be based on all the modules of the entire syllabus. For this, the modules shall be divided proportionately and further, the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and contents thereof.
4. The students will have to attempt any three questions out of remaining five questions.
5. Total four questions need to be attempted.

Oral Examination:

The oral Examination shall be based upon the entire syllabus and the term work consisting of the assignments.

Term Work:

The term work shall comprise of the neatly written report based on assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems on each sub-modules and contents thereof further. It is advisable to arrange dam visit.

Distribution of the Term Work Marks:

The marks of the term work shall be judiciously awarded depending upon the quality of the term work. The final certification and acceptance of term work warrants the satisfactory and appropriate completion of the assignments.

The following weightage of marks shall be given for different components of the term work.

- Assignments : 20 Marks
- Attendance : 05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

- 75%- 80% : 03 Marks; 81%- 90%: 04 Marks 91% onwards: 05 Marks

Recommended Books:

1. Irrigation and Water Power Engineering: *B.C. Punmia, Pande B.B.Lal, A.K Jain*. Laxmi Publications Pvt, Ltd. New Delhi.
2. Irrigation Engineering and Hydraulic Structures: *S.K. Ukarande*, Ane Books Pvt. Ltd. ISBN, 9789383656899.
3. Irrigation Water Resources and Water Power Engineering: *P.N. Modi*, Standard Book House, Delhi, ISBN 978-81-87401-29-0.
4. Irrigation Engineering and Hydraulics Structures: *S. K. Garg*, Khanna Publishers. Delhi.
5. Design of Irrigation Structures: *S. K. Sharma*, S. Chand and Co.
6. Theory and Design of Irrigation Structures: *R. S. Varshney and R. C. Gupta*, Nem Chand
7. Engineering for Dams, Vol. I to III: *Crager, Justin and Hinds*, John Wiley
8. Design of Small Dams: USBR.
9. Hydro Power Structures: *R. S. Varshney*, Nem Chand and Bross.
10. Concrete Dams: *R. S. Varshney*, Oxford and IBH Publishing Co.

Semester-VII		
Subject Code	Subject Name	Credits
CE-DLO 7041	Department Level Elective: Pre-stressed Concrete	5

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorials	Theory	Practical	TW/Tutorials	Total
3	-	2	3	-	2	5

Evaluation Scheme

Theory					Termwork/Practical/ Oral/Tutorials			Total
Internal Assessments			ESE	Duration of ESE	TW/TU	PR	OR	
IAE-I	IAE-II	Avg						
20	20	20	80	3Hr	25	-	25	150

Rationale

The course is aimed to make the student to be aware of highly mechanized technology in civil engineering construction and to develop the basic understanding of pre-stressed concrete which is used in a wide range of building and civil structures. A Pre-stressed Concrete section improves performance/efficiency, reduces structural thicknesses, and material savings compared with simple reinforced concrete sections. Typical applications of pre-stressed concrete include high rise buildings, residential slabs and bridge structures etc.

Objectives

- To bring the students to such a level so as to enable them to take the appropriate decision in respect of choice of pre-stressed section over R. C. C. as a civil engineer.
- To make the candidate to understand the analysis of Pre-stressed Concrete sections and losses in pre-stress.
- To make the candidate able to understand and implement the guidelines of Indian Standard code for analysis and design sections using limit state philosophy.

Detailed Syllabus

Module	Sub module/Contents	Hrs
I	Introduction to pre-stressed concrete and analysis of pre-stressed concrete section : Basic concept and general principles, materials used and their properties, methods, techniques and systems of pre-stressing	04
II	Analysis of Pre-stressed Concrete Section: Loading stages, stress method, load balancing method and internal resisting couple method of analysis, cable profiles, pressure line, kern points, choice and efficiency of sections	10
III	Losses in pre-stress: Loss of stresses due to elastic deformation of concrete, creep in concrete, creep in steel, shrinkage in concrete, relaxation in steel, anchorage slip and friction	06
IV	Analysis of Pre-stressed Concrete Members in Limit State of Serviceability deflection: Short time and long time deflection of uncracked members, permissible limits	05

V	Analysis and Design of Pre-stressed Concrete Members for Limit State of Collapse Shear Calculation of principle tension, permissible principle tension, Analysis and Design of members in shear (sections uncracked in flexure)	05
VI	Analysis and Design of Pre-stressed Concrete Members for Limit State of Collapse Flexure and Serviceability Cracking General philosophy of design, Analysis and design of members in flexure, permissible stresses in concrete and steel at different stages, suitability of section, safe cable zone	09

Contribution to outcome

On successful completion of the course, the students shall be able:

- To understand the basic concept, application and behaviour of pre-stressing over that of the RC structure.
- To have knowledge of modern engineering tools necessary for pre-tensioning and post-tensioning technology.
- To evaluate various losses occurring in pre-stressed concrete structure
- To analyze the various pre-stressed components of the structure and design the same for flexure as well as shear using relevant IS Code.
- To analyze pre-stressed concrete members for limit state of serviceability for cracking and deflection

Theory Examination:-

- Question paper will comprise of **six** questions; each carrying 20 marks.
- The **first** question will be **compulsory** which will have the short questions having weightage of 4-5 marks covering the entire syllabus.
- The remaining **five** questions will be based on all the modules of entire syllabus. For this, the module shall be divided proportionately further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and contents thereof.
- There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
- The students will have to attempt any **three** questions out of remaining five questions.
- Total **four** questions need to be attempted.

Oral Examination:

The oral Examination shall be based upon the entire syllabus, site visit and the term work.

Site Visit/ Field Visit:

The students shall visit the site where the construction of structure using pre-stressed concrete is going on. The students shall prepare the detailed report thereof and submit as a part of the term work.

Term Work:

The term work shall consist of the assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least three problems/ questions on each modules/ sub-modules and contents thereof further. The report of the site visit/ field visit shall also form a part of the term work.

Distribution of Term Work Marks:

The marks of term-work shall be judiciously awarded depending upon its quality. The final certification and acceptance of the term-work warrants the satisfactory and the appropriate completion of the assignments, properly compiled report of the site visit /field visit and the minimum passing marks to be obtained by the student.

The following weightage of marks shall be given for different components of the term work.

Assignments:	15 Marks
Report of the Site Visit/Field Visit:	05 Marks
Attendance:	05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to:

75%- 80%: 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks

Recommended Books:

1. Prestressed Concrete: *N. Krishna Raju*, McGraw Hill, New York.
2. Prestressed Concrete: *N. Rajgopalan*, Narosa Publishing House.
3. Fundamentals of Prestressed Concrete: *Sinha, N.C. and S.K. Roy*, S.C. Chand and Company.
4. Prestressed Concrete Structures: *Dayaratnam, P.*, Oxford and IBH
5. Design of Prestressed Concrete Structures: *T.Y. Lin and N.H. Burns*, John Willey, New York.
6. Design of Prestressed Concrete: *Nilson Arthur*, McGraw Hill Book Company.
7. Prestressed Concrete Vol—I: *IY. Guyon*, Contractors Record, London.
8. Prestressed Concrete: *S. Ramamurtham*, Dhanpat Rai and Son's
9. Relevant latest IS codes (IS:1343-2012)

Semester-VII		
Subject Code	Subject Name	Credits
CE-DLO 7042	Department Level Elective: Solid Waste Management	5

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorials	Theory	Practical	TW/Tutorials	Total
3	-	2	3	-	2	5

Evaluation Scheme

Theory					Teamwork/Practical/ Oral/Tutorials			Total
Internal Assessments			ESE	Duration of ESE	TW/TU	PR	OR	
IAE-I	IAE-II	Average						
20	20	20	80	3Hr	25	-	25	150

Rationale

This course will be of interest to those wishing to understand the principles and techniques of solid waste management, including the legislative, environmental, economic and social drivers. Students will be introduced to the selection and design of appropriate methods of storage, collection, transfer, treatment and disposal in both industrialized and developing countries. The course also provides the opportunity to visit recycling facilities and disposal sites to better understand links between theory and practice.

Objectives

- To make the students conversant with different aspects of the types, sources, generation, storage, collection, transport, processing and disposal of municipal solid waste.
- To provide knowledge of different types of sources, sampling and characteristics of solid waste.
- To impart knowledge and skills in the collection, storage, transport and recycling options for solid wastes including the related engineering principles, design criteria, methods and equipments.
- To fully appreciate the current practices available and implement the systems available in solid waste management.
- To be aware of the significance of recycling, reduce, reuse of solid wastes and also to impart students with the skill of design and operation of disposal system based on latest technology.
- To provide students prerequisite knowledge necessary for higher studies and research in the field of Solid waste management.

Module	Sub Modules/Contents	Hrs
I	Introducing Municipal Solid Waste Management Overview: problems and issues of solid waste management - Need for solid waste management-Functional elements such as waste generation, storage, collection, transfer and transport, processing, recovery and disposal in the management of solid waste.	03
II	Generation and characteristics of waste Sources, Types, composition, quantity, sampling and characteristics of waste, factors affecting generation of solid wastes	03
III	Waste collection, storage and transport Collection and storage of municipal solid waste; Methods of collection - House to House collection -collection routes; on site storage methods-materials used for containers -Recycling and Reuse of waste -Need for transfer and transport; transfer station-selection of location, operation and maintenance; transportation Methods-manual, Mechanical methods with or without compaction, economy in transportation of waste optimization of transportation routes.	10
IV	Waste processing techniques Processing techniques-biological and chemical conversion technologies – composting and its methods, Vermi-composting, mechanical composting, In vessel composting, incineration, pyrolysis, gasification.	04
V	Disposal of Solid Waste Segregation, Volume reduction at source, recovery and recycle; dumping of solid waste-sanitary waste- sanitary landfills-site selection-design and operation of sanitary landfill - leachate and landfill gas management-landfill closure and environmental monitoring-landfill remediation; Municipal solid waste in Indian conditions, legal aspects of solid waste disposal, Plastic waste disposal.	10
VI	Types of Solid Waste Industrial Waste products during manufacturing and packing, operation of pollution control facilities, generation, and minimization at source, recycling, disposal. Hazardous waste Definition, sources, hazardous characteristics, management, treatment and disposal Electronic waste Waste characteristics, generation, collection, transport and disposal Biomedical waste Definition, sources, classification, collection, segregation- Color coding, treatment and disposal.	09

Contribution to outcomes

On completion of this course, the students will be able to understand the various methods of disposal of solid waste. They will have better understanding of the nature and characteristics of solid waste and regulatory requirements regarding solid waste management and further they will have an ability to plan waste minimization. Besides, they will be prepared to contribute practical solutions to environmental problems in our society.

After the completion of the course the student should be able to

- Explain generation, storage, collection, transfer and transport, processing, recovery and disposal in the management of solid waste.
- Understand the characteristics of different types of solid waste and the factors affecting variation.
- Identify the methods of collection, storage and transportation of solid waste.
- Suggest suitable technical solutions for processing of wastes.
- Ability to plan waste minimization and disposal of municipal solid waste.
- Ensure the safe handling and treatment of Hazardous, Electronic and Biomedical waste.

Theory Examination:-

- Question paper will comprise of six questions; each carrying 20 marks.
- The first question will be compulsory which will have the short questions having weightage of 4-5 marks covering the entire syllabus.
- The remaining five questions will be based on all the modules of entire syllabus. For this, the module shall be divided proportionately further, the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module contents thereof.
- The students will have to attempt any three questions out of remaining five questions.
- Total four questions need to be attempted.

Oral Examination:-

The oral Examination shall be based upon the entire syllabus and the term work consisting of the Assignments, Tutorials including the site visit report.

Mini Project- Student should perform activities related to solid waste management at institute level forming groups 4 to 5 students, Report of the activity should be part of term work

Site Visit: The students will visit landfilling /composting site in the nearby vicinity and prepare detailed report thereof. This report will form a part of the term work.

Term Work:-

The Term Work shall comprise essentially of the following assignments covering the entire syllabus. The report of the site visit/ field visit and mini-project shall also form a part of the term work.

Distribution of Term Work Marks:

The marks of the term work shall be judiciously awarded for the various components depending upon the quality of the term work. The final certification and acceptance of term work warrants the satisfactory and appropriate completion of the assignments. Each student shall prepare a report on any industrial/hazardous/municipal solid waste comprising source, characterization, transportation, recycles, treatment and disposal.

The following weightage of marks shall be given for different components of the term work.

- a. Report (on any industrial/hazardous/municipal solid waste/site visit): 05 Marks
- b. Seminar/Mini Project : 05Marks
- c. Attendance : 05 Marks
- d. Assignments and Tutorials :10 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to

75%- 80%: 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks

Recommended Books:-

1. Integrated Solid Waste Management: Techobanglous, Thisen and Vigil, McGraw Hill International.
2. Hazardous Waste Management: Lagrega, Buckingham and Evans, McGraw Hill International.
3. Solid Waste Management in Developing Countries: A.D. Bhide, Nagpur publications.
4. Environmental Pollution Control Engineering: C.S. Rao, Wiley Eastern, Manual of solid waste of management, CPHEEO.
5. E-Waste: Implications, Regulations, and Management in India and Current Global Best Practices, Rakesh Johri, The Energy and Resources Institute.
6. Biomedical Waste Management in India: [Jugal Kishore](#) and [G. K. Ingle](#), Century Publications.

Semester-VII		
Subject Code	Subject Name	Credits
CE-DLO 7043	Department Level Elective: Pavement Subgrade and Materials	5

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorials	Theory	Practical	TW/Tutorials	Total
3	-	2	3	-	2	5

Evaluation Scheme

Theory					Termwork/Practical/ Oral/Tutorials			Total
Internal Assessments			ESE	Duration of ESE	TW/TU	PR	OR	
IAE-I	IAE-II	Average						
20	20	20	80	3Hr	25	-	25	150

Rationale

Highway and airways mode of transportation contributes to the economical, industrial, social and cultural development of any country. For the design and construction of highway and airfield, it is imperative to know the properties of the materials such as soil, aggregates and bitumen used in the construction of pavements. The various tests are required to be conducted to evaluate the properties of these materials for the scientific design of the pavements and economic utilization of the different materials. The course also deals with the soil survey, stresses in soil and various ways and means of improving the soil and implementing techniques of improvement. The course also deals with the various surface and sub-surface drainage.

Objectives

- To give the students hands on experience on various material properties and testing procedures of pavement materials as per IRC standards.
- To study the significance of the soil subgrade along with its functions.
- To study the soil classification for highway engineering purpose as per different classification system.
- To understand the concept of stresses in soil.
- To enable the student to identify the basic deficiencies of various soil deposits and to arrive upon the various ways and means of improving the soil and implementing the techniques of improvement.
- Learn bituminous mix and cement concrete mix designs
- Learn basic principles of superpave technology of bituminous mixes

Detailed Syllabus

Module	Sub-Modules/ Contents	Hrs
I.	Soil: Soil-Classification methods, Tests: CBR test, effect of lateral confinement on CBR and E value of Subgrade soil, Consistency, Engineering Properties and Modulus of sub-grade reaction of soil, estimation of modulus of subgrade reaction, Static and cyclic plate load test, correction for plate size, correction for worst moisture content. Soil classification as per HRB.	08
II.	Stresses in Soil: Theories of elastic and plastic behavior of soils, Cyclic triaxial test on subgrade soils, resilient deformation, resilient strain, resilient modulus Stabilized Soils: Method of sampling and Preparation of Stabilized Soils for testing, Relation for Moisture content and Dry Density of Stabilized mixes, UCS of Stabilized soil, test for: soil bituminous, soil lime and soil fly ash mixes.	06
III.	Aggregate: Classification, requirements, Blending of aggregates, Importance of aggregate shape factor in mix design. Grading requirements for aggregate, selection of bases and sub-base material (including stabilized materials),	04
IV.	Bitumen, Tar and Bituminous Mix Design; requirements, criteria for selection of different binders, Temperature susceptibility, Bituminous emulsion and Cutbacks, fillers, extenders Polymers, Crum rubber, and rubber modified bitumen and anti-Stripping agents on pavement performance.	08
V.	Bituminous Mix Design: selection of different grade of bitumen, skid qualities, types of bituminous surfaces, bituminous mix design, Marshall Stability test, design aspect of paving concrete. Experimental characteristics of road aggregate.	06
VI.	Introduction to Super pave Technology: Methods of selection of suitable ingredient for super pave method, Gyratory compaction, rolling thin film oven, pressure aging vessel, rotational viscometer, dynamic shear rheometer, bending beam rheometer, direct tension test. Use of super pave perform and grade binder specifications. Comparison between Marshall Mix method and Super pave method.	07

Contribution to Outcomes

On the successful completion of the course, the students shall be able to:

- Understand the soil classification in accordance with various soil classify the system and evaluate the ability of the soil as a subgrade material.
- Understand the requirements and desirable properties of the various materials to be used in the construction of pavements.
- Understand the characterization of different paving materials along with the tests to be conducted on these materials.
- Know the various ground improvement methods.
- Understand subgrade soil strength in terms of standard engineering parameters.
- Application of basic principles of mix design of cement concrete and bituminous mixes

Theory Examination:

- Question paper will comprise of **six** questions; each carrying 20 marks.
- The **first** question will be **compulsory** which will have the short questions having weightage of 4-5 marks covering the entire syllabus.
- The remaining five questions will be based on all the modules of entire syllabus. For this, the module shall be divided proportionately further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and contents thereof.
- There can be an internal choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
- The students will have to attempt any three questions out of remaining five questions.
- Total four questions need to be attempted.

Oral Examination:

The oral examination shall be based upon the entire syllabus and the term work.

Term Work:

The term-work shall comprise of the neatly written report comprising of the assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least two problems/ two questions on each modules/ sub-modules and contents thereof further.

Distribution of Term Work Marks:

The marks of term-work shall be judiciously awarded depending upon the quality of the term work which will comprise of the report on assignments. The final certification and acceptance of term-work warrants the satisfactory and the appropriate completion of the termwork; and the minimum passing marks to be obtained by the students.

The following weightage of marks shall be given for different components of the term work.

Assignments : 20 Marks

Attendance : 05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

75%- 80%: 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks

Recommended Books:-

1. Principles of Pavement Design, Second Edition, 1975: *Yoder, E.J.* , John Wiley and Sons, Inc., New York.
2. Concrete Roads: *HMSO*, Road Research Laboratory, London.
3. Highway Engineering: *Khanna, S.K., Justo, C.E.G. and Veeraragavan, A.*, Nem Chand and Brothers, Roorkee (10th Revised Edition, 2014)
4. Principles and Practices of Highway Engineering; *Dr. L. R. Kadiyali and Dr. N. B.Lal*, Khanna Publishers, New Delhi.
5. Highway Engineering, *Sharma, S.K.*, S. Chand Technical Publishers, New Delhi (3rd Revised Edition, 2013).
6. Principles of Transportation and Highway Engineering: *Rao, G.V.* , Tata Mc-Graw Hill Publications, New Delhi

Semester-VII		
Subject Code	Subject Name	Credits
CE-DLO 7044	Department Level Elective: Structural Dynamics	5

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorials	Theory	Practical	TW/Tutorials	Total
3	-	2	3	-	2	5

Evaluation Scheme

Theory					Termwork/Practical/ Oral/Tutorials			Total
Internal Assessments			ESE	Duration of ESE	TW/TU	PR	OR	
IAE-I	IAE-II	Avg.						
20	20	20	80	3Hr	25	-	25	150

Course Objective

- To expose the students to understand the basic theory of structural dynamics, structural behaviour under vibratory load and the effect of damping.
- To study the difference between static load and different types of dynamic loads.
- To study the free vibration analysis of SDOF systems, concept of damping and dynamic analysis of SDOF system subjected to different dynamic loads.
- To study the dynamic degrees of freedom and calculation of the frequencies and mode shapes for lumped mass for discrete Two DOF systems,
- To study the modal analysis of Two DOF systems and analysis of systems with distributed mass for continuous system.

Details Syllabus

Module	Contents	Hrs
I	Introduction to structural Dynamics- Definition of Basic Problem in Dynamics. Static vs. Dynamic loads. Different types of dynamics loads	4
II	Introduction to single Degree of freedom (SDOF) Systems. Undamped vibration of SDOF system natural frequency and period of vibration Damping in structures, viscous damping and Coulomb damping, effect of damping on frequency of vibration and amplitude of vibration, Logarithmic decrement. Forced vibration, response to periodic loading, response to pulsating forces, dynamic load factor. Response of structure subjected to General dynamic load, Duhamel's Integral Numerical Evaluation of Dynamics Response of SDOF system. Equivalent stiffness of spring in series and parallel	8

III	Introduction to vibration isolation. Distributed mass system idealized as SDOF system, use of Rayleigh's method. Response of SDOF system subjected to ground motion	4
IV	Lumped mass multi-degree of freedom (Two DOF) system, coupled and uncoupled system Direct determination of frequencies of vibration and mod shape. Orthogonality principle. Vibration of Two DOF systems with initial conditions Approximate method of determination of natural frequencies of vibration and mode shapes – Energy methods	9
V	Earthquake analysis – Introduction. Seismicity of a region, causes of earthquake Intensity of earthquake, Richter Scale, Measurement of Earthquake ground motion, Seismogram, construction of seismograph Application of modal analysis concept to seismic disturbance, Introduction to Response spectrum method.	8
VI	I.S code provisions for seismic analysis of buildings. Approximate method of earthquake analysis– Seismic co-efficient method and its limitation Introduction to time history analysis.(6)	6

Contributions to Outcomes

The students will be able to

- Understand the difference between static and dynamic loads and analysis.
- Evaluate the response of SDOF and Two DOF systems to different types of dynamic loads including ground motions.
- Understand the basics of random vibrations and the application of this concept
- Analyze Linear SDOF systems.

Term Work:

The term-work shall comprise of the neatly written report of the assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems on each modules/ sub-module content thereof further. There shall be theory questions as well.

Distribution of Term-work Marks

The marks of term-work shall be judiciously awarded depending upon the quality of the term work including that of the report on experiments assignments. The final certification acceptance of term-work warrants the satisfactory the appropriate completion of the assignments the minimum passing marks to be obtained by the students. The following weightage of marks shall be given for different components of the term work.

- Assignments: 20 Marks
- Attendance: 05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to: 75%- 80%: 03 Marks; 81%- 90%: 04 Marks 91% onwards: 05 Marks

Theory Examination:

- Question paper will comprise of **six** questions; each carrying 20 marks.
- The **first** question will be **compulsory** which will have the short questions having weightage of 4-5 marks covering the entire syllabus.
- The remaining five questions will be based on all the modules of entire syllabus. For this, the module shall be divided proportionately further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and contents thereof.
- There can be an internal choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
- The students will have to attempt any three questions out of remaining five questions.
- Total four questions need to be attempted.

Oral Examination

Oral examination will be based on entire syllabus and the afore-mentioned term work.

Recommended Books:-

1. Craig R.R.: 'Structural Dynamics-An Introduction to Computer Methods', *John Wiley and Sons*.
2. Anil K. Chopra: 'Dynamics of Structures', *Prentice Hall India Pvt. Ltd*.
3. Cloguhand Penzein: 'Dynamics of Structures' *TataMc-Graw Hill Pvt. Ltd*.
4. John M. Biggs: 'Structural Dynamics', *TataMc-Graw Hill*.
5. Mario Paz: 'Structural Dynamics Theory and Computation', *CBS Publisher*.

Semester VII		
Subject Code	Subject Name	Credits
CE-DLO 7045	Department Level Elective: Applications of Geographic Information Systems & Remote Sensing	05

Teaching Scheme						
Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
03	--	02	03	--	02	05

Evaluation Scheme								
Theory					Term Work/ Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Avg.						
20	20	20	80	03 Hrs.	25	-	25	150

Rationale

Geographic Information Systems & Remote Sensing Applications provides power of mapping to civil engineers. GIS lets us visualize, question, analyze and interpret data to understand relationships, patterns and trends. In this subject, the students get acquainted with the detailed study of GIS & Remote sensing. Data models of spatial and non-spatial information are also explained. An overview on digitizing, editing and structuring of map data is also provided for error detection, correction and appropriate topology creation. Digital Elevation Models (DEM) and their needs are also incorporated along with the applications of Remote Sensing and GIS. Solution can be provided for Various Civil Engineering problems using Integration GIS-GPS & Remote Sensing Techniques.

Objectives

- To study principles of physics of Electromagnetic radiation as applied to remote sensing.
- To learn the GIS data & its processing using Softwares
- To get acquainted with GPS Satellite & their segments
- To understand the GIS & RS Applications in various fields of Civil Engineering

Module	Content	Hrs
I	Remote sensing (RS): Introduction, physics of remote sensing- electromagnetic radiations and their characteristics, thermal emissions, multi-concept in remote sensing, remote sensing satellites and their data products, sensors and orbital characteristics, spectral reflectance curves for earth surface features, methods of remotely sensed data interpretation- visual interpretation, concept of fcc, digital image processing- digital image and its characteristics, satellite data formats, image rectification and restoration, image enhancement- contrast manipulation, spatial feature manipulation, multi-image manipulation.	8

II	Geographical Information System (GIS): History, Introduction, spatial and non- spatial information, geographical concept and terminology, advantages of GIS, Basic component of GIS Commercially available GIS hardware and Software Field data, statistical data, maps, aerial Photographs, satellite data, points , lines, and areas features, vector and raster data, data entry through keyboard, digitizer and scanners, pre-processing of data rectification and registration , interpolation techniques, introduction to GIS softwares (Arc GIS, QGIS, Gram++, etc.)	8
III	Global Positioning System (G.P.S) : G.P.S. Segments: Spaces Segment, Control Segment, User Segment Features of G.P.S. Satellites, Principle of Operation Surveying with G.P.S.: Methods of observations, Absolute Positioning, Relative Positioning, differential G.P.S., Kinematics of G.P.S. G.P.S. Receivers: Navigational Receivers, Surveying Receivers, Geodetic Receivers, Computation of Co-ordinates:- Transformation from Global to Local Datum , Geodetic Coordinates to map co- ordinates , G.P.S. Heights and mean sea level Heights Applications of G.P.S	5
IV	Application of G.I.S.& R.S. in Water Resources & Environmental Studies: Site selection of Hydraulic Structures, Surface water delineation, surface keys for subsurface water, Steps in water investigations of the area, Water management	6
V	Application of G.I.S.& R.S. in Infrastructure Management; Role of GIS in Town Planning, Urban Transport Planning, Underground Infrastructure Management	6
VI	Application of G.I.S.& R.S in Disaster Management : RS and GIS applications for disaster vulnerable zones, fire hazards, flood and storm water inundations, earthquake impact assessment, post Tsunami/ cyclone damage assessment.	5

Contribution to Outcomes

After completion of course, student will be able to:

- Explain the principles of physics of Electromagnetic radiation as applied to remote sensing.
- Describe Spatial and non-spatial database of geographic information system
- Demonstrate the GPS Satellites & their Segments.
- Apply the GIS & RS techniques in Urban Planning, Water Resources & Environmental Management.
- Integrate the GIS-GPS & RS techniques for Infrastructure Management
- Illustrate applications of GIS& RS in Disaster Management

Theory examination:

- Question paper will comprise of **six** questions; each carrying 20 marks.
- The **first** question will be **compulsory** which will have the short questions having weightage of 4-5 marks covering the entire syllabus.

- The remaining **five** questions will be based on all the modules of entire syllabus. For this, the module shall be divided proportionately further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module or contents thereof.
- There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
- The students will have to attempt any **three** questions out of remaining five questions.
- Total **four** questions need to be attempted.

Oral Examination:

The oral examination will be based on the entire syllabus and the term work.

Term Work:

The term work will comprise of the neatly written report based on assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems and /or questions on each sub-modules and contents thereof further

Distribution of Term Work Marks:

The marks of the term-work shall be judiciously awarded depending upon the quality of the term work including that of the report on assignments. The final certification and acceptance of the term-work warrants the satisfactory and the appropriate completion of the assignments; and the minimum passing marks to be obtained by the students. The following weight age of marks shall be given for different components of the term work.

Assignments : 20 Marks

Attendance : 05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

75%- 80%: 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks

Recommended Books:

1. Introduction to Geographic Information Systems: Kang-Tsung Chang, TataMcGrawHill.
2. Text book on Remote Sensing –C.S. Agrawal and P.K.Garg, Wheeler Publishing, New-Delhi.
3. G.I.S- Anji Reddy, publishers- MGH.
4. GIS, Spatial Analysis, and Modeling: Maguire, D., M.Batty, and M. Goodchild. 2005. ESRI Press.
5. Remote sensing in Civil Engineering – T. J. M. Kennie and M. C. Mathews, Surry University press, London
6. Principles of Remote Sensing- P.N.Patel and Surendra Singh, Scientific Publishers, Jodhapur.
7. Remote Sensing and Image Interpretation: Lillesand and Kiefer, John Wiley, 1987.
8. Global Positioning System: Signals, Measurements, and Performance, Pratap Misra and Per Enge (2nd Ed.), 2006.
9. Introduction to Geomatics – QGIS user guide – Mr.C.V. Nishinkanth, Mrs. Annu Nishinkanth, Dr S S Vasudevan, Dr P Ramkumar

10. Fundamental of Remote sensing: George Joseph, Universities Press Publications.
11. Remote Sensing and GIS, Basudeb Bhatta, Publisher: Oxford University Press, India, Latest Edition

Semester VII		
Subject Code	Subject Name	Credits
CEC-DLO7046	Foundation Analysis and Design	5

Teaching Scheme						
Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
03	-	02	03	-	02	05

Evaluation Scheme								
Theory					Term Work/ Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03 Hrs.	25	-	25	150

Objectives

- To study the bearing capacity and settlement of shallow foundations and To understand the design concepts for shallow foundations including strip and raft foundations
- To study the estimation of vertical stresses in soil
- To study different types of well foundations
- To study the load carrying capacity of pile and design of under reamed piles
- To study Cantilever sheet piles including anchored sheet piles in cohesion-less and cohesive soils and to analyse braced cuts
- To learn different types of machine foundations and understand the design philosophy; and carry out the design thereof.

Detailed Syllabus		
Module	Sub Modules/Contents	Hrs
I	Estimation of stresses in soils: Boussinesque and Westergaard's theories, Newmark Chart, Practical applications.	06
II	Shallow Foundation: Basic requirements of foundation, types and selection of foundation, design of shallow foundations by Terzaghi's and IS code method; total settlement analysis including elastic settlements; Structural design of strip and raft foundation.	07
III	Pile Foundation: Introduction, Necessity of piles, Types of pile foundation, load carrying capacity of single pile and pile in group, , group efficiency, group settlements, design of single pile and pile cap, design of under-reamed pile foundation	06
IV	Floating Foundation and Well Foundation: Floating Foundation- Introduction, Floatation, bottom elastic heave, Design of floating foundation on piles, Well Foundation- Introduction, forces acting on well foundation.	06
V	Sheet piles and Braced cuts: Cantilever sheet piles including anchored sheet piles in cohesion-less and cohesive soils: lateral earth pressure diagram,	08

	computation of embedment depth. Difference in open cut and retaining wall theories, apparent earth pressure diagram, Average apparent earth pressure diagram for cohesion-less and cohesive soils. Estimation of strut loads in braced cuts placed in cohesion-less and cohesive soils.	
VI	Machine Foundations: Introduction, Dynamic soil properties, types of machine vibrations, basic principal of machine foundation.	06

Contribution to outcomes

- On successful completion of the course, the learner shall have an: 1. Ability to identify, formulate and solve geotechnical engineering problem.
- Ability to design a suitable foundation system from economic and safe aspects
- Ability to design machine foundations
- Ability to relate easily to allied subjects such soil dynamics; advanced engineering geology, rock mechanics etc.
- Ability to understand design of sheet pile
- Ability to analyze vertical stresses developed in soil and used in practical problems

Theory Examination:-

- Question paper will comprise of six questions; each carrying 20 marks.
- The first question will be **compulsory** which will have the short questions having weightage of 4-5 marks covering the entire syllabus.
- The remaining five questions will be based on all the modules of entire syllabus. For this, the module shall be divided proportionately further, the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module contents thereof.
- The students will have to attempt any three questions out of remaining five questions.
- Total four questions need to be attempted.

Oral Examination:-

The oral Examination shall be based upon the entire syllabus and the term work consisting of the Assignments, Tutorials.

Distribution of Term Work Marks:

The marks of the term work shall be judiciously awarded for the various components depending upon the quality of the term work. The final certification and acceptance of term work warrants the satisfactory and appropriate completion of the assignments. Each student shall prepare a report on any industrial/hazardous/municipal solid waste comprising source, characterization, transportation, recycles, treatment and disposal.

The following weightage of marks shall be given for different components of the term work.

- Attendance : 05 Marks
- Assignments and Tutorials :20 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to

75%- 80%: 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks

Recommended Books:-

1. Bowels J.E.: 'Analytical and Computer Methods in Foundation', *McGraw Hill Book Co. New York, 1974*
2. Das, B. M.: 'Geotechnical Engineering Handbook', *J. Ross Publishing, 2010*
3. Verghese, P. C.: 'Foundation Engineering', *PHI Learning Private Limited, Delhi, 2012*
4. Verghese, P. C.: 'Design of Reinforced Concrete Foundations', *PHI Learning Private Limited, Delhi, 2011*
5. N. Subramanian: 'Reinforced Concrete Structures', *Oxford University Press, 2013*
6. Alam Singh: 'Soil Mechanics and Foundation Engineering', Vol. I- II. *Standard Book House, Delhi*
7. Swami Saran: 'Analysis and Design of Substructures', *Oxford and IBH publishing company, Delhi 1998*

SemesterVII		
Course Code	Course Name	Credits
CE-C ILOC-7011	Institute Level Elective: Product Life cycle Management	03

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	--	--	03	--	--	03

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03 Hrs.	--	--	--	100

Objectives:

- To familiarize the students with the need, benefits and components of PLM
- To acquaint students with Product Data Management & PLM strategies
- To give insights into new product development program and guidelines for designing and developing a product
- To familiarize the students with Virtual Product Development

Module	Detailed Contents	Hrs
I	Introduction to Product Lifecycle Management (PLM): Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications PLM Strategies: Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	10
II	Product Design: Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	09
III	Product Data Management (PDM):	05

	Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	
IV	Virtual Product Development Tools: For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	05
V	Integration of Environmental Aspects in Product Design: Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	05
VI	Life Cycle Assessment and Life Cycle Cost Analysis: Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	05

Contribution to Outcomes:

Students will be able to

- Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
- Illustrate various approaches and techniques for designing and developing products.
- Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
- Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

Assessment:

Internal:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Theory Examination:

In question paper, weightage of each module will be approximately proportional to number of respective lecture hours as mentioned in the syllabus.

- Question paper will comprise of total six questions carrying 20 marks
- Question no. 1 is compulsory. Any 3 out of remaining 5 need to be solved
- Remaining question (Q.2 to Q.6) will be selected from all the modules.
- Questions may be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) may be from any module other than module 3)

References:

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, Antonino Risitano, "Product Design for the environment- A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229
3. Saaksvuori Antti, Immonen Anselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265

Semester VII		
Course Code	Course Name	Credits
CE-C ILOC7012	Institute Level Elective: Reliability Engineering	03

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	--	--	03	--	--	03

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03 Hrs.	--	--	--	100

Objectives

- To familiarize the students with various aspects of probability theory
- To acquaint the students with reliability and its concepts
- To introduce the students to methods of estimating the system reliability of simple and complex systems
- To understand the various aspects of Maintainability, Availability and FMEA procedure

Module	Detailed Contents	Hrs
I	Probability theory: Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. Probability Distributions: Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. Measures of Dispersion: Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	08
II	Reliability Concepts: Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. Failure Data Analysis: Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. Reliability Hazard Models: Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	08
III	System Reliability: System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	05
IV	Reliability Improvement: Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	08
V	Maintainability and Availability: System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics,	05

	Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	
VI	Failure Mode, Effects and Criticality Analysis: Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fault tree analysis and Event tree Analysis	05

Outcomes

Students will be able to...

- Understand and apply the concept of Probability to engineering problems
- Apply various reliability concepts to calculate different reliability parameters
- Estimate the system reliability of simple and complex systems
- Carry out a Failure Mode Effect and Criticality Analysis

Assessment:

Internal:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Theory Examination:

In question paper, weightage of each module will be approximately proportional to number of respective lecture hours as mentioned in the syllabus.

- Question paper will comprise of total six question carrying 20 marks
- Question no. 1 is compulsory. Any 3 out of remaining 5 need to be solved
- Remaining question (Q.2 to Q.6) will be selected from all the modules.
- Questions may be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) may be from any module other than module 3)

References:

1. L.S. Srinath, "Reliability Engineering", Affiliated East-West Press (P) Ltd., 1985.
2. Charles E. Ebeling, "Reliability and Maintainability Engineering", Tata McGraw Hill.
3. B.S. Dhillon, C. Singh, "Engineering Reliability", John Wiley & Sons, 1980.
4. P.D.T. Connor, "Practical Reliability Engg.", John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, "Reliability in Engineering Design", John Wiley & Sons.
6. Murray R. Spiegel, "Probability and Statistics", Tata McGraw-Hill Publishing Co. Ltd.

Semester VII		
Course Code	Course Name	Credits
CE-C ILOC7013	Institute Level Elective: Management Information System	03

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	--	--	03	--	--	03

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03 Hrs.	--	--	--	100

Objectives:

- The course is blend of Management and Technical field.
- Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
- Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
- Identify the basic steps in systems development

Module	Detailed Contents	Hrs
I	Introduction To Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS.	4
II	Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management. Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results	7
III	Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls	7
IV	Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	7
V	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	6
VI	Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	8

Contribution to Outcomes

Students will be able to:

- Explain how information systems Transform Business
- Identify the impact information systems have on an organization
- Describe IT infrastructure and its components and its current trends
- Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
- Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

In question paper, weightage of each module will be approximately proportional to number of respective lecture hours as mentioned in the syllabus.

- Question paper will comprise of total six question carrying 20 marks
- Question no. 1 is compulsory. Any 3 out of remaining 5 need to be solved
- Remaining question (Q.2 to Q.6) will be selected from all the modules.
- Questions may be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) may be from any module other than module 3)

References:

1. Kelly Rainer, Brad Prince, Management Information Systems, Wiley
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

SemesterVII		
Course Code	Course Name	Credits
CE-C ILOC7014	Institute Level Elective: Design of Experiments	03

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theor y	Practical	Tutorial	Total
03	--	--	03	--	--	03

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03 Hrs.	--	--	--	100

Objectives:

- To understand the issues and principles of Design of Experiments (DOE)
- To list the guidelines for designing experiments
- To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

Module	Detailed Contents	Hrs
I	Introduction 1.1 Strategy of Experimentation 1.2 Typical Applications of Experimental Design 1.3 Guidelines for Designing Experiments 1.4 Response Surface Methodology	06
II	Fitting Regression Models 2.1 Linear Regression Models 2.2 Estimation of the Parameters in Linear Regression Models 2.3 Hypothesis Testing in Multiple Regression 2.4 Confidence Intervals in Multiple Regression 2.5 Prediction of new response observation 2.6 Regression model diagnostics 2.7 Testing for lack of fit	08
III	Two-Level Factorial Designs 3.1 The 2^2 Design 3.2 The 2^3 Design 3.3 The General 2^k Design 3.4 A Single Replicate of the 2^k Design 3.5 The Addition of Center Points to the 2^k Design, 3.6 Blocking in the 2^k Factorial Design 3.7 Split-Plot Designs	07
IV	Two-Level Fractional Factorial Designs 4.1 The One-Half Fraction of the 2^k Design 4.2 The One-Quarter Fraction of the 2^k Design	07

	4.3 The General 2^{k-p} Fractional Factorial Design 4.4 Resolution III Designs 4.5 Resolution IV and V Designs 4.6 Fractional Factorial Split-Plot Designs	
V	Response Surface Methods and Designs 5.1 Introduction to Response Surface Methodology 5.2 The Method of Steepest Ascent 5.3 Analysis of a Second-Order Response Surface 5.4 Experimental Designs for Fitting Response Surfaces	07
VI	Taguchi Approach 6.1 Crossed Array Designs and Signal-to-Noise Ratios 6.2 Analysis Methods 6.3 Robust design examples	04

Contribution to Outcomes

Students will be able to

- Plan data collection, to turn data into information and to make decisions that lead to appropriate action
- Apply the methods taught to real life situations
- Plan, analyze, and interpret the results of experiments

Assessment:

Internal:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Theory Examination:

In question paper, weightage of each module will be approximately proportional to number of respective lecture hours as mentioned in the syllabus.

- Question paper will comprise of total six question carrying 20 marks
- Question no. 1 is compulsory. Any 3 out of remaining 5 need to be solved
- Remaining question (Q.2 to Q.6) will be selected from all the modules.
- Questions may be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) may be from any module other than module 3)

References:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition, John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss

Semester VII		
Course Code	Course Name	Credits
CE-C ILOC7015	Institute Level Elective: Operation Research	03

Teaching Scheme						
Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	--	--	03	--	--	03

Evaluation Scheme								
Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03 Hrs.	--	--	--	100

Objectives:
- Formulate a real-world problem as a mathematical programming model. - Understand the mathematical tools that are needed to solve optimization problems. - Use mathematical software to solve the proposed models.

Module	Detailed Contents	Hrs
I	Introduction to Operations Research: Introduction, , Structure of the Mathematical Model, Limitations of Operations Research Linear Programming: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, Duality, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis Transportation Problem: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel’s approximation method. Optimality test: the stepping stone method and MODI method. Assignment Problem: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem Integer Programming Problem: Introduction, Types of Integer Programming Problems, Gomory’s cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.	14
II	Queuing models: queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	05

III	Simulation: Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	05
IV	Dynamic programming. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	05
V	Game Theory. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	05
VI	Inventory Models: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	05

Outcomes:

Students will be able to

- Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.
- Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
- Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
- Understand the applications of integer programming and a queuing model and compute important performance measures

Assessment:

Internal:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Theory Examination:

In question paper, weightage of each module will be approximately proportional to number of respective lecture hours as mentioned in the syllabus.

- Question paper will comprise of total six question carrying 20 marks
- Question no. 1 is compulsory. Any 3 out of remaining 5 need to be solved
- Remaining question (Q.2 to Q.6) will be selected from all the modules.
- Questions may be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) may be from any module other than module 3)

References:

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009.
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut.
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons.

Semester VII		
Course Code	Course Name	Credits
CE-C ILOC7016	Institute Level Elective: Cyber Security and Laws	03

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	--	--	03	--	--	03

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03 Hrs.	--	--	--	100

Objectives:

- To understand and identify different types cybercrime and cyber law
- To recognized Indian IT Act 2008 and its latest amendments
- To learn various types of security standards compliances

Module	Detailed Contents	Hrs
I	Introduction to Cybercrime: Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	4
II	Cyber offenses & Cybercrime: How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	9
III	Tools and Methods Used in Cyberline Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	6
IV	The Concept of Cyberspace E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law, The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	8

V	Indian IT Act. Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	6
VI	Information Security Standard compliances SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	6

Outcomes

Students will be able to:

- Understand the concept of cybercrime and its effect on outside world
- Interpret and apply IT law in various legal issues
- Distinguish different aspects of cyber law
- Apply Information Security Standards compliance during software design and development

Assessment:

Internal:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Theory Examination:

In question paper, weightage of each module will be approximately proportional to number of respective lecture hours as mentioned in the syllabus.

- Question paper will comprise of total six question carrying 20 marks
- Question no. 1 is compulsory. Any 3 out of remaining 5 need to be solved
- Remaining question (Q.2 to Q.6) will be selected from all the modules.
- Questions may be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) may be from any module other than module 3)

References:

1. Nina Godbole, Sunit Belapure, Cyber Security, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, Information Systems Security, Wiley India, New Delhi
6. Kenneth J. Knapp, Cyber Security & Global Information Assurance Information Science Publishing.
7. William Stallings, Cryptography and Network Security, Pearson Publication
8. Websites for more information is available on : The Information Technology ACT, 2008- TIFR : <https://www.tifrh.res.in>
9. Website for more information , A Compliance Primer for IT professional : <https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538>

Semester VII		
Course Code	Course Name	Credits
CE-C ILOC7017	Institute Level Elective: Disaster Management and Mitigation Measures	03

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	--	--	03	--	--	03

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03 Hrs.	--	--	--	100

Objectives

- To understand physics and various types of disaster occurring around the world
- To identify extent and damaging capacity of a disaster
- To study and understand the means of losses and methods to overcome /minimize it.
- To understand role of individual and various organization during and after disaster
- To understand application of GIS in the field of disaster management
- To understand the emergency government response structures before, during and after disaster

Module	Detailed Contents	Hrs
I	Introduction 1.1 Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	03
II	Natural Disaster and Manmade disasters: 2.1 Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion 2.2 Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	09
III	Disaster Management, Policy and Administration 3.1 Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. 3.2 Policy and administration:	06

	Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	
IV	Institutional Framework for Disaster Management in India: 4.1 Importance of public awareness, Preparation and execution of emergency management programme.Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India.Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. 4.2 Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	06
V	Financing Relief Measures: 5.1 Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. 5.2 International relief aid agencies and their role in extreme events.	09
VI	Preventive and Mitigation Measures: 6.1 Pre-disaster, during disaster and post-disaster measures in some events in general 6.2 Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication 6.3 Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. 6.4 Do's and don'ts in case of disasters and effective implementation of relief aids.	06

Outcomes:

Students will be able to...

- Get to know natural as well as manmade disaster and their extent and possible effects on the economy.
- Plan of national importance structures based upon the previous history.
- Get acquainted with government policies, acts and various organizational structure associated with an emergency.
- Get to know the simple do's and don'ts in such extreme events and act accordingly.

Assessment:

Internal:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Theory Examination:

In question paper, weightage of each module will be approximately proportional to number of respective lecture hours as mentioned in the syllabus.

- Question paper will comprise of total six question carrying 20 marks
- Question no. 1 is compulsory. Any 3 out of remaining 5 need to be solved
- Remaining question (Q.2 to Q.6) will be selected from all the modules.
- Questions may be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) may be from any module other than module 3)

References:

1. 'Disaster Management' by Harsh K. Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S. Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elsevier Publications.
4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
5. 'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
7. Concepts and Techniques of GIS – C.P. Lo Albert, K.W. Yonng – Prentice Hall (India) Publications.

(Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

Semester VII		
Course Code	Course Name	Credits
CE-C ILOC7018	Institute Level Elective: Energy Audit and Management	03

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	--	--	03	--	--	03

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Avg						
20	20	20	80	03 Hrs.	--	--	--	100

Objectives:

- To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
- To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
- To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Module	Detailed Contents	Hrs
I	Energy Scenario: Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	04
II	Energy Audit Principles: Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	08
III	Energy Management and Energy Conservation in Electrical System: Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. Energy efficiency measures in lighting system, Lighting control: Occupancy sensors, daylight integration, and use of intelligent controllers.	10

	Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	
IV	Energy Management and Energy Conservation in Thermal Systems: Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	10
V	Energy Performance Assessment: On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	04
VI	Energy conservation in Buildings: Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	03

Outcomes:

Students will be able to:

- To identify and describe present state of energy security and its importance.
- To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
- To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
- To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
- To analyze the data collected during performance evaluation and recommend energy saving measures

Assessment:

Internal:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Theory Examination:

In question paper, weightage of each module will be approximately proportional to number of respective lecture hours as mentioned in the syllabus.

- Question paper will comprise of total six question carrying 20 marks
- Question no. 1 is compulsory. Any 3 out of remaining 5 need to be solved
- Remaining question (Q.2 to Q.6) will be selected from all the modules.
- Questions may be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) may be from any module other than module 3)

References:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. www.energymanagertraining.com
9. www.bee-india.nic.in

Semester-VIII

Semester VIII		
Subject Code	Subject Name	Credits
CE-C 801	Design and Drawing of Reinforced Concrete Structures	5

Teaching Scheme						
Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
04	02	--	04	01	--	05

Evaluation Scheme								
Theory					Term Work/ Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	04 Hrs.	25	-	25	150

Rationale

Reinforced concrete construction are widely used for residential, commercial and industrial structures. IS code has specified the use of Limit State Method (LSM) design philosophy for design of structures. Pre-stressed Concrete structures are another class of structures used for bridge girders, long span slabs etc. Civil engineers must have knowledge of designing and detailing of RCC and PSC structures to make structures safe and serviceable during its life span. Also the knowledge about response of structures during an earthquake is prerequisite of design engineers. During previous semester students have studied design of basic elements by LSM. This course covers complete design of G+ 3 structures in addition to advanced topics of design of water tank and retaining wall. The course also contains PSC beam topics and introduces Earthquake Resistant Design of structures, drawing and detailing of structures.

Objectives

- To explain the LSM design procedure of G+ 3 structures by proper application of IS code clauses including loading calculation, analysis and design of individual elements.
- To acquaint the concepts in the design of staircase, water tank and retaining wall.
- To explain concept of Pre-stressed Concrete members.
- To introduce Earthquake Resistant Design method.
- To explain drawing and detailing of structures.
- To develop the concept of design using ready charts and curves for different elements of structure.

Detailed Syllabus		
Module	Contents	Hrs
I	COMPREHENSIVE DESIGN OF BUILDING: Complete design of residential/commercial/industrial G+ 3 structures. Load transfer mechanism, arrangement of beams, slabs, columns. Design of footing, beams, columns, staircase, lintels, chajja.	12
II	DESIGN OF STAIRCASE: Design of dog legged and open well staircase	3
III	DESIGN OF RETAINING WALL: Design of Cantilever and Counterfort retaining wall	7
IV	DESIGN OF WATER TANK Classification of Water Tank, Permissible Stresses, design of circular and rectangular water tanks resting on ground and underground. Codal provisions. Use of IS coefficient method and approximate method. Design of elevated water tank frame and shaft type of staging.	11
V	EARTHQUAKE RESISTANT DESIGN OF STRUCTURES: Earthquake and ground motion, response of structure, design forces calculation by seismic coefficient method. Ductile design and detailing as per IS:13920.	12
VI	PRE-STRESSED CONCRETE: Pre-stressed Concrete: Basic principles of pre-stressed concrete, materials used, systems of pre-stressing, losses in pre-stress, analysis of beam sections at transfer and service loads.	7

Contribution to Outcomes

On successful completion of the course, the student shall be able to:

- Design independently RCC structure by applying IS code provisions.
- Design staircase, water tank and retaining wall.
- Explain principles of PSC and calculate losses.
- Draw and explain the structural detailing.
- Explain response of structure during an earthquake and calculate design forces.

Theory Examination:-

- Question paper will comprise of five questions. First question will carry 32 marks and remaining four will carry 16 marks each. The **first** question will be **compulsory**. From remaining four questions any **three** questions can be answered. Total **four** questions need be attempted.
- The **first** question will be based on design project from following. (any one out of given two is to be answered)
- Design of slab and continuous beam (max three span) or design of column from terrace to footing.
- Design of counter fort retaining wall
- Design of overhead water tank including design of staging
- The next four questions will be based on remaining modules of syllabus and the weightage of the marks shall be judiciously awarded in proportion to the importance of the module and number of hours allotted for the module. There can be an **internal** choice in various

sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.

- All relevant IS codes will be allowed during examination.

Oral Examination:@

The oral examination accompanied by **sketching** will be based on entire syllabus and the term work and site visit report.

Term Work:

The term work shall consist of a neatly written Design Report including detailed drawings on the following topics:

- Design report of (G+3) building using relevant IS codes.
- Design report of counter fort retaining wall OR overhead water tank and staging.
- Report of one site visit to under construction building/PSC site.
- Assignments consisting of max five questions each on module III to VI.

Design report and at least four A-1 (Full imperial) size drawings sheets for above two projects shall be submitted as term work. All drawing work is to be done in pencil only. Design of building project will be done using design aids and anyone of available software.

Distribution of Term Work Marks: The marks of term-work shall be judiciously awarded depending upon its quality. The final certification and acceptance of the term-work warrants the satisfactory and the appropriate completion of the assignments, properly compiled design report; and the minimum passing marks to be obtained by the students.

The following weightage of marks shall be given for different components of the term work.

- Design report and drawing sheets : 15marks
- Assignments and site visit report: 05 marks
- Attendance : 05 marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

Attendance	Marks awarded
75%- 80%	03 Marks
81%- 90%	04 Marks
91% onwards	05 Marks

Recommended Books:-

1. Design of Reinforced Concrete Structures: *Dayaratnam, P*; Oxford and IBH.
2. Limit State Design – Reinforced Concrete: *Shah and Karve*, Structure Publications, Pune.
3. Reinforced Concrete - Limit State Design: Ashok K. Jain, Nemchand & bro.
4. Reinforced Concrete: *H.J. Shah*, Charotar Publishers, Anand.
5. Illustrated Reinforced Concrete Design: *Dr. V. L. Shah and Dr. S. R. Karve*, Structure Publications, Pune.
6. Reinforced Concrete Design: Wang, C. K., Salmon, C. G., and Pincheira, J. A., John Wiley.
7. Reinforced Concrete Fundamentals: Ferguson, P. M., Breen, J. E., and Jirsa, J. O., John Wiley & Sons.
8. Design of Prestressed Concrete Structures: Lin T.Y. and Ned Burns; John Wiley.
9. Prestressed concrete : Krishna Raju, Tata Mc-Graw Hill Publishing House, New Delhi
10. Prestressed concrete, problems and solutions , Krishna Raju, CBS Publishers and distributors, New Delhi.
11. Prestressed concrete: N. Rajgopalan, Narosa Publishers.
12. Earthquake resistant design of structures: S. K. Duggal, Oxford University Press.
13. Earthquake resistant design of structures: Pankaj Agarwal, Manish Shrikhande, PHI, New Delhi.
14. Relevant IS Codes: BIS Publications, New Delhi

Semester VIII		
Subject Code	Subject Name	Credits
CE-C 802	Construction Management	5

Teaching Scheme						
Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
04	02	--	04	01	--	05

Evaluation Scheme								
Theory					Term Work/ Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03 Hrs.	25	-	25	150

Rationale

This course is intended to teach students the management skills to be applied during all the stages of Civil Engineering Project. The professional construction engineering practice will be rendered meaningless if service is not offered with a scientific approach and managerial practices. This course deals with the techniques to be applied for scheduling projects, optimizing time-cost and other resources in construction, monitoring & ensuring quality and safety aspects in projects.

Objectives

- To understand the basic functions and construction management.
- To apply scheduling techniques such as CPM & PERT.
- To gain knowledge of time-cost optimization & effective utilization of resources on construction sites.
- To understand allocating the resources and project monitoring
- To know about safety and quality aspect of construction works..

Detailed Syllabus		
Module	Sub Modules/Contents	Hrs
I	Introduction to Construction Management 1.1 Concept of Management, Principles of management, contribution by eminent personalities towards growth of management thoughts. 1.2 Significance of construction, management, objectives& functions of construction management 1.3 Resources required for construction.	06

II	Construction Projects: 2.1 Role of Construction industry in economic development of country 2.2 Unique features of construction industry. 2.3 Construction projects- Classification, Characteristics, Project life cycle etc. 2.4 Roles and responsibilities of various agencies associated with a Construction project. 2.5 Pre-requisites of commencing construction work such as sanctions, Approvals to be sought, and feasibility studies. 2.6 Site layout, organizing & mobilizing the site	06
III	Construction project planning & Scheduling: 3.1 Stages of planning in the view of owner/Department as well as contractor. 3.2 W.B.S, Bar Charts. 3.3 Network-Terminology, Network Rules, Fulkerson's rule, skip numbering, Precedence network etc. 3.4 C.P.M- Activity & event with their types, activity times, event times, Critical path, forward pass, backward pass, float & its types. 3.5 P.E.R.T- Assumption underlying PERT analysis time estimates, slack& its types, probability of completing the project etc.	12
IV	Resources Management & Allocation : 4.1 Material Management- Importance, objectives, functions of material management, Inventory control, A-B-C analysis, E.O.Q etc. 4.2 Human Resource Management- Manpower planning, recruitment, Selection training, performance evaluation of worker etc. 4.3 Resources Allocation Methods- Resource levelling resource smoothening.	10
V	Project Monitoring & Cost Control : 5.1 Supervision, record keeping, Periodic progress reports etc. 5.2 Updating- Purpose of frequency of updating method of updating a network etc. 5.3 Time cost optimization in construction projects compression & decompression of network etc. 5.4 Common causes of time over run & cost overrun & Corrective measures.	08
VI	Construction Safety, Quality Control & Labour Legislation : 6.1 Common causes of accidents on construction sites, costs of accident, precautionary measures to avoid accidents, 6.2 Occupational health hazards in construction industry. 6.3 Safety & Health Campaign. 6.4 O.S.H.A 6.5 Concept of Quality, quality control check list in quality control etc. 6.6 Role of inspection in quality control, 6.7 Quality manual, Quality assurance statistical quality control 6.8 ISO14000 6.9 Need for legislation & Importance of labour laws. 6.10 Acts applicable to Indian construction labours such as Payment of wages act, Minimum wages act, Workmen's compensation act, Factories act etc.	10

Contribution to Outcomes

On completion of the course, the learners will be able to:-

- Understand & apply the knowledge of management functions like planning, scheduling, executing & controlling the construction projects.
- Prepare feasible project schedule by using various scheduling techniques.
- Gain knowledge of managing various resources & recommend best method of allocating the resources to the project.
- develop optimum relationship between time & cost for construction project
- Implement quality & safety measures on construction sites during execution of civil engineering projects.
- Understand the importance of labour legislation

Term Work: At least 10 assignments covering the entire syllabus.

Distribution of Term Work Marks: The marks of term-work shall be judiciously awarded depending upon its quality. The final certification and acceptance of the term-work warrants the satisfactory and appropriate completion of the assignments and the minimum passing marks to be obtained by the students.

The following weightage of marks shall be given for different components of the term work.

- Assignments: 20 marks
- Attendance : 05 marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

Attendance	Marks awarded
75%- 80%	03 Marks
81%- 90%	04 Marks
91% onwards	05 Marks

Theory Examination:

- The question paper will comprise of six questions, each carrying 20 marks.
- The first question will be compulsory & out of remaining questions students have to attempt any three questions.
- Total four questions need to be attempted.

Oral Examination: The oral examination shall be based on the entire syllabus & the Term-work prepared by the students including assignments..

Recommended books:

- 1) Construction Engineering and Management: S.Seetharaman.
- 2) Construction Planning & Management – Dr.U.K.Shrivastava.
- 3) Professional Construction Management: Barrie D.S. & Paulson B C, McGraw Hill
- 4) Construction Project Management: Chitkara K K Tata McGraw Hill
- 5) Handbook of Construction Management: P K Joy, Macmillan, India
- 6) Critical Path Methods in Construction Practice: Antill J M & Woodhead R W, Wiley
- 7) Construction Hazard and Safety Handbook: King & Hudson, Butterworths

Semester VIII		
Subject Code	Subject Name	Credits
CE-C DLO8031	Department Level Elective: Advanced Design of Steel Structures	5

Teaching Scheme						
Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
04	02	--	04	01	--	05

Evaluation Scheme								
Theory					Term Work/ Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03 Hrs.	25	-	25	150

Rationale

There are various types of the Civil Engineering structures which are subjected to various types of loading and their combination. Most of the industrial structures for which the higher strength is a prime concern, are made up of steel. These special structures are designed by working stress method and limit state method. The design approaches of different components given in the syllabus are based on limit state method and working state method.

Objectives

- To understand the analysis and design concept of round tubular structures
- To understand the design concept of different type of steel water tank
- To understand the design concept of lattice tower and steel chimney
- To understand the design concept of gantry girder
- To develop Civil Engineering graduates having clear understanding of concepts and practical knowledge of modern Civil Engineering techniques for design of steel structures.
- Use various relevant IS codes for designing such special steel structures

Detailed Syllabus		
Module	Sub – Modules / Contents	Hrs
I	1.1 Introduction to Steel Structure Introduction to types of steel, mechanical properties of Structural steel, advantages of steel as structural material, design philosophies of Working Stress Method (WSM), Limit state method and design of simple bolted connection.	03
	1.2 Moment Resistant Beam End Connections : Design of moment resistant bolted and welded beam end connections by limit state method	05
II	2.1 Round Tubular Structural Members : Properties of steel tubes, design of tension member and compression member, design of welded connections, design of flexural members, analysis and design of tubular trusses including purlins and supports.	06
III	3.1 Elevated Steel Tanks and Stacks :	14

	Loads acting on tanks including wind and earthquake, design of circular tanks with hemispherical and conical bottom, supporting ring beam, staging for circular tanks including design of columns and foundation, design of rectangular steel tanks including design of staging, columns and foundation. .(consider the effect of wind and earthquake)	
IV	4.1. Gantry Girder : Loads acting on gantry girder, Analysis of gantry girder, design of gantry girder by limit state method.	07
V	5.1 Lattice Tower : Different configuration of lattice towers, loads acting on lattice towers, Analysis of lattice tower, design of lattice tower including welded or bolted connections for members by limit state method.(consider the effect of wind and earthquake)	09
VI	6.1 Steel Chimney : Forces acting on chimney, design of self supporting welded and bolted chimney and components including design of foundation. .(consider the effect of wind and earthquake)	08

Contribution to Outcomes

On completion of this course, the students will be able

1. To perform the analysis and design of special steel structures
2. The will be able to analysis and design the gantry girder by limit state method.
3. They will be able to analysis and design steel chimney, lattice tower, tubular truss and water tank
4. Students should able to independently design steel structures using relevant IS codes.

Theory Examination:-

1. Question paper will comprise of six question; each carrying 20 marks.
2. The first question will be compulsory and will have short question having weightage of 4-5 marks covering the entire syllabus.
3. The remaining five questions will be based on all the modules of the entire syllabus. For this, the modules shall be divided proportionately and further, the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and contents thereof.
4. The students will have to attempt any three questions out of remaining five questions.
5. Total four questions need to be attempted

Oral Examination:

The oral examination shall be based upon the entire syllabus and the term work consisting of the assignments and projects.

Term Work:

The Term work shall consists of a design report and detailed drawings on three projects as indicated below:

- 1) Roofing system including details of supports using tubular section
- 2) Design of elevated circular tank with conical bottom or rectangular steel tank.
- 3) Design of lattice tower or steel chimney.

The drawing should be drawn in pencil only on minimum of A-1 (imperial) size drawing sheets. Each student has to appear for at least two written test during term .The term work shall comprise of the neatly written report based on assignments. The assignments shall be given covering the entire syllabus.

Distribution of the Term Work Marks:

The marks of the term work shall be judiciously awarded depending upon the quality of the term work.

The final certification and acceptance of term work warrants the satisfactory and appropriate completion of the assignments and projects.

Recommended Books:

- 1 Design of Steel Structures : N Subramanian, Oxford- University Press
- 2 Design of Steel Structures: Punamia, A. K. Jain & Arun Kumar Jain .Laxmi Publication
- 3 Design of Steel Structures: Dayaratnam, Wheeler Publication, New Delhi.
- 4 Design of steel structures: Krishnamachar B.S, & Ajitha Sinha D.
- 5 Design of Steel Structures: Mac. Ginely T.
- 6 Design of Steel Structures: Kazimi S. M. & Jindal R. S., Prentice Hall of India.
- 7 Design of Steel Structures: Breslar, Lin and Scalzi, John Willey, New York.
- 8 Design of Steel Structures: Arya and Ajmani, New chand & Bros.
- 9 Relevant IS codes, BIS Publication, New Delhi
- 10 Steel structures, Controlling behavior through design: R. Englekirk, Wiley
- 11 LRFD Steel Design : William T. Segui, PWS Publishing
- 12 Design of Steel Structures: Edwin H. Gaylord, Charles N. Gaylord and James. Stallmeyer, McGraw-Hill

Semester VIII		
Subject Code	Subject Name	Credits
CE-C DLO8032	Department Level Elective: Industrial Waste Treatment	5

Teaching Scheme						
Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
04	02	--	04	01	--	05

Evaluation Scheme								
Theory					Term Work/ Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03 Hrs.	25	-	25	150

Rationale

Industrial waste waters are generally much more polluted than the domestic or even commercial wastewaters. Such industrial wastewaters cannot always be treated easily by the normal methods of treating domestic wastewaters, and certain specially designed methods. In order to achieve this aim, it is generally always necessary, and advantageous to isolate and remove the troubling pollutants from the wastewaters, before subjecting them to usual treatment processes. Thus Wastewater treatment is closely related to the standards and/or expectations set for the effluent quality. Wastewater treatment processes are designed to achieve improvements in the quality of the wastewater.

Objectives

- To provide knowledge of different types and characteristics of industrial wastes. Also to make the students conversant with effluent and stream standards.
- To study the problems faced by many industrial plants with new effluent limits to be met with their existing treatment plant.
- To understand in-depth yet practical review of wastewater treatment technologies and how to optimize their operation.
- To develop rational approaches towards sustainable waste water management via sludge recovery and treatments.
- To provide an understanding of the mechanisms and processes used to treat waters that have been contaminated in some way by various industrial activities prior to its release into the environment or its re-use.
- To study the sources of contaminants, legislative framework for their remediation as well as the technical aspects of the unit operations involved. To Utilize EIA documents for policy development, project planning or for legal or political action planning.

Detailed Syllabus		
Module	Sub Modules/Contents	Hrs
I	General: Liquid wastes from industries – their volumes and characteristics, Effect of disposal into natural water courses, Municipal sewers and on land, stream standards and effluent standards.	04
II	Sampling and analysis of industrial wastes, Treatability study, good housekeeping, bioassay test, population equivalence.	04
III	Stream sanitation: Effects of industrial wastes on self-purification of streams and fish life, Statement and significance of the parameters of Streeter and Phelps' equation and BOD equations, Deoxygenating and reaeration, Oxygen sag and numerical based on this.	06
IV	General treatment of industrial wastes: Neutralization, Equalization, segregation. Modification of conventional aerobic and anaerobic biological treatment methods. Dewatering and disposal of sludges, unit operation– floatation, Vacuum filtration, Centrifugation, Filter press and membrane filters, Advanced treatment.	12
V	Detailed consideration of wastes produced from following industries: Manufacturing processes normally followed, Volume and effects of raw and treated effluent on streams, Sewers, Characteristics of effluents and land Treatment methods, reuse-recovery 1) Sugar-sugarcane 2) Distilleries 3) Pulp & paper: Sulphate process 4) Textiles: Cotton 5) Dairy 6) Tanneries 7) Electroplating	16
VI	Provision of various acts pertaining to industrial wastes / effluents, introduction to environmental impact assessment and environmental audit. Common Effluent Treatment Plants (CETPs): Location, Need, Design, Operation & Maintenance Problems and Economical aspects.	10

Contribution to outcomes

On completion of this course, the students will have an ability to understand the industrial waste sources, effects and its treatment. The students will understand the various methods of disposal of industrial waste. They will have an understanding of the nature and characteristic of industrial waste and regulatory requirements regarding industrial waste treatment and further, they will have an ability to plan industrial waste minimization.

Students should be able to

- Understand the characteristics of industrial wastewater.
- Identify sampling method and analyze industrial waste.
- Design facilities for the processing and reclamation of industrial waste water.
- Explain on-site treatment methods and solve Analyze and design wastewater treatment systems. (floatation, vacuum filtration, centrifugation, filter press and membrane filters)
- Detailed on-site manufacturing processes and treatments of industrial waste water.
- Analyze proposed development project plans for possible environmental effects and to improve treated effluent quality to confirm standard prescribed by regulatory agencies.

Theory Examination:-

- Question paper will comprise of six questions; each carrying 20 marks.
- The first question will be compulsory which will have the short questions having weightage of 4-5 marks covering the entire syllabus.
- The remaining five questions will be based on all the modules of entire syllabus. For this, the module shall be divided proportionately further, the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module contents thereof.
- The students will have to attempt any three questions out of remaining five questions.
- Total four questions need to be attempted.

Oral Examination:-

The oral Examination shall be based upon the entire syllabus and the term work consisting of the Assignments and Tutorial including the site visit report.

Term Work:

Mini Project- Student should perform activities related to solid waste management at institute level forming groups 4 to 5 students, Report of the activity should be part

Distribution of Term Work Marks:

The marks of the term work shall be judiciously awarded for the various components depending upon the quality of the term work. The final certification and acceptance of term work warrants the satisfactory and appropriate completion of the assignments. Each student shall prepare a report comprising design criteria and flow sheet of the proposed treatment scheme including laboratory analysis for any one industrial waste. Demonstration of available software for design of effluent treatment plant is to be considered.

The following weightage of marks shall be given for different components of the term work.

- Report (on any industry/site visit): 05 Marks
- Seminar/Mini Project : 05Marks
- Attendance : 05 Marks
- Assignments and Tutorials :10 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to

75%- 80%: 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks

Recommended Books:-

1. Waste Water Treatment: Rao & Datta, Oxford & IBH Publishing Co.
2. Environmental Pollution and control in chemical process industries: S.C.Bhatia, Khanna Publication.
3. Industrial Water Pollution Control: W W Eckenfelder Jr, Mc Graw Hill.
4. Industrial Water Pollution Management: E F Gurnham, John Wiley.
5. Biological Waste Treatment: Eckenfelder & Connor Pergamon Press.
6. Theories and Practices of Industrial Waste Treatment: Addison Wesley.
7. Pollution Control in Process Industries: S P Mahajan , Tata mcgraw Hill.
8. Industrial Waste: W Rudolfs ,(Ed), L E C Publishers Inc.
9. The Treatment of Industrial Wastes: E D BesselievreMcgraw Hill.

10. Industrial Waste Disposal: R D Ross , (Ed), Reinhld Bok Croporation.
11. Wastewater Engineering, Treatment and Reuse : Metcalf and Eddy,Tatamcgraw Hill
12. Industrial Wastewater Management Handbook, Hardam S. Azad.
13. Industrial Waste Treatment, Frank Woodward.
14. Environmental Impact Assessment :Larry W. Canter, Mcgraw Hill Book Company.
15. Environmental Impact Analysis Handbook :G.J. Rao and C.D. Weeten ,Mcgraw Hill
16. Environmental Management, Vijay Kulkarni and T. V. Ramchandra, Capital Publishing
17. Environmental Audit, MhaskarA.K.,Enviro Media Publications.

Semester VIII		
Subject Code	Subject Name	Credits
CE-C DLO8033	Department Level Elective: Pavement Design and Construction	5

Teaching Scheme						
Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
04	02	--	04	01	--	05

Evaluation Scheme								
Theory					Term Work/ Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03 Hrs.	25	-	25	

Rationale

The pavements are classified according to mode of transportation (highway and airways) and structural behaviour (flexible and rigid). The design of any pavement warrants the proper analysis thereof. The course deals with the various methods of the analyses and design of pavements. The evaluation of the pavements on routine basis and subsequent maintenance is essential to avoid the distresses in pavements. The course also covers the various distresses likely to take place in the pavements and various methods of evaluating the existing pavements. The distressed pavement needs either strengthening or rehabilitation depending upon the distresses the pavement has undergone. For the proper working and maintenance of the pavement, the concept of pavement management system has emerged. The course also covers these aspects. It also gives major thrust on the low volume roads and construction of concrete roads.

Objectives

- To study the different types of pavements(highway and airfield) depending upon the mode of transportation, use and structural behaviour.
- To understand the concept of consideration of wheel loads, axle loads, wheel-axle configuration and allied aspects as a pre-requisite in the analysis and design of the pavement.
- To study the various types of structural responses (stresses and deformations) inducing the pavements due to wheel load and other climatic variations.
- To study the various methods of analysis and design of the pavements and its subsequent applications to the various types of pavements.
- To study the different types of distresses in pavement, evaluation of the existing pavements using different methods and rehabilitation of the distressed pavements.
- To study the construction of the concrete roads and low volume roads.
- To study the quality control and quality assurance in the road construction and introduce pavement management system.

Detailed Syllabus		
Module	Sub-Modules/ Contents	Hrs
I.	Pavement structure and functional attributes, factors affecting pavement design, types of wheel loads for highways and airports, development of design method for highway and airport pavements.	12
	Stresses in flexible pavements, 1-layer, 2-layer, 3-layers theories, EWLF, ESWL Stresses in Rigid pavement: load and temperature stresses, combined stresses.	
II.	Flexible Pavement Design Airport pavement: Corps of Engineer's method, FAA method CDOT method, Asphalt institute method. Highway Pavement: Empirical methods using no soil strength criteria, empirical method based no soil strength criteria: CBR method as specified by IRC-37 1970,1984,2001,2012,2018 Road note 29 methods, AASHTO method, Asphalt institute method. Fatigue and rutting as a failure criterion.	16
	Rigid Pavement Design: Airport pavements: PCA methods, corps of Engineer's method, FAA method. Joints and reinforcement requirement. Highway pavement: Current British procedure, IRC-58-2012,2015. method.	
III.	Evaluation and strengthening: flexible and rigid pavement distresses, condition and evaluation surveys, present serviceability index, roughness measurement, Benkelman beam deflections, design of overlays(IRC-81-1997), skid resistance and measurement.	12
	Concrete road construction: Mix design, concrete strength, size of aggregates, gradation, and workability, preparation of base form work, placing of reinforcement, compaction, and finishing, curing, joints.	
IV.	Low Cost Roads (Rural Areas) (IRC-SP-20-2002) Classification of low cost roads, construction of low cost roads, stabilization of subgrade, base and its advantages, construction of granular base courses, macadam surface, macadam bases, low cost materials and methods used for highway construction, suitability of different types of roads under different situation. Soils.	05
V	Quality control (QC) and Quality assurance (QA) during construction of various pavements, importance, process control and end product control, statistical methods in quality control, control charts, frequency of testing etc. (IRC-SP-11-1997) (MORTH SECTION 900).	05
VI	Introduction to pavement management systems.	02

Course Outcome

On successful completion of the course, the students shall be able to:

- Understand the structural actions involved in the pavement due to different types of load acting thereon and the various methods of analysis of pavements.
- Understand the applications of the analysis in the design of pavements using different methods of pavement design.
- Know the different types of distresses occurring in the existing pavements and carry out the structural and functional evaluation of the pavements.
- Apply the knowledge of evaluation in pre-empting the failure and to arrive upon the methodology of the rehabilitation of pavements.
- Understand the various aspects of the construction of concrete roads and low volume roads.
- Understand the pavement management system and quality control and assurance criteria and subsequently, its application in the highway construction.

Theory Examination:-

- Question paper will comprise of **six** questions; each carrying 20 marks.
- The **first** question will be **compulsory** which will have the short questions having weightage of 4-5 marks covering the entire syllabus.
- The remaining **five** questions will be based on all the modules of entire syllabus. For this, the module shall be divided proportionately further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and contents thereof.
- There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
- The students will have to attempt any **three** questions out of remaining five questions.
- Total **four** questions need to be attempted.

Oral Examination:-

The oral examination shall be based upon the entire syllabus and the term work.

Term work:

The term-work shall comprise of the neatly written assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least three problems and/ or questions on each modules/ sub-modules and contents thereof, further.

Distribution of Term Work Marks:

The marks of the term-work shall be judiciously awarded depending upon its quality of the term work. The final certification and the acceptance of the term-work warrant the satisfactory and the appropriate completion of the assignments;and further, minimum passing marks to be obtained by the students.

The following weightage of marks shall be given for different components of the term work.

- Assignments : 20 Marks
- Attendance : 05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

75%- 80%: 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks

Recommended Books:-

1. Principles and Practice of Highway Engineering: *L.R.Kadiyali*, Khanna publications.
2. Highway Engineering: *Khanna S.K. and Justo C.E.G.* Nem Chand (Revised 10th Edition, 2014)
3. Pavement design
4. Principles, Practice and Design of Highway Engineering (Including Airport Pavements): *Sharma, S.K.*, S. Chand Technical Publications (3rd Revised Edition, 2013) 4.Pavement Analysis and Design: *Yang H. Huang*, Prentice Hall, New Jersey, 1993
5. Pavement Design: *Yoder and Witzech*, McGraw-Hill, 1982.
6. The Design and Performance of Road Pavements: *Croney, David et al*, McGraw Hill.

Semester VIII		
Subject Code	Subject Name	Credits
CE-C DLO8034	Department Level Elective: Bridge Engineering and Design	5

Teaching Scheme						
Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
04	02	--	04	01	--	05

Evaluation Scheme								
Theory					Term Work/ Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03 Hrs.	25	-	25	

Rationale

In the age of increase in traffic load and rapid transportation, bridges are a very important part of a nation's transportation infrastructure associated with the economic growth. They allow for roads and railways to cross over otherwise impassable obstacles such as rivers, valleys or other roads etc. Bridges are being built mainly with reinforced concrete, pre-stressed concrete or steel depending on various factors such as environment & site conditions, nature of loads and span etc. The civil engineering profession is much concerned with proper planning, design and construction, as well as maintenance, repairs and rehabilitation of bridges which are of utmost importance. In this subject, students will be well acquainted with the types of bridges and their selection based on the specific needs. They will learn analysis and design of superstructure of Reinforced Concrete Culvert and Pre-stressed Concrete bridges for IRC loads along with basics of substructure (foundation, Pier, abutments) using relevant IRC. They will also understand the analysis and design of a lattice girder bridge in steel for railway loading using relevant bridge rules and IRS.

Objectives

- To bring the students to such a level that they being civil engineers will be able to take the appropriate decision in respect of choice of site, type of bridge, components of bridge, superstructure, sub structure, foundation, type of bearing and launching method of girder and construction methods.
- To make the candidate to understand the analysis and design of reinforced concrete culvert/Pre-stressed Concrete bridges using relevant IRCs.
- To make the candidate to understand the analysis and design of lattice girder steel bridge for railway loading using relevant IRS code.

Detailed Syllabus		
Module	Sub module/Contents	Hrs
I.	Introduction: Types of Bridges, Selection of suitable site and type of bridge, Components of a bridge, aesthetics, economic span	06
II.	Design Loads and their Distribution: IRC loads: IRC-Class AA tracked and wheeled, 70R tracked and wheeled, Class-A, Class-B, distribution of loads on RC culverts, Pre-stressed Concrete deck slab and girdered bridge, IRS loads: Railway loading and distribution on lattice girder bridge	10
III.	Design of Superstructure: Design of pre-stressed concrete deck slab bridge, I-girder bridge and box girder bridge for roadway, Design of RC Culvert, Design of balanced cantilever RC bridge for roadway, Design of steel lattice girder bridge for railway	20
IV.	Substructure: Different types of foundations, their choice and methods of construction, well foundation, pile foundation, piers and abutments, wing walls	06
V	Bearing: Various types of bearings and their suitability	05
VI	Construction Methods: Various methods of erection of bridge girders, cantilever method of construction of bridge	05

Contribution to outcome

On successful completion of the course, the student shall be able to:

- Select the suitable type of bridge according to the site condition.
- Understand IRC loads, distribution of these loads on deck slab and among longitudinal beams/girders of a bridge.
- Design of culvert, balanced cantilever reinforced concrete bridge, prestressed concrete deck slab bridge, I-girdered and box girdered bridge, lattice girder railway bridge.
- Understand different types of foundations, piers and abutments, their methods of construction.
- Understand various types of bearings and their suitability, erection of bridge superstructure.

Theory Examination: -

- Question paper will comprise of **six** questions; each carrying 20 marks.
- The **first** question will be **compulsory** which will have the short questions having weightage of 4-5 marks covering the entire syllabus.
- The remaining **five** questions will be based on all the modules of entire syllabus. For this, the module shall be divided proportionately further, and the weightage of the marks shall be judiciously awarded in proportion to importance of sub-module and contents thereof.
- There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
- The students will have to attempt any **three** questions out of remaining five questions.
- Total **four** questions need to be attempted.

Site Visit/ Field Visit:

The students shall visit the site where the construction of bridge structure using pre-stressed concrete is going on. The students shall prepare the detailed report thereof and submit as a part of the term work.

Oral Examination:

The oral Examination shall be based upon the entire syllabus, term work and site/field visit.

Term work:

The termwork shall comprise of the neatly written assignments. The assignments shall be given covering the entire syllabus. There shall be minimum four problems for design of roadway bridges and one railway bridge.

Presentation on any emerging trend in bridges, its design, methods of erection and construction, types of foundations and bearings etc relevant to syllabus.

Distribution of Term Work Marks:

The marks of the term-work shall be judiciously awarded depending upon the quality of the term work. The final certification and the acceptance of the term-work warrants the satisfactory and the appropriate completion of the assignments; and further, minimum passing marks to be obtained by the students.

The following weightage of marks shall be given for different components of the term work.

- Assignments: **10 Marks**
- Presentation: **05 Marks**
- A Bridge site visit report **or** A project on Design of superstructure of a bridge using software: **05 Marks**
- Attendance: **05 Marks**

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

75%- 80%: 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks

References

A-Recommended Books:

1. Design of Bridges: *Raju N. K.*, Oxford and IBH fifth Edition.
2. Bridge Engineering: *Ponnuswamy S.*, Tata Mc Graw Hill.
3. Concrete Bridge Practice: *Raina V. K.*, Tata Mc Graw Hill.
4. Essentials of Bridge Engineering: *Victor D.J.*, Oxford and IBH.
5. Design of Bridge Superstructures: *T.R. Jagdeesh and M.A. Jayaram*, Prentice Hall India Private Ltd., New Delhi.
6. Bridge Engineering Handbook: *Chen W. F. and Duan L.*, CRC Press, 2000.
7. Bridge Bearings and Expansion Joints: *David Lee*, E & FN Spon.

B-IRC Codes:

IRC: SP13- 2004, IRC: 5- 2015, IRC: 6- 2016, IRC: 18-2000, IRC: 21-2000, IRC: 24-2001, IRC: 27-2009, IRC: 45, IRC: 78-2014, IRC: 83 (i)-1999, IRC: 83 (ii)-1987, IRC: 83 (iii)-2002, IRC:112- 2011

C-IRS Codes:

IRS- 2003, Bridge rules (Railway board): Rules specifying the loads for design of super-structure and sub-structure of bridges and for assessment of the strength of existing bridges- 2008.

Indian railway standard code of practice for the design of steel or wrought iron bridges carrying rail, road or pedestrian traffic (steel bridge code) adopted- 2003

Semester VIII		
Subject Code	Subject Name	Credits
CE-DLO 8035	Department Level Elective: Appraisal & Implementation of Infrastructure Projects	05

Teaching Scheme						
Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
04	02	--	04	01	--	05

Evaluation Scheme								
Theory					Term Work/ Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03 Hrs.	25	-	25	150

Rationale

This course is intended to make students aware of the appraisal criteria for any Civil engineering project. This course will make students understand the importance of feasibility studies and acquaint them with the process of preparing a project report, both of which play a significant role in deciding the viability of a project. The professional construction engineering practice will be rendered meaningless if student do not grasp the knowledge of financial analysis. This course shall be helpful to students in studying all the economic aspects of Infrastructure projects.

Objectives

- To know the procedure of feasibility studies for any infrastructure project.
- To learn the procedure of appraisals required for deciding the worthiness of any project.
- To learn the procedure of forecasting demand and know its importance.
- To know the components and importance of technical appraisal.
- To make students acquainted with important decision making tools like Break even analysis, SWOT analysis and other ways to carry out economic analysis of a project.
- To get acquainted with different methods of implementing a project.

Detailed Syllabus			
Module	Sub-Modules/ Contents		Hrs
I.	Construction Projects and Report Preparation		06
	1.1	Classification of construction projects. Project Formulation and phases involved in it.	
	1.2	Feasibility studies, SWOT analysis. Preparation of Project report.	
II.	Project Appraisal		08
	2.1	Importance and phases in a project development cycle for major infrastructure projects.	
	2.2	Importance of Appraisal, its need and steps involved in it.	
III.	Market Appraisal		10
	3.1	Importance and methods of carrying out demand analysis. Sources to gather project related information and ways to carry out market survey.	
	3.2	Methods to forecast demands. Uncertainties involved in demand forecasting.	
IV.	Technical and Managerial Appraisal		08
	4.1	Method to study the technical appraisal/viability of a project in terms of its location, type of land and intended use of building, technology requirements of the project, Size and complexity of tools and plants, raw materials to be used and their impact on the vicinity, energy requirements, water supply and disposal of effluents if any.	
	4.2	Study of managerial requirements of a project, Desirable organisational structure and hierarchy to manage as well as implement the project, Method of assessment of entrepreneurs.	
V.	Financial analysis and Economic Appraisal		10
	5.1	Various costs related to a project, Methods to determine the profitability of a project, Break even analysis.	
	5.2	Economic appraisal: Urgency, Payback period, Avg. Rate of return, Net Present Value, Internal rate of return, Benefit cost ratio, Cost of Capital etc.	
VI.	Project Financing and Implementation		10
	6.1	Types and Sources of finance in local, National and International context. Issues related to project financing.	
	6.2	Agencies involved in the implementation of a project. Methods of implementation like Built, operate and Transfer and its other variants like B.O.O, B.O.O.T, B.L.T, etc.	

Contribution to Outcomes

On successful completion of the course, the learners will be able to:

- **Classify** the projects and **describe** the phases involved in project formulation.
- **Prepare** detailed project report on the basis of various feasibility studies and SWOT analysis.
- **Devise** a project's development cycle and get acquainted with the different appraisals in the process of deciding the worthiness of a project.
- **Exhibit** and **apply** the managerial skills and knowledge of financial aspects required during the implementation of projects.
- **Identify** various sources for project finance.
- **Know** the various agencies involved in project implementation as well as **select** the method of project implementation which is best suited for a particular project.

Theory Examination:

- Question paper will comprise of **six** questions; each carrying 20 marks.
- The **first** question will be **compulsory** which will have the short questions having weightage of 4-5 marks covering the entire syllabus.
- The remaining **five** questions will be based on all the modules of entire syllabus. For this, the module shall be divided proportionately further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module or contents thereof.
- There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
- The students will have to attempt any **three** questions out of remaining five questions.
- Total **four** questions need to be attempted.

Oral Examination:

The oral examination will be based on the entire syllabus and the term work.

Term Work:

The term work shall consist of the following:

- Minimum **Six assignments** covering the entire syllabus.
- **Report** on studying the SWOT Analysis of any one major infrastructure project.
- **Case study – Powerpoint presentation** covering the various appraisals of any one major infrastructure project.

Distribution of Term Work Marks:

The marks of the term-work shall be judiciously awarded depending upon the quality of the term work including that of the report and powerpoint presentation. The final certification and acceptance of the term-work warrants the satisfactory and the appropriate completion of the assignments; and the minimum passing marks to be obtained by the students. The following weightage of marks shall be given for different components of the term work.

Assignments:20 Marks.

Attendance: 05 Marks. Further, while giving weightage of marks on the attendance, guideline to be resorted to is: 75%- 80%: 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Mark

Recommended Books:

- 1) Project Preparation, Appraisal, Budgeting, and Implementation: Prasanna Chandra (Tata McGraw Hill).
- 2) Infrastructure Development & Financing in India - N. Mani (New Century Publications).
- 3) Infrastructure & economic development - Anu Kapil (Deep&Deep Publications).
- 4) Construction Management: Planning and finance - Cormican D.(Construction press, London).
- 5) Engineering Economics – Kumar (Wiley, India).
- 6) Real Estate, Finance and investment - Bruggeman.Fishr (McGraw Hill).
- 7) The cost management toolbox; A Managers guide to controlling costs and boosting profits.
- Oliver, Lianabel (Tata McGraw Hill).

Semester VIII		
Subject Code	Subject Name	Credits
CE-DLO 8036	Department Level Elective: Soil Dynamics	05

Teaching Scheme						
Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
04	02	--	04	01	--	05

Evaluation Scheme								
Theory					Term Work/ Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03 Hrs.	25	-	25	150

Rationale

In basic geotechnical engineering course generally various static loads are considered in the theories and analysis of soil. But practically many geotechnical applications require the knowledge of the behaviour and properties/response of soil as a material which is subjected to various types of dynamic or cyclic time-dependent loadings. Some of the structures which are subjected to dynamic loadings are machine foundations, shallow and deep foundations, retaining structures, slopes, sub grade soil below railway, pavement, runway etc. This course provides the fundamental theoretical and computational aspects of dynamics for some important geotechnical problems and structures.

Objectives

- To study fundamental concepts of vibrations, degrees of freedom and damping systems.
- To study phenomena like liquefaction and their effects.
- To study principals of machine foundation design and dynamic earth pressure theories on retaining wall.
- To learn test methods of evaluating dynamic properties of soil.
- To know the basic earth pressure on retaining walls

Detailed Syllabus		
Module	Sub- Modules/Contents	Hrs
I.	Scope and objective; Nature and types of dynamic loading; Importance of soil dynamics. Vibration of elementary system, degree of freedom, analysis of system with one degree of freedom, spring-mass system, harmonic vibration, uniform circular motion natural frequency, free and forced vibrations with and without damping, type of damping	10
II.	Wave propagation in elastic rods, in an elastic infinite medium and in Semi-elastic half space, wave generated by surface footing.	05

III.	Liquefaction of soils, criterion and factors affecting liquefaction of soil, laboratory and field studies on liquefaction, liquefaction studies in oscillatory simple shear, evaluation of liquefaction potentials, Liquefaction of clay.	10
IV.	Principles of machine foundation design, criteria for satisfactory machine foundation, degree of freedom of a block foundation analysis of vertical and sliding vibration of a machine foundation, mass of soil participating in vibration. Practical design considerations and codal provisions.	06
V.	Vibration isolation and screening methods, improvement of distressed machine foundation.	07
VI.	Field and laboratory tests for evaluation of dynamic properties of soil under vertical vibration coefficient of elastic uniform shear, spring constant damping modulus of elasticity typical values of soils. Basics of dynamic earth pressure on retaining walls: conventional gravity type, reinforced soils, distribution of pressure, point of application of the resultant, simple examples.	14

Course Outcome

On successful completion of the course, the students are expected to:

- Acquire the knowledge of concepts, principles and applications of soil under dynamic loading.
- Develop an ability to design with reference to code provisions and solve the practical soil problems subjected to vibrations.
- Provide an impetus to new developments in related dynamic topics.
- Carry out field tests on soil to know the dynamic properties of soil.
- Calculate the dynamic earth pressure on retaining walls.

Theory Examination:-

- Question paper will comprise of **six** questions; each carrying 20marks.
- The **first** question will be **compulsory** which will have the short questions having weightage of 4-5 marks covering the entire syllabus.
- The remaining five questions will be based on all the modules of entire syllabus. For this, the module shall be divided proportionately further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and contents thereof.
- There can be an internal choice in various sub-questions/ questions in order to accommodate the questions on all the topics/sub-topics.
- The students will have to attempt any **three** questions out of remaining **five** questions.

Total **four** questions need to be attempted.

Laboratory Test

It is recommended to conduct block foundation tests.

Oral Examination:-

The oral examination will be based on the entire syllabus.

Term Work:

Each student shall prepare a project report covering the selection of design parameters, design analysis including drawing on any aspect of soil dynamics included in the syllabus. The project report referred above along with the assignments will form a part of the term work. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems and/or questions on each modules/ sub- modules and contents thereof, further. The report on the block vibration tests, if conducted, shall also form a part of the term work.

Distribution of Term Work Marks:

The marks of the term-work shall be judiciously awarded for various components of the term work depending upon its quality. The final certification and the acceptance of the term-work warrant the satisfactory and the appropriate completion of the assignments, proper compilation of the project report and that of experiments/ practical, if conducted; and further, minimum passing marks to be obtained by the students.

The following weightage of marks shall be given for different components of the term work.

- Assignments : 20Marks
- Attendance : 05Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

75%- 80%: 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks

Recommended books:

1. Soil Dynamics: *Shamsher Prakash*, McGraw-Hill book company
2. Principles of Soil Dynamics: *Braja, M. Das*, PWS-Kent Publishing Company
3. Dynamics of Bases and Foundations: *Barkan, D. D.*, McGraw- Hill Book company
4. Steven L. Kramer, "Geotechnical Earthquake Engineering", Prentice Hall Inc.
5. E. E. Richart et al. "Vibrations of Soils and Foundations", Prentice Hall Inc.
6. Relevant IS codes

Semester VIII		
Subject Code	Subject Name	Credits
CE-DLO 8037	Department Level Elective: Applied Hydrology & Flood Control	05

Teaching Scheme						
Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
04	02	--	04	01	--	05

Evaluation Scheme								
Theory					Term Work/ Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03 Hrs.	25	-	25	

Rationale

This subject deals with the various processes involved in hydrological cycle and provides in depth understanding of the theories and concepts of surface, subsurface and ground water hydrology. It focuses on types and forms of precipitations. It also explains the application of hydrographs, unit hydrographs and further describes various techniques of estimating stream flows. It further describes the various techniques of estimating streamline flows. It also describes the importance of floods, flood routing and ground water hydrology.

Objectives

- To understand the various processes involved in the hydrological cycle.
- To measure rainfall, computation of average rainfall, various water losses etc.
- To know the various stream flow measurement and its importance.
- To study the hydrograph and unit hydrographs, applications of unit hydrograph concept.
- To study various flood control methods, estimate design flood, and flood routing
- To study the concepts of ground water movement, steady and unsteady flow towards fully penetrating wells and well yields.

Detailed Syllabus

Module	Sub-Modules/ Contents	Hrs
I	Introduction: Hydrological cycle, scope of hydrology, water budget equation, data sources. Precipitation: Measurement of precipitation, network of rain gauges and their adequacy in a catchment, methods of computing average rainfall, hyetograph and mass curve of rainfall, adjustment of missing data, station year method and double mass curve analysis, Depth-Area -Duration relationship, Intensity-Duration -Frequency relationship, Probable Maximum Precipitation.	10
II	Abstractions from Precipitation: Evaporation and transpiration, evapo-transpiration, interception, depression storage, infiltration and infiltration indices, determination of water losses. Stream Flow Measurement: Measurement stream-flow by direct and indirect methods, measurement of stage and velocity, area-velocity method, stage-discharge relationships, current meter method, pitot tube method, slope-area method, rating curve method, dilution technique, electro-magnetic method, ultrasonic method.	10
III.	Runoff: Catchment, watershed and drainage basins, Factors affecting runoff, rainfall-runoff relationship, runoff estimation, droughts.	8
IV.	Hydrograph Analysis: Characteristics, base flow separation, unit hydrograph, S-hydrograph, complex hydrograph, synthetic hydrograph, dimensionless unit hydrograph, Instantaneous unit hydrograph.	8
V.	Floods: Estimation, envelope curves, flood frequency studies, probability and stochastic methods, estimation of design flood, flood control methods, Limitations, risk-reliability and safety factor. Flood routing: Hydrologic and hydraulic routings.	8
VI.	Ground Water Hydrology: Yield, transmissibility, Darcy's law, DuPont's theory of unconfined flow, steady flow towards fully penetrating wells(confined and unconfined).Unsteady flow towards wells: Jacob's curve and other methods, use of well Function, pumping tests for aquifer characteristics, methods of recharge.	8

Contribution to Outcomes

On successful completion of the course, the students are expected to:

- Explain hydrologic cycle and various methods of Measurement of rainfall.
- Calculate optimum number of rain gauge stations for average rainfall and missing rainfall over catchment
- Describe various methods of measurement of stream flow and to calculate abstraction losses over the catchment
- Develop rainfall runoff relationship and calculating runoff over catchment
- Perform hydrologic and hydraulic routing
- Derive the equations for the discharge of well for confined and unconfined aquifer

Theory examination:

- Question paper will comprise of **six** questions; each carrying 20 marks.
- The **first** question will be **compulsory** which will have the short questions having weightage of 4-5 marks covering the entire syllabus.
- The **remaining five** questions will be based on all the modules of entire syllabus. For this, the module shall be divided proportionately further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and contents thereof.
- The students will have to attempt any **three** questions out of remaining five questions.
- Total **four** questions need to be attempted.

Oral Examination:

The oral Examination shall be based upon the entire syllabus and the term work.

Term Work:

The term work shall comprise of the neatly written report of the assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems and / or questions on each sub-modules and contents thereof further.

Distribution of Term Work Marks:

The marks of term-work shall be judiciously awarded depending upon the quality of the term work. The final certification and acceptance of term-work warrants the satisfactory and the appropriate completion of the assignments; and the minimum passing marks to be obtained by the students. The following weightage of marks shall be given for different components of the term work.

Assignments : 20 Marks

Attendance : 05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

75%- 80%: 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks

Recommended Books:

- Engineering Hydrology: *K. Subramanya*, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
- Irrigation Engineering and Hydraulic Structures: *S. K. Ukarande*, Ane's Books Pvt. Ltd. (Abridged Edition 2015), ISBN 9789383656899
- Hydrology: *H. M. Raghunath*, New Age International Publishers, New Delhi
- Irrigation and Water Power Engineering: *Dr. B.C. Punmia* and *Dr. Pande, B.B.Lal*, Laxmi Publications Pvt. Ltd. New Delhi.
- Irrigation Engineering and Hydraulics Structures: *S. K. Garg*, Khanna Publishers. Delhi
- Irrigation Water Resources and Water Power Engineering: *Dr. P.N. Modi*, Standard Book House. Delhi.
- Elementary Hydrology: *V. P. Singh*, Prentice Hall
- Engineering Hydrology: Principles and practice: *V. M. Ponce*, Prentice Hall

Semester VIII		
Subject Code	Subject Name	Credits
CE-C ILOC8021	Institute Level Elective: Project Management	03

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	--	--	03	--	--	03

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Avg						
20	20	20	80	03 Hrs.	--	--	--	100

Objectives:

- To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
- To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Module	Detailed Contents	Hrs
I	Project Management Foundation: Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge areas as per Project Management Institute (PMI).	5
II	Initiating Projects: How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	6
III	Project Planning and Scheduling: Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart. Introduction to Project Management Information System (PMIS).	8

IV	Planning Projects: Crashing project time, Resource loading and leveling, Goldratt's critical chain, Project Stakeholders and Communication plan. Risk Management in projects: Risk management planning, Risk identification and risk register. Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	6
V	5.1 Executing Projects: Planning monitoring and controlling cycle. Information needs and reporting, engaging with all stakeholders of the projects. Team management, communication and project meetings. 5.2 Monitoring and Controlling Projects: Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep. Project audit. 5.3 Project Contracting Project procurement management, contracting and outsourcing,	8
VI	6.1 Project Leadership and Ethics: Introduction to project leadership, ethics in projects. Multicultural and virtual projects. 6.2 Closing the Project: Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	6

Outcomes	
Students will be able to : • Apply selection criteria and select an appropriate project from different options. • Write work break down structure for a project and develop a schedule based on it. • Identify opportunities and threats to the project and decide an approach to deal with them strategically. • Use Earned value technique and determine & predict status of the project. • Capture lessons learned during project phases and document them for future reference	

Assessment:

Internal:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Theory Examination:

In question paper, weightage of each module will be approximately proportional to number of respective lecture hours as mentioned in the syllabus.

- Question paper will comprise of total six question carrying 20 marks
- Question no. 1 is compulsory. Attempt any 3 from remaining 5 questions
- Remaining question (Q.2 to Q.6) will be selected from all the modules.
- Questions may be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) may be from any module other than module 3)

References:

1. Jack Meredith & Samuel Mantel, Project Management: A managerial approach, Wiley India, 7thEd.
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Gido Clements, Project Management, Cengage Learning.
4. Gopalan, Project Management, , Wiley India
5. Dennis Lock, Project Management, Gower Publishing England, 9th Ed.

Semester VIII		
Course Code	Course Name	Credits
CE-C ILOC8022	Institute Level Elective: Finance Management	03

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	--	--	03	--	--	03

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Avg						
20	20	20						

Objectives:

- Overview of Indian financial system, instruments and market
- Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
- Knowledge about sources of finance, capital structure, dividend policy

Module	Detailed Contents	Hrs
I	Overview of Indian Financial System: Characteristics, Components and Functions of Financial System. Financial Instruments: Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. Financial Markets: Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market Financial Institutions: Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	06
II	Concepts of Returns and Risks: Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. Time Value of Money: Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	06
III	Overview of Corporate Finance: Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision.	09

	Financial Ratio Analysis: Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	
IV	Capital Budgeting: Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) Working Capital Management: Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	10
V	Sources of Finance: Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. Capital Structure: Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure	05
VI	Dividend Policy: Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	03

Outcomes

Students will be able to...

- Understand Indian finance system and corporate finance
- Take investment, finance as well as dividend decisions

Assessment:

Internal:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Theory Examination:

In question paper, weightage of each module will be approximately proportional to number of respective lecture hours as mentioned in the syllabus.

- Question paper will comprise of total six question carrying 20 marks
- Question no. 1 is compulsory. Attempt any 3 from remaining 5 question
- Remaining question (Q.2 to Q.6) will be selected from all the modules.
- Questions may be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) may be from any module other than module 3)

References:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.

Semester VIII		
Course Code	Course Name	Credits
CE-C ILOC8023	Institute level Elective : Entrepreneurship Development and Management	03

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	--	--	03	--	--	03

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Avg						
20	20	20	80	03 Hrs.	--	--	--	100

Objectives:

- To acquaint with entrepreneurship and management of business
- Understand Indian environment for entrepreneurship
- Idea of EDP, MSME

Module	Detailed Contents	Hrs
I	Overview Of Entrepreneurship: Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	04
II	Business Plans And Importance Of Capital To Entrepreneurship: Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur Entrepreneurship And Business Development: Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	09
III	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises.	05

IV	Indian Environment for Entrepreneurship: key regulations and legal aspects , MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	08
V	Effective Management of Business: Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	08
VI	Achieving Success In The Small Business: Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	05

Outcomes:

Students will be able to...

- Understand the concept of business plan and ownerships
- Interpret key regulations and legal aspects of entrepreneurship in India
- Understand government policies for entrepreneurs

Internal:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Theory Examination:

In question paper, weightage of each module will be approximately proportional to number of respective lecture hours as mentioned in the syllabus.

1. Question paper will comprise of total six question carrying 20 marks
2. Question no. 1 is compulsory. Attempt any 3 from remaining 5 question
3. Remaining question (Q.2 to Q.6) will be selected from all the modules.
4. Questions may be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) may be from any module other than module 3)

References:

1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
6. MaddhurimaLall, ShikahSahai, Entrepreneurship, Excel Books
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad

8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. Laghu Udyog Samachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

Semester VIII		
Course Code	Course Name	Credits
CE-C ILOC8024	Institute level Elective : Human Resource Management	03

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	--	--	03	--	--	03

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03 Hrs.	--	--	--	100

Objectives:

- To introduce the students with basic concepts, techniques and practices of the human resource management.
- To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations.
- To familiarize the students about the latest developments, trends & different aspects of HRM.
- To acquaint the student with the importance of inter-personal & inter-group behavioral skills in an organizational setting required for future stable engineers, leaders and managers.

Module	Detailed Contents	Hrs
I	Introduction to HR Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions. Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues.	5
II	Organizational Behavior (OB) Introduction to OB Origin, Nature and Scope of Organizational Behavior, Relevance to Organizational Effectiveness and Contemporary issues Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behavior. Motivation: Theories of Motivation and their Applications for Behavioral Change (Maslow, Herzberg, McGregor);	7

	Group Behavior and Group Dynamics: Work groups formal and informal groups and stages of group development. Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. Case study	
III	Organizational Structure & Design Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress. Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership. Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.	6
IV	Human resource Planning Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale. Performance Appraisal Systems: Traditional & modern methods, Performance Counseling, Career Planning. Training & Development: Identification of Training Needs, Training Methods	5
V	Emerging Trends in HR Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes & transformation in HR. Organizational Change, Culture, Environment Cross Cultural Leadership and Decision Making: Cross Cultural Communication and diversity at work, Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation.	6
VI	HR & MIS Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries) Strategic HRM Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals Labour Laws & Industrial Relations Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act	10

Contribution to Outcomes:

Students will be able to:

- Understand the concepts, aspects, techniques and practices of the human resource management.
- Understand the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.
- Gain knowledge about the latest developments and trends in HRM.

- Apply the knowledge of behavioral skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

Assessment:**Internal:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Theory Examination:

In question paper, weightage of each module will be approximately proportional to number of respective lecture hours as mentioned in the syllabus.

1. Question paper will comprise of total six question carrying 20 marks
2. Question no. 1 is compulsory. Attempt any 3 from remaining 5 question
3. Remaining question (Q.2 to Q.6) will be selected from all the modules.
4. Questions may be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) may be from any module other than module 3)

References:

1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15th edition, 2015
5. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

Semester VIII		
Course Code	Course Name	Credits
CE-C ILOC8025	Intitute level Elective : Professional Ethics and CSR	03

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	--	--	03	--	--	03

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03 Hrs.	--	--	--	100

Objectives:

- To understand professional ethics in business
- To recognized corporate social responsibility

Module	Detailed Contents	Hrs
01	Professional Ethics and Business: The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	04
02	Professional Ethics in the Marketplace: Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy Professional Ethics and the Environment: Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	08
03	Professional Ethics of Consumer Protection: Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy Professional Ethics of Job Discrimination: Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	06
04	Introduction to Corporate Social Responsibility: Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	05
05	Corporate Social Responsibility: Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP)	08
06	Corporate Social Responsibility in Globalizing India: Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry	08

	of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	

Contribution to outcomes

Students will be able to...

- Understand rights and duties of business
- Distinguish different aspects of corporate social responsibility
- Demonstrate professional ethics
- Understand legal aspects of corporate social responsibility

Assessment:

Internal:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Theory Examination:

In question paper, weightage of each module will be approximately proportional to number of respective lecture hours as mentioned in the syllabus.

- Question paper will comprise of total six question carrying 20 marks
- Question no. 1 is compulsory
- Remaining question (Q.2 to Q.6) will be selected from all the modules.
- Questions may be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) may be from any module other than module 3)

References:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
4. Corporate Social Responsibility in India (2015) by Bidyut Chakrabarty, Routledge, New Delhi.

SemesterVIII		
Course Code	Course Name	Credits
CE-C ILOC8026	Institute level Elective : Research Methodology	03

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	--	--	03	--	--	03

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03 Hrs.	--	--	--	100

Objectives:

- To understand Research and Research Process
- To acquaint students with identifying problems for research and develop research strategies
- To familiarize students with the techniques of data collection, analysis of data and interpretation

Module	Detailed Contents	Hrs
01	Introduction and Basic Research Concepts 1.1 Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology 1.2 Need of Research in Business and Social Sciences 1.3 Objectives of Research 1.4 Issues and Problems in Research 1.5 Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	09
02	Types of Research 2.1. Basic Research 2.2. Applied Research 2.3. Descriptive Research 2.4. Analytical Research 2.5. Empirical Research 2.6 Qualitative and Quantitative Approaches	07
03	Research Design and Sample Design 3.1 Research Design – Meaning, Types and Significance 3.2 Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	07
04	Research Methodology 4.1 Meaning of Research Methodology 4.2. Stages in Scientific Research Process: a. Identification and Selection of Research Problem b. Formulation of Research Problem c. Review of Literature	08

	d. Formulation of Hypothesis e. Formulation of research Design f. Sample Design g. Data Collection h. Data Analysis i. Hypothesis testing and Interpretation of Data j. Preparation of Research Report	
05	Formulating Research Problem 5.1 Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	04
06	Outcome of Research 6.1 Preparation of the report on conclusion reached 6.2 Validity Testing & Ethical Issues 6.3 Suggestions and Recommendation	04

Outcomes

Students will be able to:

- Prepare a preliminary research design for projects in their subject matter areas
- Accurately collect, analyze and report data
- Present complex data or situations clearly
- Review and analyze research findings

Internal:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Theory Examination:

In question paper, weightage of each module will be approximately proportional to number of respective lecture hours as mentioned in the syllabus.

- Question paper will comprise of total six question carrying 20 marks
- Question no. 1 is compulsory. Attempt any 3 from remaining 5 question
- Remaining question (Q.2 to Q.6) will be selected from all the modules.
- Questions may be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) may be from any module other than module 3)

References:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R., 1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nded), Singapore, Pearson Education

SemesterVIII		
Course Code	Course Name	Credits
CE-C ILOC8027	Institute level Elective : IPR & Patenting	03

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	--	--	03	--	--	03

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Avg						
20	20	20	80	03 Hrs.	--	--	--	100

Objectives:

- To understand intellectual property rights protection system
- To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
- To get acquaintance with Patent search and patent filing procedure and applications

Module	Detailed Contents	Hr
01	Introduction to Intellectual Property Rights (IPR): Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc. Importance of IPR in Modern Global Economic Environment: Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	05
02	Enforcement of Intellectual Property Rights: Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement Indian Scenario of IPR: Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	07
03	Emerging Issues in IPR: Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	05
04	Basics of Patents: Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while	07

	patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	
05	Patent Rules: Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	08
06	Procedure for Filing a Patent (National and International): Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication etc, Time frame and cost, Patent Licensing, Patent Infringement Patent databases: Important websites, Searching international databases	07

Outcomes:

Students will be able to...

- understand Intellectual Property assets
- assist individuals and organizations in capacity building
- work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

Assessment:

Internal:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Theory Examination:

In question paper, weightage of each module will be approximately proportional to number of respective lecture hours as mentioned in the syllabus.

- Question paper will comprise of total six question carrying 20 marks
- Question no. 1 is compulsory. Attempt any 3 from remaining 5 question
- Remaining question (Q.2 to Q.6) will be selected from all the modules.
- Questions may be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) may be from any module other than module 3)

Reference Books:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. LousHarns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi, IPR: Drafting, Interpretation of Patent Specifications and Claims, New India Publishing Agency
14. Vivien Irish, 2005, Intellectual Property Rights for Engineers, IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

Semester VIII		
Course Code	Course Name	Credits
CE-C ILOC8028	Institute Level Elective : Digital Business Management	03

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	--	--	03	--	--	03

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Avg						
20	20	20	80	03 Hrs.	--	--	--	100

Objectives:

- To familiarize with digital business concept
- To acquaint with E-commerce
- To give insights into E-business and its strategies

Module	Detailed content	Hrs
1	Introduction to Digital Business- Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy, Drivers of digital business- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) Opportunities and Challenges in Digital Business,	09
2	Overview of E-Commerce E-Commerce- Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	06
3	Digital Business Support services: ERP as e –business backbone, knowledge Tope Apps, Information and referral system Application Development: Building Digital business Applications and Infrastructure	06

4	Managing E-Business -Managing Knowledge, Management skills for e-business, Managing Risks in e –business Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	06
5	E-Business Strategy -E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	04
6	Materializing e-business: From Idea to Realization -Business plan preparation Case Studies and presentations	08

Outcomes:

Students will be able to:

- Identify drivers of digital business
- Illustrate various approaches and techniques for E-business and management
- Prepare E-business plan

Assessment:

Internal:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Theory Examination:

In question paper, weightage of each module will be approximately proportional to number of respective lecture hours as mentioned in the syllabus.

- Question paper will comprise of total six question carrying 20 marks
- Question no. 1 is compulsory
- Remaining question (Q.2 to Q.6) will be selected from all the modules.
- Questions may be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) may be from any module other than module 3)

References:

1. A textbook on E-commerce, Er. Arunrajan Mishra, Dr W K Sarwade, Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, Vinocenzo Morabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective -DOI:[10.1787/9789264221796-en](https://doi.org/10.1787/9789264221796-en)OECD Publishing

Semester VIII		
Course Code	Course Name	Credits
CE-C ILOC8028	Institute level Elective : Environmental Management	03

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	--	--	03	--	--	03

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Avg						
20	20	20	80	03 Hrs.	--	--	--	100

Objectives:

- Understand and identify environmental issues relevant to India and global concerns
- Learn concepts of ecology
- Familiarise environment related legislations

Module	Detailed Contents	Hrs
I	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities. Environmental issues relevant to India, Sustainable Development, The Energy scenario.	10
II	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	06
III	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	05
IV	Scope of Environment Management, Role & functions of Government as a planning and regulating agency. Environment Quality Management and Corporate Environmental Responsibility	10
V	Total Quality Environmental Management, ISO-14000, EMS certification.	05
VI	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	03

Contribution to Outcomes

Students will be able to...

- Understand the concept of environmental management
- Understand ecosystem and interdependence, food chain etc.
- Understand and interpret environment related legislations

Assessment:

Internal:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Theory Examination:

In question paper, weightage of each module will be approximately proportional to number of respective lecture hours as mentioned in the syllabus.

- Question paper will comprise of total six question carrying 20 marks
- Question no. 1 is compulsory. Attempt any 3 from remaining 5 question
- Remaining question (Q.2 to Q.6) will be selected from all the modules.
- Questions may be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) may be from any module other than module 3)

References:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management, T V Ramachandra and Vijay Kulkarni, TERI Press
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Macmillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press
7. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing. 2015

UNIVERSITY OF MUMBAI



Revised syllabus (Rev- 2016) from Academic Year 2016 -17
Under

FACULTY OF TECHNOLOGY

Information Technology

Second Year with Effect from AY 2017-18

Third Year with Effect from AY 2018-19

Final Year with Effect from AY 2019-20

As per **Choice Based Credit and Grading System**

with effect from the AY 2016–17

Co-ordinator, Faculty of Technology's Preamble:

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's). It is also resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Choice based Credit and Grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

Choice based Credit and grading system is implemented from the academic year 2016-17 through optional courses at department and institute level. This will be effective for SE, TE and BE from academic year 2017-18, 2018-19 and 2019-20 respectively.

Dr. S. K. Ukarande

Co-ordinator,

Faculty of Technology,

Member - Academic Council

University of Mumbai, Mumbai

Preamble

It is an honor and a privilege to present the revised syllabus of Bachelor of Engineering in Information Technology (effective from year 2016-17) with inclusion of cutting edge technology.

Information Technology is comparatively a young branch among other engineering disciplines in the University of Mumbai. It is evident from the placement statistics of various colleges affiliated to the University of Mumbai that IT branch has taken the lead in the placement. The branch also provides multi-faceted scope like better placement and promotion of entrepreneurship culture among students, and increased Industry Institute Interactions.

Industries views are that, only 16 % graduates are directly employable. One of the reasons is a syllabus which is not in line with the latest technologies. Our team of faculties has tried to include all the latest technologies in the syllabus. Also the first time we are giving the choice of elective from fifth semester such that students will be master in one of the IT domain.

The syllabus is peer reviewed by experts from reputed industries and as per their suggestions it covers future trends in IT technology and research opportunities available due to these trends.

I would like to thank senior faculties of IT department of all colleges affiliated to Mumbai University for significant contribution in framing the syllabus. Also behalf of all faculties I thank all the industry experts for their valuable feedback and suggestions.

I sincerely hope that the revised syllabus will help all graduate engineers to face the future challenges in the field of information and technology

Program Outcome for graduate Program in Information Technology

1. Apply Core Information Technology knowledge to develop stable and secure IT system.
2. Design, IT infrastructures for an enterprise using concepts of best practices in information Technology management and security to enterprise processes.
3. Manage IT projects using written and oral communication skills in collaborative environments by Participating on teams that address solutions for IT management challenges.
4. Identify and discuss professional, individual, organizational, societal, and regulatory implications of Information systems and technology.
5. Assess Security of the IT Systems and able to respond to any breach in IT system
6. Ability to work in multidisciplinary projects and make it IT enabled.
7. Ability to propose the system to reduce carbon footprint.
8. Ability to adapt the lifelong learning process to be in sync with trends in Information Technology

Dr. Deven Shah

**Chairman (Ad-hoc Board Information Technology)
University of Mumbai)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
ITC301	Applied Mathematics III	4+1@	-	-	5	-	-	5
ITC302	Logic Design	4	-	-	4	-	-	4
ITC303	Data Structures & Analysis	4	-	-	4	-	-	4
ITC304	Database Management System	4	-	-	4	-	-	4
ITC305	Principle of Communications	3+1\$	-	-	4	-	-	4
ITL301	Digital Design Lab	-	2	-	-	1	-	1
ITL302	Data Structures Lab	-	2	-	-	1	-	1
IT303	SQL Lab	-	2	-	-	1	-	1
ITL304	Java Programming Lab	-	2+2*	-	-	2	-	2
	Total	21	10	-	21	5	-	26

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)				
		Test 1	Test 2	Avg.						
ITC301	Applied Mathematics III	20	20	20	80	3	-	-	-	100
ITC302	Logic Design	20	20	20	80	3	-	-	-	100
ITC303	Data Structures & Analysis	20	20	20	80	3	-	-	-	100
ITC304	Database Management System	20	20	20	80	3	-	-	-	100
ITC305	Principle of Communications	20	20	20	80	3	--	-	-	100
ITL301	Digital Design Lab	-	-	-	-	-	25	--	25	50
ITL302	Data Structures Lab	-	-	-	-	-	25	--	25	50
IT303	SQL Lab	-	-	-	-	-	25	-	25	50
ITL304	Java Programming Lab	-	-	-	-	-	50	--	50	100
Total		100	100	100	400	-	125	--	125	750

@ 4 hours shown as theory to be taken class wise and 1 hour to be taken tutorial as class wise

\$ 3 hours shown as theory to be taken class wise and 1 hour to be taken tutorial as batch wise

* 2 hours shown as practical's to be taken class wise lecture and another 2 hours to be taken as batch wise practices in the lab.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC301	Applied Mathematics III	04	--	01	04	--	--	05

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of Two Tests					
ITC301	Applied Mathematics III	20	20	20	80	--	--	--	100

Course Objectives: Students will try to learn:

1. The concepts of Set theory and Relation.
2. The concepts of Functions and define the recursive functions.
3. The concept of Laplace transforms.
4. The concept of Inverse Laplace transforms.
5. The concept of permutations and combinations.
6. The concept of variable and also identify the mapping.

Course Outcomes: Students will able to:

1. Apply the Set theory and Relation concepts.
2. Apply the Functions and define the recursive functions.
3. Apply Laplace transform to different applications.
4. Apply Inverse Laplace transform to different applications.
5. Identify the permutations and combinations.
6. Define variable and also identify the mapping.

Prerequisite: Applied Mathematics I, Applied Mathematics II

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic of AM-I and AM-II.	02	
I	Set Theory	Set Theory: Definition of Sets, Venn Diagrams, complements, cartesian products, power sets, counting principle, cardinality and countability (Countable and Uncountable sets), proofs of some general identities on sets, pigeonhole principle.	08	CO1

II	Relation & Function	Relation: Definition, types of relation, composition of relations, domain and range of a relation, pictorial representation of relation, properties of relation, partial ordering relation. Function: Definition and types of function, composition of functions, recursively defined functions.	08	CO1 CO2
III	Laplace Transform	Introduction, Definition of Laplace transforms Laplace transform of constant, trigonometrical, exponential functions. Important properties of Laplace transform: First shifting theorem, Laplace transform of $L\{f(at)\}$, $L\{t^n f(t)\}$, $L\left\{\frac{f(t)}{t}\right\}$, $L\left\{\frac{d^n f(t)}{dt^n}\right\}$, $L\left\{\int_0^t f(u)du\right\}$ (all without proof). Unit step function, Heaviside function, Dirac-delta function, Periodic function and their Laplace transforms, Second shifting theorem.	08	CO3
IV	Inverse Laplace Transform	Inverse Laplace transform with Partial fraction and Convolution theorem (without proof). Application to solve initial and boundary value problem involving ordinary differential equations with one dependent variable and constant coefficients.	08	CO4
V	Complex Variable & mapping	Functions of a complex variable, Analytic functions, Cauchy-Riemann equations in Cartesian co-ordinates, Polar co-ordinates. Harmonic functions, Analytic method and Milne Thomson methods to find $f(z)$, Orthogonal trajectories. Conformal Mapping, Linear, Bilinear transformations, Cross ratio, fixed points and standard transformation such as rotation and magnification, inversion, translation.	10	CO6
VI	Permutations, Combinations and Probability	Rule of sum and product, Permutations, Combinations, Algorithms for generation of	08	CO5

		Permutations and Combinations. Discrete Probability, Conditional Probability, Bayes' Theorem, Information and Mutual Information.		

Text Books:

1. Higher Engineering Mathematics by Grewal B. S. 38th edition, Khanna Publication 2005.
2. Advanced Engineering Mathematics by Kreyszig E. 9th edition, John Wiley.
3. A Text Book of Applied Mathematics Vol. I & II by P.N.Wartilar & J.N.Wartikar, Pune, Vidyarthi Griha Prakashan, Pune.
4. Modern Digital Electronics by R. P. Jain 8th edition, Tata Mcgraw Hill
5. C. L. Liu and D. P. Mohapatra, "Elements of Discrete Mathematics", SiE Edition, TataMcGraw-Hill.

References:

1. Advanced Engineering Mathematics by C. Ray Wylie & Louis Barrett, TMH International Edition.
2. Mathematical Methods of Science and Engineering by Kanti B. Datta, Cengage Learning.
3. Laplace Transforms by Murray R. Spiegel, Schaun's out line series-McGraw Hill Publication.

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC302	Logic Design	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of Two Tests					
ITC302	Logic Design	20	20	20	80	--	--	--	100

Course Objectives: Students will try to learn:

1. The concept of various components.
2. The concepts that underpin the disciplines of Analog and digital electronic logic circuits.
3. Various Number system and Boolean algebra.
4. Design and implementation of combinational circuits
5. Design and implementation of Sequential circuits
6. Hardware description language

Course Outcomes: Students will able to:

1. Understand the concepts of various components to design stable analog circuits.
2. Represent numbers and perform arithmetic operations.
3. Minimize the Boolean expression using Boolean algebra and design it using logic gates
4. Analyze and design combinational circuit.
5. Design and develop sequential circuits
6. Translate real world problems into digital logic formulations using VHDL.

Prerequisite: Basic Electrical Engineering

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Semiconductor theory, Diodes, Integrated Circuits	02	
I	Biasing of BJT	Biasing of BJT: DC operating point, BJT characteristics & parameters, all biasing circuits, analysis of above circuits and their design, variation of operation point and its stability. Differential	08	CO1

		Amplifier, constant current source, current mirror.		
II	Number System and codes	Introduction to Number systems, Binary Number systems, Signed Binary Numbers, Binary, Octal, Decimal and Hexadecimal number Systems and their conversion, Binary arithmetic using compliments, Gray Code, BCD Code, Excess-3 code, ASCII Code.inter-conversion of codes,	08	CO2
III	Boolean Algebra and Logic gates	Introduction, NAND and NOR operations, Exclusive –OR and Exclusive –NOR operations, Boolean Algebra Theorems and Properties , Standard SOP and POS form, Reduction of Boolean functions using Algebraic method, K-map method (2,3,4 Variable).Variable entered Maps, Quine Mc Cluskey, Mixed Logic Combinational Circuits and multiple output function Basic Digital Circuits: NOT,AND, OR,NAND,NOR,EX-OR,EX-NOR Gates.	10	CO2 CO3
IV	Design and Analysis of Combinational Circuits	Introduction, Half and Full Adder, Half and Full Subtractor, Four Bit Binary Adder, One digit BCD Adder, code conversion, Encoder and Decoder ,Multiplexers and Demultiplexers, Decoders, Binary comparator (2,3 variable)4-bit Magnitude Comparator IC 7485 and ALU IC74181.	08	CO2 CO3 CO4
V	Sequential Logic Design	Flip Flops : SR, JK, D, T, master slave flip flop, Truth Table, excitation table and conversion Register: Shift register, SISO, SIPO, PISO, PIPO, Bi-directional and universal shift register. Counters: Design of synchronous and asynchronous ,Modulo Counter, Up Down counter IC 74193, Ring and Johnson Counter	9	CO4 CO5
VI	VHDL	Introduction to VHDL, Library, Entity, Architecture Modeling styles, Concurrent and Sequential statements, data objects and data types, attributes, design examples	07	CO5 CO6

		for combinational circuits		

Text Books:

1. Robert L. Boylestad, Louis Nashelsky, "Electronic devices and circuit Theory", PHI
2. R. P. Jain, "Modern Digital Electronics", Tata McGraw Hill.
3. M. Morris Mano, "Digital Logic and computer Design", PHI
4. J. Bhasker. "VHDL Primer", Pearson Education.
5. Balbaniam, Carison, "Digital Logic Design Principles", Wiley Publication

References:

1. Martin s. Roden, Gordon L. Carpenter, William R. Wieserman "Electronic Design-From Concept to Reality", Shroff Publishers and Distributors.
2. A. Anand Kumar, "Fundamentals of Digital Circuits ", Prentice Hall India
3. Subrata Ghosal, "Digital Electronics", Cengage Learning.
4. Anil K. Maini, "Digital Electronics Principles and Integrated Circuits", Wiley India
5. Donald p Leach, Albert Paul Malvino, "Digital principles and Applications", Tata McGraw Hill

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination:

Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC303	Data Structures & Analysis	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of two Tests					
ITC303	Data Structures & Analysis	20	20	20	80	--	--	--	100

Course Objectives: Students will try to:

1. Understand and remember algorithms and its analysis procedure.
2. Introduce the concept of data structures through ADT including List, Stack, Queues .
3. To design and implement various data structure algorithms.
4. To introduce various techniques for representation of the data in the real world.
5. To develop application using data structure algorithms.
6. Compute the complexity of various algorithms.

Course Outcomes: Students will be able to:

1. Select appropriate data structures as applied to specified problem definition.
2. Implement operations like searching, insertion, and deletion, traversing mechanism etc. on various data structures.
3. Students will be able to implement Linear and Non-Linear data structures.
4. Implement appropriate sorting/searching technique for given problem.
5. Design advance data structure using Non-Linear data structure.
6. Determine and analyze the complexity of given Algorithms.

Prerequisite: C Programming Language

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	C Programming Language	02	
I		Introduction to Data structures, Need of Data structures, Types of	07	CO1

	Introduction to Data structures and Analysis	Data structures : Linear and non linear data structures Arrays, Stacks, Queue, Linked list and Tree, Graph, Recursion, ADT (Abstract Data type). Introduction to Analysis, Algorithms, characteristics of an algorithms, Time and Space complexities, Order of growth functions, Asymptotic notations		CO2 CO3 CO6
II	Stack	Introduction to Stack, Stack as ADT, Operations on stack, Application of stack: – reversing string, Polish notations	07	CO1 CO2 CO3 CO6
III	Queue	Introduction to Queue, Queue as ADT, Operations on Queue, Linear representation of queue, Circular Queue, Priority Queue, De-queue, Application of Queues	06	CO1 CO2 CO3 CO6
IV	Linked list	Introduction to Linked List, Basic concept of Linked List, Memory allocation & de allocation of Linked list, Singly Linked list, Doubly Linked list, Circular linked list, Operations on linked list, Linked representation of stack, Linked representation of Queue, Application of linked list.	08	CO1 CO2 CO3 CO6
V	Sorting and Searching	Introduction to Sorting: Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort, Shell Sort, Radix sort. Analysis of Sorting Techniques. Comparison of sorting Techniques Introduction to Searching: Linear	12	CO4 CO5 CO6

		search, Binary search, Hashing Techniques, Different Hash functions, Collision& Collision resolution techniques, Analysis of searching Techniques.		
VI	Trees & Graph	Introduction to Trees, Definitions& Tree terminologies, Binary tree representation, Operations on binary tree, Traversal of binary trees, Binary search tree, Threaded Binary tree, Expression tree, Application of Trees Introduction to Graph, Introduction Graph Terminologies, Graph Representation, Type of graphs, Graph traversal:Depth first search(DFS)&Breadth First search(BFS), Minimum Spanning Tree : Prim's & Kruskal's Shortest Path Algorithm – Dijkstra's Algorithm. Applications of graph	10	CO1 CO2 CO3 CO6

Text Books:

1. Data structures using C by Tenenbaum, Langsam, Augenstein , Pearson.
2. Data Structures using C, ReemaThareja, Oxford.
3. C and Data structures, Prof. P.S.Deshpande, Prof. O.G.Kakde, Dreamtech Press.
4. Introduction to Data Structure and its Applications Jean-Paul Tremblay, P. G. Sorenson

Reference Books:

1. Data Structures Using C & C++, Rajesh K. Shukla, Wiley- India.
2. Data Structures and Algorithm Analysis in C ,Mark A.Weiss ,Pearson
3. ALGORITHMS Design and Analysis, Bhasin, OXFORD.
4. Computer Algorithms by Ellis Horowitz and Sartaj Sahni, Universities Press.

Assessment:

Internal Assessment for 20 marks:

Consisting of Two Compulsory Class Tests

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**

- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC304	Database Management Systems	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of two Tests					
ITC304	Database Management Systems	20	20	20	80	--	--	--	100

Course Objectives: Students will try:

1. To describe a sound introduction to the discipline of database management systems.
2. To give a good formal foundation on the relational model of data and usage of Relational Algebra
3. To introduce the concepts of basic SQL as a universal Database language
4. To enhance knowledge to advanced SQL topics like embedded SQL, procedures connectivity through JDBC
5. To demonstrate the principles behind systematic database design approaches by covering conceptual design, logical design through normalization
6. To provide an overview of physical design of a database system, by discussing Database indexing techniques and storage techniques.

Course Outcomes: Student should be able to:

1. Explain the features of database management systems and Relational database
2. Design conceptual models of a database using ER modeling for real life applications and also construct queries in Relational Algebra
3. Create and populate a RDBMS for a real life application, with constraints and keys, using SQL.
4. Retrieve any type of information from a data base by formulating complex queries in SQL.
5. Analyze the existing design of a database schema and apply concepts of normalization to design an optimal database.
6. Build indexing mechanisms for efficient retrieval of information from a database

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisites	Basic knowledge of operating systems and file systems, Any programming	02	

		knowledge		
I	Introduction Database Concepts	Introduction, Characteristics of databases, File system V/s Database system, Users of a Database system Data Models, Schemas, and Instances, Three-Schema Architecture and Data Independence, Database Administrator (DBA), Role of a DBA	05	CO 1
II	Entity–Relationship Data Model	Conceptual Modeling of a database, The Entity-Relationship (ER) Model, Entity Types, Entity Sets, Attributes, and Keys, Relationship Types, Relationship Sets, Weak Entity Types Generalization, Specialization and Aggregation, Extended Entity-Relationship (EER) Model.	09	CO 2
III	Relational Model and Relational Algebra	Introduction to Relational Model, Relational Model Constraints and Relational Database Schemas, Concept of Keys: Primary Key, Secondary key, Foreign Key, Mapping the ER and EER Model to the Relational Model, Introduction to Relational Algebra, Relational Algebra expressions for • Unary Relational Operations, • Set Theory operations, • Binary Relational operation Relational Algebra Queries	09	CO 2
IV	Structured Query Language (SQL)	Overview of SQL , Data Definition Commands, Set operations , aggregate function , null values, , Data Manipulation commands, Data Control commands , Views in SQL, Complex Retrieval Queries using Group By, Recursive Queries, nested Queries ; Referential integrity in SQL. Event Condition Action (ECA) model (Triggers) in SQL; Database Programming with JDBC, Security and authorization in SQL Functions and Procedures in SQL and cursors.	10	CO 3, CO 4
V	Relational–Database Design	Design guidelines for relational schema, Functional Dependencies, Definition of Normal Forms- 1NF, 2NF, 3NF, BCNF, Converting Relational Schema to higher normal forms.	08	CO 5

VI	Storage and Indexing	Operation on Files; hashing Techniques; Types of Indexes: Single-Level Ordered Indexes; Multilevel Indexes; Overview of B-Trees and B+-Trees; Indexes on Multiple Keys.	09	CO 6

Text Books:

1. Korth, Silberchatz, Sudarshan, "Database System Concepts", 6th Edition, McGraw – Hill
2. Elmasri and Navathe, "Fundamentals of Database Systems", 6th Edition, PEARSON Education.
3. G. K. Gupta : "Database Management Systems", McGraw – Hill

References:

1. Raghu Ramkrishnan and Johannes Gehrke, "Database Management Systems", TMH
2. Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom "Database System Implementation", Pearson Ltd. 1/e
3. Thomas M. Connolly Carolyn Begg, Database Systems : A Practical Approach to Design, Implementation and Management, 4/e, Pearson Education.

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC305	Principle of Communications	03	--	01	03	--	01	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ITC305	Principle of Communications	20	20	20	80	--	--	--	100

\$ 3 hours shown as theory to be taken class wise and 1 hour to be taken tutorial as batch wise

Course Objectives: Students will try to:

1. Study the basic principles and techniques used in analog and digital communications.
2. Understand the concept of noise and Fourier transform for designing and analysing communication system.
3. Acquire the knowledge of different modulation techniques such as AM , FM and study the block diagrams of transmitter and receiver.
4. Study the Sampling theorem and Pulse Analog Modulation techniques.
5. Learn the concepts of Digital modulation techniques such as PCM, DM, ADM and multiplexing techniques.
6. Gain the core idea of Electromagnetic Radiation and propagation of waves.

Course Outcomes: Students will be able to:

1. Differentiate analog and digital communication systems
2. Identify different types of noise occurred, its minimization and able to apply Fourier analysis in frequency & time domain to quantify bandwidth requirement of variety of analog and digital communication systems.
3. Design generation & detection AM, DSB, SSB, FM transmitter and receiver.
4. Apply sampling theorem to quantify the fundamental relationship between channel bandwidth, digital symbol rate and bit rate
5. Explain different types of line coding techniques for generation and detection of signals.
6. Describe Electromagnetic Radiation and propagation of waves.

Prerequisite: Basic Electrical Engineering

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Electrical engineering concepts, analog and digital electronics.	02	--
I	Introduction	Basics of analog communication systems (Block diagram), Sources of information, Baseband and band pass signals, Types of communication channels, Frequency / Spectrum allocations, Need for modulation and demodulation	03	CO1
II	Fourier Transform and Noise	Introduction to Fourier Transform, its properties (time and frequency shifting and convolution property), Fourier transform of unit step, delta and gate function. Correlated and uncorrelated sources of noise in communication system, Noise parameters –Signal to noise ratio, Noise factor, Noise figure, Friis formula and Equivalent noise temperature	05	CO2
III	Modulation and Demodulation (AM and FM)	AM: Amplitude modulation techniques and its types- DSBFC AM, DSBSC-AM, SSB SC AM- spectrum, waveforms, bandwidth, Power calculations. AM Receivers – Block diagram of TRF receivers and Super heterodyne receiver. Receiver characteristics - Sensitivity, Selectivity, Fidelity, Image frequency and its rejection and double spotting FM : Principle of FM- waveforms, spectrum, bandwidth. Pre-emphasis and de-emphasis in FM, FM noise triangle, Comparison of AM and FM systems, FM generation: Direct method –Varactor diode Modulator, Indirect method (Armstrong method) block diagram and waveforms. FM demodulator: Foster Seely discriminator, Ratio detector.	12	CO3
IV	Pulse Analog Modulation	Sampling theorem for low pass and band pass signals with proof, Anti- aliasing filter, PAM, PWM and PPM generation and	05	CO4

		Degeneration.		
V	Digital Modulation Techniques and Transmission	Introduction to digital communication (Block diagram), Quantization process, Pulse code modulation, Delta modulation, Adaptive delta modulation, Principle of time division multiplexing, Frequency division multiplexing and its applications. Introduction to Line codes, Inter-symbol interference, Binary phase shift keying, Differentially encoded phase shift keying, Quadrature phase shift keying, M-ary phase shift keying, Quadrature amplitude shift keying	08	CO5
VI	Radiation and Propagation of Waves	Electromagnetic radiation, fundamentals, types of propagation, ground wave, sky wave, tropospheric scatter propagation	04	CO6

Text Books:

1. Simon Haykin, Michael Moher, Introduction to Analog & Digital Communications, Wiley India Pvt. Ltd., 2nd Ed.
2. Herbert Taub, Donald L Schilling, Goutam Saha, Principles of Communication Systems, Tata McGraw Hill, 3rd Ed.
3. V Chandrasekar, Communication Systems, Oxford University Press, 1st Ed.

References:

1. George Kennedy, Bernard Davis, SRM Prasanna, Electronic Communication Systems, Tata McGraw Hill, 5th Ed.
2. Wayne Tomasi, Electronic Communications Systems, Pearson Publication, 5th Ed.
3. BP Lathi, Zhi Ding, Modern Digital and Analog Communication Systems, Oxford University.
4. K Sam Shanmugam, Digital and Analog Communication Systems, Wiley India Pvt. Ltd, 1st Ed.

Suggested Topics for Tutorials (Any 10):

1. Demonstration of Amplitude modulation.
2. Demonstration of Frequency modulation.
3. Study of AM/ FM receiver.
4. Demonstration of Signal sampling and reconstruction.
5. Study of PWM generation and detection.
6. Study of PCM coding and decoding.
7. Study of Delta modulation and demodulation
8. Demonstration of TDM/ FDM.
9. Demonstration of BPSK, BFSK, BASK
10. Study of QPSK
11. Study of Inter symbol Interference and Line coding.
12. Study of different types of Propagation.

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ITL301	Digital Design Lab	--	2	--	--	1	--	01

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITL301	Digital Design Lab	--	--	--	--	25	25	50

Lab Objectives: Students will try to:

1. Learn to minimize and design combinational logic;
2. Understand the relationships between combination logic and Boolean algebra, and between sequential logic and finite state machines;
3. Appreciate tradeoffs in complexity and speed of combinational designs;
4. Understand how state can be stored in a digital logic circuit;
5. Study how to design a simple finite state machine from a specification and be able to implement this in gates and edge triggered flip-flops
6. Learn to translate real world problems into digital logic formulations

Lab Outcomes: Students will be able to:

1. Minimize the Boolean algebra and design it using logic gates.
2. Analyse and design combinational circuit.
3. Realise given function using combinational circuit.
4. Design and develop sequential circuits
5. Implement digital systems using programmable logic devices
6. Translate real world problems into digital logic formulations using VHDL.

Prerequisite: Concepts of Logic Design

Hardware requirement:

Digital Trainer kit, ICs for various logic gates and functions, connecting wires

Software requirement:

VHDL tool

Detail Syllabus:

Sr. No.	Module	Detailed Content	Hours	LO Mapping

I	Boolean Algebra and Logic gates	a. Verify the truth table of logic gates (basic and universal gates) b. Realization of Boolean algebra using gates	04	LO1
II	Design and Analysis of Combinational Circuits	a. Design of Full Adder and Full Subtractor. b. verify the operation of 4- bit magnitude comparator	04	LO2
III	Implementation of Combinational Circuits	a. Implementation of MUX and DeMUX. b. Implementation of Encoder and Decoder	04	LO3
IV	Sequential Logic Design	a. To verify and observe the operation of flip-flop(any two) b. To design any two shift register. c. To design Modulo and ring Counter	06	LO4
V	Programmable logic Devices	a. Evaluate and observe Boolean expression using PALs and PLAs..	04	LO5
VI	VHDL	a. Implementation of Logic Gates using VHD b. Evaluate and observe combinational circuits on VHDL.	04	LO6

Text Books:

1. R. P. Jain, "Modern Digital Electronics", Tata McGraw Hill.
2. Balbaniam, Carison, "Digital Logic Design Principles", Wiley Publication

References:

1. M. Morris Mano, "Digital Logic and computer Design", PHI
2. J. Bhasker. "VHDL Primer", Pearson Education.

Term Work:

Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral & Practical Exam: An Oral & Practical exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ITL302	Data Structures Lab	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITL302	Data Structures Lab	--	--	--	--	25	25	50

Lab Objectives: Students will try:

1. Understand and remember algorithms and its analysis procedure.
2. Introduce the concept of data structures through ADT including List, Stack, Queues .
3. To design and implement various data structure algorithms.
4. To introduce various techniques for representation of the data in the real world.
5. To develop application using data structure algorithms.
6. Compute the complexity of various algorithms.

Lab Outcomes: Students will be able to:

1. Select appropriate data structures as applied to specified problem definition.
2. Implement operations like searching, insertion, and deletion, traversing mechanism etc. on various data structures.
3. Students will be able to implement Linear and Non-Linear data structures.
4. Implement appropriate sorting/searching technique for given problem.
5. Design advance data structure using Non-Linear data structure.
6. Determine and analyze the complexity of given Algorithms.

Prerequisite: C Programming Language

Hardware Requirement: PC i3 processor and above	Software requirement: Turbo/Borland C complier.

Detailed Syllabus:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Introduction of C programming language		
I	Stack	1. Implementations of stack menu driven program 2. Implementation of multistack in one array. 3. *Implementations of Infix to Postfix Transformation and its evaluation program. 4. Implementations of Infix to Prefix Transformation and its evaluation program.	04	LO1 LO2 LO3 LO6
II	Queue	1. Implementations of circular queue menu driven program 2. * Implementations of double ended queue menu driven program 3. Implementations of queue menu driven program 4. Implementation of Priority queue program using array.	04	LO1 LO2 LO3 LO6
III	Linked List	1. Implementations of Linked Lists menu driven program. 2. *Implementation of different operations on linked list –copy, concatenate, split, reverse, count no. of nodes etc 3. Implementation of polynomials operations (addition, subtraction) using Linked List. 4. Implementations of Linked Lists menu driven program (stack and queue)	04	LO1 LO2 LO3 LO6
IV	Tree & Graph	1. Implementations of Binary Tree menu driven program 2. Implementation of Binary Tree Traversal program. 3. *Implementation of construction of expression tree using postfix expression. 4. Implementations of BST program 5. Implementation of various operations on tree like – copying tree, mirroring a tree, counting the number of nodes in the tree, counting only	04	LO1 LO2 LO3 LO6

		leaf nodes in the tree. 6. Implementation of Preorder traversal of a threaded binary tree. 7. Implementations of Huffman code construction 8. Implementations of Graph menu driven program (DFS & BSF)		
V	Sorting	1. Implementations of Shell sort, Radix sort and Insertion sort menu driven program. 2. *Implementations of Quick Sort, Merge sort and Heap Sort menu driven program 3. Implementations of Advanced Bubble Sort, Insertion Sort and Selection Sort menu driven program	04	LO4 LO5 LO6
VI	Searching	1. Implementations of searching methods (Index Sequential, Interpolation Search) menu driven program 2. *Implementation of hashing functions with different collision resolution techniques	02	LO4 LO5 LO6

Text Books:

1. Data structures using C by Tenenbaum, Langsam, Augenstein , Pearson.
2. Data Structures using C, ReemaThareja, Oxford.

Reference Books:

1. C and Data structures, Prof. P.S.Deshpande, Prof. O.G.Kakde, Dreamtech Press.
2. Data Structures A Pseudocode Approach with C, Richard F. Gilberg & Behrouz A. Forouzan, second edition, CENGAGE Learning.

Term Work:

Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral & Practical Exam: An Oral & Practical exam will be held based on the above syllabus.

		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ITL303	SQL Lab	--	2	--	--	01	--	01

Subject Code	Subject Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test 1	Test 2	Avg. of 2 Tests				
ITL303	SQL Lab	--	--	--	--	25	25	50

Course Objectives: Students will try:

1. To provide a sound introduction to the creation of problem statements from real life situations.
2. To give a good formal foundation on the relational model of data and usage of Relational Algebra.
3. To introduce the concepts of basic SQL as a universal Database language.
4. To enhance knowledge to advanced SQL topics like embedded SQL, procedures connectivity through JDBC.
5. To enable the design of an efficient database using normalization concepts.
6. To enable students to be create indexes for databases for efficient retrieval.

Course Outcomes: Student should be able to:

1. Construct problem definition statements for real life applications and implement a database for the same.
2. Design conceptual models of a database using ER modeling for real life applications and also construct queries in Relational Algebra.
3. Create and populate a RDBMS, using SQL.
4. Write queries in SQL to retrieve any type of information from a data base.
5. Analyze and apply concepts of normalization to design an optimal database.
6. Implement indexes for a database using techniques like B or B+ trees.

Hardware Requirement: PC i3 processor and above	Software requirement: Any SQL Compiler

Prerequisite: C Programming Language

Detailed syllabus:

Sr. No.	Detailed Content	Hours	CO Mapping
1	a) Students to be given assignments to construct detailed problem definitions for real life applications. b) Construction of ER/EER diagrams for the given problems. c) Assignment based on relational Algebra	4	CO 1 CO 2
2	a) Basic SQL Queries-DDL and DML. b) Construction of Database-Keys c) Population of the database	5	CO 3
3	Complex Queries using group by, nested queries, recursive queries, joins, views, Triggers, Cursors	5	CO 4
4	Design and Implementation of a fully fledged Database with front end for a real life application (Using JDBC)	4	CO 1
5	Assignment for conversion of relation to different normal forms.	2	CO 5
6	Program for construction of index- B-Tree / B+-Tree	4	CO 6

Text Books:

1. SQL The Complete Reference, 3rd Edition , James R Groff, Paul N. Weinberg, Andy Oppel, McGraw Hill.
2. G. K. Gupta :”Database Management Systems”, McGraw – Hill

References:

1. Korth, Slberchatz,Sudarshan, :”Database System Concepts”, 6th Edition, McGraw – Hill
2. Raghu Ramkrishnan and Johannes Gehrke, “ Database Management Systems”, TMH

Term Work:

Term Work shall consist of at least 10 to 12 practical’s based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral & Practical Exam: An Oral & Practical exam will be held based on the above SQL syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ITL304	Java Programming Lab	--	2+2*	--	--	2	--	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg. of two Tests				
ITL304	Java Programming Lab	--	--	--	--	50	50	100

* 2 hours shown as practical's to be taken class wise lecture and other 2 hours to be taken as batch wise practical's in Lab.

Lab Objectives: Students will try:

1. To understand how to design, implement, test, debug, and document programs that use basic data types and computation, simple I/O, conditional and control structures, string handling and functions.
2. To understand the importance of Classes & objects along with constructors, Arrays and Vectors.
3. Discuss the principles of inheritance, interface and packages and demonstrate through problem analysis assignments how they relate to the design of methods, abstract classes and interfaces and packages.
4. To understand importance of Multi-threading & different exception handling mechanisms.
5. To learn experience of designing, implementing, testing, and debugging graphical user interfaces in Java using applet and AWT that respond to different user events.
6. To understand Java Swings for designing GUI applications based on MVC architecture.

Lab Outcomes: Upon Completion of the course the learner should be able to:

1. Implement Object Oriented programming concept using basic syntaxes of control Structures, strings and function for developing skills of logic building activity.
2. Identify classes, objects, members of a class and the relationships among them needed for a finding the solution to specific problem
3. Demonstrates how to achieve reusability using inheritance, interfaces and packages and describes faster application development can be achieved.
4. Demonstrate understanding and use of different exception handling mechanisms and

- concept of multithreading for robust faster and efficient application development.
5. Identify and describe common abstract user interface components to design GUI in Java using Applet & AWT along with response to events
 6. Identify, Design & develop complex Graphical user interfaces using principal Java Swing classes based on MVC architecture

Hardware Requirements	Software Requirements	Other Requirements
PC With Following Configuration 1. Intel PIV Processor 2. 2 GB RAM 3. 500 GB Harddisk 4. Network interface card	1. Windows or Linux Desktop OS 2. JDK 1.8 or higher 3. Notepad ++ 4. JAVA IDEs like Netbeans or Eclipse	1. Internet Connection for installing additional packages if required

Detailed Syllabus:

Sr. No.	Module	Detailed Contents	Hours	LO Mapping
1)	Fundamental of Java Programming	Theory 1.1 Overview of procedure and object oriented Programming, Java Designing Goals, Features of Java Language. 1.2 Introduction to the principles of object-oriented programming: Classes, Objects, Abstraction, Encapsulation, Inheritance, Polymorphism, 1.3 Keywords, Data types, Variables, Operators, Expressions, Types of variables and methods. 1.4 Control Statements: If Statement, If-else, Nested if, switch Statement, break, continue. Iteration Statements: for loop, while loop, and do-while loop. Experiment 1: (Perform any three programs that covers Classes, Methods, Control structures and Looping statements) i) Write a Java program to understand how to accept input using Scanner or	12	LO 1 LO 2

		BufferedReader and print output using System.out.println statement. ii) Write a Java program to display the default value of all primitive data types in Java. iii) Write a Java program that prints all real solutions to the quadratic equation $ax^2+bx+c = 0$. Read in a, b, c and use the quadratic formula. If the discriminate b^2-4ac is negative, display a message stating that there are no real solutions. iv) Write a java program to test whether string is palindrome or not v) Write a java program to count number of alphabets, digits, special symbols, blank spaces and words from the given sentence. vi) Write a java program to count number of vowels and consonants from the given strings. vii) Write a Menu driven program in java to implement simple banking application. Application should read the customer name, account number, initial balance, rate of interest, contact number and address field etc. Application should have following methods. 1. createAccount() 2. deposit() 3. withdraw() 4. computeInterest() 5. displayBalance() viii) Write a menu driven Java program which will		

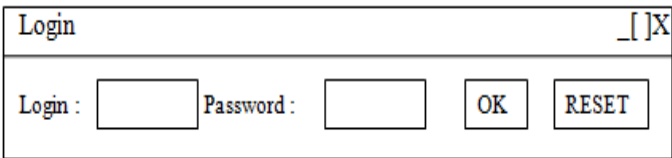
		read a number and should implement the following methods 1. factorial() 2. reverse() 3. testArmstrong() 4. testPalindrome() 5. testPrime() 6. fibonacciSeries() ix) Write a Java program to demonstrate Method overloading		
2)	Classes, Objects, Arrays and Recursion	Theory 2.1 Classes & Objects: Class Fundamentals: Assigning Object Reference Variables, Passing parameters to Methods and Returning parameters from the methods, Nested and Inner Classes. 2.2 Constructors: Parameterized Constructors, finalize() Method, Method overloading, Constructors overloading, Recursion, Command-Line Arguments. 2.3 Wrapper classes, Java.util.Scanner, Java.io.BufferedReader, Java.io.DataInputStream, Java.io.DataOutputStream and String Buffer classes and String functions. 2.4 Arrays & Vectors: One Dimensional arrays, Two Dimensional array, Irregular arrays, dynamic arrays, Array List and Array of Object. Experiment 2 (Perform any Five programs that covers Classes & objects, Constructors, Command Line Arguments,	12	LO 1 LO 2

		Arrays/Vectors & recursions) i) Write a java program to demonstrate Constructors, Parameterized Constructors and Constructor Overloading ii) Write a java program to demonstrate Command Line Arguments iii) Write a java program to demonstrate String Functions iv) Write a java program to demonstrate Array and Vectors operations v) Write a java programs to add n strings in a vector array. Input new string and check whether it is present in the vector. If it is present delete it otherwise add it to the vector. vi) Write a java programs to test whether the given element is present in the vector array. vii) Write a java programs to find frequency of a element in the given Vector array. viii) Write a java programs to add n strings in a vector array. Input new string and check whether it is present in the vector. If it is present delete it otherwise add it to the vector. ix) Write menu driven program to implement recursive functions for following tasks. a) To find GCD and LCM b) To find X^Y c) To print n Fibonacci numbers		

		d) To find reverse of number e) To $1+2+3+4+\dots+(n-1)+n$ x) Write the Menu driven program to perform a) Addition of two matrices of order $m*n$ and $p*q$ b) Multiplication of two matrices of order $m*n$ and $p*q$ c) Transpose of matrix of order $m*n$ d) addition of diagonal and non-diagonal elements		
3)	Inheritance, Interface and Packages	Theory 3.1 Inheritance Basics, , Types of Inheritance in Java, Concept of Super and sub class, inheriting Data members and Methods, Role of Constructors in inheritance, Making methods and classes final , Method overriding, Dynamic Method Dispatch, Abstract classes and methods 3.2 Defining an interface, extending interfaces , implementing interfaces, accessing implementations through interface references, Interfaces vs. Abstract classes. 3.3 Packages – Steps for defining, creating and accessing a Package, importing packages,Making JAR Files for Library Packages, java.util.Vector Experiment 3 (Perform any Two programs that covers Inheritance, interfaces and packages) i) Write a java programs to demonstrate hierarchical inheritance ii) Write a java program to demonstrate extending & implementing Interfaces	08	LO 3

		iii) Write a java program to demonstrate Modules and packages iv) Write a java program to create user defined packages		
4)	Exception Handling and Multithreading	Theory: 4.1 Exception handling Mechanism: try, catch, throw, throws and finally. 4.2 Multithreading: Need of Multithreading , Java thread Model, thread Life-Cycle, thread class Methods, Implementing Runnable, Extending thread, Synchronizing threads, synchronized Statement, Critical Factor in Thread –Deadlock. Experiment 4 (Perform any Two programs that covers Exception Handling & Multithreading) i) Write java programs to demonstrate Exception handling using try, catch, throw, throws and finally statements. ii) Write a Java Program to input the data through command Line and Find out total valid and in-valid integers. (Hint: use exception handling). iii) Write a Java Program to calculate the Result. Result should consist of name, seatno, date, center number and marks of semester three exam. Create a User Defined Exception class MarksOutOfBoundsException, If Entered marks of any subject is greater than 100 or less than 0, and then program should create a user defined Exception of type MarksOutOfBoundsException and must have a provision to handle it.	06	LO3 LO 4

		iv) Write java program to create a user defined Exception class known as PayOutOfBoundsException. Organization does not offer basic salary less than 8000. If entered salary is less than 8000 then program should create an Exception of Type PayOutOfBoundsException. Program should calculate gross salary by considering salary parameters such as DA, HRA, CA, TA, Professional tax, TDS, PF.. etc v) Write java programs to create user defined threads by extending thread class and by implementing runnable. vi) Write java program to print Table of Five, Seven and Thirteen using Multithreading (Use Thread class for the implementation) . vii) Write a java program to print first 20 prime numbers and 15 Fibonacci numbers by creating two child threads and also print the total time taken by each thread for the execution. viii) Write a java program to implement use of nested try-catch concept using appropriate example. ix) Write java program to create the child thread. Comment on the execution of main and Child Thread. x) Write java program to implement the concept of Thread Synchronization xi) Write a Java program to identify whether inputted data is byte/short/int/long/float/double/String/char type. (Use Exception Handling)		
5)	Applet Programming, GUI	5.1 Applet: Applet fundamentals, Applet lifecycle, Creating applet, paint method Applet tag, Applet class methods.	10	LO3 LO4

	development using AWT and Event handling	5.2 Designing Graphical User Interfaces in Java, Components and Containers, Basics of Components, Using Containers, Layout Managers, AWT Components, Adding a Menu to Window, Extending GUI Features 5.3 Event-Driven Programming in Java, Event-Handling Process, Event- Handling Mechanism, Delegation Model of Event Handling, Event Classes, Event Sources, Event Listeners, Adapter Classes as Helper Classes in Event Handling. Experiment 5 (Perform any Three programs that covers Applet Programming, GUI development using AWT and Event handling) i) Write java program to draw the house on an applet. ii) On Applet: Take a Login and Password from the user and display it on the third Text Field which appears only on clicking OK button and clear both the Text Fields on clicking RESET button Perform same using AWT and Swings as well.  iii) Write java program to create an advertisement banner on an applet using multithreading iv) Write java program to create a registration form using AWT. v) Write a Java program to demonstrate the use of AWT components namely buttons, labels, text boxes, lists/combos, menus with event handling.		LO 5

		vi) Write a java program to store personal telephone directory in such a way that when user hits a character, the names which starts with the character and telephone numbers should appear.		
6)	Java Swings	Theory 6.1 Introducing Swing: AWT vs Swings, Components and Containers, Swing Packages, A Simple Swing Application, Painting in Swing, Designing Swing GUI Application using Buttons, JLabels, Checkboxes, Radio Buttons, JScrollPane, JList, JComboBox, Trees, Tables Scroll pane Menus and Toolbars Experiment 6 (Perform any one programs that covers concept of Swings) i) Write a Java program to implement Swing components namely Buttons, JLabels, Checkboxes, Radio Buttons, JScrollPane, JList, JComboBox, Trees, Tables Scroll pane Menus and Toolbars to design interactive GUI. ii) Write a program to create a window with four text fields for the name, street, city and pincode with suitable labels. Also windows contains a button MyInfo. When the user types the name, his street, city and pincode and then clicks the button, the types details must appear in Arial Font with Size 32, Italics.	06	LO4 LO 6

Textbook Books:

1. Herbert Schildt, "Java-The Complete Reference", Seventh Edition, Tata McGraw Hill Publication
2. E. Balguruswamy, "Programming with java A primer", Fifth edition, Tata McGraw Hill Publication

Reference Books:

1. D.T. Editorial Services, "Java 8 Programming Black Book", Dreamtech Press
University of Mumbai, B. E. (Information Technology), Rev 2016

2. H. M. Deitel, P. J. Deitel, S. E. Santry, “Advanced Java 2 Platform How to Program” Prentice Hall
3. Learn to Master JAVA, from Star EDU solutions , by ScriptDemics

Term Work:

The term Work shall consist of at least 12 to 15 practical's based on the above list. The also Term work Journal must include at least 2 assignments.

Term Work Marks: 50 Marks (Total marks) = 40 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral & Practical Exam: An Oral & Practical exam will be held based on the above syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
ITC401	Applied Mathematics-IV	4+1@	-	-	5	-	-	5
ITC402	Computer Networks	4	-	-	4	-	-	4
ITC403	Operating Systems	4	-	-	4	-	-	4
ITC404	Computer Organization and Architecture	4	-	-	4	-	-	4
ITC405	Automata Theory	3+1\$	-	-	4	-	-	4
ITL401	Networking Lab	-	2	-	-	1	-	1
ITL402	Unix Lab	-	2	-	-	1	-	1
ITL403	Microprocessor Programming Lab	-	2	-	-	1	-	1
ITL404	Python Lab	-	2+2*	-	-	2	-	2
Total		21	10	-	21	5	-	26

ourse Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)				
		Test 1	Test 2	Avg.						
ITC401	Applied Mathematics-IV	20	20	20	80	3	-	-	-	100
ITC402	Computer Networks	20	20	20	80	3	-	-	-	100
ITC403	Operating Systems	20	20	20	80	3	-	-	-	100
ITC404	Computer Organization and Architecture	20	20	20	80	3	-	-	-	100
ITC405	Automata Theory	20	20	20	80	3	--	-	-	100
ITL401	Networking Lab	-	-	-	-	-	25	25	--	50
ITL402	Unix Lab	-	-	-	-	-	25	--	25	50
ITL403	Microprocessor Programming Lab	-	-	-	-	-	25	25	--	50
ITL404	Python Lab	-	-	-	-	-	50	--	50	100
Total		100	100	100	400	-	125	50	75	750

@ 4 hours shown as theory to be taken class wise and 1 hour to be taken tutorial as class wise

\$ 3 hours shown as theory to be taken class wise and 1 hour to be taken tutorial as batch wise

*2 hours shown as practical's to be taken class wise lecture and other 2 hours to be taken as batch wise practicals in Lab.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC401	Applied Mathematics IV	04	--	01	04	--	--	05

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of Two Tests					
ITC401	Applied Mathematic s IV	20	20	20	80	--	--	--	100

Course Objectives: Students will try to learn:

1. The concepts of Number Theory by using different theorem.
2. The concepts of probability and study PDF.
3. The concept of sampling theory and correlation.
4. The concept of graphs and trees.
5. The concept of groups theory.
6. The concept of Lattice theory.

Course Outcomes: Students will able to:

1. Apply the Number Theory to different applications using theorem.
2. Apply probability and understand PDF.
3. Understand sampling theory and correlation.
4. Apply the graphs and trees concepts to different applications.
5. Understand group's theory.
6. Understand the Lattice theory.

Prerequisite: Applied Mathematics III

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic of Set, Permutations, Combination and Probability .	02	
I	Elements of Number Theory I	Modular Arithmetic, Divisibility and Euclid Algorithm, Primes and the Sieve of Eratosthenes, Testing for primes, Prime Number Theorem	06	CO1

II	Elements of Number Theory II	Euler's, Fermat's Little theorems, Congruences, Computing Inverse in Congruences, Legendre and Jacobi Symbols, Chinese Remainder Theorem	06	CO1
III	Probability	Statistics: Formal concept, sample space, outcomes, events Random Variables: discrete & continuous random variables, expectation, Variance, Probability Density Function & Cumulative Density Function Moments, Moment Generating Function Probability distribution: binomial distribution, Poisson & normal distribution	08	CO2
IV	Sampling theory	Test of Hypothesis, Level of significance, Critical region, One Tailed and two Tailed test, Test of significant for Large Samples:- Means of the samples and test of significant of means of two large samples Test of significant of small samples:- Students t- distribution for dependent and independent samples Chi square test:- Test of goodness of fit and independence of attributes, Contingency table. Correlation Scattered diagrams Karl Pearson's coefficient of correlation Spearman's Rank correlation Regression Lines	10	CO3
V	Graph & Groups theory.	Introduction to graphs, graph terminology, representing graphs and graph isomorphism, connectivity, Euler and Hamilton paths, planar graphs, graph coloring, introduction to trees, application of trees. Groups, subgroups, generators and evaluation of powers, cosets and Lagrange's theorem, permutation groups and Burnside's theorem, isomorphism, automorphisms, homomorphism and normal	12	CO4 CO5

		subgroups, rings, integral domains and fields.		
VI	Lattice theory	Lattices and algebras systems, principles of duality, basic properties of algebraic systems defined by lattices, distributive and complimented lattices, Boolean lattices and Boolean algebras, uniqueness of finite Boolean expressions, propositional calculus. Coding theory: Coding of binary information and error detection, decoding and error correction.	08	CO5

Text Books:

1. Cryptograph and Network Security by B. A. Forouzan & D. Mukhopadhyay, 11th edition, McGraw Hill Publication.
2. Network Security and Cryptograph by Bernard Menezes, Cengage Learning Publication.
3. Higher Engineering Mathematics by Grewal B. S. 38th edition, Khanna Publication 2005.
4. Probability and Statistics for Engineering, Dr. J Ravichandran, Wiley-India.
5. Mathematical Statistics by H. C Saxena, S Chand & Co.
6. C. L. Liu: *Elements of Discrete Mathematics*, 2nd edition, TMH

References:

1. Elementary Number Theory and its applications by Kenneth H. Rosen, 5th edition, Addison Wesley Publication.
2. Abstract Algebra by I. N. Herstein, 3rd edition, John Wiley and Sons Publication.
3. Discrete Mathematics by Norman Biggs, 2nd edition, Oxford University Press.
4. Advanced Engg. Mathematics by C. Ray Wylie & Louis Barrett. TMH International Edition.
5. Mathematical Methods of Science and Engineering by Kanti B. Datta, Cengage Learning.
6. Advanced Engineering Mathematics by Kreyszig E. 9th edition, John Wiley.
7. Probability by Seymour Lipschutz, McGraw-Hill publication.

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination:

Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**

- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC402	Computer Networks	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of two Tests					
ITC402	Computer Networks	20	20	20	80	--	--	--	100

Course Objectives: Students will try to:

1. Study the basic taxonomy and terminology of the computer networking and enumerate the layers of OSI model and TCP/IP model.
2. Acquire knowledge of Application layer and Presentation layer paradigms and protocols.
3. Study Session layer design issues, Transport layer services, and protocols.
4. Gain core knowledge of Network layer routing protocols and IP addressing.
5. Study data link layer concepts, design issues, and protocols.
6. Read the fundamentals and basics of Physical layer, and will apply them in real time applications.

Course Outcomes: Students will be able to:

1. Describe the functions of each layer in OSI and TCP/IP model.
2. Explain the functions of Application layer and Presentation layer paradigms and Protocols.
3. Describe the Session layer design issues and Transport layer services.
4. Classify the routing protocols and analyze how to assign the IP addresses for the given network.
5. Describe the functions of data link layer and explain the protocols.
6. Explain the types of transmission media with real time applications.

Prerequisite: COA, Logic Design

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Von Neumann model, Modulation, Demodulation, encoding, Decoding.	02	--

I	Introduction	Network Criteria, Physical Structures, Network Types: LAN, WAN, Switching, OSI Reference model, TCP/IP suite, Comparison of OSI and TCP/IP, Network devices.	04	CO1
II	Application layer and Presentation layer	Introduction: Providing Services, Application layer Paradigms, Client-Server Paradigm: Application Programming Interface, Using Services of the Transport Layer, Standard Client Server applications: World Wide Web and HTTP, FTP, Electronic Mail, TELNET, Secure Shell (SSH), Domain Name System (DNS), Compression: Lossless Compression, Lossy Compression, Multimedia data: Text, Image, Video , Audio ,Multimedia in the Internet: Streaming Stored Audio/Video, Streaming Live Audio/Video, Real-Time Interactive Audio/Video, Optimal Compression Algorithms, Huffman Coding, Adaptive Huffman Compression, Dictionary Based Compression, Speech Compression, LZW, RLE, Image Compression – GIF,JPEG.	10	CO1 CO2
III	Session layer and Transport layer	Session layer design issues, Session Layer protocol - Remote Procedure Call (RPC), Transport layer services, Transport Layer Protocols: Simple Protocol, Stop-and-Wait Protocol, Go-Back-N Protocol (GBN), Selective-Repeat Protocol, Bidirectional Protocols: Piggybacking, Internet Transport-Layer Protocols, User Datagram Protocol: User Datagram, UDP Services, UDP Applications, Transmission Control Protocol: TCP Services, TCP Features, Segment, Segment, A TCP Connection, State Transition Diagram, Windows in TCP, Flow Control, Error Control, TCP Congestion Control, TCP Timers, Options.	10	CO1 CO3
IV	Network Layer	Introduction: Network-Layer Services, Packet Switching, Network-Layer Performance, Network-Layer Performance, Network-Layer Congestion, Structure of A Router, Network Layer Protocols: IPv4 Datagram Format, IPv4 Addresses,	12	CO1 CO4

		Forwarding of IP Packets, ICMPv4, Unicast Routing: General Idea, Routing Algorithms, Unicast Routing Protocols, Multicast Routing : Introduction, Multicasting Basics, Intradomain Routing Protocols, Interdomain Routing Protocols, Next generation IP: Packet Format , IPv6 Addressing , Transition from IPv4 to IPv6, ICMPv6, Mobile IP: Addressing , Agents , Three Phases , Inefficiency in Mobile IP.		
V	Data Link Layer	Wired Networks; Introduction: Nodes and Links, Two Types of Links, Two Sublayers, Data Link Control: Framing, Flow and Error Control, Error Detection and Correction, Two DLC Protocols, Medium Access Protocols: Random Access, Controlled Access, Channelization, Link Layer Addressing, Wired LANS: Ethernet Protocol; IEEE Project 802, Standard Ethernet, Fast Ethernet (100 Mbps), Gigabit Ethernet, 10-Gigabit Ethernet, Virtual LANs, Other Wired Networks: Point-to-Point Networks, SONET, Switched Network: ATM, Connecting Devices: Repeaters or Hubs, Link-Layer Switches, Routers, Sliding Window Compression.	09	CO1 CO5
VI	Physical Layer	Data and Signals: Analog and Digital, Transmission Impairment, Data Rate Limits, Performance, Digital Transmission: Digital-to-Digital Conversion , Analog-to-Digital Conversion, Analog Transmission: Digital-to-Analog Conversion, Analog-to-Analog Conversion ,Bandwidth Utilization: Multiplexing, Spread Spectrum, Transmission Media: Guided Media, Unguided Media: Wireless, Real Time Interactive Protocols: Rationale for New Protocols, RTP, Session Initialization Protocol (SIP), H.323, SCTP.	05	CO1 CO6

Text Books:

1. Behrouz A. Forouzan, Forouzan Mosharrat , Computer Networks A Top down Approach, Mc Graw Hill education.
2. Andrew S Tanenbaum, Computer Networks -, 4th Edition, Pearson Education.
3. Ranjan Bose, Information Theory, Coding and Cryptography, Ranjan Bose, Tata McGrawHill , Second Edition.

4. Diane Teare, “ Authorized Self- Study Guide Designing for CISCO Internetwork Solutions(DESIGN), Second Edition.

References:

1. Behrouz A. Forouzan, Data communications and Networking, Fifth edition TMH 2013.
2. James F. Kurose, K. W. Ross, Computer Networking: A Top-Down Approach Featuring the Internet, 3rd Edition, Pearson Education.
3. L. L. Peterson and B. S. Davie, Computer Networks: A Systems Approach, 4th Ed, Elsevier India.
4. S. Keshav, An Engineering Approach to Computer Networks, 2nd Edition, Pearson Education.
5. W. A. Shay, Understanding communications and Networks, 3rd Edition, W. A. Shay, Cengage Learning.
6. Khalid Sayood, Introduction to Data Compression, Third Edition, Morgan Kaufman.

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC403	Operating System	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of two Tests					
ITC403	Operating System	20	20	20	80	--	--	--	100

Course Objectives: Students will try:

1. To understand the main components of an OS & their functions.
2. To study the process management and scheduling.
3. To understand various issues in Inter Process Communication (IPC) and the role of OS in IPC.
4. To understand the concepts and implementation Memory management policies and virtual memory.
5. To understand the working of an OS as a resource manager, file system manager, process manager, memory manager and I/O manager and methods used to implement the different parts of OS
6. To study the need for special purpose operating system with the advent of new emerging technologies

Course Outcomes: Student will be able to

1. Describe the important computer system resources and the role of operating system in their management policies and algorithms.
2. Understand the process management policies and scheduling of processes by CPU
3. Evaluate the requirement for process synchronization and coordination handled by operating system
4. Describe and analyze the memory management and its allocation policies.
5. Identify use and evaluate the storage management policies with respect to different storage management technologies.
6. Identify the need to create the special purpose operating system.

Prerequisite: Programming Language C

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Programming Language C. Basic of Hardware i.e. ALU, RAM, ROM, HDD etc.	02	
I	Overview of Operating System	Introduction: Operating System Structure and operations, Process management, Memory management, storage management, Protection and security, Distributed and special purpose Systems; System Structure: Operating system services and interface, System calls and its types, System programs, Operating System Design and implementation, OS structure, Virtual machines, OS debugging and generation, System boot.	07	C01
II	Process Management	Process concept: Process Scheduling, Operation on process and Interprocess communication; Multithreading, Process: Multithreading models and thread libraries, threading issues; Process Scheduling: Basic concepts, Scheduling algorithms and Criteria, Thread Scheduling and Multiple Processor Scheduling;	09	C02
III	Process coordination	Synchronization: The critical Section Problem, Peterson's Solution, synchronization Hardware and semaphores, Classic problems of synchronization, monitors, Atomic transactions; Deadlocks: System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.	09	CO3
IV	Memory Management	Memory Management strategies: Background, Swapping, Contiguous Memory Allocation, Paging, Structure of the Page Table, Segmentation; Virtual Memory Management: Demand Paging, Copy-on-Write, Page Replacement, Allocation of Frames, Thrashing, Memory-Mapped Files, Allocating Kernel Memory, Other Considerations.	10	C04
V	Storage Management	File system: File Concept, Access Methods, Directory and Disk Structure, File-System Mounting, File Sharing, Protection; Implementing file System: File-System Structure, File-System Implementation, Directory Implementation, Allocation Methods, Free-Space Management, Efficiency and Performance, Recovery, NFS; Secondary Storage Structure: Overview of Mass-Storage Structure, Disk Structure, Disk Attachment, Disk Scheduling, Disk Management, RAID Structure, Stable-Storage Implementation, Tertiary-Storage Structure, Swap-Space Management; I/O systems: Overview I/O Hardware, Application I/O Interface, Kernel I/O Subsystem, Transforming I/O Requests to	09	C05

		Hardware Operations, STREAMS, Performance		
VI	Distributed Systems	Distributed operating System: Network based OS, Network Structure and Topology, Communication Structure and Protocols; Distributed File system: Naming and transparency, Remote file access, Stateful Versus Stateless Service, File Replication; Distributed Synchronization: Mutual Exclusion, Concurrency Control and Deadlock Handling,	06	C06

Text Books:

1. Operating System Concepts, Abraham Silberschatz, Greg Gagne, Peter Baer Galvin, 8th edition Wiley.
2. Modern Operating System, Tanenbaum, Pearson Education.
3. Operating Systems: Internal and Design Principles: William Stallings, PHI

Reference Books:

1. Operating System Design and Implementation, A Tanenbaum, Pearson
2. Real Time Systems Design and Analysis, Wiley, IEEE Press
3. Principles of Operating Systems: Naresh Chauhan, Oxford Higher Education

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination:

Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC404	Computer Organization and Architecture	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg. of two Tests				
ITC404	Computer Organization and Architecture	20	20	20	80	--	--	100

Course Objectives: Students will try to:

1. Conceptualize the basics of organizational and architectural issues of a digital computer.
2. Analyze processor performance improvement using instruction level parallelism.
3. Learn the function of each element of a memory hierarchy.
4. Study various data transfer techniques in digital computer.
5. Articulate design issues in the development of processor or other components that satisfy design requirements and objectives.
6. Learn microprocessor architecture and study assembly language programming.

Course Outcomes: Students will be able to:

1. Describe basic organization of computer and the architecture of 8086 microprocessor.
2. Implement assembly language program for given task for 8086 microprocessor.
3. Demonstrate control unit operations and conceptualize instruction level parallelism.
4. Demonstrate and perform computer arithmetic operations on integer and real numbers.
5. Categorize memory organization and explain the function of each element of a memory hierarchy.
6. Identify and compare different methods for computer I/O mechanisms.

Prerequisite: Fundamentals of Computer, Digital Logic Design

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	basic combinational and sequential logic circuits, binary numbers and arithmetic, basic computer organizations	02	
I	Overview of Computer Architecture &	Introduction of Computer Organization and Architecture. Basic organization of computer and block level description of the functional	07	CO1

	Organization	units. Evolution of Computers, Von Neumann model. Performance measure of Computer Architecture. Architecture of 8086 family, 8086 Hardware Design, Minimum mode & Maximum mode of Operation. Study of bus controller 8288 & its use in Maximum mode.		
II	Programming 8086	Addressing modes, Instruction Set, Assembly Language Programming, Mixed Language Programming, Programs based on Stacks, Strings, Procedures, Macros, Timers, Counters & delay.	10	CO2
III	Processor Organization and Architecture	CPU Architecture, Register Organization, Instruction formats, basic instruction cycle. Instruction interpretation and sequencing. Control Unit: Soft wired (Micro-programmed) and hardwired control unit design methods. Microinstruction sequencing and execution. Micro operations, concepts of nano programming. Introduction to parallel processing concepts, Flynn's classifications, pipeline processing, instruction pipelining, pipeline stages, pipeline hazards.	11	CO3
IV	Data Representation and Arithmetic Algorithms	Number representation: Binary Data representation, two's complement representation and Floating-point representation. Integer Data arithmetic: Addition, Subtraction. Multiplication: Unsigned & Signed multiplication- Add & Shift Method, Booth's algorithm. Division of integers: Restoring and non-restoring division, signed division, basics of floating point representation IEEE 754 floating point(Single & double precision) number representation. Floating point arithmetic: Addition, subtraction	10	CO4
V	Memory Organization	Introduction to Memory and Memory parameters. Classifications of primary and secondary memories. Types of RAM and ROM, Allocation policies, Memory hierarchy and characteristics. Cache memory: Concept, architecture (L1, L2, L3), mapping techniques. Cache Coherency, Interleaved and Associative memory.	07	CO5
VI	I/O Organization	Input/output systems, I/O modules and 8089 IO processor. Types of data transfer techniques: Programmed I/O, Interrupt driven I/O and DMA.	05	CO6

Text Books:

1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, “Computer Organization”, Fifth Edition, Tata McGraw-Hill.
2. William Stallings, “Computer Organization and Architecture: Designing for Performance”, Eighth Edition, Pearson.
3. 8086/8088 family: Design Programming and Interfacing: By John Uffenbeck (Pearson Education)
4. Microprocessor and Interfacing: By Douglas Hall (TMH Publication).

References:

1. B. Govindarajulu, “Computer Architecture and Organization: Design Principles and Applications”, Second Edition, Tata McGraw-Hill.
2. Dr. M. Usha, T. S. Srikanth, “Computer System Architecture and Organization”, First Edition, Wiley-India.
3. John P. Hayes, “Computer Architecture and Organization”, McGraw-Hill, Third Edition.
4. K Bhurchandi, “Advanced Microprocessors & Peripherals”, Tata McGraw-Hill Education

Assessment:**Internal Assessment for 20 marks:**

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC405	Automata Theory	03	--	01	03	--	01	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of two Tests					
ITC405	Automata Theory	20	20	20	80	--	--	--	100

\$ 3 hours shown as theory to be taken class wise and 1 hour to be taken tutorial as batch wise

Course Objectives: Students will try:

1. To learn fundamentals of Regular and Context Free Grammars and Languages
2. To understand the relation between Regular Language and Finite Automata and machines.
3. To learn how to design Automata's and machines as Acceptors, Verifiers and Translators.
4. To understand the relation between Contexts free Languages, PDA and TM.
5. To learn how to design PDA as acceptor and TM as Calculators.
6. To learn how to co-relate Automata's with Programs and Functions.

Course Outcomes: The students will be able to:

1. Understand, design, construct, analyze and interpret Regular languages, Expression and Grammars.
2. Design different types of Finite Automata and Machines as Acceptor, Verifier and Translator.
3. Understand, design, analyze and interpret Context Free languages, Expression and Grammars.
4. Design different types of Push down Automata as Simple Parser.
5. Design different types of Turing Machines as Acceptor, Verifier, Translator and Basic computing machine.
6. Compare, understand and analyze different languages, grammars, Automata and Machines and appreciate their power and convert Automata to Programs and Functions

Prerequisite: Basic Mathematical Fundamentals: Sets, Logic, Relations, Functions.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Introduction and Regular	Languages: Alphabets and Strings. Regular Languages: Regular Expressions, Regular Languages, Regular Grammars, RL and LL	06	CO1

	Languages	grammars, Closure properties		
II	Finite Automata and machines	Finite Automata: FA as language acceptor or verifier, NFA (with and without ϵ) , DFA, RE to NFA, NFA to DFA, Reduced DFA , NFA-DFA equivalence, FA to RE. Finite State Machines: m/c with output Moore and Mealy machines. M/c as translators. Melay and Moore m/c conversion	09	CO2
III	Context Free Grammars	Context Free Languages: CFG, Leftmost and Rightmost derivations, Ambiguity, Simplification and Normalization (CNF) and Chomskey Hierarchy (Types 0 to 3)	08	CO3
IV	Push Down Automata	Push Down Automata: Deterministic (single stack)PDA, Equivalence between PDA and CFG.	05	CO4
V	Turing Machine	Turing Machine: Deterministic TM , Multi-track and Multi-tape TMs, concept of UTM and idea of system program. Issue and concept of Halting Problem	07	CO5
VI	Applications of Automata	1.Power and Limitations of Regular and Context Free Grammars and Machines 2.Designing Functions: FA: Acceptor and Verifier. FSM: Translator PDA: Simple Parser for WF parenthesis, palindromes etc. TM: Basic bit wise calculator(+ /- /AND/OR) and Translator (Note Added)	04	CO2 CO4 CO5 CO6

Text books

1. J.C.Martin, "Introduction to languages and the Theory of Computation", TMH.
2. Kavi Mahesh, "Theory of Computation A Problem Solving Approach", Wiley India

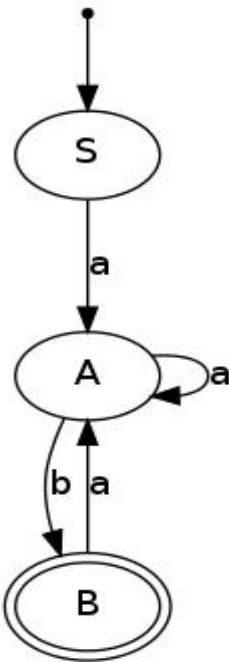
References

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, "Introduction to Automata Theory, Languages and Computation", Pearson Education.
2. Daniel I.A. Cohen, "Introduction to Computer Theory", John Wiley & Sons.
3. Theory of Computation - By Vivek Kulkarni from Oxford University.
4. N.Chandrashekhar& K.L.P. Mishra, "Theory of Computer Science, Automata Languages & Computations", PHI publications.

Sample Example for Tutorial: Applications of Automata

An automata can be easily converted to functions by converting *States* to *functions* and *Transitions* to *function calls* or *gotos* beginning with Starting state and *Accepting* in a terminating state.

A simple example of DFA is:

	Functions
	S(x) { if(x == 'a') goto A(next); else print("Error"); }
	A(x) { if(x == 'a') goto A(next); else if(x == 'b') goto B(next); else print("Error"); \}
	B(x) { if(x == 'a') goto A(next); else if(x == 'b') goto B(next); else if(end) print("Accept"); else print("Error"); \}

Suggested Tutorials:

Sr. No.	Module	Detailed Content
I	Introduction and Regular Languages	1 Tutorial on design of RE, RG, RLG and LLG for given Regular Language.
II	Finite Automata and machines	3 Tutorials for converting RE to NFA, NFA to DFA to Reduced DFA, FA to RE. 1 Tutorial on design of Moore and Mealy machines.
III	Context Free Grammars	1 Tutorial on design of CFG and Leftmost and Rightmost derivations. 1 Tutorial for converting CFG to CNF.
IV	Push Down Automata	1 Tutorial on design of Push Down Automata.
V	Turing Machine	1 Tutorial on design of single tape Turing Machine. 1 Tutorial on design of Multi-track and Multi-tape TMs.
VI	Applications of Automata	2 Tutorials for converting Automata to Functions: a. FA to Acceptor / Verifier. b. FSM to Translator. c. PDA to Simple Parser for WF parenthesis, palindromes etc. d. TM to Basic bit wise calculator(+ /- /AND/OR) / Translator

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination:

Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ITL401	Networking Lab	--	02	--	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral	Total
		Internal assessment			End Sem. Exam			
		Test 1	Test 2	Avg. of 2 Tests				
ITL401	Networking Lab	--	--	--	--	25	25	50

Lab Objectives: Students will try:

1. To get familiar with the basic network administration commands.
2. To install and configure network simulator and learn basics of TCL scripting.
3. To understand the network simulator environment and visualize a network topology and observe its performance
4. To analyze the traffic flow and the contents of protocol frames.
5. To implement client-server socket programs.
6. To design and configure a network for an organization.

Lab Outcomes: Student will be able to

1. Execute and evaluate network administration commands and demonstrate their use in different network scenarios
2. Demonstrate the installation and configuration of network simulator.
3. Demonstrate and measure different network scenarios and their performance behavior.
4. Analyze the contents the packet contents of different protocols.
5. Implement the socket programming for client server architecture.
6. Design and setup a organization network using packet tracer.

Hardware Requirement: PC i3 processor and above	Software requirement: NS2.34, Protocol Analyzer (eg. Wireshark), Packet tracer (Eg. CISCO packet tracer)

Prerequisite: C Programming Language

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Programming Language (C/java), Basic commands of windows and unix operating system, editor commands (eg nano/vi editor etc)	02	
I	Fundamentals of Computer Network	Understanding Basic networking Commands: Ping, Tracert, tracert, ipconfig, ifconfig, nslookup, netstat	02	LO1
II	Basics of Network simulation	Installation and configuration of NS2 Introduction to Tcl Hello Programming	03	LO2
III	Simulation of Network Topology	Implementation of Specific Network topology with respect to 1. Number of nodes and physical layer configuration 2. Graphical simulation of network with Routing Protocols and traffic consideration (TCP, UDP) using NAM. 3. Analysis of network performance for quality of service parameters such as packet-delivery-ratio, delay and throughput 4. Comparative analysis of routing protocols with respect to QOS parameters using Xgraph/gnuplot for different load conditions.	05	LO3
IV	Protocol Analyzer	Installation of Wire shark Analysis of Packet headers,	04	LO4
V	Socket Programming	Socket Programming with C/Java 1.TCP Client, TCP Server	04	LO5

		2. UDP Client, UDP Server		
VI	Case study on designing network topology	A case study to design and configure any organization network eg. College network or campus network, using any packet tracer or network topology design software based on infrastructure requirements, servers and clients, traffic consideration and application requirements.	06	L06

Text Books:

1. Computer Network: Top Down approach, Behrouz Forouzan, Firoz Mossharraf. MGH
2. Packet analysis with Wire shark, Anish Nath, PACKT publishing

Reference Books:

1. NS2.34 Manual
2. Introduction to Network Simulator NS2, 2nd Edition, Teerawat Issariyakul, Ekram Hossain, Springer

Term Work:

Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ITL402	Unix Lab	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test 1	Test 2	Avg. of two Tests				

ITL402	Unix Lab	--	--	--	--	25	25	50

Lab Objectives: Students will try:

1. To introduce Basic Unix general purpose Commands
2. To learn network Unix commands.
3. To learn C programming in Unix editor environment.
4. To learn shell script and sed concepts.
5. To learn file management and permission advance commands.
6. To learn awk, grap, perl scripts.

Lab Outcomes: Student will be able to:

1. Identify the basic Unix general purpose commands.
2. Apply and change the ownership and file permissions using advance Unix commands.
3. Use the awk, grep, perl scripts.
4. Implement shell scripts and sed.
5. Apply basic of administrative task.
6. Apply networking Unix commands.

Prerequisite: C Programming Language and Operating System

Hardware requirement:

PC i3 and above.

Software requirement:

Unix, Editor, Bash shell, Bourne shell and C shell.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Programming syntax, Installation of Unix, concepts of operating system	02	--
I	Basic Commands	A brief history of UNIX, Unix Architecture. Logging into (and out of) UNIX systems, Changing your password, General format of UNIX commands. a) Installation of Unix operating system. b) User management in Unix. c) Study of Unix general purpose	04	LO1

		utility command list obtained from (cd, cp, ps, ls, mv, rm, mkdir, rmdir, man, who, cat, echo, more, date, time, kill, history, chmod, passwd, who am i, who, time, bc, history, clear, man, lost, chown, finger, pwd, cal, logout, shutdown) commands.		
II	Advance Commands	a) Study of Unix networking commands (ifconfig, ping, traceroute, netstat, nslookup, whois, hostname, tcpdump). b) Study of Unix file system (tree structure). c) Study of .bashrc, /etc/bashrc and Environment variables. d) Study File and directory permissions. e) Study of Editor Vi/other editor. f) Study of Bash shell, Bourne shell and C shell in Unix operating system.	04	LO1 LO2 LO5 LO6
III	Basic System administrative task	Process management Memory management File system management User management	04	LO1 LO2 LO5
IV	Shell scripts	a) Write a shell script program to display list of user currently logged in. b) Write a shell script program to display “HELLO WORLD”. c) Write a shell script program to develop a scientific calculator. d) Write a shell Script program to check whether the given number is	04	LO1 LO4

		even or odd. e) Shell script Program to search whether element is present is in the list or not.		
V	Shell scripts and sed	a) Shell script program to check whether given file is a directory or not. b) Shell script program to count number of files in a Directory. c) Shell script program to copy contents of one file to another. d) Create directory, write contents on that and Copy to a suitable location in your home directory. e) Use a pipeline and command substitution to set the length of a line in file to a variable. f) Write a program using sed command to print duplicated lines of Input.	06	LO1 LO4
VI	grep, awk, perl scripts	a) Write a grep/egrep script to find the number of words character, words and lines in a file. b) Write an awk script to develop a Fibonacci series. c) Write a perl script to compute the power of a given number. d) Write an awk script to display the pattern of given string or number. e) Write a perl script to check a number is prime or not. f) Write an egrep script to display	04	LO1 LO2 LO3

		list of files in the directory.		

Text Books:

1. Unix, concepts and applications by Sumitabha Das, McGraw-Hill
2. Mastering Shell Scripting, Randal. K. Michael , Second Edition, Wiley Publication

References:

1. Unix Shell Programming by Yashwant Kanetkar
2. Unix shell programming by forozun

Term Work:

Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral & Practical Exam: An Oral & Practical exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ITL403	Microprocessor Programming Lab	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg. of two Tests				
ITL403	Microprocessor Programming Lab	--	--	--	--	25	25	50

Lab Objectives: Students will try to:

1. Learn assembling and disassembling of PC.
2. Get hands on experience with Assembly Language Programming.
3. Study interfacing of peripheral devices with 8086 microprocessor.
4. Understand techniques for faster execution of instructions and improve speed of operation and performance of microprocessors.
5. Learn fundamentals of designing embedded systems
6. Write and debug programs in TASM/MASM/hardware kits

Lab Outcomes: Students will be able to :

1. Apply the fundamentals of assembly level programming of microprocessors.
2. Build a program on a microprocessor using arithmetic & logical instruction set of 8086.
3. Develop the assembly level programming using 8086 loop instruction set.
4. Write programs based on string and procedure for 8086 microprocessor.
5. Analyze abstract problems and apply a combination of hardware and software to address the problem
6. Make use of standard test and measurement equipment to evaluate digital interfaces.

Prerequisite: Logic Design, Programming Languages(C, C++), COA

Hardware Requirement:

- Motherboard, RAM, Processor, Connectors, Cables, SMPS, HDD, Monitor, Graphics card (optional), Cabinet.
- 8086 microprocessor experiment kits with specified interfacing study boards.

Software Requirement:

- Microsoft Macro Assembler (TASM)/Turbo Assembler(TASM)

NOTE: Programs can be executed on assembler or hardware boards,

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
I	PC Assembly	1. Study of PC Motherboard Technology (South Bridge and North Bridge). 2. Disassembling the System Unit & Identifying Internal Components and Connections. 3. Study of various connections and ports used in computer communication.	06	LO1
II	Arithmetic and logical operations in 8086 Assembly language programming	1. Program for 16 bit BCD addition 2. Program to evaluate given logical expression. 3. Convert two digit Packed BCD to Unpacked BCD. (any two)	04	LO2 LO6
III	Loop operations in 8086 Assembly language programming	1. Program to move set of numbers from one memory block to another. 2. Program to count number of 1's	06	LO3 LO6

		and 0;s in a given 8 bit number 3. Program to find the smallest/largest number from a given set of numbers. 4. Program to search for a given number (any three)		
IV	String and procedure in 8086 Assembly language programming	1. Check whether a given string is a palindrome or not.	04	LO4 LO6
V	Procedure in 8086 Assembly language programming	1. Compute the factorial of a positive integer 'n' using recursive procedure. 2. Generate the first 'n' Fibonacci numbers. (any one)	02	LO4 LO6
VI	Interfacing with 8086 microprocessor	3. Interfacing Seven Segment Display 4. Interfacing keyboard matrix 5. Interfacing DAC (any two)	04	LO5 LO6

Text Books:

1. Scott Mueller,"Upgrading and repairing PCs", Pearson,
2. John Uffenbeck, "8086/8088 family: Design Programming and Interfacing:"Pearson Education

Reference Books:

1. K Bhurchandi, "Advanced Microprocessors & Peripherals", Tata McGraw-Hill Education

Term Work:

Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ITL404	Python lab	--	2+2*	--	--	02	--	02

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg. of two Tests				
ITL404	Python lab	--	--	--	--	50	50	100

*2 hours shown as practical's to be taken class wise lecture and other 2 hours to be taken as batch wise practicals in Lab.

Lab Objectives: The course will help the students to get familiar with:

1. Basics of Python programming
2. Decision Making and Functions in Python
3. Object Oriented Programming using Python
4. Files Handling in Python
5. GUI Programming and Databases operations in Python
6. Network Programming in Python

Lab Outcomes: Upon Completion of the course the learner should be able to:

1. Describe the Numbers, Math functions, Strings, List, Tuples and Dictionaries in Python
2. Express different Decision Making statements and Functions
3. Interpret Object oriented programming in Python
4. Understand and summarize different File handling operations
5. Explain how to design GUI Applications in Python and evaluate different database operations
6. Design and develop Client Server network applications using Python

Hardware & Software Requirements:

Hardware Requirements	Software Requirements	Other Requirements
PC With following Configuration 1. Intel PIV Processor 2. 2 GB RAM 3. 500 GB Harddisk 4. Network interface card	1. Windows or Linux Desktop OS 2. Python 3.6 or higher 3. Notepad ++ 4. Python IDEs like Pydev, Netbeans or Eclipse 5. Mysql	1. Internet Connection for installing additional packages

Detailed Syllabus:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Basic Programming syntax of Java/C. Installation and configuration of python.	02	
I	Basics of Python	Theory: Numbers in Python, Basic & Built-in Math functions, Number Formats, Strings, Quotes, print() Function, Assigning Values to Names & Changing Data Through Names, Copying Data, Tuples — Unchanging Sequences of Data, Lists — Changeable Sequences of Data, Dictionaries — Groupings of Data Indexed by Name, Special String Substitution Using Dictionaries , Arrays, Treating a String Like a List, Special Types, Ranges of Sequences, Working with Sets, Arrays. Lab Experiment: Write python programs to understand Expressions, Variables, Quotes, Basic Math operations, Strings: Basic String Operations & String Methods, List, Tuples, Dictionaries, Arrays. (Minimum Three Programs based on math operations, Strings and List/Tuples/ Dictionaries)	10	LO 1
II	Decision Making and Functions	Theory: If statement, if-elif-else, Repetition using while loop, for loop, break statement, Handling Errors- try: statement, except: statement, Functions-Grouping Code under a Name, defining a Function, describing a	10	LO 2

		function in the function, Checking & Setting Your Parameters, Calling Functions from within Other Functions, Functions Inside of Functions, Layers of Functions Lab Experiment: Write python programs to understand different decision making statements and Functions. (Minimum Three Programs based on Decision making, Looping Statements and Functions)		
III	Object Oriented Programming using Python programming	Theory: Creating a Class, Self Variables, Constructors, Types of Methods, Inner Classes, Constructors in Inheritance, Polymorphism,, The super() Method, Method Resolution Order (MRO), Operator Overloading, Method Overloading & Overriding, Interfaces in Python. Exceptions Handling: Errors in a Python Program, Exceptions, Exception Handling, Types of Exceptions, The Except Block, The assert Statement. Modules and Packages: Creating Modules and Packages, Documenting & Viewing Module, Basics of Testing Your Modules and Packages, Importing & exporting Modules. Lab Experiment: Write python programs to understand different Object oriented features in Python (Minimum four programs based on a) Classes & objects,	10	LO 3

		b) Constructors, c) Inheritance & Polymorphism, d) Exception handling		
IV	Files Handling	Theory: Types of Files in Python, Opening a File, Closing a File. Writing Text Files, Knowing Whether a File Exists or Not, Working with Binary Files, Appending Text to a File, Reading Text Files, File Exceptions, The with Statement Pickle in Python, Lambda and Filter, Map & range functions. Lab Experiment: Write python programs to understand different File handling operations	07	LO 4
V	GUI Programming and Databases	Theory: GUI Programming - Writing a GUI with Python: GUI Programming Toolkits, Creating GUI Widgets with Tkinter, Creating Layouts, Radio Buttons and Checkboxes, Dialog Boxes. Database Access - Python's Database Connectivity, Types of Databases Used with Python, Mysql database Connectivity with Python, Performing Insert, Deleting & Update operations on database Lab Experiment: Write python programs to understand GUI designing and database operations (Minimum Three programs based on GUI designing using Tkinter, Mysql database creation & Database connectivity with DML	07	LO 5

		operations using python		
VI	Web Programming	Theory: Understanding Protocols, Introduction to Sockets, TCP/IP Server, TCP/IP Client, UDP Server, UDP Client, File Server, File Client, Two-Way Communication between Server and Client, Multithreaded Client-Server Chat Application Lab Experiment: Write python programs to understand TCP and UDP Sockets in Python (Minimum One programs based on TCP or UDP Sockets)	06	LO 6

Text Books:

1. James Payne, "Beginning Python: Using Python 2.6 and Python 3.1", Wrox Publication
2. Dr. R. Nageswara Rao, "Core Python Programming", Dreamtech Press, Wiley Publication.
3. Magnus Lie Hetland, "Beginning Python From Novice to Professional", Second Edition", Apress Publication.

Reference Books:

1. Wesley J Chun, "Core Python Applications Programming", Third Edition, Pearson Publication.
2. E. Balguruswamy, "Introduction to Computing and Problem Solving using Python", McGraw Hill Publication
3. Learn to Master Python, from Star EDU solutions, by ScriptDemics

Term Work:

Term Work shall consist of at least 12 to 15 practical's based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 50 Marks (Total marks) = 40 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral & Practical Exam: An Oral & Practical exam will be held based on the above syllabus.

University of Mumbai

Program Structure B.E. Information Technology, (Rev. 2016)

T. E. Information Technology (Semester-V)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
ITC501	Microcontroller and Embedded Programming	4	-	-	4	-	-	4
ITC502	Internet Programming	4	-	-	4	-	-	4
ITC503	Advanced Data Management Technology	4	-	-	4	-	-	4
ITC504	Cryptography & Network Security	4	-	-	4	-	-	4
ITDLO-I	Department Level Optional Course-I	4	-	-	4	-	-	4
ITL501	Internet Programming Lab	-	2	-	-	1	-	1
ITL502	Security Lab	-	2	-	-	1	-	1
ITL503	OLAP Lab	-	2	-	-	1	-	1
ITL504	IOT (Mini Project) Lab	-	2	-	-	1	-	1
ITL505	Business Communication and Ethics	-	2+2*	-	-	2	-	2
	Total	20	14	-	20	7	-	26

Course Code	Course Name			Examination Scheme						
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)				
		Test 1	Test 2	Avg.						
ITC501	Microcontroller and Embedded Programming	20	20	20	80	3	-		-	100
ITC502	Internet Programming	20	20	20	80	3	-		-	100
ITC503	Advanced Data Management Technology	20	20	20	80	3	-		-	100
ITC504	Cryptography & Network Security	20	20	20	80	3	-		-	100
ITDLO-I	Department Level Optional Course-I	20	20	20	80	3	--		-	100
ITL501	Internet Programming Lab	-	-	-	-	-	25	--	25	50
ITL502	Security Lab	-	-	-	-	-	25	25	--	50
ITL503	OLAP Lab	-	-	-	-	-	25	25	--	50

ITL504	IOT (Mini Project) Lab	-	-	-	-	-	25	25	--	50
ITL505	Business Communication and Ethics	-	-	-	-	-	50	--	--	50
Total		100	100	100	400	-	150	75	25	750

Department Level Optional Course (DLO)

Every student is required to take one Department Elective Course for Semester V. Different sets of courses will run in both the semesters. Students can take these courses from the list of department electives, which are closely allied to their disciplines.

(DLO-I subjects will have no Labs only Theory)

Subject Code	Department Level Optional Course (DLO)
Semester V	
ITDLO5011	Advanced Data Structures & Analysis of Algorithms
ITDLO5012	Image Processing
ITDLO5013	E-Commerce & E-Business
ITDLO5014	IT Enabled Services
ITDLO5015	Computer Graphics & Virtual Reality

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC501	Microcontroller and Embedded Programming	04	--		04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITC501	Microcontroller and Embedded Programming	20	20	20	80	--	--	--	100

Course Objectives: Students will try to learn:

1. The concepts and architecture of embedded systems
2. Basic of microcontroller 8051.
3. The concepts of microcontroller interface.
4. The concepts of ARM architecture
5. The concepts of real-time operating system
6. Different design platforms used for an embedded systems application

Course Outcomes: Students will be able to:

1. Explain the embedded system concepts and architecture of embedded systems
2. Describe the architecture of 8051 microcontroller and write embedded program for 8051 microcontroller.
3. Design the interfacing for 8051 microcontroller.
4. Understand the concepts of ARM architecture.
5. Demonstrate the open source RTOS and solve the design issues for the same.
6. Select elements for an embedded systems tool.

Prerequisite: COA, Microprocessors and Assembly Programming languages

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Revision of microcomputer system terminologies, High level, Machine level and Assembly level programming language , difference between microprocessor and microcontroller	02	

I	Introduction to Embedded systems	Overview of Embedded System Architecture, Application areas, Categories of embedded systems, specialties of embedded systems. Recent trends in embedded systems. Brief introduction to embedded microcontroller cores CISC, RISC, ARM, DSP and SoC.	05	CO1
II	The Microcontroller Architecture and Programming of 8051:	Introduction to 8051 Microcontroller, Architecture, Pin configuration, Memory organization, Input /Output Ports, Counter and Timers, Serial communication, Interrupts. Instruction set, Addressing modes, Development tools, Assembler Directives, Programming based on Arithmetic & Logical Operations, I/O parallel and serial ports, Timers & Counters, and ISR.	14	CO2
III	Interfacing with 8051Microcontroller	Interfacing ADC, DAC, Stepper motor, LCD, KBD matrix, 8255 PPI	06	CO3
IV	ARM 7 Architecture	Architectural inheritance, Detailed study of Programmer's model, ARM Development tools, Instruction set: Data processing, Data Transfer, Control flow. Addressing modes. Writing simple assembly language programs. Pipelining, Brief introduction to exceptions and interrupts handling.	10	CO4
V	Open source RTOS	Basics of RTOS: Real-time concepts, Hard Real time and Soft Real-time, differences between general purpose OS & RTOS, basic architecture of an RTOS, scheduling systems, inter-process communication, performance Matrix in scheduling models, interrupt management in RTOS environment, memory management, file systems, I/O systems, advantage and disadvantage of RTOS. POSIX standards, RTOS issues – selecting a Real Time Operating System, RTOS comparative study.	07	CO5
VI	Introduction to Embedded target boards	Introduction to Arduino, Raspberry Pi, ARM Cortex, Intel Galileo etc. Open-source prototyping platforms. Basic Arduino programming; Extended Arduino libraries; Arduino-based Internet communication; Raspberry pi; ARM	08	CO6

		Cortex Processors; Intel Galileo boards; Sensors and Interfacing: Temperature, Pressure, Humidity		

Text Books:

1. M. A. Mazidi, J. G. Mazidi, R. D., McKinlay ,”The 8051 microcontroller & Embedded systems Using Assembly and C”, Pearson, 3rd edition
2. Embedded / real – time systems: concepts, design & programming, Black Book, Dr. K. V. K. K. Prasad, Dreamtech press, Reprint edition 2013
3. Shibu K. V., “Introduction to embedded systems”, McGraw Hil

References:

1. Laya B. Das, “Embedded systems an integrated approach”, Pearson, Third impression, 2013
2. Steve Furber, “ARM System on chip Architecture”, Pearson, edition second
3. Michael Margolis, “Arduino Cookbook”, O’reilly
4. Simon Monk,” Raspberry Pi Cookbok”, O’reilly
5. Raspberry Pi User Guide.
6. Massimo Banzi, “Getting Started with Arduino: The Open Source Electronics Prototyping Platform (Make)”, O'Reilly Media.

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1 will be compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC502	Internet Programming	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITC502	Internet Programming	20	20	20	80	--	--	--	100

Course Objectives: Students will try to learn:

- 1 To get familiar with basics of the Internet Programming.
2. To acquire knowledge and skills for creation of web site considering both client and server side programming
3. To gain ability to develop responsive web applications
4. To explore different web extensions and web services standards
5. To learn characteristics of RIA –Web Mashup Eco System
6. To be familiarized with Python web framework-Django.

Course Outcomes: Students will be able to:

1. Implement interactive web page(s) using HTML,CSS and JavaScript.
2. Design a responsive web site using HTML5 and CSS3.
3. Demonstrate Rich Internet Application .
4. Build Dynamic web site using server side PHP Programming and Database connectivity.
5. Describe and differentiate different Web Extensions and Web Services.
6. Demonstrate web application using Python web Framework-Django

Prerequisite: Basic Java Programming and Python Programming.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Introduction to web technologies: Introduction to OSI layers,	02	---
I	Client Side Programming :HTML, CSS and JavaScript	Basic of HTML: Web System architecture-1,2,3 and n tier architecture, URL, domain name system, overview of HTTP and FTP, Cross browser compatibility issues, W3C Validators. Formatting and Fonts, Anchors, images, lists, tables, frames and forms. Introduction to CSS: Evolution of CSS, Syntax of CSS, Exploring CSS Selectors, Inserting CSS in an HTML Document, Defining Inheritance in CSS. Introduction to JavaScript: JavaScript language constructs, Objects in JavaScript- Built in, Browser objects and DOM objects, event handling, form validation and cookies.	09	CO1
II	HTML5 and Responsive Web Design with CSS3	HTML 5 : Fundamental Syntax and Semantics, Native Audio and Video, Micro data and Custom data, Accessibility, Geo-location, Canvas CSS3 and Responsive Web Design Media Queries: Supporting Differing Viewports, Embracing Fluid Layout. CSS3: Selectors, Typography and color Modes, Stunning Aesthetics with CSS3, CSS3 Transitions, Transformations and Animations, Conquer Forms HTML5 and CSS3	12	CO1 CO2
III	Rich Internet Application(RIA)	Characteristics of RIA, Introduction to AJAX : AJAX design basics, AJAX vs Traditional Approach, , Rich User Interface using Ajax. Working with JavaScript Object Notation(JSON): Create data in JSON format, JSON Parser .	09	CO3

		Web Mashup Eco Systems –Mashup Techniques: Mashing on the Web Server, Mashing with JSON		
IV	Server Side Programming: PHP	Introduction to PHP- Data types, control structures, built in functions, Building web applications using PHP- tracking users, PHP and Mysql database connectivity with example. Introduction to PHP Framework.	08	CO4
V	Web Extensions and Web Services	Web Extensions: Introduction to XML, Introducing XSL. Web services: Evolution and differences with Distributed computing, WSDL, SOAP, UDDI. REST-ful web services, Resource Oriented Architecture	07	CO5
VI	Python Web Framework: Django	Introduction, Web Frameworks, Introduction to Django ,Projects and Apps, “Hello World” Application.	05	CO6

Text Books:

1. HTML 5 Black Book: Kogent Learning solutions
2. “Learning PHP 5”, David Sklar, O’Reilly Publication
3. Rich Internet Application AJAX and Beyond WROX press
4. Responsive Web Design with HTML5 and CSS3, Ben Frain, PACKT Publication

References:

1. “Web Technologies: Black Book”, Dreamtech publication
2. HTML5 Cookbook, By Christopher Schmitt, Kyle Simpson, O'Reilly Media
3. Core Python Applications Programming by Wesley J Chun Third edition Pearson Publication
4. Advanced Internet Technologies (includes practicals), Deven Shah, Dreamtech publication

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC503	Advanced Data Management Technology	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITC503	Advanced Data Management Technology	20	20	20	80	--	--	--	100

Course Objectives: Students will try to learn:

1. To introduce advanced concepts of transaction management and recovery techniques.
2. To impart knowledge related to query processing and query optimizer phases of a database management system
3. To introduce concepts of advanced access control techniques like role based and discretionary methods
4. To introduce advanced database models like distributed databases.
5. To impart an overview of emerging data models like temporal, mobile and spatial databases.
6. To create awareness of how enterprise can organize and analyze large amounts of data by creating a Data Warehouse.

Course Outcomes: Students will be able to:

1. Explain and understand the concept of a transaction and how ACID properties are maintained when concurrent transaction occur in a database
2. Measure query costs and design alternate efficient paths for query execution.
3. Apply sophisticated access protocols to control access to the database.
4. Implement alternate models like Distributed databases and Design applications using advanced models like mobile, spatial databases.
5. Organize strategic data in an enterprise and build a data Warehouse.
6. Analyze data using OLAP operations so as to take strategic decisions.

Prerequisite: Database Management System.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisites	Reviewing basic concepts of a Relational database, SQL concepts	02	
I	Query Processing and Optimization:	Overview, Measures of Query Cost Selection Operation, Sorting, Join Operation, Other Operations Evaluation of Expressions. Query Optimization Overview, Transformation of Relational Expressions Estimating Statistics of Expression Results Choice of Evaluation Plans	06	CO1
II	Transactions Management and Concurrency:	Transaction concept, Transaction states, ACID properties, Implementation of atomicity and durability, Concurrent Executions, Serializability, Recoverability, Implementation of isolation, Concurrency Control: Lock-based, Time-stamp based Deadlock handling, Recovery System: Failure Classification, Storage structure, Recovery & atomicity, Log based recovery, Checkpoints, Shadow Paging, ARIES Algorithm.	10	CO2
III	Advanced Data Management techniques	Advanced Database Access protocols: Discretionary Access Control Based on Granting and Revoking Privileges; Mandatory Access Control and Role-Based Access Control. Overview of Advanced Database models like Mobile databases, Temporal databases, Spatial databases.	09	CO3 CO4
IV	Distributed Databases	Introduction : Distributed Data Processing, What is a Distributed Database System? Design Issues . Distributed DBMS Architecture. Distributed Database Design : Top-Down Design Process, Distribution Design Issues, Fragmentation , Allocation . Overview of Query Processing : Query Processing Problem, Objectives of Query Processing, Complexity of Relational Algebra Operations, Characterization of Query Processors, Layers of Query Processing, Query Optimization in Distributed Databases;	09	CO4

		Overview of Transaction Management in DDB; Overview of Concurrency Control in DDB; Overview of Recovery in DDB		
V	Data Warehousing, Dimensional Modeling and OLAP	The Need for Data Warehousing; Data Warehouse Defined; Benefits of Data Warehousing ; Features of a Data Warehouse; Data Warehouse Architecture; Data Warehouse and Data Marts; Data Warehousing Design Strategies. Dimensional Model Vs ER Model; The Star Schema; How Does a Query Execute? The Snowflake Schema; Fact Tables and Dimension Tables; Factless Fact Table; Updates To Dimension Tables, Primary Keys, Surrogate Keys & Foreign Keys; Aggregate Tables; Fact Constellation Schema or Families of Star Need for Online Analytical Processing; OLTP vs OLAP; OLAP Operations in a cube: Roll-up, Drill-down, Slice, Dice, Pivot ; OLAP Models: MOLAP, ROLAP, HOLAP.	10	CO5
VI	ETL Process	Challenges in ETL Functions; Data Extraction; Identification of Data Sources; Immediate Data Extraction, Deferred Data Extraction; Data Transformation: Tasks Involved in Data Transformation, Techniques of Data Loading, Loading the Fact Tables and Dimension Tables	06	CO6

Text Books:

1. Korth, Silberchatz, Sudarshan, : "Database System Concepts", 6th Edition, McGraw – Hill
2. Elmasri and Navathe, "Fundamentals of Database Systems", 6th Edition, PEARSON Education.
3. Theraja Reema, "Data Warehousing", Oxford University Press, 2009.
4. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems" 3rd Edition - McGraw Hill

References:

1. Paulraj Ponniah, "Data Warehousing: Fundamentals for IT Professionals", Wiley India.
2. Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom "Database System Implementation", Pearson Ltd. 1/ e
3. Thomas M. Connolly Carolyn Begg, Database Systems : A Practical Approach to Design, Implementation and Management, 4/e, Pearson Ltd.
4. Ralph Kimball, Margy Ross, "The Data Warehouse Toolkit: The Definitive Guide To Dimensional Modeling", 3rd Edition. Wiley India.
5. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann 3rd Edition.

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC504	Cryptography & Network Security	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. of two Tests					
ITC504	Cryptography & Network Security	20	20	20	80	--	--	--	100

Course Objectives: Students will try to learn:

1. The concepts of classical encryption techniques and concepts of finite fields and number theory.
2. And explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, and public key algorithms
3. And explore the design issues and working principles of various authentication protocols, PKI standards.
4. And explore various secure communication standards including Kerberos, IPsec, and SSL/TLS and email.
5. The ability to use existing cryptographic utilities to build programs for secure communication.
6. The concepts of cryptographic utilities and authentication mechanisms to design secure applications

Course Outcomes: Students will be able to:

1. Identify information security goals, classical encryption techniques and acquire fundamental knowledge on the concepts of finite fields and number theory.
2. Understand, compare and apply different encryption and decryption techniques to solve problems related to confidentiality and authentication
3. Apply the knowledge of cryptographic checksums and evaluate the performance of different message digest algorithms for verifying the integrity of varying message sizes
4. Apply different digital signature algorithms to achieve authentication and create secure applications
5. Apply network security basics, analyze different attacks on networks and evaluate the performance of firewalls and security protocols like SSL, IPSec, and PGP.
6. Apply the knowledge of cryptographic utilities and authentication mechanisms to design secure applications

Prerequisite: Computer Networks

Detailed syllabus:

Sr No	Module	Detailed Content	Hours	CO Mapping
0	Prerequisites	Basic concepts of OSI Layer	02	--
I	Introduction & Number Theory	Services, Mechanisms and attacks-the OSI security architecture-Network security model-Classical Encryption techniques (Symmetric cipher model, mono-alphabetic and poly-alphabetic substitution techniques: Vignere cipher, playfair cipher, Hill cipher, transposition techniques: keyed and keyless transposition ciphers, steganography).	09	CO1
II	Block Ciphers & Public Key Cryptography	Data Encryption Standard-Block cipher principles-block cipher modes of operation-Advanced Encryption Standard (AES)-Triple DES-Blowfish-RC5 algorithm. Public key cryptography: Principles of public key cryptosystems-The RSA algorithm, The knapsack algorithm, El-Gamal Algorithm. Key management – Diffie Hellman Key exchange	09	CO2 CO6
III	Cryptographic Hashes, Message Digests and Digital Certificates	Authentication requirement – Authentication function , Types of Authentication, MAC – Hash function – Security of hash function and MAC –MD5 – SHA – HMAC – CMAC, Digital Certificate: X.509, PKI	09	CO3
IV	Digital signature schemes and authentication Protocols	Digital signature and authentication protocols : Needham Schroeder Authentication protocol, Digital Signature Schemes – RSA, El Gamal and Schnorr, DSS.	07	CO4
V	Network Security	Network security basics: TCP/IP vulnerabilities (Layer wise), Packet Sniffing, ARP spoofing, port scanning, IP spoofing, TCP syn flood, DNS Spoofing. Denial of Service: Classic DOS attacks, Source Address spoofing, ICMP flood, SYN flood, UDP flood, Distributed Denial of Service, Defenses against Denial of Service Attacks.	10	CO5

		Firewalls, Intrusion Detection Systems: Host Based and Network Based IDS, Honey pots.		
VI	Network Security Applications	Authentication Applications, Kerberos, Internet Security Protocols: SSL, TLS, IPSEC:AH, ESP, Secure Email: PGP and S/MIME, Key Management.	06	CO5 CO6

Text Books:

1. Mark Stamp's Information Security Principles and Practice, Wiley
2. William Stallings, Cryptography and Network Security, Principles and Practice, 6th Edition, Pearson Education, March 2013
3. Behrouz A. Ferouzan, "Cryptography & Network Security", Tata Mc Graw Hill
4. Bernard Menezes, "Cryptography & Network Security", Cengage Learning

Reference Books:

1. Applied Cryptography, Protocols Algorithms and Source Code in C, Bruce Schneier, Wiley.
2. Cryptography and Network Security, Atul Kahate, Tata Mc Graw Hill.

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW /Practical	Tutorial	Total
ITL501	Internet Programming Lab	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test 1	Test 2	Avg. of two Tests				
ITL501	Internet Programming Lab	--	--	--	--	25	25	50

Lab Objectives: Students will try:

1. To Acquire knowledge and Skills for creation of Web Site considering both client- and server-side Programming.
2. To create Web application using tools and techniques used in industry.
3. To learn the characteristics of RIA
4. To Demonstrate Amazon/Google or Yahoo mashup
5. To be well versed with XML and web services Technologies.
6. To be familiarized with open source Frameworks for web development.

Lab Outcomes: Students will learn to;

1. Design a basic web site using HTML5 and CSS3 to demonstrate responsive web design.
2. Implement dynamic web pages with validation using JavaScript objects by applying different event handling mechanism.
3. Use AJAX Programming Technique to develop RIA
4. Develop simple web application using server side PHP programming and Database Connectivity using MySQL.
5. Build well-formed XML Document and implement Web Service using Java.
6. Demonstrate simple web application using Python Django Framework.

Hardware and Software requirements:

Hardware Requirements	Software Requirements	Other Requirements
PC With following Configuration 1. Intel Core i3/i5/i7 Processor 2. 4 GB RAM 3. 500 GB Harddisk	1. Windows or Linux Desktop OS 2. HTML5 compatible web browsers(Chrome, Opera, Firefox, Safari etc) 3. HTML,CSS editors like Dreamweaver, Notepad++ etc. 4. Netbeans or Eclipse IDE 5. XAMPP	1. Internet Connection installation of web frameworks

Prerequisite: Basics of Java and Python Programming

Guidelines

1. The mini project work is to be conducted by a group of three students
2. Each group will be associated with a subject Incharge/ mini project mentor. The group should meet with the concerned faculty during Laboratory hours and the progress of work discussed must be documented.
3. The students may do will visit different websites to identify their website topic for the mini project.
4. Each group will identify the Hardware and software requirement for their mini project problem statement.
5. Mini Project consists of Responsive Website Development.
6. Which includes following points
 - a. Introduction to RWD frame work?
 - b. Identify tools
 - c. CSS preprocessor
 - d. Construction and design of skeleton for website
 - e. Enhancing CSS3 and HTML5 in website
 - f. Server Side Programming: website using server side scripting in PHP and database connectivity using MySQL (PHP framework like Laravel/Joomla can be used)
 - g. XML ,XSL and Web Services

- h. Developing RIA using AJAX including -A browser built-in XMLHttpRequest object (to request data from a web server) and JavaScript and HTML DOM (to display or use the data) Building Amazon/Yahoo /Google Web Mashups for the website.
- i. Website Security
- j. Develop full website and launch it.

7. Each group may present their work in various project competitions and paper presentations.

8. A detailed report is to be prepared as per guidelines given by the concerned faculty.

Text Books:

- 1. Responsive Web Design by Example Beginner's Guide by Thoriq Firdaus, PACKT
- 2. Responsive Web Design with HTML5 and CSS3 PACKT
- 3. Professional Rich Internet Application : AJAX and Beyond WROX press

References:

- 1. Laravel: Up and Running, By Matt Stauffer O'Reilly Media.
- 2. Advanced Internet Technologies (includes practicals) ,Deven Shah ,Dreamtech publication
- 3. Django By Example By Antonio Melé,Pakt Publication

Term Work:

Term Work shall consist of full Mini Project on above guidelines/syllabus. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Mini Project) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Mini Project and Presentation.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW /Practical	Tutorial	Total
ITL502	Security Lab	--	2	-	--	1	-	1

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL502	Security Lab	--	--	--	--	25	--	25	50

Lab Objectives: Students will try:

1. To be able to apply the knowledge of symmetric cryptography to implement simple ciphers
2. To be able to analyze and implement public key algorithms like RSA and El Gamal
3. To analyze and evaluate performance of hashing algorithms
4. To explore the different network reconnaissance tools to gather information about networks
5. To explore and use tools like sniffers, port scanners and other related tools for analyzing packets in a network.
6. To be able to set up firewalls and intrusion detection systems using open source technologies and to explore email security.

Lab Outcome: Students will learn to:

1. Apply the knowledge of symmetric cryptography to implement simple ciphers
2. Analyze and implement public key algorithms like RSA and El Gamal
3. Analyze and evaluate performance of hashing algorithms
4. Explore the different network reconnaissance tools to gather information about networks
5. Use tools like sniffers, port scanners and other related tools for analyzing packets in a network.
6. Apply and set up firewalls and intrusion detection systems using open source technologies and to explore email security.

Hardware and Software requirements:

Hardware Requirements	Software Requirements
PC With following Configuration 1. Intel Core i3/i5/i7 Processor 2. 4 GB RAM 3. 500 GB Harddisk	1. Windows or Linux Desktop OS 2. Wireshark 3. ARPWATCH 4. Kismet, NetStumbler 5. Nessus

Prerequisite: Computer Networks, Operating System, Basics of Java and Python Programming

Detail Syllabus:

Module No.	Description	Hours	CO mapping
I	a) Design and Implementation of a product cipher using Substitution and Transposition ciphers b) Implementation and analysis of RSA cryptosystem and Digital signature scheme using RSA/El Gamal	4	LO1 LO2
II	a) Implementation of Diffie Hellman Key exchange algorithm b) For varying message sizes, test integrity of message using MD-5, SHA-1, and analyse the performance of the two protocols. Use crypt APIs c) Exploring wireless security tools like Kismet, NetStumbler etc.	4	LO2 LO3
III	a) Study the use of network reconnaissance tools like WHOIS, dig, traceroute, nslookup to gather information about networks and domain registrars. b) Study of packet sniffer tools wireshark, :- 1. Observer performance in promiscuous as well as non-promiscuous mode. 2. Show the packets can be traced based on different filters.	4	LO4 LO5
IV	Download and install nmap. Use it with different options to scan open ports, perform OS fingerprinting, do a ping scan, tcp port scan, udp port scan, etc.	4	LO5
V	a) Detect ARP spoofing using nmap and/or open source tool ARPWATCH and wireshark. b) Simulate DOS attack using Hping and other tools c) Use the NESSUS/ISO Kaali Linux tool to scan the network for vulnerabilities.	6	LO4 LO5

VI	a) Set up IPSEC under LINUX. b) Set up Snort and study the logs. c) Explore the GPG tool of linux to implement email security	4	LO6

Text Books:

1. Build your own Security Lab, Michael Gregg, Wiley India
2. CCNA Security, Study Guide, Tim Boyles, Sybex

Reference Books:

1. Network Security Bible, Eric Cole, Wiley India

Term Work:

Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ITL503	OLAP Lab	--	2	--	--	1	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test	Test2	Avg. of two Tests					
ITL503	OLAP Lab	--	--	--	--	25	--	25	50

Lab Objectives: Students will try:

1. To introduce advanced concepts of transaction management and recovery techniques.
2. To impart knowledge related to query processing and query optimizer phases of a database management system
3. To initiate awareness about the potential security threats that exists in database systems and how to tackle them.
4. To introduce advanced database models like distributed databases.
5. To impart an overview of emerging data models like temporal, mobile and spatial databases.
6. To create awareness of how enterprise can organize and analyze large amounts of data by creating a Data Warehouse.

Lab Outcomes: Student should be able:

1. Implement simple query optimizers and design alternate efficient paths for query execution.
2. Simulate the working of concurrency protocols, recovery mechanisms in a database
3. Design applications using advanced models like mobile, spatial databases.
4. Implement a distributed database and understand its query processing and transaction processing mechanisms
5. Build a data warehouse
6. Analyze data using OLAP operations so as to take strategic decisions.

Hardware and Software requirements:

Hardware Requirements	Software Requirements
PC With following Configuration 1. Intel Core i3/i5/i7	1. ETL tools 2. Warehouse tools 3. Java/Python compiler

Processor	
2. 4 GB RAM	
3. 500 GB Harddisk	

Prerequisite: DBMS.

Detailed syllabus:

Module No.	Detailed Content	Hours	CO Mapping
I	a) Implementation of any Query optimizer (Java/Python) b) Assignments for query evaluation path expressions.	4	LO 2
II	c) Simulation of Concurrency Control Algorithm, Recovery Algorithm (Java/Python)	4	LO1
III	a) Design of a distributed database for a real life application - Fragmentation, Query Processing b) Simulation of Recovery methods.	4	LO 4
IV	Advanced Database Models Case study based assignments for Temporal, Mobile or Spatial databases	4	LO 3
V	Data Warehouse Construction a) Real life Problem to be defined for Warehouse Design b) Construction of star schema c) ETL Operations.	6	LO 4
VI	OLAP Exercise a) Construction of Cubes b) OLAP Operations, OLAP Queries	4	LO 6

Text Books:

1. Elmasri and Navathe, “Fundamentals of Database Systems”, 6th Edition, PEARSON Education.
2. Theraja Reema, “Data Warehousing”, Oxford University Press, 2009.
3. Data Warehousing, Data Mining, & OLAP by Alex Berson McGraw Hill.

References:

1. Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom “Database System Implementation”, Pearson Ltd. 1/ e
2. Thomas M. Connolly Carolyn Begg, Database Systems : A Practical Approach to Design, Implementation and Management, 4/e Pearson Ltd

3. Ralph Kimball, Margy Ross, “The Data Warehouse Toolkit: The Definitive Guide To Dimensional Modeling”, 3rd Edition. Wiley India.

Term Work:

Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ITL504	IOT (Mini Project) Lab	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL504	IOT (Mini Project) Lab	--	--	--	--	25	--	25	50

Lab Objectives: Students will try to:

1. Address the real world problems and find the required solution.
2. Design the problem solution as per the requirement analysis done.
3. Study the basic concepts of programming/ hardware/ emulator for Raspberry pi/Arduino/ ARM Cortex/ Intel Galileo etc.
4. Fabricate and implement the mini project intended solution for project based learning.
5. Build and test the mini project successfully.
6. Improve the team building, communication and management skills of the students.

Lab Outcomes: Student will be able to:

1. Identify the requirements for the real world problems.
2. Conduct a survey of several available literatures in the preferred field of study.
3. Study and enhance software/ hardware skills.
4. Demonstrate and build the project successfully by hardware requirements, coding, emulating and testing.
5. To report and present the findings of the study conducted in the preferred domain
6. Demonstrate an ability to work in teams and manage the conduct of the research study.

Guidelines

1. The mini project work is to be conducted by a group of three students
2. Each group will be associated with a subject Incharge/ mini project mentor. The group should meet with the concerned faculty during Laboratory hours and the progress of work discussed must be documented.
3. The students may do survey for different application using Raspberry pi/Arduino/ ARM Cortex/ Intel Galileo etc topics for the mini project.

4. Each group will identify the Hardware and software requirement for their mini project problem statement.
5. Prototype/Design your own circuit board using Raspberry pi/Arduino/ ARM Cortex/ Intel Galileo etc.
6. Installation, configure and manage your Raspberry pi/Arduino/ ARM Cortex/ Intel Galileo etc board/kit.
7. Work with operating system and do coding to for input devices on board.
8. The project assessment for term work will be done at least two times at department level by giving presentation to panel members which consist of at least three (3) members as Internal examiners (including the project guide/mentor) appointed by the Head of the department of respective Programme.
9. Create and interface using Web to publish or remotely access the data on Internet.
10. Each group along with the concerned faculty shall identify a potential problem statement, on which the study and implementation is to be conducted.
11. Each group may present their work in various project competitions and paper presentations.
12. A detailed report is to be prepared as per guidelines given by the concerned faculty.

Text Books:

1. Massimo Banzi, "Getting Started with Arduino", O'reilly, 2nd edition
2. Simon Monk, "Raspberry Pi Cookbook", O'reilly
3. Raspberry Pi User Guide

References:

1. Internet of Things (A Hands-on-Approach) , Vijay Madisetti , Arshdeep Bahga

Term Work:

Term Work shall consist of full Mini Project on above guidelines/syllabus. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Mini Project) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Mini Project and Presentation.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ITL505	Business Communication and Ethics	2	2*	--	--	2	--	2

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL505	Business Communication and Ethics	--	--	--	--	50	--	--	50

* Batch wise practical's

Pre-requisite

- Communication Skills

Course Objective: Students will try:

1. To inculcate professional and ethical attitude at the workplace
2. To enhance effective communication and interpersonal skills
3. To build multidisciplinary approach towards all life tasks
4. To hone analytical and logical skills for problem-solving

Course Outcomes: Students will learn to:

1. Design a technical document using precise language, suitable vocabulary and apt style.
2. Develop the life skills/ interpersonal skills to progress professionally by building stronger relationships.
3. Demonstrate awareness of contemporary issues knowledge of professional and ethical responsibilities.
4. Apply the traits of a suitable candidate for a job/higher education, upon being trained in the techniques of holding a group discussion, facing interviews and writing resume/SOP.
5. Deliver formal presentations effectively implementing the verbal and non-verbal skills.

Module	Detailed Contents	Hrs.
01	Report Writing	05
1.1	Objectives of Report Writing	
1.2	Language and Style in a report	
1.3	Types : Informative and Interpretative (Analytical, Survey and Feasibility) and Formats of reports (Memo, Letter, Short and Long Report)	
02	Technical Writing	03
2.1	Technical Paper Writing (IEEE Format)	
2.2	Proposal Writing	
03	Introduction to Interpersonal Skills	08
3.1	Emotional Intelligence	
3.2	Leadership and Motivation	
3.3	Team Building	
3.4	Assertiveness	
3.5	Conflict Resolution and Negotiation Skills	
3.6	Time Management	
3.7	Decision Making	
04	Meetings and Documentation	02
4.1	Strategies for conducting effective meetings	
4.2	Notice, Agenda and Minutes of a meeting	
4.3	Business meeting etiquettes	
05	Introduction to Corporate Ethics	02
5.1	Professional and work ethics (responsible use of social media - Facebook, WA, Twitter etc.)	
5.2	Introduction to Intellectual Property Rights	
5.4	Ethical codes of conduct in business and corporate activities (Personal ethics, conflicting values, choosing a moral response and making ethical decisions)	
06	Employment Skills	06

6.1	Group Discussion	
6.2	Resume Writing	
6.3	Interview Skills	
6.4	Presentation Skills	
6.5	Statement of Purpose	
		26

1. Report Writing (Theory)
2. Technical Proposal
3. Technical Paper Writing (Paraphrasing a published IEEE Technical Paper)
4. Interpersonal Skills (Group activities and Role plays)
5. Interpersonal Skills (Documentation in the form of soft copy or hard copy)
6. Meetings and Documentation (Notice, Agenda, Minutes of Mock Meetings)
7. Corporate ethics (Case studies, Role plays)
8. Writing Resume and Statement of Purpose

1. Term Work:

2. Term work shall consist of all assignments from the list. The distribution of marks for term
3. work shall be as follows:

4. Book Report.....(10) Marks
5. Assignments (10) Marks
6. Project Report Presentation..... (15) Marks
7. Group Discussion..... (10) Marks
8. Attendance(05) Marks
9. **TOTAL:(50) Marks**

The final certification and acceptance of term work ensures the satisfactory performance of work assigned and minimum passing in the term work.

References

1. Fred Luthans, “*Organizational Behavior*”, McGraw Hill, edition
2. Lesiker and Petit, “*Report Writing for Business*”, McGraw Hill, edition
3. Huckin and Olsen, “*Technical Writing and Professional Communication*”, McGraw Hill

4. Wallace and Masters, "*Personal Development for Life and Work*", Thomson Learning, 12th edition
5. Heta Murphy, "*Effective Business Communication*", Mc Graw Hill, edition
6. Sharma R.C. and Krishna Mohan, "*Business Correspondence and Report Writing*", Tata McGraw-Hill Education
7. Ghosh, B. N., "*Managing Soft Skills for Personality Development*", Tata McGraw Hill. Lehman,
8. Dufrene, Sinha, "BCOM", Cengage Learning, 2nd edition
9. Bell, Smith, "Management Communication" Wiley India Edition, 3rd edition.
10. Dr. Alex, K., "Soft Skills", S Chand and Company
11. Subramaniam, R., "Professional Ethics" Oxford University Press.
12. Robbins Stephens P., "Organizational Behavior", Pearson Education
13. <https://grad.ucla.edu/asis/agep/advsopestem.pdf>

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ITDLO5011	Advanced Data Structures & Analysis of Algorithms	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO5011	Advanced Data Structures & Analysis of Algorithms	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To learn mathematical background for analysis of algorithm
2. To learn various advanced data structures.
3. To understand the concept of designing an algorithm.
4. To learn dynamic programming and greedy method.
5. To understand the concept of pattern matching
6. To learn advanced tree and graph applications.

Course Outcomes:

1. Students will be able to choose appropriate advanced data structure for given problem.
2. Students will be able to calculate complexity.
3. Students will be able to select appropriate design techniques to solve real world problems.
4. Students will be able to apply the dynamic programming technique to solve the problems.
5. Students will be able to apply the greedy programming technique to solve the problems.
6. Students will be able to select a proper pattern matching algorithm for given problem.

Prerequisite: Knowledge Any Programming Language, Data structures and Analysis

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
	Prerequisite	Data structures and analysis	02	--
I	Introduction	Introduction • Introduction to advanced data structures: • Introduction/Fundamentals of the analysis of algorithms - o Recurrences: ▪ The substitution method ▪ Recursive tree method ▪ Masters method - o Probabilistic analysis - o Amortized analysis - o Randomized algorithms - o Mathematical aspects and analysis of algorithms	10	CO1 CO2
II	Advanced Data Structures	• Introduction • AVL tree • Huffman algorithm • B/B+ tree • 2-3 tree operations • Red-Black Trees • tries • Heap operations • Implementation of priority queue using heap • Topological sort Analysis of All problems	11	CO1 CO2 CO3
III	Divide and Conquer	• Introduction • Binary search • Finding the minimum and maximum • Merge sort • Quick sort • Strassen's matrix multiplication Analysis of All problems	7	CO2 CO3
IV	Greedy algorithms	• Introduction • Knapsack problem • Job sequencing with deadlines • Minimum cost spanning trees	8	CO2 CO3

		- o Kruskal's algorithm - o Prim's algorithm • Optimal storage on tapes • Optimal merge pattern • Subset cover problem • Container loading problem Analysis of All problems		CO5
V	Dynamic algorithms And NP-Hard and NP-Complete	Introduction Dynamic algorithms • All pair shortest path • 0/1 knapsack • Travelling salesman problem • Coin Changing Problem • Matrix Chain Multiplication • Flow shop scheduling • Optimal binary search tree (OBST) • Analysis of All problems • Introduction to NP-Hard And NP-Complete Problems	8	CO2 CO3 CO4
VI	String Matching	• introduction • The naïve string matching algorithm • Rabin Karp algorithm • Knuth-Morris-Pratt algorithm (KMP) • Longest common subsequence(LCS) • Analysis of All problems • Genetic algorithms	6	CO2 CO3 CO6

Text Books:

1. Introduction to ALGORITHMS, Cormen, Leiserson, Rivest, Stein, PHI.
2. Algorithms: Design and Analysis, Harsh Bhasin, OXFORD.
3. Fundamentals of Computer Algorithms, Horowitz, Sahani, Rajsekaran, Universities Press.
4. C and Data structures, Deshpande, Kakde, Dreamtech Press.

Reference Books:

1. Data Structures and Algorithms in C++, Goodrich, Tamassia, Mount, WILEY.
2. Data Structures using C, Reema Thareja, OXFORD.
3. Data Structures and Algorithm Analysis in C, Mark A. Weiss, Pearson.

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ITDLO5012	Image Processing	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO5012	Image Processing	20	20	20	80	--	--	100

Course Objectives: The course will help the students to get familiar with

1. Fundamental concepts of a digital image processing system.
2. Concepts of image enhancement techniques.
3. Various Image Transforms.
4. Compression techniques and Morphological concepts
5. Various segmentation techniques, and object descriptors.
6. Color models and various applications of image processing.

Course Outcomes: Students should be able to:

1. Remember the fundamental concepts of image processing.
2. Explain different Image enhancement techniques
3. Understand and review image transforms
4. Analyze the basic algorithms used for image processing & image compression with morphological image processing.
5. Contrast Image Segmentation and Representation
6. Design & Synthesize Color image processing and its real world applications.

Prerequisite: Mathematics and Statistics.

Detail Syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	As images are two dimensional signals, the single dimensional Digital Signal Processing fundamentals.	02	

I	Introduction to digital image processing system	Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Image Sensing and Acquisition, Image Sampling and Quantization, Basic Relationships between Pixels.	07	CO 1
II	Image enhancement	Intensity Transformations and Spatial Filtering, Histogram processing, Filtering in Frequency Domain	09	CO 2
III	Image transforms	Discrete Fourier transform - Properties of two dimensional DFT, DCT, DST, Walsh, Hadamard, Haar Transform and their properties.	07	CO 3
IV	Image compression and morphological image processing	Fundamentals of compression, Basic compression Methods, Huffman Coding, Arithmetic Coding , LZW Coding , Run-Length Coding , Symbol-Based Coding, Bit-Plane Coding, Block Transform Coding , Predictive Coding. Image morphology, Opening & Closing, Hit or Miss Transform, Basic Morphological Algorithms	11	CO 4
V	Image segmentation and representation	The detection of discontinuities - Point, Line and Edge detections , Hough Transform, Thresholding Region based segmentation Chain codes, Polygon approximation, Shape numbers, Fourier descriptors, statistical Moments.	08	CO 5

VI	Color Image Processing and Applications	Color Fundamentals and Models, Pseudocolor Image Processing, Smoothing and Sharpening, Image Segmentation Based on Color. Biometric Authentication, Digital watermarking, Content Base Image Retrieval. Vector quantization	08	CO 6

Text Books:

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Addison - Wesley Publishing Company, New Delhi, Third Edition, 2007.
2. William K. Pratt, "Digital Image Processing", John Wiley, NJ, Fourth Edition 2007.

Reference Books:

1. Sid Ahmed M.A., "Image Processing Theory, Algorithm and Architectures", McGraw-Hill, 1995.
2. Kenneth R Castleman, "Digital Image Processing", Prentice Hall, New Delhi, 1996.
3. Anil.K.Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India Pvt Ltd., New Delhi, 1995.
4. S. Sridhar, "Digital Image Processing", second Edition, Oxford university press, New Delhi, 2016.
5. S. Jayaraman, S. Esakkirajan, T. Veerakumar "Digital Image Processing", McGraw-Hill, 2016

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1 will be compulsory and should cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ITDLO5013	E-Commerce & E-Business	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO5013	E-Commerce	20	20	20	80	--	--	100

Course Objectives: Students will try to :

1. Understand concept of Ecommerce and its types.
2. Be familiarized with technologies for Ecommerce.
3. Understand different types of Online Payment systems.
4. Understand Selling and marketing on web.
5. Be familiarized with concept of E-business and E-business Models.
6. Understand various E-business Strategies.

Course Outcomes: Students will be able to:

1. Define and differentiate various types of E-commerce.
2. Describe Hardware and Software Technologies for E-commerce.
3. Explain payment systems for E-commerce.
4. Describe the process of Selling and Marketing on web.
5. Define and Describe E-business and its Models.
6. Discuss various E-business Strategies.

Prerequisite: Internet Technologies, Internet Security, Middleware technologies, web services

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Internet Technologies, Internet Security, Middleware technologies, web services	02	
I	Introduction to E	E-commerce :Definition of e commerce , different types of E-commerce ,Examples	04	CO1

	–commerce	of E- commerce, E-commerce trade cycle , advantages and disadvantages of E-commerce , Traditional commerce Vs E -commerce		
II	Overview of Hardware and Software Technologies for Ecommerce	Overview of Client side programming (Dream weaver , Front page) Hardware and , Server side Programming (PHP) , Database Software connectivity , session tracking, middleware technologies for ecommerce perspective and security aspects with respect to e commerce, integration of web services	08	CO2
III	Payment System for Ecommerce	Traditional payment model , Characteristics of payment, Online Payment Basics, Payment Cards, Electronic Cash, Electronic Wallets, Stored-Value Cards, SET Protocol for credit card payment, Internet Technologies and the Banking Industry	10	CO3
IV	Selling and Marketing on Web	Selling on the Web: Revenue Models and Building a Web Presence: Revenue Models, Revenue Models in Transition, Revenue Strategy Issues, Creating an Effective Web Presence, Web Site Usability, Connecting with Customers Marketing on the Web: Web Marketing Strategies, Communicating with Different Market Segments, Beyond Market Segmentation: Customer Behavior and Relationship Intensity, Advertising on the Web, E-Mail Marketing, Technology-Enabled Customer Relationship Management, Creating and Maintaining Brands on the Web Online Auctions, Virtual Communities, and Web Portals	10	CO4
V	E business :- Introduction to e business and Developing E-business models	Definition of e- business , Characteristics , elements of e business , e business roles , Impact of e business , challenges of e business , difference between e business and e commerce , E-business structure, Evolution of E –business and stages , E –business models , Characteristics of Internet based software and e business solutions	10	CO5
VI	E business strategies	Strategic planning process, SCM , CRM , ERP , procurement	08	CO6

Text Books:

- 1 E -Commerce Fundamentals and application (Henry Chan) Wiley publication
2. Electronics Commerce (Gary Schneider) Thomson Course technology
- 3.E –Business , Parag Kulkarni , Sunita Jahirabadkar, Pradip Chande , Oxford Higher Education , Oxford University Press
4. E –business and E –commerce Management , Dave Chaffey , Pearson , 3rd edition
5. E commerce by Laudon

References:

1. E-Commerce Strategies, Technology and applications (David Whitley) Tata McGrawHill
2. Introduction to E-commerce Elias Awad

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1 will be compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ITDLO5014	IT Enabled Services	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO5014	IT Enabled Services	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To understand importance of IT enabled services and challenges for the same.
2. To understand strategic IT planning for industries.
3. To develop enterprise IT architecture for Information technology.
4. To encourage the use of Information Technology so as to enable students to improve their skills, knowledge and job prospects and enable them to obtain employment in sunrise industries.
5. To develop the ability to integrate various resources for optimization in the industry as well as for strategic utilization of IT enabled services and functions.
6. To develop competence in global sourcing: strategy and management to gain a perspective on the global services sourcing landscape: past, present, and future.

Course Outcomes: Students will be able to:

1. Describe the importance of IT enabled services and challenges.
2. Identify strategic IT planning for software development.
3. Recognize enterprise IT architecture for Information technology.
4. Use of Information Technology so as to enable them for job in sunrise industries.
5. Illustrate various IT web services for betterment of knowledge.
6. Use their skills to find out various current IT trends in ITES.

Prerequisite: Internet Programming.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Information Technology and Project Management, Web Engineering and Technology.	02	
I	Business strategy: challenges and opportunities for IT	Business Strategy: Challenges and Opportunities in the Globalized, Interconnected, Convergent World, Establish Principles before Practice, IT Strategy, Application Strategy, Technology Strategy for IT, IT Management Strategy, Developing IT Strategy for Competitive Advantage, Stages of IT Strategy Development and Implementation, Challenges of IT and Business Strategy Alignment, Inhibitors of Business and IT Strategy Alignment, Three-D Framework for Business and IT Strategy Alignment.	09	CO1
II	Strategic IT planning	Business Implications for IT Strategic and Planning, Strategic IT Planning Motivations, SITP Process: Prevalent Planning Approaches, Difficulties in Developing and Executing SITP, Best Practices for Achieving Good SITP, SITP Approaches-Prevalent Researches.	09	CO2
III	Enterprise IT architecture	Defining EITA, Contents of a Typical Enterprise IT Architecture, Standard for Enterprise IT Architecture, Technology Management strategy Framework, Prevalent Technology Reference Architectures Framework and Standards, Program Management, Benefits of PMO, Desired Qualities of a Program Office Manager, Maturity of PMO, Implementation of PMO Strategy, Measuring PMO Performance, Success Factors for PMO, Project Scope Management, PMO Dashboard and Reporting.	08	CO3

IV	IT service management strategy	Information Technology Infrastructure Library (ITIL), ITIL Overview, ITIL Service Support Processes, Incident Management, Problem Management, Service Delivery, Service Level Management, Financial Management, Capacity Management, IT Service Continuity Management (ITSCM), Availability Management, Imperatives for Outsourcing, IT Management Layers, Variants of Outsourcing, Business Process Outsourcing, In sourcing.	08	CO4
V	IT enabled web services	Overview of basic features of PHP: arrays, functions and state management, working with PHP forms, More advanced PHP, OOP's concept in PHP, Portable database supported with different, exception handling, concepts of UDDI, WSDL, SOAP.	08	CO5
VI	Current trends in ITES	Current Employment in the IT and ITES industry: Newly emerging area and requirement of IT enabled service sector. Industry Oriented Human Resource Requirement: Outlook of the IT and ITES Industry. Barriers to Trade in ITES Role of International Bodies (WTO & UNCTAD) in facilitating Trade in ITES/ITES, experiences and Case studies of ITES-call centers, ERP, google.	08	CO6

Text Books:

1. Sanjiva Shankar Dubey, "IT strategy and Management", PHI.
2. K. Venkatesh, "Marketing of Information Technology", TMH.
3. Steve Suehring, Timconverse, Joyoe Park, "PHP 6 and MySQL Bible", Wiley.

References:

1. Shiro Uesugi, "IT Enabled Services", Springer; 2013 edition, 2013.
2. Sanjiva Shankar Dubey, "IT Services Business Management: Concepts, Processes and Practices", PHI, 2012.
3. Nikhil Treebhoo, "Promoting IT Enabled Services", Addison-Wesley, 2013.

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ITDLO5015	Computer Graphics & Virtual Reality	04	--	---	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO5015	Computer Graphics & Virtual Reality	20	20	20	80	----	--	100

Course Objectives: Students will try:

1. To introduce the use of the components of a graphics system and become familiar with building approach of graphics system components and algorithms related with them.
2. To learn the basic principles of 3-dimensional computer graphics.
3. Provide an understanding of how to scan convert the basic geometrical primitives, how to transform the shapes to fit them as per the picture definition.
4. Provide an understanding of mapping from a world coordinates to device coordinates, clipping, and projections.
5. To be able to discuss the application of computer graphics concepts in the development of computer games, information visualization, and business applications.
6. To comprehend and analyze the fundamentals of animation, virtual reality, underlying technologies, principles, and applications.

Course Outcomes: Students will be able to:

1. To list the basic concepts used in computer graphics.
2. To implement various algorithms to scan, convert the basic geometrical primitives, transformations, Area filling, clipping.
3. To describe the importance of viewing and projections.
4. To define the fundamentals of animation, virtual reality and its related technologies.
5. To understand a typical graphics pipeline
6. To design an application with the principles of virtual reality

Prerequisite: Basic Mathematics

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Knowledge of Mathematics	2	
I.	Introduction to Computer graphics and Output primitives	Introduction: Display Devices, Bitmap and Vector based graphics, Overview of Coordinate System. Scan Conversion of: point, line using Digital differential analyzer & Bresenham's algorithm, circle using midpoint approach, Curve Generation: Bezier and B-Spline curves. Introduction to fractals: generation procedure, classification, dimension and Koch Curve.	7	CO1
II.	Area Filling, Transformations (2D and 3D)	Area filling: Inside/Outside Test, Scan line Polygon Fill Algorithm, Boundary Fill and Flood Fill algorithm. Basic Geometrical 2D Transformations: Translation, Rotation, Scaling, Reflection, Shear, their homogeneous Matrix representation and Composite transformation. Three Dimensional transformations: Translation, Scaling, Rotations, Composite.	8	CO1 CO2
III.	Viewing (2D and 3D) Projection and Clipping	Viewing: Introduction, Viewing Pipeline, View Coordinate reference frame, Window to viewport transformation. Three-Dimensional Viewing: 3D Pipeline, Viewing transformation, Projections: Parallel (Oblique and orthographic), Perspective (one Point) Clipping: Point clipping, Line clipping: Cohen Sutherland Algorithm, Liang Barsky algorithms, Polygon clipping: Sutherland Hodgeman polygon clipping and Weiler Atherton. Text Clipping.	10	CO1 CO2 CO3

IV.	Introduction To Animation	Animation: Key Frame Animation, Animation Sequence, Motion Control Methods, Morphing, Warping- Mesh Warping.	4	CO1 CO2 CO4 CO5
V.	Introduction to Virtual Reality	Virtual Reality: Basic Concepts, Overview and perspective on virtual reality, Human sensation and perception. Classical Components of VR System, Types of VR Systems, Three-Dimensional Position Trackers, Navigation and Manipulation Interfaces, Gesture Interfaces, Input Devices, Graphical Display, Sound displays, and Haptic Feedback. Graphical Rendering Pipeline, Haptic Rendering Pipeline, Open GL rendering pipeline. Applications of Virtual Reality.	9	CO1 CO2 CO4 CO6
VI.	VR Modeling and Programming	Geometric Modeling: Virtual Object Shape, Object Visual Appearance. Kinematics Modeling: Object Position, Transformation Invariants, Object Hierarchies, Physical Modeling: Collision Detection, Surface Deformation, Force Computation. Behavior Modeling. Programming through VRML/X3D: Defining and Using Nodes and Shapes, VRML Browsers, Java 3D, OpenCV for augmented reality	12	CO1 CO2 CO4 CO6

Text Books

1. Donald Hearn and M. Pauline Baker, "Computer Graphics", Pearson Education.
2. R. K Maurya, "Computer Graphics with Virtual Reality", Wiley India.

Reference Books

1. Grigore Burdea, Philippe Coiffet, "Virtual Reality Technology", Wiley.
2. Steven Harrington, "Computer Graphics", McGraw Hill.
3. Rogers, "Procedural Elements of Computer Graphics", Tata McGraw Hill.
4. Vince, "Virtual Reality Systems", Pearson Education.
5. F.S. Hill, Stephen M. Kelley, "Computer Graphics using Open GL" Prentice Hall
6. Samyak Datta, "Learning OpenCV 3 Application Development", Packt

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
ITC601	Software Engineering with Project Management	4	-	-	4	-	-	4
ITC602	Data Mining and Business Intelligence	4	-	-	4	-	-	4
ITC603	Cloud Computing & Services	4	-	-	4	-	-	4
ITC604	Wireless Networks	4	-	-	4	-	-	4
ITDLO-II	Department Level Optional Course -II	4	-	-	4	-	-	4
ITL601	Software Design Lab	-	2	-	-	1	-	1
ITL602	Business Intelligence Lab	-	2	-	-	1	-	1
ITL603	Cloud Service Design Lab	-	2	-	-	1	-	1
ITL604	Sensor Network Lab	-	2	-	-	1	-	1
ITM605	Mini-project	-	4	-	-	2	-	2
	Total	20	12	-	20	6	-	26

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)				
		Test 1	Test 2	Avg.						
ITC601	Software Engineering with Project Management	20	20	20	80	3	-	-	-	100
ITC602	Data Mining and Business Intelligence	20	20	20	80	3	-	-	-	100
ITC603	Cloud Computing & Services	20	20	20	80	3	-	-	-	100
ITC604	Wireless Networks	20	20	20	80	3	-	-	-	100
ITDLO-II	Department Level Optional Course -II	20	20	20	80	3	-	-	-	100
ITL601	Software Design Lab	-	-	-	-	-	25	25	--	50
ITL602	Business Intelligence Lab	-	-	-	-	-	25	25	--	50
ITL603	Cloud Service Design Lab	-	-	-	-	-	25	25	--	50
ITL604	Sensor Network Lab	-	-	-	-	-	25	25	--	50
ITM605	Mini-Project	-	-	-	-	-	25	25	--	50
Total		100	100	100	400	-	125	125	--	750

Department Level Optional Course (DLO)

Every student is required to take one Department Elective Course for Semester VI. Different sets of courses will run in both the semesters. Students can take these courses from the list of department electives, which are closely allied to their disciplines.

(DLO-I subjects will have no Labs only Theory)

Subject Code	Department Level Optional Course (DLO)
Semester VI	
ITDLO6021	Advance Internet Programming
ITDLO6022	Software Architecture
ITDLO6023	Digital Forensics
ITDLO6024	Multimedia Systems
ITDLO6025	Green IT

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC601	Software Engineering with Project Management	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITC601	Software Engineering with Project Management	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To understand the nature of software development and software life cycle process models, agile software development, SCRUM and other agile practices.
2. To Explain methods of capturing, specifying, visualizing and analyzing software requirements.
3. To understand concepts and principles of software design and user-centric approach and principles of effective user interfaces.
4. To know basics of testing and understanding concept of software quality assurance and software configuration management process.
5. To understand need of project management and project management life cycle.
6. To understand project scheduling concept and risk management associated to various type of projects.

Course Outcomes: Students will be able to:

1. Define various software application domains and remember different process model used in software development.
2. Explain needs for software specifications also they can classify different types of software requirements and their gathering techniques.
3. Convert the requirements model into the design model and demonstrate use of software and user-interface design principles.
4. Distinguish among SCM and SQA and can classify different testing strategies and tactics and compare them.
5. Justify role of SDLC in Software Project Development and they can evaluate importance of Software Engineering in PLC.
6. Generate project schedule and can construct, design and develop network diagram for different type of Projects. They can also organize different activities of project as per Risk impact factor.

Prerequisite: Programming and Networking.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Nature of Software, Software Definition, Software Characteristics, Software Application Domains	02	
I	The Software Process	Generic view of Process, Prescriptive Models: Waterfall Model, Incremental-RAD Model, Evolutionary Process Model- Prototyping, Spiral and Concurrent Development Model, Specialized Models: Component based, Aspect Oriented Development, Agile Methodology, Scrum and Extreme Programming	07	CO1
II	Requirements Engineering and Cost Estimation	Requirement, Types of Requirements, Requirement gathering, Requirement Engineering Task, Identifying Stakeholders, Multiple viewpoints, SRS (Software Requirement Specification) Project Estimation, LOC based, FP based and Use case based estimation.	07	CO1 CO2
III	Analysis and Design Engineering	Introduction of Analysis elements, Scenario based, Flow based, behavior and class based Design Concepts and Principles, Architecture Design, Component Level Design, System Level Design, User Interface Design.	09	CO1 CO2 CO3
IV	Quality & Configuration Management	Need for Testing, Testing Tactics, Testing strategies, McCall's Quality Factor, Software Configuration Management, SCM Process	07	CO4
V	IT Project Management	Introduction, 4 P's, W5HH Principle, Need for Project Management, Project Life cycle and ITPM, Project Feasibility, RFP, PMBOK Knowledge areas, Business Case, Project Planning, Project Charter and Project Scope.	10	CO5

VI	Project Scheduling and Risk Management	WBS, Developing the Project Schedule, Network Diagrams (AON, AOA), CPM and PERT, Gantt Chart, Risk Identification, Risk Projection and RMMM	10	CO1 CO2 CO3 CO4 CO6

Text Books:

1. Roger S Pressman “Software Engineering : A Practitioner’s Approach” 7th Edition Mcgraw-Hill ISBN:0073375977
2. Jack T. Marchewka, “Information Technology Project Management” 4th Edition ,Wiley India

References:

1. “Software Engineering : A Precise Approach” Pankaj Jalote , Wiley India
2. Ian Sommerville “ Software Engineering” 9th edition Pearson Education SBN-13: 978-0- 13-703515-1, ISBN-10: 0-13-703515-2
3. John M. Nicholas, Project Management for Business and Technology, 3rd edition, Pearson Education.
4. Software Project management by Bob Hughes, Mike Cotterell , Rajib Mall

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1 will be compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC602	Data Mining and Business Intelligence	04		--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITC602	Data Mining and Business Intelligence	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To introduce the concept of data Mining as an important tool for enterprise data management and as a cutting edge technology for building competitive advantage.
2. To enable students to effectively identify sources of data and process it for data mining
3. To make students well versed in all data mining algorithms, methods of evaluation.
4. To impart knowledge of tools used for data mining
5. To provide knowledge on how to gather and analyze large sets of data to gain useful business understanding.
6. To impart skills that can enable students to approach business problems analytically by identifying opportunities to derive business value from data.

Course Outcomes: Student will be able to:

1. Demonstrate an understanding of the importance of data mining and the principles of business intelligence
2. Organize and Prepare the data needed for data mining using pre preprocessing techniques
3. Perform exploratory analysis of the data to be used for mining.
4. Implement the appropriate data mining methods like classification, clustering or Frequent Pattern mining on large data sets.
5. Define and apply metrics to measure the performance of various data mining algorithms.
6. Apply BI to solve practical problems : Analyze the problem domain, use the data collected in enterprise apply the appropriate data mining technique, interpret and visualize the results and provide decision support.

Prerequisite: Database Management System, Advanced Data Management Technology.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisites	Knowledge of databases, and Data warehousing, OLAP	02	--
I	Introduction to Data Mining	What is Data Mining; Kind of patterns to be mined; Technologies used; Major issues in Data Mining	03	CO1
II	Data Exploration and Data Preprocessing	Types of Attributes; Statistical Description of Data; Data Visualization; Measuring similarity and dissimilarity. Why Preprocessing? Data Cleaning; Data Integration; Data Reduction: Attribute subset selection, Histograms, Clustering and Sampling; Data Transformation & Data Discretization: Normalization, Binning, Histogram Analysis and Concept hierarchy generation.	09	CO2 CO3
III	Classification	Basic Concepts; Classification methods: 1. Decision Tree Induction: Attribute Selection Measures, Tree pruning. 2. Bayesian Classification: Naïve Bayes Classifier. Prediction: Structure of regression models; Simple linear regression, Multiple linear regression. Accuracy and Error measures, Precision, Recall, Holdout, Random Sampling, Cross Validation.	09	CO4 CO5
IV	Clustering	Cluster Analysis: Basic Concepts; Partitioning Methods: K-Means, K-Medoids; Hierarchical Methods: Agglomerative, Divisive, BIRCH; Density-Based Methods: DBSCAN What are outliers? Types, Challenges; Outlier Detection Methods: Supervised, Semi Supervised, Unsupervised, Proximity based, Clustering Based.	10	CO4 CO5
V	Frequent Pattern	Market Basket Analysis, Frequent Itemsets, Closed Itemsets, and	10	CO4

	Mining	Association Rules; Frequent Pattern Mining, Efficient and Scalable Frequent Itemset Mining Methods, The Apriori Algorithm for finding Frequent Itemsets Using Candidate Generation, Generating Association Rules from Frequent Itemsets, Improving the Efficiency of Apriori, A pattern growth approach for mining Frequent Itemsets; Mining Frequent itemsets using vertical data formats; Introduction to Mining Multilevel Association Rules and Multidimensional Association Rules; From Association Mining to Correlation Analysis, lift, ; Introduction to Constraint-Based Association Mining.		CO5
VI	Business Intelligence	What is BI? Business intelligence architectures; Definition of decision support system; Development of a business intelligence system using Data Mining for business Applications like Fraud Detection, Clickstream Mining, Market Segmentation, retail industry, telecommunications industry, banking & finance CRM etc.	09	CO6

Text Books:

1. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann 3rd Edition.
2. P. N. Tan, M. Steinbach, Vipin Kumar, "Introduction to Data Mining", Pearson Education.
3. Business Intelligence: Data Mining and Optimization for Decision Making by Carlo Vercellis ,Wiley India Publications.
4. G. Shmueli, N.R. Patel, P.C. Bruce, "Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner", 2nd Edition, Wiley India.

References:

1. Michael Berry and Gordon Linoff "Data Mining Techniques", 2nd Edition Wiley Publications.
2. Michael Berry and Gordon Linoff "Mastering Data Mining- Art & science of CRM", Wiley Student Edition.
3. Vikram Pudi & Radha Krishna, "Data Mining", Oxford Higher Education.

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC603	Cloud Computing & Services	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITC603	Cloud Computing & Services	20	20	20	80	--	--	100

Course Objectives: Students will try to learn:

1. Basics of cloud computing.
2. Key concepts of virtualization.
3. Different Cloud Computing services
4. Cloud Implementation, Programming and Mobile cloud computing
5. Key components of Amazon Web Services
6. Cloud Backup and solutions

Course Outcomes: Students should be able to:

1. Define Cloud Computing and memorize the different Cloud service and deployment models
2. Describe importance of virtualization along with their technologies.
3. Use and Examine different cloud computing services
4. Analyze the components of open stack & Google Cloud platform and understand Mobile Cloud Computing
5. Describe the key components of Amazon web Service
6. Design & develop backup strategies for cloud data based on features.

Prerequisite Subjects: Computer Network, Operating System

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisites	OSI Layers, Basics of OS.	02	--
I	Introduction	Defining Cloud Computing, Cloud and other similar configurations, Components of Cloud	06	CO1

		Computing, Cloud types: NIST and Cloud Cube Models, Cloud Deployment Models and Service Models, Cloud computing architecture, Advantages and Disadvantages of Cloud Computing.		
II	Virtualization	Virtualization: Characteristics of virtualized environment, Understanding the importance of Hypervisors, Type I & Type II Hypervisors, Taxonomy of virtualization, Implementation Levels of Virtualization, Virtualization of CPU, Memory and I/O Devices , Virtualization and Cloud Computing, Pros and Cons of virtualization, Technology Examples: KVM, Xen, Vmware and HyperV	10	CO2
III	Cloud Computing Services	Exploring Cloud Computing Services: SPI Model: Software as a service, Platform as a service, and Infrastructure as a service. Anything as a service or Everything as a service (XaaS): Security as a Service, Identity management as a Service, Database as a Service, Storage as a Service, Collaboration as a Service, Compliance as a Service, Monitoring as a Service, Communication as a Service, Network as a Service, Disaster recovery as a service, Analytics as a Service, Backup as a Service.	09	CO1 CO2 CO3
IV	Cloud Implementation, Programming and Mobile Cloud Computing	Open Stack Cloud Architecture: Feature of Open stack, Components of Open stack, mode of operations. Programming support for Google apps engine-GFS, Bigtables, Chubby, Google APIs. Mobile Cloud Computing: Definition, architecture, benefits and challenges of mobile	09	CO1 CO2 CO3 CO4

		cloud computing		
V	Exploring the Components of Amazon Web Services	AWS cloud computing Platform, a) Elastic Compute Cloud(EC2): Compute Basics, Instance types, Life cycle of instances. b) Simple Storage Service (S3): Basics and Operations, Features, Amazon Glacier, Glacier vs S3. c) Elastic Block Storage (EBS):Basics and Types of EBS Volumes d)Amazon Virtual Private Cloud (Amazon VPC): Subnets, Route tables, Elastic IP Addresses (EIP), Elastic Network Interfaces (ENIs) & Security groups & ACL. e) Exploring Elastic Load Balancing (ELB): Basics, Types of load balancers, Configuring Elastic Load Balancing, Basics of Cloud Watch & Auto Scaling.	11	CO1 CO2 CO3 CO4 CO5
VI	Cloud Backup & Solutions	Cloud Backup Solutions and their features, Cloud data management interface (CDMI), Cloud Storage gateways (CSG), Comparison between different cloud platforms: Amazon web services & Open stack (Based on Type of deployment, Services supported and their components).	05	CO1 CO2 CO3 CO4 CO5 CO6

Text Books:

1. Barrie Sosinsky ,”Cloud Computing Bible”,Wiley Publication.
2. Kailash Jayaswal, Jagannath Kallalurchi, Donald J. Houde, Dr. Deven Shah, ”Cloud Computing Black Book”, Dreamtech Press.
3. Joe Baron et.al ,”AWS certified solution Architect”, Sybex publication.
4. Mastering Cloud Computing, Rajkumar Buyya, MGH publication

Reference Books:

1. Thomas Erl, Robert Cope, Amin naserpour, "Cloud Computing Design Patterns", Pearson Publication.
2. Judith Hurwitz, "Cloud Computing for Dummies", Wiley Publication.

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC604	Wireless Network	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITC604	Wireless Network	20	20	20	80	--	--	100

Course Objectives: Students will try to:

- 1 Understand the fundamentals of wireless networks.
- 2 Learn and analyze the different wireless technologies.
- 3 Evaluate Ad-hoc networks and wireless sensor networks.
- 4 Understand and evaluate emerging wireless technologies and standards
- 5 Understand design considerations for wireless networks
- 6 Learn and analyze and evaluate the security threats and related security standards

Course Outcomes: Students will be able to:

1. Explain the basic concepts of wireless network and wireless generations.
2. Demonstrate the different wireless technologies such as CDMA, GSM, GPRS etc
3. Appraise the importance of Ad-hoc networks such as MANET and VANET and Wireless Sensor networks
4. Describe and judge the emerging wireless technologies standards such as WLL, WLAN, WPAN, WMAN.
5. Explain the design considerations for deploying the wireless network infrastructure.
6. Differentiate and support the security measures, standards. Services and layer wise security considerations.

Prerequisite: Computer Networks.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Modulation and Demodulation Techniques, PSTN	02	
I	Fundamentals Wireless Communication	Fundamentals of Wireless Communication, Advantages, limitations and application, wireless media, Infrared Modulation Techniques, DSSS and FHSS, Frequency Spectrum: Radio and Infrared; Wireless generations: 1G: Cellular, 2G: Mobile Radio, 3G: UMTS- Security related Encryption Algorithm, 4G	07	CO1
II	Evolution of Wireless Technologies	Multiple Access Technique: TDMA, FDMA, CSMA, CDMA Wireless Technologies: GSM, GPRS, EDGE, CDMA, LTE, UMTS	10	CO1 CO2
III	Types of Wireless Networks	Ad-hoc: MANET & VANET, Application, Advantage and limitations; Wireless Sensor Network: Application, advantages and limitations	09	CO1 CO3
IV	Emerging Wireless Technologies and standards	WLL , WLAN- 802.11 (Wi-Fi), WPAN- 802.15.1/3/4 (Bluetooth, Zigbee), WMAN-802.16a (Wi-max) , Wi-max and LTE /3GPP comparison, Mi-fi, Ly-fi,	10	CO1 CO2 CO4
V	Wireless Network Design Considerations	Wireless technology, Cisco Unified Wireless Network, Designing Wireless Networks with Lightweight Access Points and Wireless LAN Controllers	07	CO1 CO2 CO3 CO4 CO5
VI	Wireless Network Security	The need, attacks, security serviced, WEP, Mobile IP, VPN(PPTP, LLTP, IPSec), Network Layer Security, Transport Layer Security, Email Security: PGP, S/ MIME, Internet Firewalls for Trusted System	07	CO1 CO2 CO3 CO6

Text Books:

1. Cellular Communications: A Comprehensive and Practical Guide, Nishith Tripathi, Jeffery H Reed, Wiley
2. Wireless Mobile Internet Security, 2nd Edition, Man, Young Rhee, Wiley- IEEE press
3. Designing for Cisco Internetwork Solutions (DESIGN), 2nd Edition, CCDA, Diane Teare, Cisco Press.

References:

1. Introduction to Digital mobile communication, 2nd Edition, Yoshihiko Akaiwa
2. "Wireless Communications and networks", William Stallings, Pearson / Prentice Hall
3. Wireless communication and networking, Vijay Garg

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1 will be compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITL601	Software Design Lab	--	02	--	--	1	--	1

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL601	Software Design Lab	--	--	--	--	25	--	25	50

Course Objectives: Students will try to:

- 1 Learn basic concepts of UML.
- 2 Master the vocabulary, rules, and idioms of the UML and learn how to model it effectively.
- 3 Understand how to apply the UML to solve a number of common modeling problems.
- 4 Model the systems, from concept to executable artifact, using object-oriented techniques.
- 5 Apply the knowledge of Software engineering and project management.
- 6 Understand the software development process using tool.

Course Outcomes: Students will be able to:

1. Sketch a Modeling with UML.
2. Deploy Structural Modeling.
3. Deploy Behavioral Modeling.
4. Deploy Architectural Modeling.
5. Examine estimation about schedule and cost for project development.
6. Select project development tool.

Prerequisite: Object oriented Concept, Java programming language.

Requirement:-

Hardware	Software
PC i3 or above.	IBM Rational Rose Modeler, Dia, StarUML (Any One) Orange Scrum, Xampp , GitHub

Guidelines

1. Students should take one case study as a mini project work which is to be conducted by a group of three students
2. Each group will be associated with a subject Incharge/ mini project mentor. The group should meet with the concerned faculty during Laboratory hours and the progress of work discussed must be documented.
3. The students must be able to identify Object oriented Technologies, Basic expression of Classes, Attributes and operations.
4. Students must develop a Conceptual Model of the UML for above case study.
5. Students should define Classes, Relationships, Class Diagrams, Advanced Classes and Relationship, Object Diagrams for above case study.
6. Students should define Use Cases, Use case Diagrams, Activity Diagrams, Interaction Diagrams, State Chart Diagrams for above case study.
7. Students should define Components, Deployment, Collaborations, Component Diagrams, Deployment Diagrams for above case study
8. Students should define SRS, WBS, Network Diagram, Gantt Chart, Cost Estimation Techniques
9. Demonstration it using Scrum Tool
10. Each group may present their work in various project competitions and paper presentations.
11. A detailed report is to be prepared as per guidelines given by the concerned faculty.

Text Books:

1. “The Unified Modeling Language User Guide” by Grady Booch, James Rumbaugh, Ivar Jacobson, Pearson Publication, ISBN 978-81-7758-372-4
2. Jack T. Marchewka, Information Technology Project Management, 4th edition, Wiley India, 2009.

References:

1. UML – Tutorial “www.tutorialspoints.com/uml/”
2. “An Introduction to Object-Oriented Analysis: Objects and UML in plain English” by Davis William Brown, Wiley, Second Edition
3. “Fundamentals of Object-Oriented Design in UML”, Meilir Page-Jones, Pearson Education
4. UML in 24 Hours
5. UML Basics— an Introduction to the Unified Modeling Language – IBM
“www.ibm.com › Learn › Rational”

Term Work:

Term Work shall consist of full Mini Project on above guidelines/syllabus. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Case Study) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Case Study and Presentation.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITL602	Business Intelligence lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL602	Business Intelligence Lab	--	--	--	--	25	--	25	50

Lab Objectives: Students will try:

1. To introduce the concept of data Mining as an important tool for enterprise data management and as a cutting edge technology for building competitive advantage.
2. To enable students to effectively identify sources of data and process it for data mining
3. To make students well versed in all data mining algorithms, methods, and tools.
4. To learn how to gather and analyze large sets of data to gain useful business understanding.
5. To impart skills that can enable students to approach business problems analytically by identifying opportunities to derive business value from data.
6. To identify and compare the performance of business.

Lab Outcomes: Students should be able to:

1. Identify sources of Data for mining and perform data exploration
2. Organize and prepare the data needed for data mining algorithms in terms of attributes and class inputs, training, validating, and testing files.
3. Implement the appropriate data mining methods like classification, clustering or association mining on large data sets using open source tools like WEKA
4. Implement various data mining algorithms from scratch using languages like Python/ Java etc.
5. Evaluate and compare performance of some available BI packages
6. Apply BI to solve practical problems : Analyze the problem domain, use the data collected in enterprise apply the appropriate data mining technique, interpret and visualize the results and provide decision support.

Prerequisite: Object oriented Concept, Java programming language.

Requirement:-

Hardware	Software
PC i3 or above.	Open source data mining and BI tools like WEKA, Rapid Miner, Pentaho.

Detailed syllabus:

Module	Detailed Content	Hours	LO Mapping
1 & II	2 tutorials a) Solving exercises in Data Exploration b) Solving exercises in Data preprocessing	04	LO 1 LO 2
III	Using open source tools Implement a) Classifiers b) Clustering Algorithms c) Association Mining Algorithms	06	LO 3
IV	a) Implementation of any one classifier using languages like JAVA/ python/R b) Implementation of any one clustering algorithm using languages like JAVA/ python c) Implementation of any one association mining algorithm using languages like JAVA/ python	06	LO 4
V	Detailed case study of any one BI tool (open source tools like Pentaho can be used) (paper Assignment)	04	LO 5
VI	Business Intelligence Mini Project: Each group assigned one new case study for this; A BI report must be prepared outlining the following steps: a) Problem definition, Identifying which data mining task is needed b) Identify and use a standard data mining dataset available for the problem. Some links for data mining datasets are: WEKA site, UCI Machine Learning Repository, KDD site, KDD Cup etc. c) Implement the data mining algorithm of choice	06	LO 6

	d) Interpret and visualize the results e) Provide clearly the BI decision that is to be taken as a result of mining.		

Text Books:

1. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann 3rd Edition.
2. G. Shmueli, N.R. Patel, P.C. Bruce, "Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner", 1st Edition, Wiley India.

References:

1. P. N. Tan, M. Steinbach, Vipin Kumar, "Introduction to Data Mining", Pearson Education.
2. WEKA, RapidMiner Pentaho resources from the Web.

Term Work:

Term Work shall consist of at least 10 to 12 practical's based on the below list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITL603	Cloud Service Design Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL603	Cloud Service Design Lab	--	--	--	--	25	--	25	50

Lab Objectives: Students to get familiar with:

1. Key concepts of virtualization & different types of Hypervisors used in virtualization along with implementation
2. Concept of On demand Application Delivery like SaaS using Ulteo
3. Open source cloud implementation and administration using Open Stack
4. Various Cloud services provided by Amazon Web Services
5. Programming on Platform as a Service cloud
6. Implementation of Storage as a service using Own Cloud.

Lab Outcomes: Students should be able to:

1. Define & implement Virtualization using different types of Hypervisors
2. Describe steps to perform on demand Application delivery using Ulteo .
3. Examine the installation and configuration of Open stack cloud
4. Analyze and understand the functioning of different components involved in Amazon web services cloud platform.
5. Describe the functioning of Platform as a Service
6. Design & Synthesize Storage as a service using own Cloud

Prerequisite Subjects: Computer Network, Operating System, Java Programming

Hardware & Software Requirements:

Hardware Requirements	Software Requirements	Other Requirements
a)Hardware Configuration for server 1.Intel or AMD Multi Core processors (like i3/i5/i7/Quad core/Octa core) with Intel VT-X or AMD-V support	a) Software Requirements for Server 1.Server OS for Physical Sever like CentOS /Fedora/Ubuntu/ Redhat Server 2.Pre-configured OpenSSH	1. Internet Connection for each PC with at least 2 MBPS bandwidth and LAN bandwidth of 1 GBPS.

2. 6 GB RAM 3. 500 GB Harddisk 4. Gigabit Ethernet (GbE) network interface card (NIC) b)Hardware Configuration for Cloud Client PC/Laptop/Smart phone/Thin Client or Any device which has built-in Wifi, Ethernet or data connection facility.	3.Xen Server DVD 4.Ulteo DVD a) Software Requirements for Clients 1. JDK 1.8 or higher & .NET Framework 4 2. Netbeans or Eclipse IDEs 3. OpenSSH client or putty 4.Vmware Workstation, 5.Oracle Virtualbox 6. Built-in web browser.	

Suggested List of Experiments

Sr. No.	Module	Detailed Content	Hours	LO Mapping
I	Virtualization	1. Creating and running virtual machines on Hosted Hypervisors like KVM Type 1 ,Vmware Workstation,Oracle Virtualbox 2. Creating and running virtual machines on Bare-Metal Hypervisors Type 0 like Xen,Vmware ESXI or HyperV	06	LO1
II	On demand Application Delivery and Virtual Desktop infrastructure	Installation and Configuration of Ulteo to demonstrate on demand Application delivery over web browser to explore SaaS Environment.	04	LO2
III	Open source cloud implementation and administration	To demonstrate installation and Configuration of Open stack Private cloud.	04	LO3
IV	Amazon Web Services	Like auto scaling, elastic load balancing, virtual private computing & Networking. Security service provided by Amazon web services. Accessing AWS using	06	LO4

		web services API provided by Amazon.		
V	Platform as a Service	To Demonstrate Platform as a Service using Googleapp Engine/IBM BlueMix/tSuru	04	LO5
VI	Storage as a Service	Explore Storage as a service using own Cloud for remote file access using web interfaces. S3 storage and glacier storage and understand the storage LC management provided by AWS.	02	LO6

Text Books:

1. Barrie Sosinsky ,”Cloud Computing Bible”,Wiley Publication.
2. Kailash Jayaswal, Jagannath Kallalurchi, Donald J. Houde, Dr.Deven Shah, ”Cloud Computing Black Book”, Dreamtech Press.
3. Joe Baron et.al ,”AWS certified solution Architect”, Sybex publication.
4. Mastering Cloud Computing, Rajkumar Buyya, MGH publication

Reference Books:

1. Learn to Master Cloud Computing by Star EduSolutions
2. Kai Hwang,”Distributed and Cloud Computing”,MK Publication
3. Thomas Erl,Robert Cope,Amin naserpour,”Cloud Computing Design Patterns”,Pearson Publication.
4. Judith Hurwitz ,”Cloud Computing for Dummies” , Wiley Publication.

Web Resources:

1. <http://fosshelp.blogspot.in>
2. <https://aws.amazon.com/>
3. <https://docs.openstack.org/>
4. <https://owncloud.org/>
5. <https://appengine.google.com>

Term Work:

Term Work shall consist of at least 10 to 12 practical’s based on the below list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITL604	Sensor Network Lab	--	02	--	--	1	--	1

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. of twoTests					
ITL604	Sensor Network Lab	--	--	--	--	25	--	25	50

Lab Objectives: Students will try:

1. To learn different types of sensors from Motes families.
2. To design the problem solution as per the requirement analysis done using Motes sensors.
3. To study the basic concepts of programming/sensors/ emulator like cooja etc.
4. To design and implement the mini project intended solution for project based learning.
5. To build and test the mini project successfully.
6. To improve the team building, communication and management skills of the students.

Lab Outcomes: Student will be able to:

1. Identify the requirements for the real world problems.
2. Conduct a survey of several available literatures in the preferred field of study.
3. Study and enhance software/ hardware skills.
4. Demonstrate and build the project successfully by hardware/sensor requirements, coding, emulating and testing.
5. To report and present the findings of the study conducted in the preferred domain
6. Demonstrate an ability to work in teams and manage the conduct of the research study.

Guidelines

1. The mini project work is to be conducted by a group of three students
2. Each group will be associated with a subject Incharge/ mini project mentor. The group should meet with the concerned faculty during Laboratory hours and the progress of work discussed must be documented.
3. The students may do survey for different application using different types of sensors for their mini project.

4. Each group will identify the Hardware (Motes from different Motes families) & sensor configuration and software requirement for their mini project problem statement.
5. Design your own circuit board using multiple sensors etc.
6. Installation, configure and manage your sensors in such away so that they can communicate with each other.
7. Work with operating system, emulator like contiki cooja and do coding to for input devices on sensors.
8. Create and interface using Mobile/Web to publish or remotely access the data on Internet.
9. Each group along with the concerned faculty shall identify a potential problem statement, on which the study and implementation is to be conducted.
10. Each group may present their work in various project competitions and paper presentations.
11. A detailed report is to be prepared as per guidelines given by the concerned faculty.

Text Books:

1. Fundamentals of Sensor Network Programming: Applications and Technology, By S. Sitharama Iyengar, Nandan Parameshwaran, Vir V. Phoha, N. Balakrishnan, Chuka D. Okoye, Wiley publication.
2. Contiki Cooja User Guide.

References:

1. Internet of Things (A Hands-on-Approach) , Vijay Madisetti , Arshdeep Bahga
2. A comparative review of wireless sensor network mote technologies, IEEE paper 2009

Term Work:

Term Work shall consist of full Mini Project on above guidelines/syllabus. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Mini Project) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Mini Project and Presentation.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical / Oral	Tutorial	Total
ITM605	Mini-Project	--	04	--	--	2	--	2

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITM605	Mini-Project	--	--	--	--	25	--	25	50

Lab Objectives: Students will try:

1. To offer students a glimpse into real world problems and challenges that need IT based solutions
2. To enable students to create very precise specifications of the IT solution to be designed.
3. To introduce students to the vast array of literature available of the various research challenges in the field of IT
4. To create awareness among the students of the characteristics of several domain areas where IT can be effectively used.
5. To enable students to use all concepts of IT in creating a solution for a problem
6. To improve the team building, communication and management skills of the students.

Lab Outcomes: Student will be able to:

1. Discover potential research areas in the field of IT
2. Conduct a survey of several available literature in the preferred field of study
3. Compare and contrast the several existing solutions for research challenge
4. Demonstrate an ability to work in teams and manage the conduct of the research study.
5. Formulate and propose a plan for creating a solution for the research plan identified
6. To report and present the findings of the study conducted in the preferred domain

Guidelines

1. The project work is to be conducted by a group of three students
2. Each group will be associated with a project mentor/guide. The group should meet with the project mentor/guide periodically and record of the meetings and work discussed must be documented.

3. Department has to allocate half day for the project work in VI semester, 1 day in VII semester and 2 day in VIII semester every week.
4. To encourage project based learning in the curriculum students may identify their technical domain area in semester VI and can perform the Mini-project in the VI semester or students may do literature survey
5. Each group along with its guide/mentor shall identify a potential research area/problem domain, on which the study is to be conducted.
6. Each team will do a rigorous literature survey of the problem domain by reading and understanding at least 3-5 research papers from current good quality national/international journals/conferences. (Papers selected must be indexed by Scopus/IEEE/Springer/ACM etc.). The list of papers surveyed must be clearly documented.
7. The project assessment for term work will be done at least two times at department level by giving presentation to panel members which consist of at least three (3) members as Internal examiners (including the project guide/mentor) appointed by the Head of the department of respective Programme.
8. A report is to be prepared summarizing the findings of the literature survey. A comparative evaluation of the different techniques surveyed is also to be done.
9. Teams must analyze all the results obtained by comparing with other standard techniques.
10. Every team must publish their work in national / international conference/journals (if possible publish in Scopus indexed journals).
11. The team will finally propose a plan for project work to be continued in the final year.
12. Semester VII to carry out the project good quality project and all these project part

Evaluation

1. Each team has to give presentation/demo to the Internal Panel and External examiner.
2. Each team will prepare a report that will summarize the results of the literature survey and the project proposal. The list of papers surveyed must be clearly documented.
3. Each group will be jointly evaluated by a team of Internal and External Examiners approved by the University of Mumbai.
4. Oral exam will be conduct on the project done by the students.

Term Work:

Term Work shall consist of full Mini Project on above guidelines/syllabus.

Term Work Marks: 25 Marks (Total marks) = 20 Marks (Mini Project) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Mini Project and Presentation.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO6021	Advance Internet Programming	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO6021	Advance Internet Programming	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To get familiar with the concept of Search Engine Basics.
2. To Understand Search Engine Optimization Techniques.
3. To Learn Web Service Essentials.
4. To gain knowledge of Rich Internet Application Technologies.
5. To be familiarized with Web Analytics 2.0
6. To explore Web 3.0 and Semantic web standards.

Course Outcomes: Students will be able to:

1. Determine SEO Objectives and Develop SEO plan prior to Site Development.
2. Explain Search Engine Optimization Techniques and Develop Keyword Generation.
3. Describe different Web Services Standards.
4. Develop Rich Internet Application using proper choice of Framework.
5. Apply multiple quantitative and qualitative methods for web analytics 2.0.
6. Explain Web 3.0 and Semantic web standards

Prerequisite: Basics of Internet Programming – HTML5, CSS3, XML.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Introduction to HTML 5 & CSS3 basics, XML basics	02	
I	Search Engine Basics	Search Engine Basics Algorithm based Ranking Systems – Determining Searcher Intent and Delivering Relevant, Fresh Content, Analyzing Ranking Factors, Using Advanced Search Techniques, Vertical Search Techniques, Country Specific search engines. Determining SEO Objective and Finding Your Site's Audience – Setting SEO Goals and Objective Developing SEO plans Prior to Site Development, SEO for Raw traffic ; E-commerce Sales; Mindshare/Branding; Direct Marketing; Reputation Management; Ideological Influence	09	CO1
II	Search Engine Optimization	Getting started SEO: Defining Your Site's Information Architecture, Auditing an Existing Site to identify SEO Problems, Identifying Current Server Statistic Software and Gaining Access – Determining Top competitors, Benchmarking Current Indexing Status, Current Rankings, Benchmarking Current Traffic Source and Volumes, Conduct SEO/Website SWOT analysis. Keyword Generation – Creating Pages – Website Structure- Creating Content-Creating Communities-building Links-Using Google Analytics-Social Media Optimization-Creating Pay-per-click Campaigns- Optimizing PPC Campaigns through Quality Score optimization - Tracking Results and Measuring Success.	09	CO1 CO2
III	Web Services	Web Services: Introduction to Web Services, XML, XSL, XSLT, WSDL, SOAP, UDDI, Transaction, Business Process Execution Language for web Services, WS-Security and web service security specification, WS-Reliable Messaging, WS-Policy, WS-Attachments. REST-ful web services, Resource Oriented Architecture, Comparison of REST, SOA, SOAP.	08	CO1 CO2 CO3
IV	Rich Internet Application	Introduction to AJAX, Blogs, Wikis, RSS feeds Working with Java Script Object Notation (JSON), Implement JSON on server side,	08	CO4

		Implementing Security and Accessibility in AJAX Applications: Secure AJAX application, Accessible Rich Internet Applications Developing RIA using AJAX Techniques: CSS, HTML, DOM, XMLHttpRequest, JavaScript, PHP, AJAX as REST Client Introduction to Open Source Frameworks and CMS for RIA: Django, Drupal, Joomla introduction and comparison.		
V	Web Analytics 2.0	Introduction to Web Analytics 2.0 1: State of the Analytics Union, State of the Industry, Rethinking Web Analytics: Meet Web Analytics 2.0, Optimal Strategy for Choosing Your Web Analytics Soul Mate. The Awesome World of Clickstream Analysis: Metrics. The Key to Glory: Measuring Success. Failing Faster: Unleashing the Power of Testing and Experimentation.	08	CO4 CO5
VI	Web 3.0 and Semantic Web	Web 3.0 and Semantic Web: Challenges, Components, Semantic Web Stack: RDF, RDF Schema (RDFS), Simple Knowledge Organization System (SKOS), SPARQL as RDF query language, N-Triples as a format for storing and transmitting data, Turtle (Terse RDF Triple Language), Web Ontology Language (OWL) a family of knowledge representation languages, Rule Interchange Format (RIF), a framework of web rule language dialects supporting rule interchange on the Web	08	CO4 CO5 CO6

Text Books:

1. The Art of SEO O'Reilly Publication
2. Web Services Essentials by Ethan Cerami O'Reilly Media
3. Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity, by Avinash Kaushik, ISBN: 978-0-470-52939-3, wiley publication.
4. "Semantic Web Technologies: Trends and Research in Ontology-based Systems", by John Davies, Rudi Studer, and Paul Warren John, Wiley & Son'
5. Advance Internet Technology by Dr. Deven Shah Dreamtech.

References:

1. RESTful Web Services, By Leonard Richardson, Sam Ruby, O'Reilly Media
2. Rich Internet Application AJAX and Beyond WROX press
3. Handbook of Semantic Web Technologies, by John Domingue, Dieter Fensel, Springer Reference
4. Tim O'Reilly, What is Web 2.0? : Design Patterns and Business Models for the Next Generation of Software, O'REILLY

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ITDLO6022	Software Architecture	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO6022	Software Architecture	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To understand importance of architecture in building effective, efficient, competitive software product.
2. To understand principal design decisions governing the system.
3. To understand role of architecture in software engineering
4. To understand designing application from architectural perspective
5. To understand different notations used for capturing design decisions.
6. To understand different functional and non-functional properties of complex software systems.

Course Outcomes Students will be able to:

1. Students will cite knowledge of various approaches to document a software system (Remembering)
2. Students will be able to describe functional and non-functional requirements (Understanding)
3. Students will be able to use proper architecture for software (Applying)
4. Students will be able to categorize different components used in the software system (Analyzing)
5. Students will be able to choose from different architectural styles (Evaluating)
6. Students will be able to improve quality of software by selecting proper architecture (Creating)

Prerequisite: Programming Language, UML

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Power of analogy: Architecture of the building, limitations of analogy, The reorientation of software engineering,	02	CO1
I	Introduction to Software Architecture and Software Product Life Cycle	Evolution of Software Development, Fundamentals of Software Engineering, Elements of Software Architecture. Management View, Software Engineering View, Engineering Design View, Architectural View,	07	CO1 CO2
II	Architectural Design Process and Introduction to Software Design	Understanding the problem, Identifying design elements and their relationship, Evaluating the Architecture, Transforming the Architecture, Problems in Software Architectural Design, Function form and Fabrication, The scope of Design, Psychology and Philosophy of Design, General Methodology of Design	09	CO1 CO2 CO3
III	Complexity, Modularity, Models and Knowledge Representation	Complexity, Modularity, What are Models, What are Models used for, What roles do Models Play, Modeling the Problem and Solution Domain, Views,	09	CO1 CO4
IV	Architecture Representation and Architectural Design Principles	Goals of Architecture Representation, Foundation of Architectural Representation, Architectural Description Language, Architectural Level of Design, Architecting with Design Operators, Functional Design Strategies.	09	CO4
V	Architectural Styles, Patterns and Meta models	Defining Architectural Patterns and Style, Common Architectural Styles, Understanding Metamodels, Applying Reference Models, Fundamental Metamodel for describing Software Component	08	CO4 CO5
VI	Architectural Description and Architectural	Standardizing Architectural Description, Creating an Architectural Description, Applying	08	CO1

	Framework, Architecture Quality	Architectural Description, Software Architecture Framework, 4+1 View Model of Architecture, Reference Model for Open Distributed Processing, Importance of Assessing Software Quality, How to improve Quality. DevOps practice and Architecture.		CO6

Text Books:

1. The Art of Software Architecture: Design Methods and Techniques, Stephen T.Albin, Wiley India Private Limited.
2. Software Architecture, Foundations, Theory, and Practise, Richard Taylor, Nenad Medvidovic, Eric M Dashofy, Wiley Student Edition.

References:

1. Software Architecture in Practice by Len Bass, Paul Clements, Rick Kazman, Pearson.
2. DevOps A Software Architect's Perspective, Len Bass, Ingo Weber, Liming Zhu, Addison Wesley

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
ITDLO6023	Digital Forensics	04	--	-	04	--	-	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO6023	Digital Forensics	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To understand underlying principles and many of the techniques associated with the digital forensic practices and cyber crime
2. To explore practical knowledge about ethical hacking Methodology.
3. To learn the importance of evidence handling and storage for various devices
4. To develop an excellent understanding of current cyber security issues (Computer Security Incident) and analyzed the ways that exploits in securities.
5. To investigate attacks, IDS .technical exploits and router attacks and “Trap and Trace” computer networks.
6. To apply digital forensic knowledge to use computer forensic tools and investigation report writing.

Course Outcomes: Student will able to:

1. Define the concept of ethical hacking and its associated applications in Information Communication Technology (ICT) world.
2. Underline the need of digital forensic and role of digital evidences .
3. Explain the methodology of incident response and various security issues in ICT world, and identify digital forensic tools for data collection .
4. Recognize the importance of digital forensic duplication and various tools for analysis to achieve adequate perspectives of digital forensic investigation in various applications /devices like Windows/Unix system.
5. Apply the knowledge of IDS to secure network and performing router and network analysis
6. List the method to generate legal evidence and supporting investigation reports and will also be able to use various digital forensic tools .

Prerequisite: Cryptography and Security, Computer Networks

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Cryptography and Security ,Computer Networks	2	
I	Introduction to Cyber Crime and Ethical Hacking	Introduction of Cybercrime: Types of cybercrime ,categories of cybercrime , Computers' roles in crimes, Prevention from Cyber crime, Hackers, Crackers, Phreakers Ethical Hacking : Difference between Hacking and Ethical hacking : Steps of Ethical Hacking, Exploring some tools for ethical hacking: reconnaissance tools, scanning tools	6	CO1
II	Introduction to Digital Forensics and Digital Evidences	Digital Forensic ,Rules for Digital Forensic The Need for Digital Forensics, Types of Digital Forensics, Ethics in Digital Forensics, Digital Evidences : Types and characteristics and challenges for Evidence Handling	6	CO2
III	Computer Security Incident Response Methodology	Introduction to Computer Security Incident Goals of Incident response, Incident Response Methodology, Formulating Response Strategy, IR Process – Initial Response, Investigation, Remediation, Tracking of Significant ,Investigative Information, Reporting Pre Incident Preparation, Incident Detection and Characterization. Live Data Collection : Live Data Collection on Microsoft Windows Systems: Live Data	11	CO3

		Collection on Unix-Based Systems		
IV	Forensic Duplication and Disk Analysis, and Investigation	Forensic Duplication Forensic Image Formats, Traditional Duplication, Live System Duplication, Forensic Duplication tools Disk and File System Analysis: Media Analysis Concepts, File System Abstraction Model The Sleuth Kit : Installing the Sleuth Kit , Sleuth Kit Tools Partitioning and Disk Layouts : Partition Identification and Recovery, Redundant Array of Inexpensive Disks Special Containers : Virtual Machine Disk Images , Forensic Containers Hashing, Carving : Foremost , Forensic Imaging : Deleted Data , File Slack , dd , dcfldd , dc3dd Data Analysis Analysis Methodology Investigating Windows systems , Investigating UNIX systems , Investigating Applications, Web Browsers, Email, Malware Handling: Static and Dynamic Analysis	11	CO4
V	Network Forensics	Technical Exploits and Password Cracking , Introduction to Intrusion Detection systems, Types of IDS Understanding Network intrusion and attacks , Analyzing Network Traffic, Collecting Network based evidence, Evidence Handling. Investigating Routers, Handling Router Table Manipulation Incidents, Using Routers as Response Tools	9	CO5
VI	Forensic Investigation	Report :Goals of Report, Layout of an		

	Report and Forensic Tools	Investigative Report, Guidelines for Writing a Report, sample for writing a forensic report . Computer Forensic Tools : need and types of computer forensic tools, task performed by computer forensic tools . Study of open source Tools like SFIT, Autopsy etc. to acquire, search, analyze and store digital evidence	7	CO6

Text Books:

1. Jason Luttgens, Matthew Pepe, Kevin Mandia, “Incident Response and computer forensics”, 3rd Edition Tata McGraw Hill, 2014.
2. Nilakshi Jain, Dhananjay Kalbande, ”Digital Forensic : The fascinating world of Digital Evidences ” Wiley India Pvt Ltd 2017.
3. Cory Altheide, Harlan Carvey ”Digital forensics with open source tools “Syngress Publishing, Inc. 2011.
4. Chris McNab, Network Security Assessment, By O’Reily.

References:

1. Clint P Garrison “Digital Forensics for Network, Internet, and Cloud Computing A forensic evidence guide for moving targets and data , Syngress Publishing, Inc. 2010
2. Bill Nelson, Amelia Phillips, Christopher Steuart, “Guide to Computer Forensics and Investigations” . Cengage Learning, 2014
3. Debra Littlejohn Shinder Michael Cross “Scene of the Cybercrime: Computer Forensics Handbook”, 2nd Edition Syngress Publishing, Inc. 2008.
4. Marjie T. Britz, Computer Forensics and Cyber Crime, Pearson, Third Edition.

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination:

Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
ITDLO6024	Multimedia Systems	04	--	---	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO6024	Multimedia Systems	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To learn and understand technical aspect of Multimedia Systems.
2. To understand the standards available for different audio, video and text applications.
3. To Design and develop various Multimedia Systems applicable in real time.
4. To learn various multimedia authoring systems.
5. To understand various networking aspects used for multimedia applications.
6. To develop multimedia application and analyze the performance of the same.

Course Outcomes: Students will be able to:

1. Developed understanding of technical aspect of Multimedia Systems.
2. Understand various file formats for audio, video and text media.
3. Develop various Multimedia Systems applicable in real time.
4. Design interactive multimedia software.
5. Apply various networking protocols for multimedia applications.
6. To evaluate multimedia application for its optimum performance.

Prerequisite: Knowledge of computer graphics, computer networking and database systems.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic of database, computer networks and computer graphics.	2	--
I	Multimedia Systems Design: An Introduction	Multimedia Elements. Multimedia Systems Architecture, Evolving Technologies for Multimedia Systems, Defining Objects For	9	CO1

		Multimedia Systems. Multimedia Data Interface Standards. The Need for Data Compression. Multimedia applications including digital libraries, system software , streaming videos and its applications.		
II	Compression and Decompression Data and File Format Standards	Types of Compression. Image Compression Schemes. Video Compression. Audio Compression. Rich-Text Format. TIFF File Format. Resource Interchange File Format (RIFF), MIDI File Format. JPEG DIB File Format for Still and Motion Images. JPEG Still Image. AVI video File Format. MPEG Standards.	10	CO1 CO2
III	Multimedia Application Design	Multimedia Application Classes. Types of Multimedia Systems. Virtual Reality Design. Components of Multimedia Systems. Multimedia database issues and solutions. Organizing Multimedia Databases.	8	CO1 CO2 CO3
IV	Multimedia Authoring, User Interface and	Multimedia Authoring Systems. Hypermedia Application Design Considerations. User Interface Design. Information Access. Object Display/Playback Issues	7	CO4
V	Distributed Multimedia Systems	Components of a Distributed Multimedia System. Distributed Client-Server Operation. Middleware in Distributed Workgroup Computing. Multiserver Network Topologies. Distributed Multimedia Databases. Managing Distributed Objects. Application Workflow Design Issues. Distributed Application Design Issues	8	CO4 CO5
VI	System Design: Methodology and Considerations.	Fundamental Design Issues. Determining Enterprise Requirements. Examining Current Architecture and Feasibility. Performance Analysis. Designing for Performance Multimedia System Design. System Extensibility. Multimedia Systems Design Example.	8	CO5 CO6

Text Books:

1. **Prabhat K. Andleigh, Kiran Thakrar** “Multimedia Systems Design” 1/e, Pearson , ISBN 978-93-325-4938-8
2. Fundamentals of Multimedia by Ze-Nian Li& Mark.S.Drew
3. Introduction to Multimedia Communication, Application, Middleware, Networking by K.R.Roa, Zoran S,Bojkovic & Dragorad A. Milovanovic.

References:

1. Organization of Multimedia Resources: Principles and Practice of Information Retrieval by Mary A. Burke
2. Multimedia Systems Design by Prabhat K. Andleigh/ Kiran Thakrar

Assessment:

Internal Assessment for 20 marks:

Consisting of Two Compulsory Class Tests

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO6025	Green IT	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO6025	Green IT	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To understand what Green IT is and How it can help improve environmental Sustainability
2. To understand the principles and practices of Green IT.
3. To understand how Green IT is adopted or deployed in enterprises.
4. To understand how data centres, cloud computing, storage systems, software and networks can be made greener.
5. To measure the Maturity of Sustainable ICT world.
6. To implement the concept of Green IT in Information Assurance in Communication and Social Media and all other commercial field.

Course Outcomes: Students will be able to:

1. Describe awareness among stakeholders and promote green agenda and green initiatives in their working environments leading to green movement
2. Identify IT Infrastructure Management and Green Data Centre Metrics for software development
3. Recognize Objectives of Green Network Protocols for Data communication.
4. Use Green IT Strategies and metrics for ICT development.
5. Illustrate various green IT services and its roles.
6. Use new career opportunities available in IT profession, audits and others with special skills such as energy efficiency, ethical IT assets disposal, carbon footprint estimation, reporting and development of green products, applications and services.

Prerequisite: Environmental Studies

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Environmental Studies	2	
I	Introduction	Environmental Impacts of IT, Holistic Approach to Greening IT, Green IT Standards and Eco-Labeling, Enterprise Green IT Strategy , Green IT: Burden or Opportunity? Hardware: Life Cycle of a Device or Hardware, Reuse, Recycle and Dispose. Software: Introduction, Energy-Saving Software Techniques, Evaluating and Measuring Software Impact to Platform Power.	9	CO1
II	Software development and data centers	Sustainable Software, Software Sustainability Attributes, Software Sustainability Metrics, Sustainable Software Methodology, Data Centres and Associated Energy Challenges, Data Centre IT Infrastructure, Data Centre Facility Infrastructure: Implications for Energy Efficiency, IT Infrastructure Management, Green Data Centre Metrics	9	CO1 CO2
III	Data storage and communication	Storage Media Power Characteristics, Energy Management Techniques for Hard Disks, System-Level Energy Management, Objectives of Green Network Protocols, Green Network Protocols and Standards.	9	CO1 CO3
IV	Information systems, green it strategy and metrics	Approaching Green IT Strategies, Business Drivers of Green IT Strategy, Business Dimensions for Green IT Transformation, Multilevel Sustainable Information, Sustainability Hierarchy Models, Product Level Information, Individual Level Information, Functional Level Information, Organizational Level Information, Regional/City Level Information, Measuring the Maturity of Sustainable ICT.	8	CO1 CO4

V	Green it services and roles	Factors Driving the Development of Sustainable IT, Sustainable IT Services (SITS), SITS Strategic Framework, Sustainable IT Roadmap, Organizational and Enterprise Greening, Information Systems in Greening Enterprises, Greening the Enterprise: IT Usage and Hardware, Inter-organizational Enterprise Activities and Green Issues, Enablers and Making the Case for IT and the Green Enterprise.	9	CO1 CO4 CO5
VI	Managing and regulating green it	Strategizing Green Initiatives, Implementation of Green IT, Information Assurance, Communication and Social Media, The Regulatory Environment and IT Manufacturers, Nonregulatory Government Initiatives, Industry Associations and Standards Bodies, Green Building Standards, Green Data Centres, Social Movements and Greenpeace.	6	CO1 CO5 CO6

Text Books:

1. San Murugesan, G. R. Gangadharan, Harnessing Green IT, WILEY 1st Edition-2013
2. Mohammad Dastbaz Colin Pattinson Babak Akhgar, Green Information Technology A Sustainable Approach , Elsevier 2015
3. Reinhold, Carol Baroudi, and Jeffrey Hill Green IT for Dummies, Wiley 2009

References:

1. Mark O'Neil , Green IT for Sustainable Business Practice: An ISEB Foundation Guide, BCS
2. Jae H. Kim, Myung J. Lee Green IT: Technologies and Applications, Springer, ISBN: 978-3-642-22178-1
3. Elizabeth Rogers, Thomas M. Kostigen The Green Book: The Everyday Guide to Saving the Planet One Simple Step at a Time, Springer

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
ITC701	Enterprise Network Design	4	-	-	4	-	-	4
ITC702	Infrastructure Security	4	-	-	4	-	-	4
ITC703	Artificial Intelligence	4	-	-	4	-	-	4
ITDLO-II	Department Level Optional Course -III	4	-	-	4	-	-	4
ILO-I	Institute Level Optional Course-I	3	-	-	3	-	-	3
ITL701	Network Design Lab	-	2	-	-	1		1
ITL702	Advanced Security Lab	-	2	-	-	1		1
ITL703	Intelligence System Lab	-	2	-		1		1
ITL704	Android Apps Development Lab	-	2			1		1
ITM705	Project-I	-	6/8			3	-	3
	Total	19	14	-	19	7	-	26

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)				
		Test 1	Test 2	Avg.						
ITC701	Enterprise Network Design	20	20	20	80	3	-		-	100
ITC702	Infrastructure Security	20	20	20	80	3	-		-	100
ITC703	Artificial Intelligence	20	20	20	80	3	-		-	100
ITDLO-II	Department Level Optional Course -III	20	20	20	80	3	-		-	100
ILO-I	Institute Level Optional Course-I	20	20	20	80	3	--		-	100
ITL701	Network Design Lab	-	-	-	-	-	25	25	--	50
ITL702	Advanced Security Lab	-	-	-	-	-	25	25	--	50
ITL703	Intelligence System Lab	--	-	-	-	--	25	25	--	50
ITL704	Android Apps Development Lab						25	25	--	25
ITM705	Project-I	-	-	-	-	-	50	25	--	75
Total		100	100	100	400		150	125	--	750

Department Level Optional Course (DLO)

Every student is required to take one Department Elective Course for Semester VII. Different sets of courses will run in both the semesters. Students can take these courses from the list of department electives, which are closely allied to their disciplines.

(DLO-I subjects will have no Labs only Theory)

Institute Level Optional Course (ILO)

Every student is required to take one Institute Elective Course for Semester VII, which is not closely allied to their disciplines. Different sets of courses will run in the both the semesters.

Subject Code	Department Level Optional Course (DLO)	Subject Code	Institute Level Optional Course (ILO)
Semester VII			
ITDLO7031	Storage Area Networks	ILO7011	Product Lifecycle Management
ITDLO7032	Mobile Application Development	ILO7012	Reliability Engineering
ITDLO7033	High Performance Computing	ILO7013	Management Information System
ITDLO7034	Software Testing and Quality Assurance	ILO7014	Design of Experiments
ITDLO7035	Soft Computing	ILO7015	Operation Research
		ILO7016	Cyber Security and Laws
		ILO7017	Disaster Management and Mitigation Measures
		ILO7018	Energy Audit and Management
		ILO7019	Development Engineering

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC701	Enterprise Network Design	04	--		04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITC701	Enterprise Network Design	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To be familiarized with the methodologies and approaches of the network design for an enterprise network.
2. To understand the network hierarchy and use modular approach to network design for an enterprise network.
3. To understand the campus design and data center design considerations for designing an enterprise campus.
4. To study Enterprise Edge WAN Technologies and design a WAN using them
5. Designing an IP addressing plan and selecting a Route protocol for an enterprise network.
6. To design enterprise network for given user requirements in an application.

Course Outcomes: Student should be able to:

1. Understand the customer requirements and Apply a Methodology to Network Design
2. Structure and Modularize the Network
3. Design Basic Campus and Data Center Network.
4. Design Remote Connectivity
5. Design IP Addressing and Select suitable Routing Protocols for the Network
6. Compare Openflow controllers and switches with other enterprise networks.

Pre-requisite: Computer Networks

Detailed syllabus:

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Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	1. OSI Reference Model and TCP/IP Protocol Suite 2. Routing IP Addresses 3. Internetworking Devices	02	
I	Applying a Methodology to Network Design:	The Cisco Service Oriented Network Architecture, Network Design Methodology, Identifying Customer Requirements, Characterizing the Existing Network and Sites, Using the Top-Down Approach to Network Design, The Design Implementation Process.	08	CO1, CO6
II	Structuring and Modularizing the Network:	Network Hierarchy, Using a Modular Approach to Network Design, <i>Services Within Modular Networks, Network Management Protocols and Features</i>	09	CO2, CO6
III	Designing Basic Campus and Data Center Networks	Campus Design Considerations, Enterprise Campus Design, Enterprise Data Center Design Considerations	09	CO3, CO6
IV	Designing Remote Connectivity	Enterprise Edge WAN Technologies, WAN Design, Using WAN Technologies, Enterprise Edge WAN and MAN Architecture, Selecting Enterprise Edge Components, Enterprise Branch and Teleworker Design.	09	CO4, CO6
V	Designing IP Addressing in the Network & Selecting Routing Protocols	Designing an IP Addressing Plan, Introduction to IPv6, Routing Protocol Features, Routing Protocols for the Enterprise, Routing Protocol Deployment, <i>Route Redistribution, Route Filtering, Redistributing and Filtering with BGP, Route Summarization</i>	10	CO5
VI	Software Defined	Understanding SDN and Open Flow : SDN – SDN Building		CO6

	Network	Blocks, OpenFlow messages – Controller to Switch, Symmetric and Asynchronous messages, Implementing OpenFlow Switch, OpenFlow controllers , POX and NOX, Open Flow in Cloud Computing, Case study: how SDN changed Traditional Enterprise network Design	05	

Text Books:

1. Authorized Self-Study Guide, Designing for Cisco Internetwork Solutions (DESGN), Second Edition, Cisco Press-Diane Teare.
2. Network Analysis, Architecture, and Design 3rd Edition, Morgan Kaufman, James D.
3. CCDA Cisco official Guide
4. Software Defined Networking with Open Flow : PACKT Publishing Siamak Azodolmolky

References:

1. Top-Down Network Design (Networking Technology) 3rd Edition, [Priscilla Oppenheimer](#) ,Cisco Press Book
2. Network Planning and Design Guide Paperback – 2000, [Shaun Hummel](#)

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1 will be compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
ITC702	Infrastructure Security	04	--	-	04	--	-	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITC702	Infrastructure Security	20	20	20	80	--	--	100

Course Objectives: Students will try :

1. To understand underlying principles of infrastructure security
2. To explore software vulnerabilities, attacks and protection mechanisms
To learn security aspects of wireless network infrastructure and protocols
3. To investigate web server vulnerabilities and their countermeasures
4. To develop policies for security management and mitigate security related risks in the organization
5. To Learn the different attacks on Open Web Applications and Web services.
6. To Learn the different security policies.

Course Outcomes: Students will be able to:

1. Understand the concept of vulnerabilities, attacks and protection mechanisms
2. Analyze and evaluate software vulnerabilities and attacks on databases and operating systems
3. Explain the need for security protocols in the context of wireless communication
4. Understand and explain various security solutions for Web and Cloud infrastructure
5. Understand, and evaluate different attacks on Open Web Applications and Web services
6. Design appropriate security policies to protect infrastructure components

Prerequisite: Computer Networks, Cryptography and Network Security

Detail Syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Introduction	Cyber-attacks, Vulnerabilities, Defense Strategies and Techniques, Authentication Methods- Password, Token and Biometric, Access Control Policies and Models (DAC,MAC, RBAC, ABAC, BIBA, Bell La Padula), Authentication and Access Control Services- RADIUS, TACACS, and TACACS+	6	CO1

II	Software Security	Software Vulnerabilities: Buffer overflow, Format String, Cross-Site Scripting, SQL Injection, Malware: Viruses, Worms, Trojans, Logic Bomb, Bots, Rootkits Operating System Security: Memory and Address Protection, File Protection Mechanism, User Authentication. Linux and Windows: Vulnerabilities, File System Security Database Security: Database Security Requirements, Reliability and Integrity, Sensitive Data, Inference Attacks, Multilevel Database Security	12	CO2
III	Wireless Security	Mobile Device Security- Security Threats, Device Security, GSM, UMTS and 4G Security, IEEE 802.11xWireless LAN Security, VPN Security, Wireless Intrusion Detection System (WIDS)	9	CO3
IV	Cloud Security	Cloud Security Risks and Countermeasures, Data Protection in Cloud, Cloud Application Security, Cloud Identity and Access Management, Cloud Security as a Service, SAML, OAuth	8	CO4
V	Web Security	Web Security Considerations, User Authentication and Session Management, Cookies, SSL, HTTPS, SSH, Privacy on Web, Web Browser Attacks, Account Harvesting, Web Bugs, Clickjacking, Cross-Site Request Forgery, Session Hijacking and Management, Phishing and Pharming Techniques, DNS Attacks, Web Service Security, Secure Electronic Transaction, Email Attacks, Web Server Security as per OWASP, Firewalls, Penetration Testing	12	CO4, CO5
VI	Information Security and Risk Management	Security Policies, Business Continuity Plan, Risk Analysis, Incident Management, Legal System and Cybercrime, Ethical Issues in Security Management.	5	CO6

Text Books:

1. Computer Security Principles and Practice, William Stallings, Sixth Edition, Pearson Education
2. Security in Computing, Charles P. Pfleeger, Fifth Edition, Pearson Education
3. Network Security and Cryptography, Bernard Menezes, Cengage Learning
4. Network Security Bible, Eric Cole, Second Edition, Wiley

Reference Books:

1. Web Application Hackers Handbook by Wiley.
2. Computer Security, Dieter Gollman, Third Edition, Wiley
3. CCNA Security Study Guide, Tim Boyle, Wiley
4. Introduction to Computer Security, Matt Bishop, Pearson.
5. Cloud Security and Privacy, Tim Mather, Subra Kumaraswamy, Shahed Latif, O'Riely

Assessment:**Internal Assessment for 20 marks:**

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC703	Artificial Intelligence	04 Hr/Week		--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITC703	Artificial Intelligence	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To create appreciation and understanding of both the achievements of AI and the theory underlying those achievements.
2. To introduce the concepts of a Rational Intelligent Agent and the different types of Agents that can be designed to solve problems
3. To review the different stages of development of the AI field from human like behavior to Rational Agents.
4. To impart basic proficiency in representing difficult real life problems in a state space representation so as to solve them using AI techniques like searching and game playing.
5. To create an understanding of the basic issues of knowledge representation and Logic and blind and heuristic search, as well as an understanding of other topics such as minimal, resolution, etc. that play an important role in AI programs.
6. To introduce advanced topics of AI such as planning, Bayes networks, natural language processing and Cognitive Computing.

Course Outcomes: Students will be able to:

1. Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents.
2. Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game based techniques to solve them.
3. Develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing
4. Attain the capability to represent various real life problem domains using logic based techniques and use this to perform inference or planning.
5. Formulate and solve problems with uncertain information using Bayesian approaches.
6. Apply concept Natural Language processing to problems leading to understanding of cognitive computing. .

Prerequisite: Programming, Data Structures.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisites	Knowledge of any programming language, Data structures.	2	--
I	Introduction to Intelligent Systems and Intelligent Agents	Introduction to AI, AI Problems and AI techniques, Solving problems by searching, Problem Formulation. State Space Representation Structure of Intelligent agents, Types of Agents, Agent Environments PEAS representation for an Agent.	07	CO 1 CO 2
II	Search Techniques	Uninformed Search: DFS, BFS, Uniform cost search, Depth Limited Search, Iterative Deepening. Informed Search: Heuristic functions, Hill Climbing, Simulated Annealing, Best First Search, A*, Constraint Satisfaction Programming: Crypto Arithmetic, Map Coloring, N-Queens. Adversarial Search: Game Playing, Min-Max Search, Alpha Beta Pruning	11	CO 2 CO 3
III	Knowledge and Reasoning	A Knowledge Based Agent, Overview of Propositional Logic, First Order Predicate Logic, Inference in First Order Predicate Logic: Forward and Backward Chaining, Resolution.	10	CO 4
IV	Planning	Introduction to Planning, Planning with State Space Search, Partial Ordered planning, Hierarchical Planning, Conditional Planning.	06	CO 4
V	Uncertain Knowledge and Reasoning	Uncertainty, Representing Knowledge in an Uncertain Domain, Conditional Probability, Joint Probability, Bayes' theorem, Belief Networks, Simple Inference in Belief Networks.	06	CO 5
VI	Natural Language	Language Models, Natural Language for Communication:	10	CO 6

	Processing	Syntactic Analysis, Augmented Grammars and Semantic Interpretation, Machine Translation. Overview of Cognitive Computing: Foundation of Cognitive Computing, List of Design Principles for Cognitive Systems, Natural Language Processing in Support of a Cognitive System (First three chapters from Text book 3)		

Text Books:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 2nd Edition, Pearson Education.
2. Elaine Rich, Kevin Knight, Shivshankar B Nair, Artificial Intelligence, McGraw Hill, 3rd Edition
3. Judith S. Hurwitz, Marcia Kaufman, Adrian Bowles, Cognitive Computing and Big Data Analytics, Wiley India

References:

1. George Luger, .AI-Structures and Strategies for Complex Problem Solving., 4/e, 2002, Pearson Education.
2. Nils J. Nilsson, Principles of Artificial Intelligence, Narosa Publication.
3. Patrick H. Winston, Artificial Intelligence, 3rd edition, Pearson Education.
4. Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill Publication
5. John Kelly , Steve Hamm, Smart Machines - IBM's Watson and the Era of Cognitive Computing, Columbia Business School Publishing

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1 will be compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITL701	Network Design Lab	--	2	--	--	2	--	02

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral	Practical & Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL701	Network Design Lab	--	--	--	--	25	25	--	50

Lab Objectives: Students will try:

1. To be familiarized with the requirements of an enterprise and address its major design areas
2. To recognize the hierarchical network model for the enterprise
3. Identify the networking devices and their configurations required for the design and also prepare a bill of materials
4. Propose a design for the Server Farm of an enterprise network and discuss up gradations if needed.
5. Provide suitable IP addressing plan and best possible routing protocol for an enterprise network.
6. Construct a suitable design for an enterprise network and test it using a tool.

Lab Outcomes: Students will be able to:

1. Understand the requirements of an enterprise and outline its major design areas
2. Identify functional areas to construct high level modules for enterprise architecture and analyze them.
3. Identify the networking devices, prepare a bill of materials and configure the devices as per the Core, Access and Distribution layers
4. Design the Server Farm for an enterprise network and discuss up gradations if needed.
5. Identify and select the technology for Remote site Connectivity, suitable IP addressing plan and routing protocol for an enterprise network.
6. Test and monitor the enterprise network using a tool

Prerequisite: Computer Networks.

Guidelines

1. The case study of College Campus Network must be designed as a mini project work which is to be conducted by a group of three students
2. Each group will be associated with a subject Incharge/ mini project mentor. The group should meet with the concerned faculty during Laboratory hours and the progress of work discussed must be documented.
3. The students must understand the requirements of a College campus enterprise network.
4. The students must outline the major design areas of a College campus enterprise network.
5. The students must identify the functional areas and construct high level modules for the College campus enterprise architecture.
6. The students must analyze the existing College campus enterprise network and propose up gradations to existing infrastructure.
7. The students must identify the network devices required and their locations to design a College campus enterprise network.
8. The students must configure the network devices required as per the Core Layer, Access Layer and Distribution Layer.
9. The students must Design the Server Farm for enterprise network using a configuration tool and also discuss if any other improvement is required.
10. The students must Prepare a bill of materials of all the networking devices. Develop a Request for Proposal-RFP for the enterprise network
11. The students must identify the technology for Remote Site connectivity and evaluate it as per the application requirements of the college campus enterprise network.
12. Propose a suitable IP addressing plan for the enterprise network.
13. Determine a suitable routing protocol for the enterprise network.
14. Create and Test the designed college campus enterprise network using a tool.
15. Use Nagios tool for enterprise infrastructure monitoring tool
16. Each group may present their work in various project competitions and paper presentations.
17. A detailed report is to be prepared as per guidelines given by the concerned faculty.

Text Books:

1. Authorized Self-Study Guide, Designing for Cisco Internetwork Solutions (DESGN), Second Edition, Cisco Press-Diane Teare.
2. Designing and Supporting Computer Networks, CCNA Discovery Learning Guide (Cisco Systems Networking Academy Program) Paperback – 2008, [Kenneth Stewart](#) , [Aubrey Adams](#), [Allan Reid](#) , [Jim Lorenz](#).

References:

1. 1. Top-Down Network Design (Networking Technology) 3rd Edition, [Priscilla Oppenheimer](#) ,Cisco Press Book
2. Network Planning and Design Guide Paperback – 2000, [Shaun Hummel](#)

Term Work:

Term Work shall consist of full Mini Project on above guidelines/syllabus. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Mini Project) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Mini Project and Presentation.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
ITL702	Advance Security Lab	--	02	-	--	01	-	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL702	Advance Security Lab	--	--	--	--	25	--	25	50

Lab Objective: Students will try to:

1. Implement and analyze program and database vulnerabilities Buffer overflow and SQL Injection.
2. Explore and analyze different security tools to secure mobile devices, web browser, wireless network and router
3. Explore reconnaissance, attack and forensics tools in Kali Linux
4. Learn security of system using personal firewall installation
5. Understand AAA using RADUIS
6. Understand AAA using TACACS

Lab Outcome: Students will able to:

1. Implement and analyze program and database vulnerabilities Buffer overflow and SQL Injection.
2. Explore and analyze different security tools to secure mobile devices, web browser, wireless network and router
3. Explore reconnaissance, attack and forensics tools in Kali Linux
4. Learn security of system using personal firewall installation
5. Understand AAA using RADUIS
6. Understand AAA using TACACS

Prerequisite: Computer Networks, Cryptography and Network Security.

Hardware	Software
PC i3 or above configuration.	Kali Linux, Java, Snort, Kismet, Metasploit, Wireshark, Droidcrypt

Detail Syllabus:

Sr. No	Description	Hours	CO mapping
1	Exploring Kali Linux and the inbuilt tools for reconnaissance and ethical hacking.	2	LO3
2	Implementation and analysis of SQL injection Attack	4	LO1
3	Implementation of Buffer overflow attack and its analysis using Splint, Cppcheck etc.	2	LO1
4	Setting up personal Firewall using Iptables	2	LO4
5	Exploring wireless security tools like Kismet, NetStumbler etc.	2	LO2
6	Performing a penetration testing using Metasploit	2	LO3
7	Exploring Router security, access lists using packet tracer	2	LO2
8	Exploring VPN security using Packet tracer	2	LO2
9	Exploring Authentication and access control using RADIUS, TACACS and TACACS+	2	LO5

10	Install and use a security app on an Android mobile (e.g. Droidcrypt)	2	LO2
11	Explore forensics tools in Kali Linux for acquiring, analyzing and duplicating data	2	LO3
12	Configuration of mod Security, core rule set on apache server.	2	LO2

Text Books:

1. Build your own Security Lab, Michael Gregg, Wiley India
2. CCNA Security, Study Guide, Tim Boyles, Sybex

Reference Books:

1. Network Security Bible, Eric Cole, Wiley India

Term Work:

Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITL703	Intelligence System Lab	--	2	--	--	1	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL703	Intelligence System Lab	--	--	--	--	25	--	25	50

Course Objectives: Students will try:

1. To introduce the concepts of a Rational Intelligent Agent and the different types of Agents that can be designed to solve problems
2. To impart basic proficiency in representing difficult real life problems in a state space representation so as to solve them using AI techniques.
3. To make students understand various AI methods like searching and game playing and how to apply them to solve real applications
4. To explain to students the basic issues of knowledge representation and Logic so as to build inference engines
5. To impart a basic understanding of some of the more advanced topics of AI such as planning.
6. To understand Bayes networks, natural language processing and introduce concept of cognitive computing.

Course Outcomes: Students will be able to:

1. Design the building blocks of an Intelligent Agent using PEAS representation .
2. Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game based techniques to solve them.
3. Develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing
4. Attain the capability to represent various real life problem domains using logic based techniques and use this to perform inference or planning.
5. Formulate and solve problems with uncertain information using Bayesian approaches.
6. Apply concept Natural Language processing and cognitive computing for creation of domain specific ChatBots.

Hardware	Software
PC i3 or above configuration.	Java Python

Detailed syllabus:

Module No.	Detailed Content	Hours	LO Mapping
1	Tutorial exercise for a) Design of Intelligent System using PEAS. b) Problem Definition with State Space Representation	2	LO 1, LO 2
11	Implementation of Uninformed and Informed Search Algorithms.	6	LO 2
111	Implementation of CSP and Game playing algorithms .	4	LO 3
1V	a) Assignment on Predicate Logic, for forward and backward reasoning and resolution. b) Design of a Planning system using STRIPS.	4	LO 4
V	Implementation of Bayes' Belief Network.	2	LO 5
VI	Mini project Construction of a domain specific ChatBot using Natural Language Processing techniques. (Applications can include : Medical Diagnosis, Personal Shopping Assistant, Travel Agent , Trouble shooting etc.)	8	LO6

Text Books:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 2nd Edition, Pearson Education.
2. Judith S. Hurwitz, Marcia Kaufman, Adrian Bowles, Cognitive Computing and Big Data Analytics, Wiley India

References:

1. George Luger, .AI-Structures and Strategies for Complex Problem Solving., 4/e, 2002, Pearson Education.
2. John Kelly , Steve Hamm, Smart Machines - IBM's Watson and the Era of Cognitive Computing, Columbia Business School Publishing

Term Work:

Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 20 Marks (Experiment + Mini-Project) + 5 Marks (Attendance) **Oral Exam:** An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITL704	Android Apps Development Lab		2			1		1

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of twoTests					
ITL704	Android Apps Development Lab	--	--	--	--	25	--	25	50

Hardware	Software
PC i3 or above configuration.	Java Android SDK

Lab Objectives: Students will try:

1. To gain knowledge of installing Android Studio and Cross Platform Integrated Development Environment.
2. To learn designing of User Interface and Layouts for Android App.
3. To learn how to use intents to broadcast data within and between Applications.
4. To use Content providers and Handle Databases using SQLite.
5. To introduce Android APIs for Camera and Location Based Service.
6. To discuss various security issues with Android Platform.

Lab Outcomes: Students will be able to:

1. Experiment on Integrated Development Environment for Android Application Development.
2. Design and Implement User Interfaces and Layouts of Android App.
3. Use Intents for activity and broadcasting data in Android App.
4. Design and Implement Database Application and Content Providers.
5. Experiment with Camera and Location Based service.
6. Develop Android App with Security features.

Prerequisite: Java Programming, Internet Programming.

Guidelines

1. The mini project work is to be conducted by a group of three students

2. Each group will be associated with a subject Incharge/ mini project mentor. The group should meet with the concerned faculty during Laboratory hours and the progress of work discussed must be documented.
3. The students may do survey for different application which they can create Apps using Android.
4. Students will do Installation, configuration of Android Studio & to create AVD and also try for Cross platform Integrated Development Environment (Any Open Source Tool).
5. Students will try to Design and implement following points in their Mini Project (Android Apps)
 - a. Widget box for Android phone.
 - b. Use Layouts
 - c. Use Intents
 - d. Use Activity
 - e. Use SQLite
 - f. Use Camera
 - g. Use Location API
 - h. Generate APK file
6. Each group along with the concerned faculty shall identify a potential problem statement for Apps development, on which the study and implementation is to be conducted.
7. Each group may present their work in various project competitions and paper presentations.
8. A detailed report is to be prepared as per guidelines given by the concerned faculty.

Text Books:

1. Professional Android 4 Application Development by wrox publication
2. Android Cookbook by o'reilly
3. Beginning Android Development Wrox Press

References:

1. Android Application Development For Dummies, 2nd Edition by Michael Burton, Donn Felker
2. Android Security –attack and defenses, Abhishek Dubey and Anmol Misra by CRC Press

Term Work:

Term Work shall consist of full Mini Project on above guidelines/syllabus. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Mini Project) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Mini Project and Presentation.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical / Oral	Tutorial	Total
ITM705	Project-I	--	06	--	--	3	--	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITM705	Project-I	--	--	--	--	50	--	25	75

Lab Objectives: Students will try:

1. To offer students a glimpse into real world problems and challenges that need IT based solutions
2. To enable students to create very precise specifications of the IT solution to be designed.
3. To introduce students to the vast array of literature available of the various research challenges in the field of IT
4. To create awareness among the students of the characteristics of several domain areas where IT can be effectively used.
5. To enable students to use all concepts of IT in creating a solution for a problem
6. To improve the team building, communication and management skills of the students.

Lab Outcomes: Student will be able to:

1. Discover potential research areas in the field of IT
2. Conduct a survey of several available literature in the preferred field of study
3. Compare and contrast the several existing solutions for research challenge
4. Demonstrate an ability to work in teams and manage the conduct of the research study.
5. Formulate and propose a plan for creating a solution for the research plan identified
6. To report and present the findings of the study conducted in the preferred domain

Guidelines

1. The project work is to be conducted by a group of three students
2. Each group will be associated with a project mentor/guide. The group should meet with the project mentor/guide periodically and record of the meetings and work discussed must be documented.
3. Department has to allocate 1 day in VII semester and 2 day in VIII semester every week.
4. Students will do literature survey in Sem VI or Sem VII.
5. Students will do design, implementation and coding in Sem VII.

6. Each group along with its guide/mentor shall identify a potential research area/problem domain, on which the study is to be conducted.
7. Each team will do a rigorous literature survey of the problem domain by reading and understanding at least 3-5 research papers from current good quality national/international journals/conferences. (Papers selected must be indexed by Scopus/IEEE/Springer/ACM etc.). The list of papers surveyed must be clearly documented.
8. The project assessment for term work will be done at least two times at department level by giving presentation to panel members which consist of at least three (3) members as Internal examiners (including the project guide/mentor) appointed by the Head of the department of respective Programme.
9. A report is to be prepared summarizing the findings of the literature survey. A comparative evaluation of the different techniques surveyed is also to be done.
10. Students will do testing and analyze in Sem VIII
11. Teams must analyze all the results obtained by comparing with other standard techniques.
12. Every team must publish their work in national / international conference/journals (if possible publish in Scopus indexed journals).

Evaluation

1. Each team has to give presentation/demo to the Internal Panel and External examiner.
2. Each team will prepare a report that will summarize the results of the literature survey and implementation and coding as project proposal in SEM VII. The list of papers surveyed must be clearly documented.
3. Each group will be jointly evaluated by a team of Internal and External Examiners approved by the University of Mumbai.
4. Oral exam will be conduct on the project done by the students.

Term Work:

Term Work shall consist of full Project-I on above guidelines/syllabus.

Term Work Marks: 50 Marks (Total marks) = 45 Marks (Project-I) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Project-I and Presentation.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO7031	Storage Area Network	04	--	--	04	--	01	05

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITDLO7031	Storage Area Network	20	20	20	80	--	--	--	100

Course Objectives: Students will try to:

1. Understand the need for Storage Area Network and Data protection to satisfy the information explosion requirements
2. Study storage technologies: SAN, NAS, IP storage etc., which will bridge the gap between the emerging trends in industry and academics.
3. To get an insight of Storage area network architecture, protocols and its infrastructure.
4. To study and discuss the applications of SAN to fulfill the needs of the storage management in the heterogeneous environment..
5. Study and understand the management of Storage area Networks.
6. To understand and analyze case studies on the storage area network technology

Course Outcomes: Students will able to:

1. Students will analyze the limitations of the client-server architecture and evaluate the need for data protection and storage centric architectures such as Intelligent storage system..
2. Students will understand, interpret and examine various SAN technologies.
3. Students will describe and sketch the SAN architecture and its uses.
4. Students will classify the applications as per their requirements and select relevant SAN solutions.
5. Students will understand and evaluate different SAN management strategies to fulfill business continuity requirements.
6. Students will design case studies on NAS, SAN and SAN/ NAS

Prerequisite: Computer Networks, Operating System

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Networking Protocols, File system and Memory management	02	
I	Introduction to Storage System	Introduction: Storage oriented architecture, Storage Systems, Data center Infrastructure, Challenges in managing information, Information life cycle; Basics of Storage System: Components of Storage System, Disk Drive components and Performance, Components of Host; Data Protection: Raid Components and types, RAID technologies and RAID levels, RAID impact on disk performance; Intelligent Storage System” Components of ISS, Storage Provisioning and types of ISS	09	CO1
II	Network Attached Storage	Storage on Network: NAS hardware and software architecture, NAS connectivity, NAS as a Storage System; NAS Hardware devices; NAS software components; NAS connectivity options: NAS connectivity hardware and Software Architecture.	07	CO2
III	Storage Area Networks	Architecture Overview: Creating Network for storage; Hardware devices: Fibre Channel Switch, Host Bus Adaptors, Putting the Storage in SANs, Fabric Operation from a hardware perspective, SAN hardware considerations ; Software Components: The switch’s operating system, device drivers, the supporting components, considerations for SAN software ; Configuration options for SANs: Connecting into the data center, the evolving network and device connections, SAN configuration guidelines	10	CO3

IV	Applications- Putting it together	Defining the I/O workload: Storage planning and capacity planning, the definition and characterization of workloads, the business application, I/O content and workloads, Considerations for I/O workloads in storage networking ; Applying SAN solution: SAN workload characterization, applying SAN to OLTP workloads, transactional workloads; Applying NAS solution: NAS workload characterization, applying NAS to departmental workloads, enterprise web workloads and specialized workloads; Considerations when integrating SN and NAS: Differences and similarities, the need to integrate, future storage connectivity and integration	10	CO4
V	Management	Planning business continuity: Defining the environment, the role of storage networking in business continuity, storage design and implementation of the business continuity planning ; Managing availability: Availability Metrics, Implementing the plan ; Maintaining Serviceability: Tracking the configurations, Investigating the changes and closing the loop on serviceability; Capacity Planning: Storage Analysis, developing and implementing plan for storage, Modelling performance and capacity requirements ; Security considerations: Overview of Information security, Security methods, Storage Security challenges, FC SAN security, NAS security	09	CO5
VI	Case studies	Case studies on NAS, SAN, SAN/NAS	05	CO6

Text Books:

1. Storage Networks: The Complete Reference. Spalding, Robert ,Tata McGraw-Hill Education, 2003
2. “Storage Network Management and Retrieval”, Vaishali Khairnar, Nilima Dongre. Wiley

References:

1. Richard Barker, Paul Massiglia, “Storage Area Network Essentials: A Complete Guide to Understanding and Implementing SANs”, Wiley India
2. Ulf Troppens, Wolfgang Muller-Friedt, Rainer Wolafka, “Storage Networks Explained” Wiley Publication
3. G. Somasundaram, Alok Shrivastava, “Information Storage and Management”, EMC Education services”, Wiley Publication

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITDLO7032	Mobile Application Development	04	-	-	04	-	-	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITDLO7032	Mobile Application Development	20	20	20	80	-	-	--	100

Course Objectives: Students will try:

1. To introduce Android platform and its architecture.
2. To learn activity creation and Android UI designing.
3. To be familiarized with Intent, Broadcast receivers and Internet services.
4. To work with SQLite Database and content providers.
5. To integrate multimedia, camera and Location based services in Android Application.
6. To explore Mobile security issues.

Course Outcomes: Students will be able to:

1. Describe Android platform, Architecture and features.
2. Design User Interface and develop activity for Android App.
3. Use Intent , Broadcast receivers and Internet services in Android App.
4. Design and implement Database Application and Content providers.
5. Use multimedia, camera and Location based services in Android App.
6. Discuss various security issues in Android platform.

Prerequisite: Internet Programming, Database Management System.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basics of HTML5,CSS3 & XML	02	-
I	Introduction to Android and Architecture of	Introduction of Android platform, Android features ,Android Marketplace, Evolution of Android OS, Android	07	CO1

	Android	Application Architecture, Developing for Android, Developing for Mobile and Embedded Devices, Android Development Tools		
II	Applications, Activities and Building User Interface	Application: Application Manifest File, Externalizing Resources, Android Application Lifecycle and Android Application Class. Android Activity: Creating activities, Activity lifecycle and Android Activity classes. User Interface: Fundamental Android UI Design, Layouts, Fragments, Designing UI with views, Creating new views, widget toolbox, Adapters.	09	CO2
III	Intents, Broadcast receiver and Internet Resources	Introducing Intents, Linking Activities Using intents , Calling Built-in Applications Using intents , Displaying notifications, Creating Intent Filters and Broadcast Receivers, Downloading and Parsing Internet Resources, Using the Download Manager, Internet Services, Connecting to Google App Engine, Downloading Data Without Draining the Battery	09	CO3
IV	Data Persistence and Content Providers	Introducing Android Databases, Introducing SQLite, Content Values and Cursors, Working with SQLite Databases, Parsing an XML document , Parsing JSON data . Creating Content Providers, Using Content Providers, Adding Search to Your Application, Native Android Content Providers	09	CO4
V	Audio, Video , Camera, Maps, Geocoding and Location Based services	Playing Audio and Video, Manipulating Raw Audio, Using Audio , Using the Camera for Taking Pictures, Recording Video, Using Media Effects , Adding Media to the Media Store. Using Location-Based Services , Using the Emulator with Location-Based Services, Selecting a Location Provider, Finding Your Current Location, Location Updates, Proximity Alerts, Geocoder, Map-Based Activities, Displaying Maps	08	CO5
VI	Securing and Publishing Android Application	Android Security Model, Android's Manifest Permissions, Mobile Security Issues, Recent Android Attacks, Pen Testing Android. Preparing for Publishing, Deploying	08	CO6

		APK Files		

Text Books:

1. Professional Android 4 Application Development, Retomeier, by wrox publication,
2. Android Security –attack and defenses, AbhishekDubey and AnmolMisra by CRC Press
3. Beginning Android Application Development, Wei-meng lee, by wrox publication

References:

1. Android Application Development For Dummies, 2nd Edition by Michael Burton, DonnFelker
2. Android Cookbook by o'reilly

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination:

Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ITDLO7033	High Performance Computing	04	--	-	04	--	-	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITDLO7033	High Performance Computing	20	20	20	80	--	--	--	100

Course Objectives: Students will try to:

1. Learn the concepts of parallel processing as it pertains to high-performance computing.
2. Learn to design parallel programs on high performance computing.
3. Discuss issues of parallel programming.
4. Learn the concepts of message passing paradigm using open source APIs.
5. Learn different open source tools.
6. Learn the concepts of Multi-core processor.

Course Outcomes: Students will be able to:

1. Memorize parallel processing approaches
2. Describe different parallel processing platforms involved in achieving High Performance Computing.
3. Discuss different design issues in parallel programming
4. Develop efficient and high performance parallel programming
5. Learn parallel programming using message passing paradigm using open source APIs.
6. Design algorithms suited for Multicore processor and GPU systems using OpenMP and CUDA

Prerequisite: Computer Organization

Detail Syllabus:

Sr. No.	Module	Detailed Content	Hours	CO mapping
1	Introduction	Introduction to Parallel Computing: Motivating Parallelism, Scope of Parallel Computing, Levels of parallelism (instruction, transaction, task, thread, memory, function), Models (SIMD, MIMD, SIMT, SPMD, Dataflow Models, Demand-driven Computation), Parallel Architectures: Interconnection network, Processor Array, Multiprocessor	7	CO1
2	Parallel Programming Platforms	Parallel Programming Platforms: Implicit Parallelism: Trends in Microprocessor & Architectures, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines	7	CO2
3	Parallel Algorithm Design	Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models, Basic Communication operations: Broadcast and Reduction Communication types	12	CO3
4	Performance Measures	Performance Measures : Speedup, execution time, efficiency, cost, scalability, Effect of granularity on performance, Scalability of Parallel Systems, Amdahl's Law, Gustavson's Law, Performance Bottlenecks	5	CO4
5	Fundamental Design Issues in HPC	Programming Using the Message-Passing Paradigm: Principles of Message Passing Programming, The Building Blocks: Send and Receive Operations, MPI: the Message Passing Interface, Topology and Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations,	12	CO5

		One-Dimensional Matrix-Vector Multiplication, Single-Source Shortest-Path, Sample Sort, Groups and Communicators, Two-Dimensional Matrix-Vector Multiplication, Introduction to OpenMP,		
6	General Purpose Graphics Processing Unit(GPGPU)	CUDA enabled GPGPU, GPGPU architecture, GPGPU programming using CUDA, Introduction to CUDA Programming	9	CO6

Text Books:

1. AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar , “Introduction to Parallel Computing”, Pearson Education, Second Edition, 2007.
2. Kai Hwang, Naresh Jotwani, “Advanced Computer Architecture: Parallelism, Scalability, Programmability”, McGraw Hill, Second Edition, 2010.
3. Edward Kandrot and Jason Sanders, “CUDA by Example – An Introduction to General Purpose GPU Programming”, Addison-Wesley Professional ©, 2010.
4. Georg Hager, Gerhard Wellein, “Introduction to High Performance Computing for Scientists and Engineers”, Chapman & Hall / CRC Computational Science series, 2011.

Reference Books:

1. Michael J. Quinn, “Parallel Programming in C with MPI and OpenMP”, McGraw-Hill International Editions, Computer Science Series, 2008.
2. Kai Hwang, Zhiwei Xu, “Scalable Parallel Computing: Technology, Architecture, Programming”, McGraw Hill, 1998.
3. Laurence T. Yang, MinyiGuo, “High- Performance Computing: Paradigm and Infrastructure” Wiley, 2006.

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO7034	Software Testing and Quality Assurance	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITDLO7034	Software Testing and Quality Assurance	20	20	20	80	--	--	--	100

Course Objectives: Students will try to learn:

- 1 Basic software debugging methods.
- 2 White box testing methods and techniques.
- 3 Black Box testing methods and techniques.
- 4 Designing test plans.
- 5 Different testing tools (familiar with open source tools)
- 6 Quality Assurance models.

Course Outcomes: Students will be able to:

1. Investigate the reason for bugs and analyze the principles in software testing to prevent and remove bugs.
2. Implement various test processes for quality improvement
3. Design test planning.
4. Manage the test process
5. Apply the software testing techniques in commercial environment
6. Use practical knowledge of a variety of ways to test software and an understanding of some of the trade-offs between testing techniques.

Prerequisite: Software Engineering.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Software Engineering Concepts	02	--
I	Testing Methodology	Introduction, Goals of Software Testing, Software Testing Definitions, Model for Software Testing, Effective Software Testing vs Exhaustive Software Testing, Software Failure Case Studies, Software Testing Terminology, Software Testing Life Cycle (STLC), Software Testing methodology, Verification and Validation, Verification requirements, Verification of high level design, Verification of low level design, validation.	09	CO1
II	Testing Techniques	Dynamic Testing: Black Box testing: boundary value analysis, equivalence class testing, state table based testing, cause-effect graphing based testing, error guessing. White box Testing Techniques: need, logic coverage criteria, basis path testing, graph matrices, loop testing, data flow testing, mutation testing. Static Testing. Validation Activities: Unit validation, Integration, Function, System, Acceptance Testing. Regression Testing: Progressive vs. Regressive, regression testing produces quality software, regression testability, objectives of regression testing, regression testing types, define problem, regression testing techniques.	08	CO2 CO3
III	Managing the Test Process	Test Management: test organization, structure and of testing group, test planning, detailed test design and test specification. Software Metrics: need, definition and classification of software matrices. Testing Metrics for Monitoring and Controlling the Testing Process: attributes and corresponding metrics, estimation model for testing effort, architectural design, information flow	08	CO4

		matrix used for testing, function point and test point analysis. Efficient Test Suite Management: minimizing the test suite and its benefits, test suite minimization problem, test suite prioritization its type , techniques and measuring effectiveness.		
IV	Test Automation	Automation and Testing Tools: need, categorization, selection and cost in testing tool, guidelines for testing tools. Study of testing tools: JIRA, Bugzilla, TestDirector and IBM Rational Functional Tester, Selenium etc.	09	CO1 CO5
V	Testing for specialized environment	Agile Testing, Agile Testing Life Cycle, Testing in Scrum phases, Challenges in Agile Testing Testing Web based Systems: Web based system, web technology evaluation, traditional software and web based software, challenges in testing for web based software, testing web based testing	08	CO2 CO3
VI	Quality Management	Software Quality Management, McCall's quality factors and Criteria, ISO 9126 quality characteristics, ISO9000:2000, Software quality management	06	CO6

Text Books :

1. Software Testing Principles and Practices Naresh Chauhan Oxford Higher Education
2. Software Testing and quality assurance theory and practice by Kshirasagar Naik, Priyadarshi Tripathy , Wiley Publication

References :

1. Effective Methods for Software Testing , third edition by Willam E. Perry, Wiley Publication
2. Software Testing Concepts and Tools by Nageswara Rao Pusuluri , Dreamtech press

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO7035	Soft Computing	04	--	01	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITDLO7035	Soft Computing	20	20	20	80	--	--	--	100

Course Objectives: Students will try:

1. To familiarize with soft computing concepts.
2. To introduce the fuzzy logic concepts, fuzzy principles and relations.
3. To Basics of ANN and Learning Algorithms.
4. Ann as function approximation.
5. Genetic Algorithm and its applications to soft computing.
6. Hybrid system usage, application and optimization.

Course Outcomes: Students will be able to:

1. List the facts and outline the different process carried out in fuzzy logic, ANN and Genetic Algorithms.
2. Explain the concepts and meta-cognitive of soft computing.
3. Apply Soft computing techniques the solve character recognition, pattern classification, regression and similar problems.
4. Outline facts to identify process/procedures to handle real world problems using soft computing.
5. Evaluate various techniques of soft computing to defend the best working solutions.
6. Design hybrid system to revise the principles of soft computing in various applications.

Prerequisite: NIL

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Probability and Statistics, C++/Java/ Matlab	02	

		programming.		
I	Fuzzy Set Theory	Fuzzy Sets: Basic definition and terminology, Basic concepts of fuzzy sets, Fuzzy set operations, Fuzzy relations: Cardinality of fuzzy relations, operations on fuzzy relations, properties of fuzzy relations, Fuzzy composition Fuzzification and Defuzzification: Features of the membership Functions, Fuzzification, Lambda-Cuts for Fuzzy Sets, Lambda-Cuts for Fuzzy Relations, Defuzzification methods	06	CO1 CO2
II	Fuzzy Rules, Reasoning, and Inference System	Fuzzy Rules: Fuzzy If-Then Rules, Fuzzy Reasoning Fuzzy Inference System (FIS): Mamdani FIS, Sugeno FIS, Comparison between , Mamdani and Sugeno FIS.	06	CO1 CO2
III	Neural Network-I	Introduction: What is a Neural network? Fundamental Concepts, Basic Models of Artificial Neural Networks, Artificial Intelligence and Neural Networks, McCulloch-Pitts Neuron Learning: Error-Correction Learning, Memory based Learning, Hebbian learning, Competitive Learning, Boltzmann Learning Perceptron: Perceptron Learning Rule, Perceptron Learning Algorithm, Perceptron Convergence Theorem, Perceptron learning and Non-separable sets.	09	CO1 CO2
IV	Neural Networks -II	Back propagation: Multilayered Network Architecture, Back propagation Algorithm, Practical Consideration in implementing the Back propagation Algorithm. Back propagation and XOR problem. Adaptive resonance Theory: Noise-Saturation Dilemma, Solving the Noise-Saturation Dilemma, Recurrent On-center-Off-surround Networks, Building blocks of Adaptive Resonance, Substrate of resonance, Structural details of the resonance Model, Adaptive Resonance Theory I (ART I), Neurophysiological Evidence for ART Mechanism Character Recognition: Introduction, General Algorithm Architecture for Character Recognition: Binarization, Preprocessing, Filters, Smoothing, Skew Detection and Correction, Slant Correction, Character Normalization, Thinning, Segmentation, Multilingual OCR by Rule-Based Approach and ANN	10	CO3 CO6

		Rule-Based Approach: Classification, Tests, Rules Artificial Neural Network: Inputs, Outputs, Identification Results of Multilingual OCR		
V	Genetic Algorithm	An Introduction to genetic Algorithms: What Are Genetic Algorithms? Robustness of Traditional Optimization and Search Methods, The Goals of Optimization, How Are Genetic Algorithms Different from Traditional Methods?, A Simple Genetic Algorithm Genetic Algorithms at Work—a Simulation by hand, Grist for the Search Mill—Important Similarities, Similarity Templates (Schemata), Learning the Lingo. Genetic Algorithms: Mathematical Foundations Who Shall Live and Who Shall Die? The Fundamental Theorem, Schema Processing at Work: An Example by Hand Revisited, The Two-armed and й-armed Bandit Problem, How Many Schemata Are Processed Usefully? The Building Block Hypothesis, Another Perspective: The Minimal Deceptive Problem, Schemata Revisited: Similarity Templates as Hyperplanes, Implementation of a Genetic Algorithm: Data Structures, Reproduction, Crossover, and Mutation, A Time to Reproduce, a Time to Cross, Get with the Main Program, How Well Does it Work? Mapping Objective Functions to Fitness Form, Fitness Scaling, Codings, A Multiparameter, Mapped, Fixed-Point Coding, Discretization, Constraints. Algorithm for Handwriting Recognition Using GA Generation of Graph, Fitness Function of GA: Deviation between Two Edges, Deviation of a Graph, Crossover: Matching of Points, Generate Adjacency Matrix, Find Paths, Removing and Adding Edges, Generation of Graph Results of Handwriting Recognition: Effect of Genetic Algorithms, Distance Optimization, Style Optimization	10	CO1 CO3 CO6
VI	Hybrid Computing	Introduction, Neuro-Fuzzy Hybrid Systems, Adaptive Neuro-Fuzzy Inference System (ANIFS): Introduction, ANFS Architecture, Hybrid Learning Algorithm, ANFIS as a Universal Approximator, Simulation Examples: Two-input Sinc Function and Three Input Nonlinear Function Genetic Neuro-Hybrid Systems: Properties of Genetic Neuro-Hybrid Systems, genetic Algorithm based Back-propagation Network, Advantages of Neuro-Genetic Hybrids, Genetic Fuzzy Hybrid and Fuzzy Genetic Hybrid Systems Genetic Fuzzy Rule based Systems, Advantages of Genetic Fuzzy Hybrids	09	CO4 CO6

Text Books:

1. . S.N. Sivanandan and S.N. Deepa, Principles of Soft Computing, Wiley India, 2007, ISBN: 10: 81-265-1075-7.
2. J.-S. R. Jang, C. –T. Sun, E. Mizutani, Neuro-Fuzzy and Soft Computing, A Computational Approach to Learning and Machine Intelligence, PHI Learning Private Limited-2014
3. Neural Networks: A Classroom Approach, Satish Kumar, Tata McGraw-Hill Education, 2004/2007
4. Simon Haykin, Neural Networks A Comprehensive Foundation, Second Edition, Pearson Education-2004
5. David E. Goldberg, Genetic Algorithms, in search, optimization and Machine Learning, Pearson

References:

1. Anupam Shukla, Ritu Tiwari, Rahul Kala, Real Life Applications of Soft Computing, CRC Press, Taylor & Francis Group, 2010.
2. Genetic Algorithms and Genetic Programming Modern Concepts and Practical Applications © 2009 Michael Affenzeller, Stephan Winkler, Stefan Wagner, and Andreas Beham, CRC Press
3. Laurene V. Fausett, Fundamentals of Neural Networks: Architectures, Algorithms And Applications, Pearson

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Credits
ILO7011	Product Life Cycle Management	03

Course Objectives: Students will try :

1. To familiarize the students with the need, benefits and components of PLM
2. To acquaint students with Product Data Management & PLM strategies
3. To give insights into new product development program and guidelines for designing and developing a product
4. To familiarize the students with Virtual Product Development

Course Outcomes: Students will be able to :

1. Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
2. Illustrate various approaches and techniques for designing and developing products.
3. Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
4. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

Module	Detailed Contents	Hrs
01	Introduction to Product Lifecycle Management (PLM): Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications PLM Strategies: Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	10
02	ProductDesign: Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	09
03	Product Data Management (PDM): Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	05
04	Virtual Product Development Tools: For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques,	05

	Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	
05	Integration of Environmental Aspects in Product Design: Sustainable Development, Design for Environment,Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	05
06	Life Cycle Assessment and Life Cycle Cost Analysis: Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	05

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, AntoninoRisitano, "Product Design for the environment-A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229
3. SaaksvuoriAntti, ImmonenAnselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265

Course Code	Course Name	Credits
ILO7012	Reliability Engineering	03

Objectives:

1. To familiarize the students with various aspects of probability theory
2. To acquaint the students with reliability and its concepts
3. To introduce the students to methods of estimating the system reliability of simple and complex systems
4. To understand the various aspects of Maintainability, Availability and FMEA procedure

Outcomes: Learner will be able to...

1. Understand and apply the concept of Probability to engineering problems
2. Apply various reliability concepts to calculate different reliability parameters
3. Estimate the system reliability of simple and complex systems
4. Carry out a Failure Mode Effect and Criticality Analysis

Module	Detailed Contents	Hrs
01	Probability theory: Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. Probability Distributions: Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. Measures of Dispersion: Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	08
02	Reliability Concepts: Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. Failure Data Analysis: Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. Reliability Hazard Models: Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	08
03	System Reliability: System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	05
04	Reliability Improvement: Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	08
05	Maintainability and Availability: System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	05
06	Failure Mode, Effects and Criticality Analysis: Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fault tree analysis and Event tree Analysis	05

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. L.S. Srinath, "Reliability Engineering", Affiliated East-Wast Press (P) Ltd., 1985.
2. Charles E. Ebeling, "Reliability and Maintainability Engineering", Tata McGraw Hill.
3. B.S. Dhillon, C. Singh, "Engineering Reliability", John Wiley & Sons, 1980.
4. P.D.T. Conor, "Practical Reliability Engg.", John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, "Reliability in Engineering Design", John Wiley & Sons.
6. Murray R. Spiegel, "Probability and Statistics", Tata McGraw-Hill Publishing Co. Ltd.

Course Code	Course Name	Credits
ILO7013	Management Information System	03

Objectives:

1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
4. Identify the basic steps in systems development

Outcomes: Learner will be able to...

1. Explain how information systems Transform Business
2. Identify the impact information systems have on an organization
3. Describe IT infrastructure and its components and its current trends
4. Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
5. Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

Module	Detailed Contents	Hrs
01	Introduction To Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS.	4
02	Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management. Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results	7
03	Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls	7
04	Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	7
05	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	6
06	Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	8

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Kelly Rainer, Brad Prince, Management Information Systems, Wiley
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

Course Code	Course Name	Credits
ILO7014	Design of Experiments	03

Objectives:

1. To understand the issues and principles of Design of Experiments (DOE)
2. To list the guidelines for designing experiments
3. To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

Outcomes: Learner will be able to...

1. Plan data collection, to turn data into information and to make decisions that lead to appropriate action
2. Apply the methods taught to real life situations
3. Plan, analyze, and interpret the results of experiments

Module	Detailed Contents	Hrs
01	Introduction 1.1 Strategy of Experimentation 1.2 Typical Applications of Experimental Design 1.3 Guidelines for Designing Experiments 1.4 Response Surface Methodology	06
02	Fitting Regression Models 2.1 Linear Regression Models 2.2 Estimation of the Parameters in Linear Regression Models 2.3 Hypothesis Testing in Multiple Regression 2.4 Confidence Intervals in Multiple Regression 2.5 Prediction of new response observation 2.6 Regression model diagnostics 2.7 Testing for lack of fit	08
03	Two-Level Factorial Designs 3.1 The 2^2 Design 3.2 The 2^3 Design 3.3 The General 2^k Design 3.4 A Single Replicate of the 2^k Design 3.5 The Addition of Center Points to the 2^k Design, 3.6 Blocking in the 2^k Factorial Design 3.7 Split-Plot Designs	07
04	Two-Level Fractional Factorial Designs 4.1 The One-Half Fraction of the 2^k Design 4.2 The One-Quarter Fraction of the 2^k Design 4.3 The General 2^{k-p} Fractional Factorial Design 4.4 Resolution III Designs 4.5 Resolution IV and V Designs 4.6 Fractional Factorial Split-Plot Designs	07

05	Response Surface Methods and Designs 5.1 Introduction to Response Surface Methodology 5.2 The Method of Steepest Ascent 5.3 Analysis of a Second-Order Response Surface 5.4 Experimental Designs for Fitting Response Surfaces	07
06	Taguchi Approach 6.1 Crossed Array Designs and Signal-to-Noise Ratios 6.2 Analysis Methods 6.3 Robust design examples	04

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition, John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss

Course Code	Course Name	Credits
ILO7015	Operations Research	03

Objectives:

1. Formulate a real-world problem as a mathematical programming model.
2. Understand the mathematical tools that are needed to solve optimization problems.
3. Use mathematical software to solve the proposed models.

Outcomes: Learner will be able to...

1. Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.
2. Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
3. Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
4. Understand the applications of integer programming and a queuing model and compute important performance measures

Module	Detailed Contents	Hrs
01	Introduction to Operations Research: Introduction, , Structure of the Mathematical Model, Limitations of Operations Research Linear Programming: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, Duality, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis Transportation Problem: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method. Assignment Problem: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem Integer Programming Problem: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.	14
02	Queuing models: queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	05
03	Simulation: Introduction, Methodology of Simulation, Basic Concepts,	05

	Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	
04	Dynamic programming. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	05
05	Game Theory. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	05
06	Inventory Models: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	05

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009.
3. Hiller, F. S. and Lieberman, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut.
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons.

Course Code	Course Name	Credits
ILO7016	Cyber Security and Laws	03

Objectives:

1. To understand and identify different types cybercrime and cyber law
2. To recognized Indian IT Act 2008 and its latest amendments
3. To learn various types of security standards compliances

Outcomes: Learner will be able to...

1. Understand the concept of cybercrime and its effect on outside world
2. Interpret and apply IT law in various legal issues
3. Distinguish different aspects of cyber law
4. Apply Information Security Standards compliance during software design and development

Module	Detailed Contents	Hrs
01	Introduction to Cybercrime: Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	4
02	Cyber offenses & Cybercrime: How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Bot nets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	9
03	Tools and Methods Used in Cyber line Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	6
04	The Concept of Cyberspace E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law , The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	8
05	Indian IT Act. Cyber Crime and Criminal Justice : Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	6
06	Information Security Standard compliances SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	6

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, *Information Systems Security*, Wiley India, New Delhi
6. Kenneth J. Knapp, *Cyber Security & Global Information Assurance* Information Science Publishing.
7. William Stallings, *Cryptography and Network Security*, Pearson Publication
8. Websites for more information is available on : The Information Technology ACT, 2008-TIFR : <https://www.tifrh.res.in>
9. Website for more information , A Compliance Primer for IT professional : <https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538>

Course Code	Course Name	Credits
ILO7017	Disaster Management and Mitigation Measures	03

Objectives:

1. To understand physics and various types of disaster occurring around the world
2. To identify extent and damaging capacity of a disaster
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand role of individual and various organization during and after disaster
5. To understand application of GIS in the field of disaster management
6. To understand the emergency government response structures before, during and after disaster

Outcomes: Learner will be able to...

1. Get to know natural as well as manmade disaster and their extent and possible effects on the economy.
2. Plan of national importance structures based upon the previous history.
3. Get acquainted with government policies, acts and various organizational structure associated with an emergency.
4. Get to know the simple do's and don'ts in such extreme events and act accordingly.

Module	Detailed Contents	Hrs
01	Introduction 1.1 Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	03
02	Natural Disaster and Manmade disasters: 2.1 Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion 2.2 Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	09
03	Disaster Management, Policy and Administration 3.1 Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. 3.2 Policy and administration: Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	06
04	Institutional Framework for Disaster Management in India: 4.1 Importance of public awareness, Preparation and execution of emergency management programme.Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India.Methods and measures to avoid disasters, Management of	06

	casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. 4.2 Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	
05	Financing Relief Measures: 5.1 Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. 5.2 International relief aid agencies and their role in extreme events.	09
06	Preventive and Mitigation Measures: 6.1 Pre-disaster, during disaster and post-disaster measures in some events in general 6.2 Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication 6.3 Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. 6.4 Do's and don'ts in case of disasters and effective implementation of relief aids.	06

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. 'Disaster Management' by Harsh K.Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elsevier Publications.
4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
5. 'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
7. Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications. (Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

Course Code	Course Name	Credits
ILO7018	Energy Audit and Management	03

Objectives:

1. To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
2. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
3. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Outcomes: Learner will be able to...

1. To identify and describe present state of energy security and its importance.
2. To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
3. To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
4. To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
5. To analyze the data collected during performance evaluation and recommend energy saving measures

Module	Detailed Contents	Hrs
01	Energy Scenario: Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	04
02	Energy Audit Principles: Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	08
03	Energy Management and Energy Conservation in Electrical System: Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. Energy efficiency measures in lighting system, Lighting control: Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	10

04	Energy Management and Energy Conservation in Thermal Systems: Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	10
05	Energy Performance Assessment: On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	04
06	Energy conservation in Buildings: Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	03

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. www.energymanagertraining.com
9. www.bee-india.nic.in

Course Code	Course Name	Credits
ILO7019	Development Engineering	03

Objectives:

1. To familiarise the characteristics of rural Society and the Scope, Nature and Constraints of rural Development
2. To provide an exposure to implications of 73rd CAA on Planning, Development and Governance of Rural Areas
3. An exploration of human values, which go into making a 'good' human being, a 'good' professional, a 'good' society and a 'good life' in the context of work life and the personal life of modern Indian professionals
4. To familiarise the Nature and Type of Human Values relevant to Planning Institutions

Outcomes: Learner will be able to...

1. Demonstrate understanding of knowledge for Rural Development.
2. Prepare solutions for Management Issues.
3. Take up Initiatives and design Strategies to complete the task
4. Develop acumen for higher education and research.
5. Demonstrate the art of working in group of different nature
6. Develop confidence to take up rural project activities independently

Module	Contents	Hrs
1	Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services.	08
2	Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee - linkage between Panchayati Raj, participation and rural development.	06
3	Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development	07

4	Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.	04
5	Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom	10
6	Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education	04

Assessment:

Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

Reference

1. ITPI, Village Planning and Rural Development, ITPI, New Delhi
2. Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai
3. GoI, Constitution (73rd GoI, New Delhi Amendment) Act, GoI, New Delhi
4. Planning Commission, Five Year Plans, Planning Commission
5. Planning Commission, Manual of Integrated District Planning, 2006, Planning Commission New Delhi
6. Planning Guide to Beginners
7. Weaver, R.C., The Urban Complex, Doubleday
8. Farmer, W.P. et al, Ethics in Planning, American Planning Association, Washington

9. How, E., Normative Ethics in Planning, Journal of Planning Literature, Vol.5, No.2, pp. 123-150
10. Watson, V. Conflicting Rationalities: -- Implications for Planning Theory and Ethics, Planning Theory and Practice, Vol. 4, No.4, pp.395 – 407

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/ Pract	Tut	Total
ITC801	Big Data Analytics	4	-	-	4	-	-	4
ITC802	Internet of Everything	4	-	-	4	-	-	4
ITDLO-IV	Department Level Optional Course-IV	4	-	-	4	-	-	4
ILO-II	Institute Level Optional Course-II	3	-	-	3	-	-	3
ITL801	Big Data Lab	-	2	-	-	1		1
ITL802	Internet of Everything Lab		2			1		1
ITL803	DevOps Lab	-	2	-	-	1		1
ITL804	R Programming Lab	-	2	-		1		1
ITM805	Project-II	-	16			8	-	8
	Total	15	24	-	15	12	-	27

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in				
		Test 1	Test 2	Avg.						
ITC801	Big Data Analytics	20	20	20	80	3	-	-	-	100
ITC802	Internet of Everything	20	20	20	80	3	-	-	-	100
ITDLO-IV	Department Level Optional Course-IV	20	20	20	80	3	-	-	-	100
ILO-II	Institute Level Optional Course-II	20	20	20	80	3	-	-	-	100
ITL801	Big Data Lab						25	25	-	50
ITL802	Internet of Everything Lab	-	-	-	-	-	25	25		50
ITL803	DevOps Lab	-	-	-	-	-	25	--	25	50
ITL804	R Programming Lab	-	-	-	-	-	25	--	25	50
ITM805	Project-II						100	50	--	150
Total		80	80	80	320	--	200	100	50	750

Department Level Optional Course (DLO)

Every student is required to take one Department Elective Course for Semester VIII. Different sets of courses will run in both the semesters. Students can take these courses from the list of department electives, which are closely allied to their disciplines.

(DLO-I subjects will have no Labs only Theory)

Institute Level Optional Course (ILO)

Every student is required to take one Institute Elective Course for Semester VIII, which is not closely allied to their disciplines. Different sets of courses will run in the both the semesters.

Subject Code	Department Level Optional Course (DLO)	Subject Code	Institute Level Optional Course (ILO)
Semester VIII			
ITDLO8041	User Interaction Design	ILO8021	Project Management
ITDLO8042	Information Retrieval Systems	ILO8022	Finance Management
ITDLO8043	Knowledge Management	ILO8023	Entrepreneurship Development and Management
ITDLO8044	Robotics	ILO8024	Human Resource Management
ITDLO8045	Enterprise Resource Planning	ILO8025	Professional Ethics and CSR
		ILO8026	Research Methodology
		ILO8027	IPR and Patenting
		ILO8028	Digital Business Management
		ILO8029	Environmental Management

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC801	Big Data Analytics	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITC801	Big Data Analytics	20	20	20	80	--	--	--	100

Course Objectives: Students will try:

1. To provide an overview of an exciting growing field of Big Data analytics.
2. To discuss the challenges traditional data mining algorithms face when analyzing Big Data.
3. To introduce the tools required to manage and analyze big data like Hadoop, NoSql Map-Reduce.
4. To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
5. To introduce to the students several types of big data like social media, web graphs and data streams.
6. To enable students to have skills that will help them to solve complex real-world problems in for decision support.

Course Outcomes: Student will be able to:

1. Explain the motivation for big data systems and identify the main sources of Big Data in the real world.
2. Demonstrate an ability to use frameworks like Hadoop, NOSQL to efficiently store retrieve and process Big Data for Analytics.
3. Implement several Data Intensive tasks using the Map Reduce Paradigm
4. Apply several newer algorithms for Clustering Classifying and finding associations in Big Data
5. Design algorithms to analyze Big data like streams, Web Graphs and Social Media data.
6. Design and implement successful Recommendation engines for enterprises.

Prerequisites: Database Management System.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisites	Data Mining, database Systems, Algorithms	02	--
I	Introduction to Big Data	Introduction to Big Data, Big Data characteristics, types of Big Data, Traditional vs. Big Data business approach, Big Data Challenges, Examples of Big Data in Real Life, Big Data Applications	03	CO 1
II	Introduction to Big Data Frameworks: Hadoop, NOSQL	What is Hadoop? Core Hadoop Components; Hadoop Ecosystem; Overview of : Apache Spark, Pig, Hive, Hbase, Sqoop What is NoSQL? NoSQL data architecture patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores, Mongo DB	10	CO 2
III	MapReduce Paradigm	MapReduce: The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution, Coping With Node Failures. Algorithms Using MapReduce: Matrix-Vector Multiplication by MapReduce , Relational-Algebra Operations, Computing Selections by MapReduce, Computing Projections by MapReduce, Union, Intersection, and Difference by MapReduce, Computing Natural Join by MapReduce, Grouping and Aggregation by MapReduce, Matrix Multiplication, Matrix Multiplication with One MapReduce Step . Illustrating use of MapReduce with use of real life databases and applications.	09	CO 3
IV	Mining Big Data Streams	The Stream Data Model: A Data-Stream-Management System, Examples of Stream Sources, Stream Queries, Issues in Stream Processing. Sampling Data in a Stream : Sampling Techniques. Filtering Streams: The Bloom Filter	07	CO 5

		Counting Distinct Elements in a Stream : The Count-Distinct Problem, The Flajolet-Martin Algorithm, Combining Estimates, Space Requirements . Counting Ones in a Window: The Cost of Exact Counts, The Datar-Gionis-Indyk-Motwani Algorithm, Query Answering in the DGIM Algorithm.		
V	Big Data Mining Algorithms	Frequent Pattern Mining : Handling Larger Datasets in Main Memory Basic Algorithm of Park, Chen, and Yu. The SON Algorithm and MapReduce. Clustering Algorithms: CURE Algorithm. Canopy Clustering, Clustering with MapReduce Classification Algorithms: Parallel Decision trees, Overview SVM classifiers, Parallel SVM, K-Nearest Neighbor classifications for Big Data, One Nearest Neighbour.	10	CO 4
VI	Big Data Analytics Applications	Link Analysis : PageRank Definition, Structure of the web, dead ends, Using Page rank in a search engine, Efficient computation of Page Rank: PageRank Iteration Using MapReduce, Topic sensitive Page Rank, link Spam, Hubs and Authorities, HITS Algorithm. Mining Social- Network Graphs : Social Networks as Graphs, Types , Clustering of Social Network Graphs, Direct Discovery of Communities, Counting triangles using Map-Reduce. Recommendation Engines: A Model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering.	11	CO 4 CO 6

Text Books:

1. Radha Shankarmani, M Vijayalakshmi, "Big Data Analytics", Wiley Publications,
2. Anand Rajaraman and Jeff Ullman "Mining of Massive Datasets", Cambridge University Press.
3. Alex Holmes "Hadoop in Practice", Manning Press, Dreamtech Press.
4. Professional NoSQL Paperback, by Shashank Tiwari, Dreamtech Press
5. MongoDB: The Definitive Guide Paperback, Kristina Chodorow (Author), Michael Dirolf, O'Reilly Publications

References:

1. Analytics in a Big Data World: The Essential Guide to Data Science and its Applications, Bart Baesens , WILEY Big Data Series.
2. Big Data Analytics with R and Hadoop by Vignesh Prajapati Paperback, Packt Publishing Limited
3. Hadoop: The Definitive Guide by Tom White, O'Reilly Publications

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC802	Internet of Everything	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITC802	Internet of Everything	20	20	20	80	--	--	--	100

Course Objectives: Students will try:

1. To learn the concepts of IOT.
2. To identify the different technology.
3. To learn different applications in IOT.
4. To learn different protocols used in IOT.
5. To learn the concepts of smart city development in IOT.
6. To learn how to analysis the data in IOT.

Course Outcomes: Student will be able to:

1. Apply the concepts of IOT.
2. Identify the different technology.
3. Apply IOT to different applications.
4. Analysis and evaluate protocols used in IOT.
5. Design and develop smart city in IOT.
6. Analysis and evaluate the data received through sensors in IOT.

Prerequisites: IOT Lab, Sensor Lab, Wireless Network.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisites	What are sensors, Sensor family, Architecture of single node sensor?	02	--
I	Introduction	Introduction, History of IOT, Objects in IOT, Identifier in the IOT, Technologies in IOT	03	CO 1
II	RFID Technology	Introduction, principle of RFID, components of RFID system: RFID tag, Reader, RFID middleware,	8	CO 2

		Issues etc.		
III	RFID Applications	Introduction, concepts and technology: RFID, transponder, RFID architecture, RFID applications i.e. logistics and supply chain, production, monitoring and maintenance, product safety, quality and information, access control and tracking and tracing of individuals, payment, loyalty, household etc. Hardware, Hardware issues, protocols: pure aloha, slotted aloha, frame slotted aloha, tree protocols, tree splitting algorithms, binary search algorithms, bitwise arbitration protocols. Main query tree protocols.	09	CO2 CO 3
IV	Wireless Sensor Networks	History and context, Node, connecting nodes, networking nodes, securing communication, standards and Fora. Networking and the Internet - IP Addressing, Protocols - MQTT, CoAP, REST Transferring data	09	CO2 CO3 CO4
V	Mobility and Settings.	Introduction, localization, mobility management, localization and handover management, technology considerations, performance evaluation, simulation setup, performance results. Identification of IOT (data formats. IPV6, identifiers and locators, tag etc.)	10	CO4 CO5
VI	Data Analytics for IoE	Introduction, Apache Hadoop, Using Hadoop MapReduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, Using Apache Storm for Real-time Data Analysis, Structural Health Monitoring Case Study, Tools for IoT:- Chef, Chef Case Studies, Puppet, Puppet Case Study - Multi-tier Deployment, NETCONF-YANG Case Studies, IoT Code Generator.	11	CO5 CO6

Text Books:

- 1 Internet of Things connecting objects to the web, by Hakima Chaouchi, Wiley.
2. Internet of Things (A Hands-on-Approach) by Arshdeep Bhaga and Vijay Madiseti.

Reference Books:

- 1 The Internet of Things (MIT Press) by Samuel Greengard.
- 2 The Internet of Things (Connecting objects to the web) by Hakima Chaouchi (Wiley Publications).
- 3 RFID and the Internet of Things, by Herve chabanne, Wiley

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITL801	Big Data Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL801	Big Data Lab	--	--	--	--	25	--	25	50

Lab Objectives: Students will try:

1. To introduce the tools required to manage and analyze big data like Hadoop, NoSql
2. To impart knowledge of Map reduce paradigm to solve complex problems Map-Reduce.
3. To introduce several new algorithms for big data mining like classification, clustering and finding frequent patterns.
4. To introduce to the students several types of big data like social media, web graphs and data streams.
5. To identify various sources of Big data
6. To enable students to have skills that will help them to solve complex real-world problems in for decision support.

Lab Outcomes: Students will be able to:

1. Demonstrate capability to use Big Data Frameworks like Hadoop
2. Program applications using tools like Hive, pig, , NO SQL and MongoDB for Big data Applications
3. Construct scalable algorithms for large Datasets using Map Reduce techniques
4. Implement algorithms for Clustering, Classifying and finding associations in Big Data
5. Design and implement algorithms to analyze Big data like streams, Web Graphs and Social Media data and construct recommendation systems.
6. Apply the knowledge of Big Data gained to fully develop a BDA applications for real life applications.

Prerequisite: Java, Python

Requirement

Hardware	Software
PC i3 or above, 8 GB RAM	Virtual Machine, Hadoop Frame work, NOSQL and MongoDB Compilers

Detailed syllabus:

Module	Detailed Content	Hours 2hrs	LO Mapping
1	Assignment on Study of Hadoop ecosystem	02	LO 1
2	Programming exercises on Hadoop Using Hive, Pig, Hbase Sqoop NOSQL, MongoDB	04	LO 2
3	Implementing simple algorithms in Map-Reduce Matrix multiplication, Aggregates, joins, sorting, searching etc.	04	LO3
4	Implementing Algorithms using MapReduce (Any 2) - Implementing Frequent Item set Mining - Implementing Clustering algorithms - Implementing Classification Algorithms	06	LO 4
5	Big Data Applications (Any 2) - Implementing Analytics on data streams - Implementing Social Network Analysis Algorithms - Implementing Web Graph Algorithms - Implementing recommendation Engines	05	LO 5
6	Mini Project: One real life large data application to be implemented (Use standard Datasets available on the web) a) Twitter data analysis b) Fraud Detection c) Text Mining d) Recommendation Engines (list of datasets also given in the text book)	05	LO 5 LO 6

Text Books:

1. Radha Shankarmani, M Vijayalakshmi, "Big Data Analytics", Wiley Publications,
2. Alex Holmes "Hadoop in Practice", Manning Press, Dreamtech Press.
3. Professional NoSQL Paperback, by Shashank Tiwari, Dreamtech Press
4. MongoDB: The Definitive Guide Paperback, Kristina Chodorow (Author), Michael Dirolf, O'Reilly Publications

References:

1. Analytics in a Big Data World: The Essential Guide to Data Science and its Applications, Bart Baesens , WILEY Big Data Series.
2. Hadoop: The Definitive Guide by Tom White, O'Reilly Publications
3. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data by EMC Education Services
4. NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence by Pramod J. Sadalage, Addison Wesley

Term Work:

Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITL802	Internet of Everything Lab	--	02	--	--	1	--	1

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL802	Internet of Everything Lab	--	--	--	--	25	--	25	50

Hardware and Software requirements:

Hardware Requirements	Software Requirements	Other Requirements
PC With following Configuration 1. Intel Core i3/i5/i7 Processor 2. 4 GB RAM 3. 500 GB Hard disk	1. Ubuntu or Linux Desktop OS 2. VMware 3. Cooja contiki or any open source software 4. Cupcarbon	1. Internet Connection

Lab Objectives: Students will try:

1. To learn different types of sensors from Motes families.
2. To design the problem solution as per the requirement analysis done using Motes sensors.
3. To study the basic concepts of programming/sensors/ emulator like cooja etc.
4. To design and implement the mini project intended solution for project based learning.
5. To build and test the mini project successfully.
6. To improve the team building, communication and management skills of the students.

Lab Outcomes: Student will be able to:

1. Identify the requirements for the real world problems.
2. Conduct a survey of several available literatures in the preferred field of study.
3. Study and enhance software/ hardware skills.

4. Demonstrate and build the project successfully by hardware/sensor requirements, coding, emulating and testing.
5. To report and present the findings of the study conducted in the preferred domain
6. Demonstrate an ability to work in teams and manage the conduct of the research study.

Prerequisite: Basics of Java and Python Programming

Guidelines

1. The mini project work is to be conducted by a group of three students
2. Each group will be associated with a subject Incharge/ mini project mentor. The group should meet with the concerned faculty during Laboratory hours and the progress of work discussed must be documented.
3. The students must understand the
 - a. Concept
 - b. Importance
 - c. Interdisciplinary
 - d. Challenges
 - e. Various applications/smart objects
 - f. Major Players/Industry, Standards.
4. The students must understand the IoT Architecture:
 - a. Node Structure: Sensing, Processing, Communication, Powering
 - b. Networking: Topologies, Layer/Stack architecture
 - c. Communication Technologies: Introduction to ZigBee, BLE, WiFi, LTE, IEEE 802.11ah, Discuss data rate, range, power, computations/bandwidth, QoS
 - d. Smartness - Signal Processing/Analytics: Impact on Power/Energy savings, dynamic networks, simple case studies
 - e. IoT Fabricator: Introduction to Embedded electronics, fabricating electronics, Communication Network requirements, Data processing challenges – recreation, IP/security, Challenges
 - f. Hands-on in IoT: Projects based on some Hardware (Raspberry pi, Arduino, Intel, IITH Mote, Smartphones), Software (Contiki, TinyOS, Android), IoT Fabricator etc. can be used.
5. The students may do will visit different websites to identify their IOT topic for the mini project.
6. The students may do survey for different application using different types of sensors for their mini project.

7. Each group will identify the Hardware (Motes from different Motes families) & sensor configuration and software requirement for their mini project problem statement.
8. Design your own circuit board using multiple sensors etc.
9. Installation, configure and manage your sensors in such away so that they can communicate with each other.
10. Work with operating system, emulator like contiki cooja and do coding to for input devices on sensors.
11. Each group will identify the Hardware and software requirement for their mini project problem statement.
12. Create and interface using Mobile/Web to publish or remotely access the data on Internet.
13. Each group along with the concerned faculty shall identify a potential problem statement, on which the study and implementation is to be conducted.
14. Each group may present their work in various project competitions and paper presentations.
15. A detailed report is to be prepared as per guidelines given by the concerned faculty.

Text Books:

1. Interconnecting Smart Objects with IP: The Next Internet, Jean-Philippe Vasseur, Adam Dunkels, Morgan Kuffmann
2. Designing the Internet of Things , Adrian McEwen (Author), Hakim Cassimally
3. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, Dr. Ovidiu Vermesan, Dr. Peter Friess, River Publishers
4. Internet of Things (A Hands-on-Approach) , Vijay Madiseti , Arshdeep Bahga

References:

1. 6LoWPAN: The Wireless Embedded Internet, Zach Shelby, Carsten Bormann, Wiley
2. Building the internet of things with ipv6 and mipv6, The Evolving World of M2M Communications, Daniel Minoli John Wiley & Sons
3. Contiki Cooja User Guide.
4. Fundamentals of Sensor Network Programming: Applications and Technology, By S. Sitharama Iyengar, Nandan Parameshwaran, Vir V. Phoha, N. Balakrishnan, Chuka D. Okoye, Wiley publication.
5. Recent research/white papers

Term Work:

Term Work shall consist of full Mini Project on above guidelines/syllabus. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Mini Project) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Mini Project and Presentation.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITL803	DevOps Lab	--	2	--	--	--	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL803	DevOps Lab	--	--	--	--	25	25	--	50

Lab Objectives: Students will try:

1. To understand the concept of DevOps with associated technologies and methodologies.
2. To be familiarized with Jenkins, which is used to build & test software Applications & Continuous integration in Devops environment.
3. To understand different Version Control tools like GIT, CVS or Mercurial
4. To understand Docker to build, ship and run containerized images
5. To use Docker to deploy and manage Software applications running on Container.
6. To be familiarized with concept of Software Configuration Management & provisioning using tools like Puppet, Chef, Ansible or Saltstack.

Lab Outcomes: Students will be able to:

1. Remember the importance of DevOps tools used in software development life cycle
2. Understand the importance of Jenkins to Build, Deploy and Test Software Applications
3. Examine the different Version Control strategies
4. Analyze & Illustrate the Containerization of OS images and deployment of applications over Docker
5. Summarize the importance of Software Configuration Management in DevOps
6. Synthesize the provisioning using Chef/Puppet/Ansible or Saltstack.

Hardware & Software Requirements:

Hardware Requirements	Software Requirements	Other Requirements
PC With following Configuration	1. Windows or Linux Desktop OS for Client machines	1. Internet Connection for each PC with at least 2 MBPS

1. Intel Core i3/i5/i7 Processor with Intel VT-X support	2. CentOS/Fedora/Ubuntu/Redhat Server OS for One Server	bandwidth.
2. 4 GB RAM	3. JDK 1.8 or higher	
3. 500 GB Harddisk	4. Netbeans or Eclipse	
4. Gigabit Ethernet (GbE) network interface card (NIC)	5. OpenSSH	

Prerequisite Subjects: Operating System, Virtualization, Cloud Computing, Java and Web Programming, and Software Engineering.

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	To Understand the Concept of DevOps with related technologies which are used to Code, Build, Test, Configure & Monitor the Software Applications.	02	--
I	Build & Test Applications with Continuous Integration	To Install and Configure Jenkins to test, and deploy Java or Web Applications using Netbeans or eclipse.	04	LO 1 LO2
II	Version Control	To Perform Version Control on websites/ Softwares using different Version control tools like RCS/ CVS/GIT/Mercurial (Any two)	04	LO 1 LO 3
III	Virtualization & Containerization	To Install and Configure Docker for creating Containers of different Operating System Images	04	LO 1 LO 4
IV	Virtualization & Containerization	To Build, deploy and manage web or Java application on Docker	04	LO 1 LO 4
V	Software Configuration Management	To install and configure Software Configuration Management using Chef/Puppet/Ansible or Saltstack.	04	LO 1 LO 5

VI	Provisioning	To Perform Software Configuration Management and provisioning using Chef/Puppet/Ansible or Saltstack.	04	LO 1 LO 6

Text Books:

1. Karl Matthias & Sean P. Kane, Docker: Up and Running, O'Reilly Publication.
2. Len Bass, Ingo Weber, Liming Zhu, "DevOps, A Software Architects Perspective", Addison-Wesley-Pearson Publication.
3. John Ferguson Smart, "Jenkins, The Definitive Guide", O'Reilly Publication.
4. Learn to Master DevOps by Star EduSolutions.

References:

1. Sanjeev Sharma and Bernie Coyne, "DevOps for Dummies", Wiley Publication
2. Httermann, Michael, "DevOps for Developers", Apress Publication.
3. Joakim Verona, "Practical DevOps", Pack publication

Term Work:

Term Work shall consist of experiment on above guidelines/syllabus. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITL804	R Programming Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of two Tests					
ITL804	R Programming Lab	--	--	--	--	25	25	--	50

Lab Objectives: Students will try:

1. To provide an overview of a new language R used for data science.
2. To introduce students to the R programming environment and related eco-system and thus provide them with an in-demand skill-set, in both the research and business environments
3. To introduce the extended R ecosystem of libraries and packages
4. To demonstrate usage of as standard Programming Language.
5. To familiarize students with how various statistics like mean median etc. can be collected for data exploration in R
6. To enable students to use R to conduct analytics on large real life datasets.

Lab Outcomes: students will be able to:

1. Install and use R for simple programming tasks.
2. Extend the functionality of R by using add-on packages
3. Extract data from files and other sources and perform various data manipulation tasks on them.
4. Code statistical functions in R.
5. Use R Graphics and Tables to visualize results of various statistical operations on data .
6. Apply the knowledge of R gained to data Analytics for real life applications.

SOFTWARE requirements:

1. The R statistical software program. Available from: <https://www.r-project.org/>
2. RStudio an Integrated Development Environment (IDE) for R. Available from: <https://www.rstudio.com/>

Detailed syllabus:

Module	Detailed Content	Hours	LO Mapping
0	Prerequisites - Any programming Language like Java Python. Basic statistics. Data Mining Algorithms	--	--
I	Introduction: Installing R on personal machines. installing R and RStudio. - The basic functionality of R will be demonstrated, Variable types in R. Numeric variables, strings and factors. - Accessing the help system. Retrieving R packages. - Basic data types and operations: numbers, characters and composites. - Data entry and exporting data	02	LO 1, LO 2, LO 3
II	Data structures: vectors, matrices, lists and data frames.	04	LO1, LO 3
III	R as a programming language: - Grouping, loops and conditional execution, Functions Exploratory data analysis - Range, summary, mean, variance, median, standard deviation, histogram, box plot, scatterplot	04	LO 1, LO 4
IV	Graphics in R - Graphics and tables - Working with larger datasets - Building tables with aggregate - Introduction to ggplot2 graphics	06	LO 3
V	Regression and correlation - Simple regression and correlation, Multiple regression - Tabular data and analysis of Categorical data	02	LO 4
VI	R for Data Science (Mini Project) Implementing a mini project using any data mining or big data analytics algorithm in R - Extracting data from a large Dataset - Exploratory analysis - Using Mining algorithm - Visualizations and interpretation of results	06	LO 5, LO 6

Text Books:

1. URL: <https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf> (Online Resources)
2. R Cookbook Paperback – 2011 by Teetor Paul O Reilly Publications
3. Beginning R: The Statistical Programming Language by Dr. Mark Gardener, Wiley Publications
4. R Programming For Dummies by Joris Meys Andrie de Vries, Wiley Publications

References:

1. Hands-On Programming with R by Grolemond, O Reilly Publications
2. R for Everyone: Advanced Analytics and Graphics, 1e by Lander, Pearson Ltd.
3. R for Data Science Learning Dan Toomey December 2014 Packt Publishing Limited

Term Work:

Term Work shall consist of experiment on above guidelines/syllabus. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical / Oral	Tutorial	Total
ITM805	Project-II	--	16	--	--	8	--	8

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITM805	Project-II	--	--	--	--	100	--	50	150

Lab Objectives: Students will try:

1. To offer students a glimpse into real world problems and challenges that need IT based solutions
2. To enable students to create very precise specifications of the IT solution to be designed.
3. To introduce students to the vast array of literature available of the various research challenges in the field of IT
4. To create awareness among the students of the characteristics of several domain areas where IT can be effectively used.
5. To enable students to use all concepts of IT in creating a solution for a problem
6. To improve the team building, communication and management skills of the students.

Lab Outcomes: Student will be able to:

1. Discover potential research areas in the field of IT
2. Conduct a survey of several available literature in the preferred field of study
3. Compare and contrast the several existing solutions for research challenge
4. Demonstrate an ability to work in teams and manage the conduct of the research study.
5. Formulate and propose a plan for creating a solution for the research plan identified
6. To report and present the findings of the study conducted in the preferred domain

Guidelines

1. The project work is to be conducted by a group of three students
2. Each group will be associated with a project mentor/guide. The group should meet with the project mentor/guide periodically and record of the meetings and work discussed must be documented.
3. Department has to allocate 1 day in VII semester and 2 day in VIII semester every week.
4. Students will do literature survey in Sem VI or Sem VII.
5. Students will do design, implementation and coding in Sem VII.
6. Each group along with its guide/mentor shall identify a potential research area/problem domain, on which the study is to be conducted.
7. Each team will do a rigorous literature survey of the problem domain by reading and understanding at least 3-5 research papers from current good quality national/international journals/conferences. (Papers selected must be indexed by Scopus/IEEE/Springer/ACM etc.). The list of papers surveyed must be clearly documented.
8. The project assessment for term work will be done at least two times at department level by giving presentation to panel members which consist of at least three (3) members as Internal examiners (including the project guide/mentor) appointed by the Head of the department of respective Programme.
9. A report is to be prepared summarizing the findings of the literature survey. A comparative evaluation of the different techniques surveyed is also to be done.
10. Students will do testing and analyze in Sem VIII
11. Teams must analyze all the results obtained by comparing with other standard techniques.
12. Every team must publish their work in national / international conference/journals (if possible publish in Scopus indexed journals).

Evaluation

1. Each team has to give presentation/demo to the Internal Panel and External examiner.
2. Each team will prepare a report that will summarize the results of the literature survey and implementation and coding as project proposal in SEM VII. The list of papers surveyed must be clearly documented.
3. Each group will be jointly evaluated by a team of Internal and External Examiners approved by the University of Mumbai.
4. Oral exam will be conduct on the project done by the students.

Term Work:

Term Work shall consist of full Project-I on above guidelines/syllabus.

Term Work Marks: 100 Marks (Total marks) = 95 Marks (Project-II) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Project-II and Presentation.

Course code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO8041	User Interaction Design	04	--	--	04	--	--	04

Course code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITDLO8041	User Interaction Design	20	20	20	80	--	--	--	100

Course Objectives: Students will try to:

- 1 To stress the importance of good interface design.
- 2 To understand the importance of human psychology as well as social and emotional aspect in designing good interfaces.
- 3 To learn the techniques of data gathering, establishing requirements, analysis and data interpretation.
- 4 To learn the techniques for prototyping and evaluating user experiences.
- 5 To understand interaction design process.
- 6 To bring out the creativity in each student – build innovative applications that are usable, effective and efficient for intended users.

Course Outcomes:

1. Students will be able to identify and criticize bad features of interface designs.
2. Students will be able to predict good features of interface designs.
3. Students will be able to illustrate and analyze user needs and formulate user design specifications.
4. Students will be able to interpret and evaluate the data collected during the process.
5. Students will be able to evaluate designs based on theoretical frameworks and methodological approaches.
6. Students will be able to produce/show better techniques to improve the user interaction design interfaces.

Prerequisite: Web technologies, Software Engineering, Experiences in designing interfaces for applications and web sites. Basic Knowledge of designing tools and languages like HTML , Java etc.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Software Engineering concepts and any programming Language	02	--
I	Introduction to Interaction Design	Good and Poor Design, What is Interaction Design, The User Experience, The Process Of Interaction Design, Interaction Design and the User Experience	09	CO1,CO2
II	Understanding and Conceptualizing Interaction Cognitive aspects and Social, Emotional Interaction	Understanding the Problem Space and Conceptualizing Design, Conceptual Model, Interface Types Cognitive aspects, Social Interaction and the Emerging Social Phenomena, Emotions and the User Experience, Expressive and Frustrating Interfaces, Persuasive Technologies	09	CO2,CO3
III	Data Gathering, Establishing Requirements, Analysis, Interpretation and Presentation	Establishing Requirements, Five Key Issues, Techniques for Data Gathering, Data Analysis Interpretation and Presentation, Task Description and Task Analysis	09	CO4
IV	Process of Interaction Design, Prototyping, Construction,	Interaction Design Process, Prototyping and Conceptual Design, Interface Metaphors and Analogies	09	CO4
V	Design rules and Industry standards	Design principles, Principles to support Usability, Standards and Guidelines, Golden rules and Heuristics, ISO/IEC standards	08	CO5
VI	Evaluation Techniques and Framework	The Why, What, Where and When of Evaluation, Types of Evaluation, case studies, DECIDE Framework, Usability Testing, conducting	06	CO5,CO6

		experiments, Field studies, Heuristic Evaluation and walkthroughs, Predictive models.		

Text Books:

1. *Interaction Design*, by J. Preece, Y. Rogers and H. Sharp. ISBN 0-471-49278-7.
2. *Human Computer Interaction*, by Alan Dix, Janet Finlay, Gregory D Abowd, Russell Beale
3. Alan Cooper, Robert Reimann, David Cronin, "About Face3: Essentials of Interaction design", Wiley publication.
4. Wilbert O. Galitz, "The Essential Guide to User Interface Design", Wiley publication.

References:

1. *The UX Book*, by Rex Hartson and Pardha S Pyla.
2. Donald A. Norman, "The design of everyday things", Basic books.
3. Jeff Johnson, "Designing with the mind in mind", Morgan Kaufmann Publication.

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO8042	Information Retrieval System	04	--	--	04	--	--	04

Course Code	CourseName	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of twoTests					
ITDL O804 2	Information Retrieval System	20	20	20	80	--	--	--	100

Course Objectives: students will try:

1. To learn the fundamentals of information retrieval system.
2. To classify various Information retrieval models.
3. To demonstrate the query processing techniques and operations
4. To compare the relevance of query languages for text and multimedia data
5. To evaluate the significance of various indexing and searching techniques for information retrieval.
6. To develop a effective user interface for information retrieval.

Course Outcomes:

1. Students will define and describe the objectives the basic concepts of Information retrieval system.
2. Students will evaluate the taxonomy of different information retrieval models.
3. Students will solve and process text and multimedia retrieval queries and their operations
4. Students will evaluate text processing techniques and operations in information retrieval system.
5. Students will demonstrate and evaluate various indexing and searching techniques.
6. Student will design the user interface for an information retrieval system.

Prerequisite: Data structures and algorithms

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Comment (Prerequisite syllabus should not be considered for paper setting) Indexing and searching Algorithms	02	
I	Introduction	Motivation, Basic Concepts, The retrieval Process, Information System: Components, parts and types on information system; Definition and objectives on information retrieval system	05	CO1
II	IR Models	Modeling: Taxonomy of Information Retrieval Models, Retrieval: Adhoc and filtering, Formal Characteristics of IR models, Classic Information Retrieval, Alternative Set Theoretic models, Probabilistic Models, Structured text retrieval Models, models for Browsing; Multimedia IR models: Data Modeling	09	CO2
III	Query Processing and Operations	Query Languages: Keyword based Querying, Pattern Matching, Structural Queries, Query Protocols; Query Operations: User relevance feedback, Automatic local analysis, Automatic global analysis, Multimedia IR Query Languages	10	CO3
IV	Text Processing	Text and Multimedia languages and properties: Metadata, Markup Languages, Multimedia; Text Operations: Document Preprocessing, Document Clustering, Text Compression, Comparing Text Comparison Technique	10	CO4
V	Indexing and Searching	Inverted files, Other indices for text, Boolean Queries, Sequential Searching, Pattern Matching, Structural Queries, Compression; Multimedia IR: Indexing and Searching:- Spatial Access Methods, A Generic Multimedia indexing approach, One-	11	CO5

		dimensional time series, Two dimensional color images, Automatic Feature extraction; Searching Web: Challenges, Characterizing the web, Search Engines. Browsing, Meta searches, Searching needle in haystack, Searching using Hyperlinks		
VI	User interface and visualization	Human Computer interaction, the information access process, starting points, query specifications, context, using relevance judgments, interface support for the search process	05	CO6

Text Books:

- 1.Modern Information Retrieval, Ricardo Baeza-Yates,berthier Ribeiro- Neto, ACM Press- Addison Wesley
2. Information Retrieval Systems: Theory and Implementation, Gerald Kowaski, Kluwer Academic Publisher
3. Storage Network Management and Retrieval by Dr. Vaishali Khairnar, Nilima Dongre, Wiley India

References:

1. Introduction to Information Retrieval By Christopher D. Manning and Prabhakar Raghavan, Cambridge University Press
2. Information Storage & Retieval By Robert Korfhage – John Wiley & Sons
3. Introduction to Modern Information Retrieval. G.G. Chowdhury. NealSchuman

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination:

Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO8043	Knowledge Management	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITDLO8043	Knowledge Management	20	20	20	80	--	--	--	100

Course Objectives:

1 Establish a foundation of key terms and concepts, historical events and contributions, organizational benefits, and guiding principles on which to build greater understanding of knowledge management

2 Appreciate the role and use of knowledge for individuals, as well as organizations and institutions.

3 Increase information and understanding about knowledge transfer using low- and high technology strategies

4 Explore the future of knowledge management and its influence on our jobs, communities, and society

Course Outcomes: After completion of the course the learner will be able to

- 1) Discuss KM, learning organizations, intellectual capital and related terminologies in clear terms and understand the role of knowledge management in organizations.
- 2) Demonstrate an understanding of the history, concepts, and the antecedents of management of knowledge and describe several successful knowledge management systems
- 3) Evaluate the impact of technology including telecommunications, networks, and Internet/intranet role in managing knowledge.
- 4) Discuss new jobs, roles and responsibilities resulting from the New or Knowledge Economy
Ponder KM's current and future impact on individuals, organizations and society at large

Prerequisite: An introductory course in IT/ IS

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
	Prerequisite	Meaning of data, information, knowledge and expertise Meaning of epistemology, Types of Knowledge - Subjective & Objective views of knowledge, procedural Vs. Declarative, tacit Vs. explicit, general Vs. specific.	3
I	Introduction to Knowledge Management	What is Knowledge? Types of expertise – associational, motor skill, – theoretical Characteristics of knowledge – explicitness, codifiability, teachability, specificity Reservoirs of knowledge, Meaning of Knowledge Management, Forces Driving Organizational issues in KM, KM Systems & their role Relevance of KM in today's dynamic & complex environment Future of Knowledge Management	5
II	Knowledge management system life cycle	Challenges in Building KM Systems – Conventional versus KM System Life Cycle (KMSLS) – Knowledge Creation and Knowledge Architecture – Nonaka's Model of Knowledge Creation and Transformation. Knowledge Architecture.	8
III	KM Solutions for capture, sharing & applications	KM Processes, KM Systems, Mechanisms & Technologies Knowledge Capturing Techniques: Brain Storming – Protocol Analysis – Consensus Decision Making – Repertory Grid- Concept Mapping –Blackboarding, Nominal Group Technique, Delphi method,	9
IV	Knowledge codification	Modes of Knowledge Conversion – Codification Tools and Procedures – Knowledge Developer's Skill Sets – System Testing and Deployment – Knowledge Testing – Approaches to Logical Testing, User Acceptance Testing – KM System Deployment Issues – User Training – Post implementation.	9
V	Knowledge transfer and sharing	Transfer Methods – Role of the Internet – Knowledge Transfer in e-world – KM System Tools – Neural Network – Association Rules – Classification Trees – Data Mining and Business Intelligence – Decision Making Architecture – Data Management – Knowledge Management Protocols – Managing Knowledge Workers.	9

VI	KM Impact	Dimensions of KM Impact – People, Processes, Products & Organizational Performance Factors influencing impact – universalistic & contingency views Assessment of KM Impact – Qualitative & quantitative measures Identification of appropriate KM solutions, Ethical Legal and Managerial Issues	9

Text Books:

1. Irma Becerra-Fernandez, Avelino Gonzalez, Rajiv Sabherwal (2004). Knowledge Management Challenges, Solutions, and Technologies . Prentice Hall. ISBN: 0-13-109931-0.
2. Elias M. Awad, Hassan M. Ghaziri (2004). Knowledge Management. Prentice Hall. ISBN: 0-13-034820-1
3. Donald Hislop, Knowledge Management in Organizations, Oxford 2nd Edition. Ian Watson (2002).
4. Shelda Debowski, Knowledge Management, Wiley India Edition.

References:

1. Madanmohan Rao (2004). Knowledge Management Tools and Techniques: Practitioners and Experts Evaluate KM Solutions. Butterworth-Heinemann. ISBN: 0750678186.
2. Stuart Barnes (Ed.) (2002). Knowledge Management Systems Theory and Practice. Thomson Learning.
3. Kimiz Dalkir, Knowledge Management in Theory and Practice, Elsevier, Butterworth Hinemann.
4. Applying Knowledge Management: Techniques for Building Corporate Memories. Morgan Kaufmann. ISBN: 1558607609.

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO8044	Robotics	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITDLO8044	Robotics	20	20	20	80	--	--	--	100

Course Objectives: Students will try:

1. Learn the basic concepts of Robots.
2. Learn the concepts of Kinematics of Robotics.
3. Learn the concepts of Motions, velocities and dynamic analysis of force.
4. Learn the concepts of Motion planning.
5. Learn the concepts of Trajectory Planning
6. Learn the concepts of Potential Functions, Visibility Graphs and Coverage Planning

Course Outcomes: Student will be able to:

1. Apply the basic concepts of Robots.
2. Apply and evaluate the concepts of Kinematics of Robotics.
3. Apply the Motions, velocities and dynamic analysis of force.
4. Apply and evaluate Motion planning.
5. Apply the concepts of Trajectory Planning
6. Apply the concepts of Potential Functions, Visibility Graphs and Coverage Planning

Prerequisites: Basic of Electrical Engineering.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisites	Basics of Electrical Engineering	02	--
I	Fundamentals	Robot Classification, Robot Components, Degrees of freedom, Joints, Coordinates, Coordinate	04	CO1

		frames, workspace, applications		
II	Kinematics of Robotics	Homogeneous transformation matrices, Inverse transformation matrices, Forward and inverse kinematic equations – position and orientation, Denavit-Hatenberg representation of forward kinematics, Inverse kinematic solutions, Case studies	11	CO2
III	Motions, velocities and dynamic analysis of force	Differential relationship, Jacobian, Differential motion of a frame and robot, Inverse Jacobian. Lagrangian mechanics, Moments of Inertia, Dynamic equations of robots, Transformation of forces and moment between coordinate frames	09	CO3
IV	Trajectory Planning	Trajectory planning, Joint-space trajectory planning, Cartesian-space trajectories	08	CO5
V	Motion Planning	Concept of motion planning, Bug Algorithms – Bug1, Bug2, Tangent Bug	04	CO4
VI	Potential Functions, Visibility Graphs and Coverage Planning	Attractive/Repulsive potential, Gradient descent, wave-front planner, navigation potential functions, Visibility map, Generalized Voronoi diagrams and graphs, Silhouette methods. Cell Decomposition, Localization and Mapping	14	CO6

Text Books:

1. Saeed Benjamin Niku, “Introduction to Robotics – Analysis, Control, Applications”, Wiley India Pvt. Ltd., Second Edition, 2011
2. Howie Choset, Kevin M. Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia E. Kavraki and Sebastian Thrun, “Principles of Robot Motion –Theory, Algorithms and Implementations”, Prentice-Hall of India

References:

1. Mark W. Spong & M. Vidyasagar, “Robot Dynamics & Control”, Wiley India Pvt. Ltd., Second Edition, 2004
2. John J. Craig, “Introduction to Robotics – Mechanics & Control”, Third Edition, Pearson Education, India, 2009
3. Aaron Martinez & Enrique Fernandez, “Learning ROS for Robotics Programming”, Shroff Publishers, First Edition, 2013.

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO8045	Enterprise Resource Planning	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITDLO8045	Enterprise Resource Planning	20	20	20	80	--	--	--	100

Course Objectives: Students will try:

1. To learn the basic concepts of ERP.
2. To learn different technologies used in ERP.
3. To learn the concepts of ERP Manufacturing Perspective and ERP Modules.
4. To learn what are the benefits of ERP
5. To study and understand the ERP life cycle.
6. To learn the different tools used in ERP.

Course Outcomes: Student will be able to:

1. Understand the basic concepts of ERP.
2. Identify different technologies used in ERP.
3. Understand and apply the concepts of ERP Manufacturing Perspective and ERP Modules.
4. Discuss the benefits of ERP
5. Understand and implement the ERP life cycle.
6. Apply different tools used in ERP.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisites	Basics of software.	02	--
I	Introduction to ERP	Enterprise – An Overview Integrated Management Information, Business Modeling, Integrated Data Model	04	CO1

II	ERP Technologies	Business Processing Reengineering(BPR), Data Warehousing, Data Mining, On-line Analytical Processing(OLAP), Supply Chain Management (SCM), Customer Relationship Management(CRM), MIS - Management Information System, DSS - Decision Support System, EIS - Executive Information System	06	CO2
III	ERP Manufacturing Perspective and ERP Modules	MRP - Material Requirement Planning, BOM - Bill Of Material, MRP - Manufacturing Resource Planning, DRP – Distributed Requirement Planning, PDM - Product Data Management. Finance, Plant Maintenance, Quality Management, Materials Management.	10	CO3
IV	Benefits of ERP	Reduction of Lead-Time, On-time Shipment, Reduction in Cycle Time, Improved Resource Utilization, Better Customer Satisfaction, Improved Supplier Performance, Increased Flexibility, Reduced Quality, Costs, Improved Information Accuracy and Design-making Capability	08	CO4
V	ERP Life cycle	Pre-evaluation Screening, Package Evaluation, Project Planning Phase, Gap Analysis, Reengineering, Configuration, Implementation Team Training, Testing, Going Live, End-user Training, Post-implementation (Maintenance mode).	06	CO5
VI	E-Commerce to E-business	E-Business structural transformation, Flexible Business Design, Customer Experience, Create the new techno enterprise, New generation e-business leaders, memo to CEO, Empower your customer, Integrate Sales and Service, Integrated Enterprise applications. Enterprise resource planning the E-business Backbone Enterprise architecture, planning, ERP usage in Real world, ERP Implementation, Future of ERP applications, memo to CEO ,E-Procurement, E- Governance, Developing the E-Business Design.	16	CO6

		JD Edwards-Enterprise One. Microsoft Dynamics-CRM Module.		

Text Books:

1. Enterprise Resource Planning - Alexis Leon, Tata McGraw Hill.
2. Enterprise Resource Planning – Diversified by Alexis Leon, TMH.
3. Enterprise Resource Planning - Ravi Shankar & S. Jaiswal , Galgotia.

References:

1. Guide to Planning ERP Application, Annetta Clewwto and Dane Franklin, McGRaw-Hill, 1997
2. The SAP R/3 Handbook, Jose Antonio, McGraw – Hill
3. E-Business Network Resource planning using SAP R/3 Baan and Peoplesoft : A Practical Roadmap For Success By Dr. Ravi Kalakota

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1 will be compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Credits
ILO8021	Project Management	03

Objectives:

1. To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Outcomes: Learner will be able to...

1. Apply selection criteria and select an appropriate project from different options.
2. Write work break down structure for a project and develop a schedule based on it.
3. Identify opportunities and threats to the project and decide an approach to deal with them strategically.
4. Use Earned value technique and determine & predict status of the project.
5. Capture lessons learned during project phases and document them for future reference

Module	Detailed Contents	Hrs
01	Project Management Foundation: Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge areas as per Project Management Institute (PMI).	5
02	Initiating Projects: How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	6
03	Project Planning and Scheduling: Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart. Introduction to Project Management Information System (PMIS).	8
04	Planning Projects: Crashing project time, Resource loading and leveling, Goldratt's critical chain, Project Stakeholders and Communication plan. Risk Management in projects: Risk management planning, Risk identification and risk register. Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	6
05	5.1 Executing Projects: Planning monitoring and controlling cycle. Information needs and reporting,	8

	engaging with all stakeholders of the projects. Team management, communication and project meetings. 5.2 Monitoring and Controlling Projects: Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep. Project audit. 5.3 Project Contracting Project procurement management, contracting and outsourcing,	
06	6.1 Project Leadership and Ethics: Introduction to project leadership, ethics in projects. Multicultural and virtual projects. 6.2 Closing the Project: Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	6

REFERENCES:

1. Jack Meredith & Samuel Mantel, Project Management: A managerial approach, Wiley India, 7thEd.
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Gido Clements, Project Management, Cengage Learning.
4. Gopalan, Project Management, , Wiley India
5. Dennis Lock, Project Management, Gower Publishing England, 9 th Ed.

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO8022	Finance Management	03

Objectives:

1. Overview of Indian financial system, instruments and market
2. Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
3. Knowledge about sources of finance, capital structure, dividend policy

Outcomes: Learner will be able to...

1. Understand Indian finance system and corporate finance
2. Take investment, finance as well as dividend decisions

Module	Detailed Contents	Hrs
01	Overview of Indian Financial System: Characteristics, Components and Functions of Financial System. Financial Instruments: Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. Financial Markets: Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market Financial Institutions: Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	06
02	Concepts of Returns and Risks: Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. Time Value of Money: Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	06
03	Overview of Corporate Finance: Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. Financial Ratio Analysis: Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	09
04	Capital Budgeting: Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR)	10

	Working Capital Management: Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	
05	Sources of Finance: Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. Capital Structure: Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure	05
06	Dividend Policy: Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	03

REFERENCES:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO8023	Entrepreneurship Development and Management	03

Objectives:

1. To acquaint with entrepreneurship and management of business
2. Understand Indian environment for entrepreneurship
3. Idea of EDP, MSME

Outcomes: Learner will be able to...

1. Understand the concept of business plan and ownerships
2. Interpret key regulations and legal aspects of entrepreneurship in India
3. Understand government policies for entrepreneurs

Module	Detailed Contents	Hrs
01	Overview Of Entrepreneurship: Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	04
02	Business Plans And Importance Of Capital To Entrepreneurship: Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur Entrepreneurship And Business Development: Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	09
03	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	05
04	Indian Environment for Entrepreneurship: key regulations and legal aspects, MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	08
05	Effective Management of Business: Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	08
06	Achieving Success In The Small Business: Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	05

REFERENCES:

1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
6. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. Laghu Udyog Samachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO8024	Human Resource Management	03

Objectives:

1. To introduce the students with basic concepts, techniques and practices of the human resource management.
2. To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations.
3. To familiarize the students about the latest developments, trends & different aspects of HRM.
4. To acquaint the student with the importance of inter-personal & inter-group behavioral skills in an organizational setting required for future stable engineers, leaders and managers.

Outcomes: Learner will be able to...

1. Understand the concepts, aspects, techniques and practices of the human resource management.
2. Understand the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.
3. Gain knowledge about the latest developments and trends in HRM.
4. Apply the knowledge of behavioral skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

Module	Detailed Contents	Hrs
01	Introduction to HR - Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions. - Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues.	5
02	Organizational Behavior (OB) - Introduction to OB Origin, Nature and Scope of Organizational Behavior, Relevance to Organizational Effectiveness and Contemporary issues - Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness - Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behavior. - Motivation: Theories of Motivation and their Applications for Behavioral Change (Maslow, Herzberg, McGregor); - Group Behavior and Group Dynamics: Work groups formal and informal groups and stages of group development. Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. - Case study	7
03	Organizational Structure & Design Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and	6

	stress. • Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership. • Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.	
04	Human resource Planning • Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale. • Performance Appraisal Systems: Traditional & modern methods, Performance Counseling, Career Planning. • Training & Development: Identification of Training Needs, Training Methods	5
05	Emerging Trends in HR • Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes & transformation in HR. Organizational Change, Culture, Environment • Cross Cultural Leadership and Decision Making: Cross Cultural Communication and diversity at work, Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation.	6
06	HR & MIS Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries) Strategic HRM Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals Labor Laws & Industrial Relations Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act	10

REFERENCES:

1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15th edition, 2015
5. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO8025	Professional Ethics and Corporate Social Responsibility (CSR)	03

Objectives:

1. To understand professional ethics in business
2. To recognize corporate social responsibility

Outcomes: Learner will be able to...

1. Understand rights and duties of business
2. Distinguish different aspects of corporate social responsibility
3. Demonstrate professional ethics
4. Understand legal aspects of corporate social responsibility

Module	Detailed Contents	Hrs
01	Professional Ethics and Business: The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	04
02	Professional Ethics in the Marketplace: Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy Professional Ethics and the Environment: Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	08
03	Professional Ethics of Consumer Protection: Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy Professional Ethics of Job Discrimination: Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	06
04	Introduction to Corporate Social Responsibility: Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	05
05	Corporate Social Responsibility: Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	08
06	Corporate Social Responsibility in Globalizing India: Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	08

REFERENCES:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
4. [Corporate Social Responsibility in India \(2015\) by Bidyut Chakrabarty, Routledge, New Delhi.](#)

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO8026	Research Methodology	03

Objectives:

1. To understand Research and Research Process
2. To acquaint students with identifying problems for research and develop research strategies
3. To familiarize students with the techniques of data collection, analysis of data and interpretation

Outcomes: Learner will be able to...

1. Prepare a preliminary research design for projects in their subject matter areas
2. Accurately collect, analyze and report data
3. Present complex data or situations clearly
4. Review and analyze research findings

Module	Detailed Contents	Hrs
01	Introduction and Basic Research Concepts 1.1 Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology 1.2 Need of Research in Business and Social Sciences 1.3 Objectives of Research 1.4 Issues and Problems in Research 1.5 Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	09
02	Types of Research 2.1. Basic Research 2.2. Applied Research 2.3. Descriptive Research 2.4. Analytical Research 2.5. Empirical Research 2.6 Qualitative and Quantitative Approaches	07
03	Research Design and Sample Design 3.1 Research Design – Meaning, Types and Significance 3.2 Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	07
04	Research Methodology 4.1 Meaning of Research Methodology 4.2. Stages in Scientific Research Process: a. Identification and Selection of Research Problem b. Formulation of Research Problem c. Review of Literature d. Formulation of Hypothesis e. Formulation of research Design f. Sample Design g. Data Collection h. Data Analysis i. Hypothesis testing and Interpretation of Data	08

	j. Preparation of Research Report	
05	Formulating Research Problem 5.1 Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	04
06	Outcome of Research 6.1 Preparation of the report on conclusion reached 6.2 Validity Testing & Ethical Issues 6.3 Suggestions and Recommendation	04

REFERENCES:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R., 1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nded), Singapore, Pearson Education

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or at least 6 assignment on complete syllabus or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO8027	IPR and Patenting	03

Objectives:

1. To understand intellectual property rights protection system
2. To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
3. To get acquaintance with Patent search and patent filing procedure and applications

Outcomes: Learner will be able to...

1. understand Intellectual Property assets
2. assist individuals and organizations in capacity building
3. work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

Module	Detailed Contents	Hr
01	Introduction to Intellectual Property Rights (IPR): Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc. Importance of IPR in Modern Global Economic Environment: Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	05
02	Enforcement of Intellectual Property Rights: Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement Indian Scenario of IPR: Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	07
03	Emerging Issues in IPR: Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	05
04	Basics of Patents: Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	07
05	Patent Rules: Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	08
06	Procedure for Filing a Patent (National and International): Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication etc, Time frame and cost, Patent Licensing, Patent Infringement	07

REFERENCE BOOKS:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. Lous Harns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi, IPR: Drafting, Interpretation of Patent Specifications and Claims, New India Publishing Agency
14. Vivien Irish, 2005, Intellectual Property Rights for Engineers, IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or at least 6 assignment on complete syllabus or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO8028	Digital Business Management	03

Objectives:

1. To familiarize with digital business concept
2. To acquaint with E-commerce
3. To give insights into E-business and its strategies

Outcomes: The learner will be able to

1. Identify drivers of digital business
2. Illustrate various approaches and techniques for E-business and management
3. Prepare E-business plan

Module	Detailed content	Hours
1	Introduction to Digital Business- Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy, Drivers of digital business- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) Opportunities and Challenges in Digital Business,	09
2	Overview of E-Commerce E-Commerce- Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	06

3	Digital Business Support services: ERP as e –business backbone, knowledge Tope Apps, Information and referral system Application Development: Building Digital business Applications and Infrastructure	06
4	Managing E-Business- Managing Knowledge, Management skills for e-business, Managing Risks in e –business Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	06
5	E-Business Strategy- E-business Strategic formulation- Analysis of Company’s Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	04
6	Materializing e-business: From Idea to Realization- Business plan preparation Case Studies and presentations	08

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2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, Vinocenzo Morabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective -DOI:[10.1787/9789264221796-en](https://doi.org/10.1787/9789264221796-en) OECD Publishing

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or at least 6 assignment on complete syllabus or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO8029	Environmental Management	03

Objectives:

1. Understand and identify environmental issues relevant to India and global concerns
2. Learn concepts of ecology
3. Familiarise environment related legislations

Outcomes: Learner will be able to...

1. Understand the concept of environmental management
2. Understand ecosystem and interdependence, food chain etc.
3. Understand and interpret environment related legislations

Module	Detailed Contents	Hrs
01	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities. Environmental issues relevant to India, Sustainable Development, The Energy scenario.	10
02	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	06
03	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	05
04	Scope of Environment Management, Role & functions of Government as a planning and regulating agency. Environment Quality Management and Corporate Environmental Responsibility	10
05	Total Quality Environmental Management, ISO-14000, EMS certification.	05
06	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	03

REFERENCES:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management, **T V Ramachandra and Vijay Kulkarni, TERI Press**
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Macmillan India, 2000

6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press
7. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing, 2015

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

AC-11.05.2017

Item No. 4.210

UNIVERSITY OF MUMBAI



Revised syllabus (Rev- 2016) from Academic Year 2016 -17
Under

FACULTY OF TECHNOLOGY

Electronics and Telecommunication Engineering

Second Year with Effect from AY 2017-18

Third Year with Effect from AY 2018-19

Final Year with Effect from AY 2019-20

As per **Choice Based Credit and Grading System**
with effect from the AY 2016–17

Co-ordinator, Faculty of Technology's Preamble:

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's). It is also resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Choice based Credit and Grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

Choice based Credit and grading system is implemented from the academic year 2016-17 through optional courses at department and institute level. This will be effective for SE, TE and BE from academic year 2017-18, 2018-19 and 2019-20 respectively.

Dr. S. K. Ukarande
Co-ordinator,
Faculty of Technology,
Member - Academic Council
University of Mumbai, Mumbai

Chairman's Preamble:

The curriculum in higher education is a living entity. It evolves with time; it reflects the ever changing needs of the society and keeps pace with the growing talent of the students and the faculty. The engineering education in India is expanding in manifolds and the main challenge is the quality of education. All stakeholders are very much concerned about it. The curriculum of Electronics & Telecommunication in Mumbai University is no exception. In keeping with the demands of the changing times, it contains innovative features. The exposure to the latest technology and tools used all over the world is given by properly selecting the subjects. It is designed in such a way to incorporate the requirements of various industries. The major emphasis of this process is to measure the outcomes of the program. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of post-graduation. So the curriculum must be refined and updated to ensure that the defined objectives and outcomes are achieved.

I, as Chairman Ad-hoc Board of Studies in Electronics and Telecommunication Engineering, University of Mumbai, happy to state here that, the heads of the department and senior faculty from various institutes took timely and valuable initiative to frame the Program Educational objectives as listed below.

Objectives:

1. To produce Electronics & Telecommunication engineers, having strong theoretical foundation, good design experience and exposure to research and development.
2. To produce researcher who have clear thinking, articulation and interest to carry out theoretical and/or applied research resulting in significant advancement in the field of specialization.
3. To develop an ability to identify, formulate and solve electronics and telecommunication engineering problems in the latest technology.
4. To develop the ability among students to synthesize data and technical concepts from applications to product design.

These are the suggested and expected main objectives, individual affiliated institutes may add further in the list. I believe that the small step taken in the right direction will definitely help in providing quality education to the stake holders.

This book of curricula is the culmination of large number of faculty members and supporting staff. It also reflects the creative contribution of hundreds of teachers – both serving and retired. I sincerely hope that the faculty and students of Electronics and Telecommunication in Mumbai University will take full advantage of dynamic features of curriculum and make teaching-learning process a truly sublime experience for all.

At the end I must extend my gratitude to all experts and colleagues who contributed to make curriculum competent at par with latest technological development in the field of Electronics & Telecommunication Engineering.

Dr. Uttam D. Kolekar

Chairman, Ad-hoc Board of Studies in Electronics and Telecommunication Engineering

**Program Structure for
B.E. Electronics & Telecommunication Engineering (Rev. 2016)
University of Mumbai
(With Effect from 2017-2018)**

Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned		
		Theory	Pracs	Tut	Theory	TW/ Pracs	Total
ECC301	Applied Mathematics- III	4	-	2@	4	1	5
ECC302	Electronic Devices and Circuits I	4	-	-	4	-	4
ECC303	Digital System Design	4	-	-	4	-	4
ECC304	Circuit Theory and Networks	4	-	2@	4	1	5
ECC305	Electronic Instrumentation and Control	4	-	2@	4	1	5
ECL301	Electronic Devices and Circuits I Laboratory	-	2	-	-	1	1
ECL302	Digital System Design Laboratory	-	2	-	-	1	1
ECL303	OOP using JAVA Laboratory	-	2	-	-	1	1
Total		20	6	6	20	6	26

@ 2 hour to be taken as tutorial classwise

Course Code	Course Name	Examination Scheme							
		Theory					TW	Oral/ Prac	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
ECC301	Applied Mathematics-III	20	20	20	80	03	25	--	125
ECC302	Electronic Devices and Circuits I	20	20	20	80	03	--	--	100
ECC303	Digital System Design	20	20	20	80	03	--	--	100
ECC304	Circuit Theory and Networks	20	20	20	80	03	25	--	125
ECC305	Electronic Instrumentation and Control	20	20	20	80	03	25	--	125
ECL301	Electronic Devices and Circuits I Laboratory	--	--	--	--	--	25	25	50
ECL302	Digital System Design Laboratory	--	--	--	--	--	25	25	50
ECL303	OOP using JAVA Laboratory	--	--	--	--	--	25	25	50
Total				100	400		150	75	725

Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned		
		Theory	Pracs	Tut	Theory	TW/ Pracs	Total
ECC401	Applied Mathematics- IV	4	-	2@	4	1	5
ECC402	Electronic Devices and Circuits II	4	-	-	4	-	4
ECC403	Linear Integrated Circuits	4	-	-	4	-	4
ECC404	Signals & Systems	4	-	2@	4	1	5
ECC405	Principles of Communication Engineering	4	-	-	4	-	4
ECL401	Electronic Devices and Circuits II Laboratory	-	2	-	-	1	1
ECL402	Linear Integrated Circuits Laboratory	-	2	-	-	1	1
ECL403	Principles of Communication Engineering Laboratory	-	2	-	-	1	1
Total		20	6	4	20	5	25

@ 2 hour to be taken as tutorial classwise

Course Code	Course Name	Examination Scheme							
		Theory					TW	Oral & Prac	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
ECC401	Applied Mathematics- IV	20	20	20	80	03	25	--	125
ECC402	Electronic Devices and Circuits II	20	20	20	80	03	--	--	100
ECC403	Linear Integrated Circuits	20	20	20	80	03	--	--	100
ECC404	Signals & Systems	20	20	20	80	03	25	--	125
ECC405	Principles of Communication Engineering	20	20	20	80	03	--	--	100
ECL401	Electronic Devices and Circuits II Laboratory	--	--	--	--	--	25	25	50
ECL402	Linear Integrated Circuits Laboratory	--	--	--	--	--	25	25	50
ECL403	Principles of Communication Engineering Laboratory	--	--	--	--	--	25	25	50
Total				100	400		125	75	700

Semester V

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned		
		Theory	Pracs	Tut	Theory	TW/ Pracs	Total
ECC501	Microprocessor & Peripherals Interfacing	4	-	-	4	-	4
ECC502	Digital Communication	4	-	-	4	-	4
ECC503	Electromagnetic Engineering	4	-	1@	4	1	5
ECC504	Discrete Time Signal Processing	4	-	-	4	-	4
ECCDLO 501X	Department Level Optional Course I	4	-	-	4	-	4
ECL501	Microprocessor & Peripherals Interfacing Lab	-	2	-	-	1	1
ECL502	Digital Communication Lab	-	2	-	-	1	1
ECL503	Business Communication & Ethics Lab	-	2+2*	-	-	2	2
ECL504	Open Source Technology for Communication Lab	-	2	-	-	1	1
ECLDLO 501X	Department Level Optional Lab I	-	-	2#	-	1	1
Total		20	10	3	20	7	27

@ 1 hour to be taken as tutorial classwise #2 hours to be taken as either lab or tutorial based on subject requirement
 *2 hours to be taken as tutorial batchwise

Course Code	Course Name	Examination Scheme							
		Theory					TW	Oral/ Prac	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
ECC501	Microprocessor & Peripherals Interfacing	20	20	20	80	03	--	--	100
ECC502	Digital Communication	20	20	20	80	03	--	--	100
ECC503	Electromagnetic Engineering	20	20	20	80	03	25	--	125
ECC504	Discrete Time Signal Processing	20	20	20	80	03	--	--	100
ECCDLO 501X	Department Level Optional Course I	20	20	20	80	03	--	--	100
ECL501	Microprocessor & Peripherals Interfacing Lab	--	--	--	--	--	25	25	50
ECL502	Digital Communication Lab	--	--	--	--	--	25	25	50
ECL503	Business Communication & Ethics Lab	--	--	--	--	--	50	--	50
ECL504	Open Source Technology for Communication Lab	--	--	--	--	--	25	25	50
ECLDLO 501X	Department Level Optional Lab I	--	--	--	--	--	25	--	25
Total				100	400		175	75	750

Course Code	Department Level Optional Course I
ECCDLO 5011	Microelectronics
ECCDLO 5012	TV & Video Engineering
ECCDLO 5013	Finite Automata Theory
ECCDLO 5014	Data Compression and Encryption

Semester VI

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned		
		Theory	Pracs	Tut	Theory	TW/ Pracs	Total
ECC601	Microcontrollers & Applications	4	-	--	4	--	4
ECC602	Computer Communication Networks	4	-	-	4	-	4
ECC603	Antenna & Radio Wave Propagation	4	-	-	4	-	4
ECC604	Image Processing and Machine Vision	4	-	--	4	--	4
ECCDLO 602X	Department Level Optional Course II	4	-	-	4	-	4
ECL601	Microcontroller & Applications Lab	-	2	-	-	1	1
ECL602	Computer Communication Network Lab	-	2	-	-	1	1
ECL603	Antenna & Radio Wave Propagation Lab	-	2	-	-	1	1
ECL604	Image Processing and Machine Vision Lab	-	2	-	-	1	1
ECLDLO 602X	Department Level Optional Lab II	-	2	-	-	1	1
Total		20	10	-	20	5	25

Course Code	Course Name	Examination Scheme							
		Theory					TW	Oral & Prac	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
ECC601	Microcontroller& Applications	20	20	20	80	03	--	--	100
ECC602	Computer Communication Network	20	20	20	80	03	--	--	100
ECC603	Antenna & Radio Wave Propagation	20	20	20	80	03	--	--	100
ECC604	Image Processing and Machine Vision Lab	20	20	20	80	03	--	--	100
ECCDLO 602X	Department Level Optional Course II	20	20	20	80	03	--	--	100
ECL601	Microcontroller & Applications Lab	--	--	--	--	--	25	25	50
ECL602	Computer Communication Network Lab	--	--	--	--	--	25	25	50
ECL603	Antenna & Radio Wave Propagation Lab	--	--	--	--	--	25	25	50
ECL604	Image Processing and Machine Vision Lab	--	--	--	--	--	25	25	50
ECLDLO 602X	Department Level Optional Lab II	--	--	--	--	--	25	--	25
Total				100	400		125	100	725

Course Code	Department Level Optional Course II
ECCDLO 6021	Digital VLSI Design
ECCDLO 6022	Radar Engineering
ECCDLO 6023	Database Management System
ECCDLO 6024	Audio Processing

Semester VII

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned		
		Theory	Pracs	Tut	Theory	TW/ Pracs	Total
ECC701	Microwave Engineering	4	-	-	4	-	4
ECC702	Mobile Communication System	4	-	-	4	-	4
ECC703	Optical Communication	4	-	--	4	-	4
ECCDLO 703X	Department Level Optional Course III	4	-	-	4	-	4
ILO701X	Institute Level Optional Course I	3	-	-	3	-	3
ECL701	Microwave Engineering Lab	-	2	-	-	1	1
ECL702	Mobile Communication System Lab	-	2	-	-	1	1
ECL703	Optical Communication Lab	-	2	-	-	1	1
ECLDLO 703X	Department Level Optional Lab III	-	2	-	-	1	1
ECL704	Project-I	-	6	-	-	3	3
Total		19	14	-	19	7	26

Course Code	Course Name	Examination Scheme							
		Theory					TW	Oral & Prac	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
ECC701	Microwave Engineering	20	20	20	80	03	--	--	100
ECC702	Mobile Communication System	20	20	20	80	03	--	--	100
ECC703	Optical Communication	20	20	20	80	03	--	--	100
ECCDLO 703X	Department Level Optional Course III	20	20	20	80	03	--	--	100
ILO701X	Institute Level Optional Course I	20	20	20	80	03	--	--	100
ECL701	Microwave Engineering Lab	--	--	--	--	--	25	25	50
ECL702	Mobile Communication System Lab	--	--	--	--	--	25	25	50
ECL703	Optical Communication Lab	--	--	--	--	--	25	25	50
ECLDLO 703X	Department Level Optional Lab III	--	--	--	--	--	25	25	50
ECL704	Project-I	--	--	--	--	--	50	50	100
Total				100	400		150	150	800

Course Code	Department Level Optional Course III	Course Code	Institute Level Optional Course I[#]
ECCDLO7031	Neural Networks and Fuzzy Logic	ILO7011	Product Lifecycle Management
ECCDLO7032	Big Data Analytics	ILO7012	Reliability Engineering
ECCDLO7033	Internet Communication Engineering	ILO7013	Management Information System
ECCDLO7034	CMOS Mixed Signal VLSI	ILO7014	Design of Experiments
ECCDLO7034	Embedded System	ILO7015	Operation Research
		ILO7016	Cyber Security and Laws
		ILO7017	Disaster Management and Mitigation Measures
		ILO7018	Energy Audit and Management
		ILO7019	Development Engineering

Common with all branches

Semester VIII

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned		
		Theory	Pracs	Tut	Theory	TW/ Pracs	Total
ECC801	RF Design	4	-	--	4	--	4
ECC802	Wireless Networks	4	-	-	4	-	4
ECCDLO 804X	Department Level Optional Course IV	4	-	-	4	-	4
ILO802X	Institute Level Optional Course II	3	-	-	3	-	3
ECL801	RF Design Lab	-	2	-	-	1	1
ECL802	Wireless Networks Lab	-	2	-	-	1	1
ECLDLO 804X	Department Level Optional Lab IV	-	2	-	-	1	1
ECL803	Project-II	-	12	-	-	6	6
Total		15	18	-	15	9	24

Course Code	Course Name	Examination Scheme							
		Theory					TW	Oral & Prac	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
ECC801	RF Design	20	20	20	80	03	--	--	100
ECC802	Wireless Networks	20	20	20	80	03	--	--	100
ECCDLO 804X	Department Level Optional Course IV	20	20	20	80	03	--	--	100
ILO802X	Institute Level Optional Course II	20	20	20	80	03	--	--	100
ECL801	RF Design Lab	--	--	--	--	--	25	25	50
ECL802	Wireless Networks Lab	--	--	--	--	--	25	25	50
ECLDLO 804X	Department Level Optional Lab IV	--	--	--	--	--	25	25	50
ECL803	Project-II	--	--	--	--	--	100	50	150
Total				80	320		175	125	700

Course Code	Department Level Elective Course IV	Course Code	Institute Level Elective Course II [#]
ECCDLO8041	Optical Networks	ILO8021	Project Management
ECCDLO8042	Advanced Digital Signal Processing	ILO8022	Finance Management
ECCDLO8043	Satellite Communication	ILO8023	Entrepreneurship Development and Management
ECCDLO8044	Network management in Telecommunication	ILO8024	Human Resource Management
		ILO8025	Professional Ethics and CSR
		ILO8026	Research Methodology
		ILO8027	IPR and Patenting
		ILO8028	Digital Business Management
		ILO8029	Environmental Management

Common with all branches

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC301	Applied Mathematics-III	04	--	@2	04	--	01	05

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC301	Applied Mathematics-III	20	20	20	80	25	--	--	125

@ 2 hour to be taken as tutorial classwise

Course Pre-requisite:

- Applied Mathematics I
- Applied Mathematics II

Course Objectives:

1. To build the strong foundation in Mathematics of students needed for the field of electronics and Telecommunication Engineering
2. To provide students with mathematics fundamentals necessary to formulate, solve and analyses complex engineering problems.
3. To prepare student to apply reasoning informed by the contextual knowledge to engineering practice.
4. To prepare students to work as part of teams on multi-disciplinary projects.

Course Outcome:

After successful completion of the course student will be able to

1. Students will demonstrate basic knowledge of Laplace Transform. Fourier series, Bessel Functions, Vector Algebra and Complex Variable.
2. Students will demonstrate an ability to identify and Model the problems of the field of Electronics and Telecommunication and solve it.
3. Students will be able to apply the application of Mathematics in Telecommunication Engineering

Module No.	Unit No.	Detailed Content	Hours
1		Laplace Transform	07
	1.1	Laplace Transform (LT) of Standard Functions: Definition of Laplace transform, Condition of Existence of Laplace transform, Laplace transform of e^{at} , $\sin(at)$, $\cos(at)$, $\sinh(at)$, $\cosh(at)$, t^n Heaviside unit step function, Dirac-delta function, Laplace transform of Periodic function	
	1.2	Properties of Laplace Transform: Linearity, first shifting theorem, second shifting theorem, multiplication by t^n , Division by t , Laplace Transform of derivatives and integrals, change of scale, convolution theorem, Evaluation of integrals using Laplace transform.	
2		Inverse Laplace Transform & its Applications	06
	2.1	Partial fraction method, Method of convolution, Laplace inverse by derivative	
	2.2	Applications of Laplace Transform: Solution of ordinary differential equations, Solving RLC circuit differential equation of first order and second order with boundary condition using Laplace transform (framing of differential equation is not included)	
3		Fourier Series	11
	3.1	Introduction: Orthogonal and orthonormal set of functions, Introduction of Dirichlet's conditions, Euler's formulae.	
	3.2	Fourier Series of Functions: Exponential, trigonometric functions of any period $=2L$, even and odd functions, half range sine and cosine series	
	3.3	Complex form of Fourier series, Fourier integral representation, Fourier Transform and Inverse Fourier transform of constant and exponential function.	
4		Vector Algebra & Vector Differentiation	07
	4.1	Review of Scalar and Vector Product: Scalar and vector product of three and four vectors, Vector differentiation, Gradient of scalar point function, Divergence and Curl of vector point function	
	4.2	Properties: Solenoidal and irrotational vector fields, conservative vector field	

5		Vector Integral	06
	5.1	Line integral	
	5.2	Green's theorem in a plane, Gauss' divergence theorem and Stokes' theorem	
6		Complex Variable & Bessel Functions	11
	6.1	Analytic Function: Necessary and sufficient conditions (No Proof), Cauchy Reiman equation Cartesian form (No Proof) Cauchy Reiman Equation in polar form (with Proof), Milne Thomson Method and it application, Harmonic function, orthogonal trajectories	
	6.2	Mapping: Conformal mapping, Bilinear transformations, cross ratio, fixed points	
	6.3	Bessel Functions: Bessel's differential equation, Properties of Bessel function of order +1/2 and -1/2, Generating function, expression of $\cos(x\sin\theta)$, $\sin(x\sin\theta)$ in term of Bessel functions	

Note: Term Work should be based on Tutorials.

Textbooks :

1. H.K. Das, “*Advanced engineering mathematics*”, S . Chand, 2008
2. A. Datta, “*Mathematical Methods in Science and Engineering*”, 2012
3. B.S. Grewal, “*Higher Engineering Mathematics*”, Khanna Publication

Reference Books:

1. B. V. Ramana, “*Higher Engineering Mathematics*”, Tata Mc-Graw Hill Publication
2. Wylie and Barret, “*Advanced Engineering Mathematics*”, Tata Mc-Graw Hill 6th Edition
3. Erwin Kreysizg, “*Advanced Engineering Mathematics*”, John Wiley & Sons, Inc
4. Murry R. Spieget, “*Vector Analysis*”, Schaum's outline series, Mc-Graw Hill Publication

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC302	Electronic Devices & Circuits-I	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC302	Electronic Devices & Circuits-I	20	20	20	80	--	--	--	100

Course Pre-requisite:

- Basic Electrical Engineering
- Applied Physics

Course Objectives:

1. To understand operation of semiconductor devices.
2. To understand DC analysis and AC models of semiconductor devices.
3. To apply concepts for the design of Regulators and Amplifiers
4. To verify the theoretical concepts through laboratory and simulation experiments.
5. To implement mini projects based on concept of electronics circuit concepts.

Course Outcome:

After successful completion of the course student will be able to

1. Understand the current voltage characteristics of semiconductor devices,
2. Analyze dc circuits and relate ac models of semiconductor devices with their physical Operation,
3. Design and analyze of electronic circuits,
4. Evaluate frequency response to understand behaviour of Electronics circuits.

Module No.	Unit No.	Detailed Content	Hours
1		Diode and material science	06
	1.1	Study of various types of resistor, capacitor and inductors	
	1.2	Basic fabrication steps of passive elements.	
	1.3	PN junction Diode characteristics, small signal model	
2		Rectifier, Filters and Regulator	08
	2.1	Analysis and design of rectifier circuit with Filters (L, LC, C,CLC,CRC)	
	2.2	Concept of load and line regulation in power supply circuits.	
	2.3	Analysis and design of zener voltage regulator	
3		Transistor biasing and design	08
	3.1	Operation of BJT, FET (N-CHANNEL, P-CHANNEL) with characteristics and equation.	
	3.2	Bipolar Junction Transistor: BJT characteristics, DC/AC load line, DC analysis and design of fixed bias, collector to base bias and voltage divider bias, stability factor analysis	
	3.3	Junction Field Effect Transistor: Analysis and design of self-bias and voltage divider bias, zero temp drift biasing.	
4		Transistor modeling and Small signal analysis of amplifier	12
	4.1	Hybrid and hybrid-pi model of BJT with graphical representation.	
	4.2	Small signal model of FET with graphical representation.	
	4.3	Small signal analysis (Z_i , Z_o , A_v and A_i) of CE, CB, and CC configurations using hybrid-pi model of BJT	
	4.4	small signal (mid-frequency) analysis of CS, CD and CG amplifiers using FET	
5		High frequency response of BJT and FET amplifiers	08
	5.1	High frequency hybrid-pi equivalent Circuits of BJT and FET, Miller effect and Miller capacitance, gain bandwidth product	
	5.2	Effects of capacitors on frequency response of single stage amplifier using BJT and FET	
	5.3	Analysis of single stage amplifiers at HF and gain bandwidth product.	

6		Design of small signal amplifiers	06
	6.1	Design of single stage RC Coupled CE amplifier.	
	6.2	Design of single stage RC Coupled CS amplifier. (USE of parameters from data sheet compulsory)	

Textbooks :

1. D. A. Neamen, "*Electronic Circuit Analysis and Design*," Tata McGraw Hill, 2nd Edition.
2. A. S. Sedra, K. C. Smith, and A. N. Chandorkar, "*Microelectronic Circuits Theory and Applications*," International Version, OXFORD International Students, 6th Edition
3. R. S. Dudhe and M. Farhan, "*Electronic Devices and Circuits*," Synergy Knowledgeware, 1st Edition, 2013.

Reference Books:

1. Boylestad and Nashelsky, "*Electronic Devices and Circuits Theory*," Pearson Education, 11th Edition.
2. A. K. Maini, "*Electronic Devices and Circuits*," Wiley.
3. T. L. Floyd, "*Electronic Devices*," Prentice Hall, 9th Edition, 2012.
4. A. Rockett, "*Material Science of Semiconductors*," Springer, 1st Edition, 2009
5. A. Mottershead, "*Electronic Devices and Circuits; An Introduction*,"

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC303	Digital System Design	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC303	Digital System Design	20	20	20	80	--	--	--	100

Course Objectives:

1. To understand number representation and conversion between different representation in digital electronic circuits.
2. To analyze logic processes and implement logical operations using combinational logic circuits.
3. To understand characteristics of memory and their classification.
4. To understand concepts of sequential circuits and to analyze sequential systems in terms of state machines.
5. To understand concept of Programmable Devices, PLA, PAL, CPLD and FPGA and implement digital system using VHDL.
6. To implement combinational and sequential circuits using VHDL.

Course Outcome:

After successful completion of the course student will be able to

1. Develop a digital logic and apply it to solve real life problems.
2. Analyze, design and implement combinational logic circuits.
3. Classify different semiconductor memories.
4. Analyze, design and implement sequential logic circuits.
5. Analyze digital system design using PLD.
6. Simulate and implement combinational and sequential circuits using VHDL systems.

Module No.	Unit No.	Detailed Content	Hours
1		Number Systems and Codes	04
	1.1	Review of Number System, Binary Code, Binary Coded Decimal, Octal Code, Hexadecimal Code and their conversions, Binary Arithmetics, Gray Code	
2		Logic Gates and Combinational Logic Circuits	18
	2.1	Analog and Digital signals and systems, Logic levels, TTL and CMOS Logic families and their characteristics	
	2.2	Digital logic gates, Realization using NAND, NOR gates, Boolean Algebra, De Morgan's Theorem, SOP and POS representation, K Map up to four variables and Quine-McClusky method	
	2.3	Arithmetic Circuits: Half adder, Full adder, Half Subtractor, Full Subtractor, Serial and Parallel Addition, Carry Look ahead adder and BCD adder. Binary Multiplier, Magnitude Comparator,	
	2.4	Multiplexer and De-multiplexer: Multiplexer operations, cascading of Multiplexer, Boolean Function implementation using multiplexer and basic gates, de-multiplexer, encoder and decoder	
3		Different Types of Memory	02
		Classification and Characteristics of memory, SRAM, DRAM, ROM, PROM, EPROM and Flash memories	
4		Sequential Logic Circuits:	12
	4.1	Flip flops: RS, JK, Master slave flip flops; T & D flip flops with various triggering methods, Conversion of flip flops, Registers: SISO, SIPO, PISO, PIPO, Universal shift registers.	
	4.2	Counters: Asynchronous and Synchronous, Up/Down, MOD N, BCD	
	4.3	Applications of Sequential Circuits: Frequency division, Ring Counter, Johnson Counter. models, State transition diagram, Design of Moore and Mealy circuits-Design of Serial Adder and vending Machine	
	4.4	State Reduction Techniques: Row elimination and Implication table methods	
5		Programmable Logic Devices:	09
		Introduction : Programmable Logic Devices (PLD),	

		Programmable Logic Array (PLA), Programmable Array Logic(PAL), CPLD and FPGA, Keyboard Encoder system design using PLD	
6		VHSIC Hardware Description Language (VHDL)	03
	6.1	Data types, Structural modeling using VHDL, Attributes, Data Flow behavioral, Implementation of Priority Encoder-combinational circuit and Fibonacci Series Generator-sequential circuits using VHDL	

Textbooks :

1. John F. Warkerly, “*Digital Design Principles and Practices*”, Pearson Education, Fourth Edition (2008).
2. R. P. Jain, “*Modern Digital Electronics*”, Tata McGraw Hill Education, Third Edition (2003).
3. J. Bhaskar, “*VHDL Primer*”, PHI, Third Edition (2009).
4. Volnei A. Pedroni, “*Digital Electronics and Design with VHDL*” Morgan Kaufmann Publisher (2008)

Reference Books:

1. Morris Mano / Michael D. Ciletti, “*Digital Design*”, Pearson Education, Fourth Edition (2008).
2. Thomas L. Floyd, “*Digital Fundamentals*”, Pearson Prentice Hall, Eleventh Global Edition (2015).
3. Mandal, “*Digital Electronics Principles and Applications*”, McGraw Hill Education, First Edition (2010).
4. Stephen Brown & Zvonko Vranesic, “*Fundamentals of Digital Logic Design with VHDL*”, Second Edition, TMH (2009).
5. Ronald J. Tocci, Neal S. Widmer, “*Digital Systems Principles and Applications*”, Eighth Edition, PHI (2003)
6. Donald P. Leach / Albert Paul Malvino/Gautam Saha, “*Digital Principles and Applications*”, The McGraw Hill, Seventh Edition (2011).

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC304	Circuit Theory and Networks	04	--	@2	04	--	1	05

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC304	Circuit Theory and Networks	20	20	20	80	25	--	--	125

@ 2 hour to be taken as tutorial classwise

Course Pre-requisite:

- Basic Electrical Engineering
- Solution to Differential Equations and Laplace Transform

Course Objectives:

1. To analyze the Circuits in time and frequency domain
2. To study network Topology, network Functions, two port network
3. To synthesize passive network by various methods

Course Outcome:

After successful completion of the course student will be able to

1. Apply their knowledge in analysing Circuits by using network theorems.
2. Apply the time and frequency method of analysis.
3. Find the various parameters of two port network.
4. Apply network topology for analyzing the circuit
5. Synthesize the network using passive elements.

Module No.	Unit No.	Detailed Content	Hours
1		Electrical circuit analysis	08
	1.1	Analysis of DC & AC Circuits: Analysis of Circuits with and without controlled sources using generalized loop and node matrix methods Circuit Theorems: Superposition, Thevenin's, Norton's, maximum power transfer and reciprocity theorems	
	1.2	Magnetic circuits: Concept of Self and mutual inductances, coefficient of coupling, dot convention, equivalent circuit Coupled circuit- solution using mesh analysis	
2		Graph Theory	08
	2.1	Objectives of graph theory, Linear Oriented Graphs, graph terminologies Matrix representation of a graph: Incidence matrix, Circuit matrix, Cut-set matrix, reduced incident matrix, tieset matrix, f-cutset matrix.	
	2.2	Relationship between sub matrices A, B & Q.	
	2.3	KVL & KCL using matrix	
3		Time and frequency domain analysis	08
	3.1	Time domain analysis of R-L and R-C Circuits: Forced and natural response, initial and final values Solution using first order differential equation for impulse, step, ramp, exponential & sinusoidal signals	
	3.2	Time domain analysis of R-L-C Circuits: Forced and natural response, effect of damping factor. Solution using second order equation for step, ramp, exponential & sinusoidal signals.	
	3.3	Frequency domain analysis: Frequency - domain representation of R, L, C, initial value theorem & final value theorem, applications of Laplace Transform in analyzing electrical circuits	
4		Network functions	08
	4.1	Network functions for the one port and two port networks, Driving point and transfer functions, Poles and Zeros of Network functions, necessary condition for driving point functions, necessary condition for transfer functions, calculation of residues by analytical and graphical methods,	

		Time domain behavior as related to the Pole-Zero plot Stability & causality, testing for Hurwitz polynomial	
	4.2	Analysis of ladder & symmetrical lattice network	
5		Two port Networks	08
	5.1	Parameters: Open Circuits, short Circuit, Transmission and Hybrid parameters, relationship among parameters, conditions for reciprocity and symmetry	
	5.2	Interconnections of Two-Port networks T & π representation.	
	5.3	Terminated two-port networks	
6		Synthesis of RLC circuits	08
	6.1	Positive Real Functions: Concept of positive real function , testing for necessary and sufficient conditions for Positive real Functions	
	6.2	Synthesis of LC, RC & RL Circuits: properties of LC, RC & RL driving point functions, LC, RC & RL network Synthesis in Cauer-I & Cauer-II , Foster-I & Foster-II forms	

Note: Term Work should be based on Tutorials.

Textbooks :

1. Franklin F Kuo, “*Network Analysis and Synthesis*”, Wiley Toppan, 2nd.ed. 1966
2. M E Van Valkenburg, “*Network Analysis*”, Prentice-Hall of India Pvt Ltd, New Delhi, 26th Indian Reprint, 2000

Reference Books:

1. A Chakrabarti, “*Circuit Theory*”, Dhanpat Rai & Co., Delhi, 6h Edition
2. A. Sudhakar, Shyammohan S. Palli “*Circuits and Networks*, Tata McGraw-Hill education
3. Smarajit Ghosh, *Network Theory Snalysis & Syntshesis*, PHI learning
4. K.S. Suresh Kumar, *Electric circuit analysis*, Pearson (2013)
5. D Roy Choudhury, *Networks and Systems*, New Age International 1998.

TUTORIALS: At least 10 tutorials covering various topics of the syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC305	Electronic Instrumentation & Control	04	--	@2	04	--	1	05

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC305	Electronic Instrumentation & Control	20	20	20	80	25	--	--	125

@ 2 hour to be taken as tutorial classwise

Course Pre-requisite:

- Basic Electrical Engineering

Course Objectives:

1. To provide basic knowledge about the various sensors and data acquisition systems applied in Wireless sensor network.
2. To provide fundamental concepts of control system such as mathematical modeling, time response and frequency response.
3. To develop concepts of stability and its assessment criteria.

Course Outcome:

After successful completion of the course student will be able to

1. Students will be able to explain principle of operation for various sensors.
2. Students will be able to describe functional blocks of data acquisition system.
3. Students will be able to find transfer functions for given system.
4. Students will be able to calculate time domain and frequency domain parameter for given system
5. Students will be able to predict stability of given system using appropriate criteria.

Module No.	Unit No.	Detailed Content	Hours
1		Principle of Measurement, Testing and Measuring instruments	07
	1.1	Introduction to Basic instruments: Components of generalized measurement system Concept of accuracy, precision, linearity, sensitivity, resolution, hysteresis, calibration.	
	1.2	Measurement of Resistance: Kelvin's double bridge, Wheatstone bridge and Mega ohm bridge Measurement of Inductance: Maxwell bridge and Hey bridge Measurement of Capacitance: Schering bridge Q-Meter: Operating principle and applications Energy and power meters: Working of energy and power meter	
2		Sensors and Transducers	08
	2.1	Basics of sensors and Transducers-Active and passive transducers, characteristics and selection criteria of transducers, working principle of Eddy-current sensors, Pizelectric transducers, photoelectric and photovoltaic sensors, capacitive sensors	
	2.2	Displacement and pressure- Potentiometers, pressure gauges, linear Variable differential transformers(LVDT) for measurement of pressure and displacement strain gauges	
	2.3	Temperature Transducers- Resistance temperature detectors(RTD). Thermistors and thermocouples , their ranges and applications	08
3		Telemetry and Data Acquisition System	
	3.1	Introduction and characteristics, Landline Telemetry, Radio Telemetry Types of Multiplexing Systems,	
	3.2	Data Acquisition: Components of Analog and Digital Data Acquisition System,	
	3.3	Uses of Data Acquisition System, Use of recorders in Digital systems, Modern Digital Data Acquisition System.	07
4		Introduction to control system Analysis	

	4.1	Introduction: Open and closed loop systems, example of control systems	
	4.2	Modelling: Modelling, Transfer function model of electrical systems, Block diagram reduction techniques and Signal flow graph	
	4.3	Dynamic Response: Standard test signals, transient and steady state behaviour of first and second order systems , steady state errors in feedback control systems and their types	
5		Stability Analysis in Time Domain	08
	5.1	Concept of stability: Routh and Hurwitz stability criterion	
	5.2	Root locus Analysis: Root locus concept, general rules for constructing root-locus ,root locus analysis of control system, concept of design of lag and lead compensator	
6		Stability Analysis in frequency domain	10
	6.1	Introduction: Frequency domain specification, Relationship between time and frequency domain specification of system, stability margins	
	6.2	Bode Plot: Magnitude and phase plot, Method of plotting Bode plot, Stability margins and analysis using bode plot. Frequency response analysis of RC, RL, RLC circuits	
	6.3	Nyquist Criterion: Concept of Polar plot and Nyquist plot, Nyquist stability criterion ,gain and phase margin	

Note: Term Work should be based on Tutorials.

Textbooks :

1. A.K. Sawhney, “*Electrical & Electronic Measurement & Instrumentation*” – DRS . India
2. M.M.S. Anand, “*Electronic Instruments and instrumentation Technology*”.
3. H.S.Kalsi, “*Electronic Instrumentation*”-TMH, 2nd Edition.
4. Nagrath, M.Gopal, “*Control System Engineering*”, Tata McGraw Hill.
5. K.Ogata, “*Modern Control Engineering*, Pearson Education”, IIIrd edition.

Reference Books:

1. Helfrick&Copper, “*Modern Electronic Instrumentation & Measuring Techniques*” – PHI
2. W.D. Cooper, “*Electronic Instrumentation And Measuring Techniques*” – PHI
3. Benjamin C.Kuo, “*Automatic Control Systems*, Pearson education”, VIIth edition

4. Rangan C. S., Sarma G. R. and Mani V. S. V., "*Instrumentation Devices And Systems*", Tata McGraw-Hill, 2nd Ed., 2004.
5. Bell David A. "*Electronic Instrumentation and Measurements*", PHI Pearson Education, 2006.
6. Madan Gopal, "*Control Systems Principles and Design*", Tata McGraw hill, 7th edition, 1997.
7. Normon, "*Control System Engineering*", John Wiley & sons, 3rd edition.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL301	Electronic Devices & Circuits-I Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL301	Electronic Devices & Circuits-I Laboratory	--	--	--	--	25	25	--	50

Laboratory plan

Maximum of 8 practicals including **minimum 2 simulations** should be conducted based on following topics

- Study of different measuring instruments such as CRO, Function Generator, Multimeter, and Power Supply. (Compulsory)
- Filter circuits
- Biasing of BJT and FET
- Frequency response
- Zener regulator
- Single stage amplifiers

Minimum One project based on:

- Design of single stage CE and CS amplifier
- Design of filter and regulator circuits
- Design of power supply
- Any other relevant topic based on syllabus

Note : Small project should be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done. **The practical and oral examination will be based on entire syllabus.**

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL302	Digital System Design Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL302	Digital System Design Laboratory	--	--	--	--	25	25	--	50

Laboratory plan

Maximum of 8 practicals including **minimum 2 simulations** should be conducted.

Suggested list of experiments:

1. Verify different logic gates.
2. Simplification of Boolean functions.
3. Verify Universal gates NAND and NOR and design EXOR and EXNOR gates using Universal gates.
4. Implement Half adder, Full adder, Half subtractor and Full subtractor circuits.
5. Implement BCD adder using four bit binary adder IC-7483.
6. Flip flops conversion JK to D, JK to T and D to TFF.
7. Implement logic equations using Multiplexer.
8. Design synchronous MOD N counter using IC-7490.
9. Verify encoder and decoder operations.
10. Implement digital circuits to perform binary to gray and gray to binary operations.
11. Verify truth table of different types of flip flops.
12. Verify different counter operations.
13. Write VHDL simulation code for different logic gates.
14. Write VHDL simulation code for combinational and sequential circuits
15. Write VHDL simulation code for 4:1 Multiplexer, 2 line to 4 line binary decoder

Minimum One project

Suggested list of Mini Projects:

1. Design Clock pulse generator.
2. Design Clap operated remote control for Fan.
3. Design BCD counter and show operation on Seven Segment Display.
4. Design digital stop watch.
5. Write VHDL code to implement traffic light controller.
6. Design water level indicator for overhead water tank.
7. Design frequency divider circuit.
8. Design switch debounce circuit.
9. Design sequence generator circuit.
10. Design sequence detector circuit.
11. Design Even/Odd parity generator/checker circuit.
12. Design simple LED flasher circuit.
13. Design digital dice.
14. Design fastest finger first indicator.
15. Design Toggle switch using TFF.

Note : Small project should be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL303	OOP using JAVA laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL303	OOP using JAVA laboratory	--	--	--	--	25	25	--	50

Course Pre-requisites:

- Fundamentals of C-Programming
- Control Structures
- Arrays and String

Course Objectives:

1. To understand Object Oriented Programming and its principles.
2. To describe & explain keywords and Data types.
3. Able to implement Methods, Constructors, Arrays, Multithreading and Applet
4. To help students to understand how to use a programming language to resolve problems.

Course Outcomes:

1. Students will be able to code a program using JAVA constructs.
2. Students will be able to understand fundamental features of an object oriented language: object classes and interfaces, exceptions and libraries of object collections.
3. Students will be able to develop a program that efficiently implements the algorithm for given tasks.
4. Students will be able to utilize the knowledge acquired in this course to develop higher level algorithms.

Module No.	Unit No.	Detailed Content	Hours
1		Fundamental Concepts of Object Oriented Programming	06
	1.1	Introduction to Object-Oriented Programming	
	1.2	Classes, Objects, Creating Classes and Objects, Principles of OOP: Abstraction, Encapsulation, Inheritance, Polymorphism	
	1.3	Differences And Similarity Between C and Java	
2		Fundamental Of Java Programming	08
	2.1	Features of Java, JDK Environment & Tools, Structure of Java Program	
	2.2	Java Keywords, Super Keyword, Final Keyword, Abstract Class	
	2.3	Data Types, Variables, Operators, Expressions	
	2.4	Input Output Using Scanner Class	
	2.5	Exception Handling, Object-Oriented Containers	
3		Method, Constructors, Destructors And Arrays	04
	3.1	Passing and Returning Parameters to Methods	
	3.2	Constructor and Types, Destructor	
	3.3	Arrays and Types: Create, One Dimensional Arrays, Two Dimensional Array, Multidimensional Array, String Array	
4		Inheritance, Interface And Package	04
	4.1	Types of Inheritance: Single, Multilevel, Hierarchical	
	4.2	Method Overloading and Method Overriding	
	4.3	Interface	
	4.4	Packages	
5		Multithreading And Applet	04
	5.1	Life Cycle Of Thread	
	5.2	Priority In Multithreading	
	5.3	Applet Life Cycle	
	5.4	Creating Applet, Applet Tag	

Textbooks :

1. Herbert Schidt, “*The Complete Reference*”, Tata McGraw-Hill Publishing Company Limited, Ninth Edition
2. D.T. Editorial Services ,“*Java 8 Programming Black Book*”, Dreamtech Press, Edition: 2015
3. Yashwant Kanitkar,”*Let Us Java*”, BPB Publications; 2nd Edition edition.

Reference Books:

1. Java: How to Program, 8/e, Dietal, Dietal, PHI
2. Grady Booch, James Rumbaugh, Ivar Jacobson, “*The Unified Modeling Languageser Guide*”, Pearson Education
3. Sachin Malhotra, Saurabh Chaudhary “*Programming in Java*”, Oxford University Press, 2010

Software Tools:

1. Raptor-Flowchart Simulation:<http://raptor.martincarlisle.com/>
2. Eclipse: <https://eclipse.org/>
3. Netbeans:<https://netbeans.org/downloads/>
4. CodeBlock:<http://www.codeblocks.org/>
5. J-Edit/J-Editor/Blue J

Online Repository:

1. Google Drive
2. GitHub
3. Code Guru

Laboratory plan

Maximum of 8 practicals including **minimum 2 simulations** should be conducted based on following topics

Section	Experiment Name	Module
1.	Write a program using command line argument in java. • Echoing Command-Line Arguments. • Parsing Numeric Command-Line arguments.	Module 1
2.	Study of simple java programs • WAP to calculate area & circumference of circle • WAP to swap given two strings • WAP to separate out digits of a number • WAP to convert temperature from Fahrenheit to Celsius • WAP to find a square , squarroot, and Cube of a given no. using abstraction	Module 1
3.	Study of different operators in java • WAP to compare two numbers. • WAP to print truth table for java logical operators • WAP to read the number & shift left & right by 3 bits.	Module 1
4.	Write a program for various ways of accepting data through keyboard & display its content. • Read through DataInputStream. • Read input through Scanner. • Read input through BufferedReader.	Module 2
5.	Study of Arrays Write a program for addition, subtraction and multiplication of two matrices.	Module 3
6.	Study of Objects and Classes • Define a class to represent a bank account. Include the following members: Data: name of the depositor account number	Module 3

	type of account balance amount in the account Methods: 1.to assign initial values 2.to deposit an amount 3.to withdraw an amount after checking balance. 4.to display the name & balance • WAP using this keyword	
7.	Study of Strings. Accept the two strings from user & do the following operations • convert to lowercase • convert to uppercase • Replace all appearance of one character by another • Compare two strings • Derive the substring of a string • Derive the position of a character in a string • Calculate the length of a string • Derive the nth character of a string	Module 2
8.	WAP to implement following constructors • Default constructor • Parameterized constructor	Module 3
9.	Study of Interface. Create an interface Area & implement the same in different classes Rectangle ,circle ,triangle.	Module 4
10.	Study of utility package • WAP to generate a year using random class and check whether it is leap or not. • Write a program to display current date. Also display Time in hours &	Module 4

	Minutes using Date class.	
11.	Study of Inheritance <pre> classDiagram class Staff { code } class Typist class Teacher { subject } class Officer class Regular { name } class Casual { dailywedges } Staff -- > Typist Staff -- > Teacher Staff -- > Officer Typist -- > Regular Typist -- > Casual </pre>	Module 4
12.	Study of Exception Handling in java. Write a program to use throw finally and try catch to handle exception.	Module 2

13.	Study of Multithreading. WAP to illustrate function yield(), isAlive(), sleep(), join(). Create three threads as P,Q,R. Thread P has maximum priority, thread Q has minimum priority, thread R has normal priority.	Module 5
14.	Study graphics using applet. WAP to draw all geometric shapes and fill them with different colors.	Module 5

Minimum One project

Suggested list of mini projects

1. Inventory Control System
2. Develop Calculator
3. Develop Editor (Example: Notepad)
4. Develop Multimedia App to teach primary students (Shapes, Colors, etc.)
5. Create an audio or video applet or swing based application with play, pause and stop options.

Note : Small project should be considered as a part of term-work.

Term Work:

At least **10** experiments covering entire syllabus should be set to have well predefined inference and conclusion.

The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Students are encouraged to share their experiments/mini project codes on online repository.

Practical from any 10 sections out of 14 sections is compulsory . Practical exam slip should cover all at least 10 sections.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC401	Applied Mathematics-IV	04	--	@2	04	--	01	05

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC401	Applied Mathematics-IV	20	20	20	80	25	--	--	125

@2 hour to be taken as tutorial classwise

Course Pre-requisite:

- Applied Mathematics I
- Applied Mathematics II
- Applied Mathematics III

Course Objectives:

1. To build the strong foundation in Mathematics of students needed for the field of Electronics and Telecommunication Engineering
2. To provide students with mathematics fundamentals necessary to formulate, solve and analyses complex engineering problems.
3. To prepare student to apply reasoning informed by the contextual knowledge to engineering practice.
4. To prepare students to work as part of teams on multi-disciplinary projects

Course Outcome:

After successful completion of the course student will be able to

1. Demonstrate basic knowledge of Calculus of variation, Vector Spaces, Matrix Theory, Random Variables, Probability Distributions, Correlation and Complex Integration.
2. Demonstrate an ability to identify and Model the problems in the field of Electronics and Telecommunication and solve it.
3. Apply the application of Mathematics in Telecommunication Engineering.

Module No.	Unit No.	Detailed Content	Hours
1		Calculus of Variation:	06
	1.1	Euler's Langrange equation, solution of Euler's Langrange equation (only results for different cases for Function) independent of a variable, independent of another variable, independent of differentiation of a variable and independent of both variables	
	1.2	Isoperimetric problems, several dependent variables	
	1.3	Functions involving higher order derivatives: Rayleigh-Ritz method	
2		Linear Algebra: Vector Spaces	06
	2.1	Vectors in n-dimensional vector space: properties, dot product, cross product, norm and distance properties in n-dimensional vector space.	
	2.2	Vector spaces over real field, properties of vector spaces over real field, subspaces	
	2.3	The Cauchy-Schwarz inequality, Orthogonal Subspaces, Gram-Schmidt process	
3		Linear Algebra: Matrix Theory	10
	3.1	Characteristic equation, Eigen values and Eigen vectors, properties of Eigen values and Eigen vectors.	
	3.2	Cayley-Hamilton theorem (without proof), examples based on verification of Cayley- Hamilton theorem.	
	3.3	Similarity of matrices, Diagonalisation of matrices.	
	3.4	Functions of square matrix, derogatory and non-derogatory matrices.	
4		Probability	10
	4.1	Baye's Theorem (without proof)	
	4.2	Random variable: Probability distribution for discrete and continuous random variables, Density function and distribution function, expectation, variance.	
	4.3	Moments, Moment Generating Function.	

	4.4	Probability distribution: Binomial distribution, Poisson & normal distribution (For detailed study)	
5		Correlation	04
	5.1	Karl Pearson's coefficient of correlation, Covariance, Spearman's Rank correlation,	
	5.2	Lines of Regression.	
6		Complex integration	12
	6.1	Complex Integration: Line Integral, Cauchy's Integral theorem for simply connected regions, Cauchy's Integral formula.	
	6.2	Taylor's and Laurent's Series	
	6.3	Zeros, singularities, poles of $f(z)$, residues, Cauchy's Residue theorem.	
	6.4	Applications of Residue theorem to evaluate real Integrals of different types.	

Note: Term Work should be based on Tutorials.

Textbooks :

1. H.K. Das, "*Advanced engineering mathematics*", S . Chand, 2008
2. A. Datta, "*Mathematical Methods in Science and Engineering*", 2012
3. B.S. Grewal, "*Higher Engineering Mathematics*", Khanna Publication
4. P.N.Wartilar&J.N.Wartikar, "*A Text Book of Applied Mathematics*" Vol. I & II, Vidyarthi Griha Prakashan, Pune

Reference Books:

1. B. V. Ramana, "*Higher Engineering Mathematics*", Tata Mc-Graw Hill Publication
2. Wylie and Barret, "*Advanced Engineering Mathematics*", Tata Mc-Graw Hill 6th Edition
3. Erwin Kreysizg, "*Advanced Engineering Mathematics*", John Wiley & Sons, Inc
4. Seymour Lipschutz "*Beginning Linear Algebra*" Schaum's outline series, Mc-Graw Hill Publication
5. Seymour Lipschutz "*Probability*" Schaum's outline series, Mc-Graw Hill Publication

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC402	Electronic Devices & Circuits-II	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC402	Electronic Devices & Circuits-II	20	20	20	80	--	--	--	100

Course Pre-requisite:

- Electronic Devices & Circuits-I

Course Objectives:

1. To understand the operation of the various bias circuits of MOSFET and Analyze and design MOSFET bias circuits.
2. To understand the operation and design of multistage amplifier for a given specification.
3. To understand the operation and design of transformer coupled various types of power amplifier circuits.
4. To understand the effects of negative feedback on amplifier circuits.
5. To analyze the different *RC* and *LC* oscillator circuits to determine the frequency of oscillation.

Course Outcome:

After successful completion of the course student will be able to

1. Design and analyse the basic operations of MOSFET.
2. Know about the multistage amplifier using BJT and FET in various configuration to determine frequency response and concept of voltage gain.
3. Know about different power amplifier circuits, their design and use in electronics and communication circuits.
4. Know the concept of feedback amplifier and their characteristics.
5. Design the different oscillator circuits for various frequencies

Module No.	Unit No.	Detailed Content	Hours
1		Introduction to MOSFET	08
	1.1	MOSFET - Symbol, Types of MOSFET - Depletion and Enhancement type MOSFET (N channel and P channel),	
	1.2	Construction, Operation, and V-I characteristics of MOSFET	
	1.3	MOSFET biasing - Types of Depletion & enhancement MOSFET biasing,	
	1.4	MOSFET as amplifier	
2		Introduction of Multistage amplifiers	06
	2.1	RC coupled, transformer coupled, direct coupled,	
	2.2	Low and high frequency considerations of cascade amplifier, cascode amplifier (CE-CB), Darlington pair amplifier.	
3		Design of Multistage amplifiers	10
		Analysis and design considerations of multistage amplifiers (CE-CE, CS-CS, CS-CE,), effect of source and load resistance	
4		Large signal amplifiers	08
	4.1	Harmonic distortion and power efficiency of Class A, B, AB, and C amplifiers	
	4.2	Design of Class A, Class B, and Push-Pull Power amplifier design.	
	4.3	Thermal considerations and design selection of heat sinks.	
5		Feedback amplifiers	08
	5.1	Feedback concept, ideal feedback amplifier, classification of feedbacks, Various topologies	
	5.2	Analysis and design of different types of negative feedback.	
6		Oscillators	08
	6.1	Principle of oscillation, RC oscillator, twin T oscillator	
	6.2	Oscillator with LC feedback. Colpitts oscillator, Hartley oscillator, Crystal controlled oscillator.	
	6.3	Design of different oscillator circuits.	

Textbooks :

1. D. A. Neamen, "*Electronic Circuit Analysis and Design*," Tata McGraw Hill, 2nd Edition.
2. R. L. Boylestad, "Electronic Devices and Circuit Theory," Pearson, 11th Edition.
3. T. F. Bogart, "Electronic Devices And Circuit," Merrill, 6th Edition.
4. R. S. Dudhe and M. Farhan, "Electronic Devices and Circuits," Synergy Knowledgeware, 1st Edition

Reference Books:

1. Salivahanan, N. Suresh Kumar, "*Electronic Devices and Circuits*," Tata McGraw Hill, 3rd Edition
2. J. Millman, Christos CHalkias, and Satyabratatajit, Millman's, "*Electronic Devices and Circuits*," McGrawHill, 3rd Edition
3. Muhammad H. Rashid, "*Microelectronics Circuits Analysis and Design*," Cengage Learning, 2nd Edition.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC403	Linear Integrated Circuits	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC403	Linear Integrated Circuits	20	20	20	80	--	--	--	100

Course Pre-requisite:

- Basic Electrical Engineering
- Electronic Devices & Circuits-I

Course Objectives:

1. To understand the concepts, working principles and key applications of linear integrated circuits.
2. To perform analysis of circuits based on linear integrated circuits.
3. To design circuits and systems for particular applications using linear integrated circuits.

Course Outcome:

After successful completion of the course student will be able to

1. Understand the fundamentals and areas of applications for the integrated circuits.
2. Analyze important types of integrated circuits.
3. Demonstrate the ability to design practical circuits that perform the desired operations.
4. Understand the differences between theoretical, practical & simulated results in integrated circuits.
5. Select the appropriate integrated circuit modules to build a given application.

Module No.	Unit No.	Detailed Content	Hours
1		Introduction to operational amplifiers	08
	1.1	Analysis of differential amplifier circuit configurations using FETs, Effect of Swamping resistor, Current sources using FETs, Widlar current source, Wilson current source, Voltage sources and references, DC level shifters.	
	1.2	Ideal & Practical Operational Amplifiers, Operational amplifier characteristics, Operational amplifier parameters, Operational amplifier open loop and closed loop configurations.	
2		Applications of Operational Amplifier	08
	2.1	Amplifiers: Inverting, non-inverting, buffer, summing & difference amplifiers, integrator & differentiator (ideal & practical), current amplifier, instrumentation amplifier, log and antilog amplifiers..	
	2.2	Converters: Current to voltage converters, voltage to current converters, voltage to frequency converter, frequency to voltage converter.	
	2.3	Active Filters: Second order active low pass, high pass, band pass and band reject filters, Introduction to switch capacitor filters.	
	2.4	Sine Wave Oscillators: RC phase shift oscillator, Wien bridge oscillator.	
3		Non-Linear Applications of Operational Amplifier	08
	3.1	Comparators: Inverting comparator, non-inverting comparator, zero crossing detector, window detector, peak detector, sample & hold circuits.	
	3.2	Schmitt Triggers: Inverting Schmitt trigger, non-inverting Schmitt trigger.	
	3.3	Waveform Generators: Square wave generator and triangular wave generator.	
	3.4	Precision Rectifiers: Half wave and full wave precision rectifiers.	
4		Analog to Digital and Digital to Analog Converters	08
	4.1	Performance specifications of ADC, single ramp ADC, ADC using DAC, dual slope ADC, successive approximation ADC.	
	4.2	Performance specifications of DAC, binary weighted resistor DAC, R/2R ladder DAC, inverted R/2R ladder DAC.	
5		Special Purpose Integrated Circuits	08
	5.1	Functional block diagram and working of IC 555, design of astable and monostable multivibrator using IC 555, application	

		of IC 555 as pulse position modulator, pulse width modulator and Schmitt Trigger.	
	5.2	Functional block diagram and working of VCO IC 566 and application as frequency modulator, Functional block diagram and working of PLL IC 565 and application as FSK Demodulator, Functional block diagram and working of multiplier IC 534 and application as a phase detector, Functional block diagram and working of waveform generator XR 2206 and application as sinusoidal FSK generator.	
6		Voltage Regulators	08
	6.1	Functional block diagram, working and design of three terminal fixed (78XX, 79XX series) and three terminal adjustable (LM 317, LM 337) voltage regulators.	
	6.2	Functional block diagram, working and design of general purpose 723 (LVLC, LVHC, HVLC and HVHC) with current limit and current fold-back protection, Switching regulator topologies, Functional block diagram and working of LT1070 monolithic switching regulator.	

Textbooks :

1. Ramakant A. Gayakwad, “Op-Amps and Linear Integrated Circuits”, Pearson Prentice Hall, 4th Edition.
2. K. R. Botkar, “Integrated Circuits”, Khanna Publishers (2004)
3. D. Roy Choudhury and S. B. Jain, “Linear Integrated Circuits”, New Age International Publishers, 4th Edition.

Reference Books:

1. Sergio Franco, “Design with operational amplifiers and analog integrated circuits”, Tata McGraw Hill, 3rd Edition.
2. David A. Bell, “Operation Amplifiers and Linear Integrated Circuits”, Oxford University Press, Indian Edition.
3. R. F. Coughlin and F. F. Driscoll, “Operation Amplifiers and Linear Integrated Circuits”, Prentice Hall, 6th Edition.
4. “J. Millman, Christos CHalkias, and Satyabratajit, Millman’s, “Electronic Devices and Circuits,” McGrawHill, 3rd Edition”.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC404	Signals and Systems	04	--	2@	04	--	01	05

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC404	Signals and Systems	20	20	20	80	25	--	--	125

@2 hour to be taken as tutorial classwise

Course Pre-requisite:

- Applied Maths-III
- Circuit Theory and Networks

Course Objectives:

1. To introduce students the concept and theory of signals and systems needed in electronics and telecommunication engineering fields.
2. To introduce students to the basic idea of signal and system analysis and its characterization in time and frequency domain

Course Outcome:

After successful completion of the course student will be able to

1. Understand about various types of signals and systems, classify them, analyze them, and perform various operations on them,
2. Understand use of transforms in analysis of signals and system in continuous and discrete time domain.
3. Observe the effect of various properties and operations of signals and systems.
4. Evaluate the time and frequency response of Continuous and Discrete time systems which are useful to understand the behaviour of electronic circuits and communication systems.

Module No.	Unit No.	Detailed Content	Hours
1		Introduction to signals and systems	08
	1.1	Introduction to signals: Definition, sampling theorem, sampling of continuous time signals, elementary signals: exponential, sine, step, impulse, ramp, rectangular, triangular, signum, sinc, operations on signals,	
	1.2	Classification of signals: Continuous and discrete time, deterministic and non-deterministic, periodic and aperiodic, symmetric (even) and asymmetric (odd), energy and power, causal and anti-causal signal, Case study of different signals from communication and biomedical field	
	1.3	Introduction to systems: Definition, Classification of systems: Static and dynamic, time variant and time invariant, linear and nonlinear, causal and non-causal, stable and unstable systems., communication and control system as examples	
2		Time domain analysis of continuous time and discrete time systems	08
	2.1	Representation of systems using differential /difference equation, Impulse, step and exponential response, system stability	
	2.2	Use of convolution integral and convolution sum for analysis of LTI systems, properties of convolution integral/sum, impulse response of interconnected systems	
	2.3	Correlation and spectral Density: auto-correlation, cross correlation, analogy between correlation and convolution, energy spectral density, power spectral density, relation of ESD,PSD with auto-correlation	
3		Frequency domain analysis of continuous and discrete signals:	10
	3.1	Review of Fourier series: Trigonometric and exponential Fourier series representation of signals, Gibbs phenomenon, Discrete Time Fourier Series, properties, analogy between Continuous Time Fourier Series (CTFS) and Discrete Time Fourier Series (DTFS).	
	3.2	Fourier Transform (FT): Fourier Transform and Inverse Fourier Transform on periodic and non-periodic signals, limitations of CT/DT Fourier Transform and need for Laplace/Z Transform.	
	3.3	Overview of Laplace Transform: Need of Laplace Transform, review of unilateral and bilateral Laplace	

		Transform, properties, inverse of Laplace Transform, concept of Region of Convergence (ROC), poles and zeros, relation between continuous time Fourier Transform and Laplace Transform.	
4		Z-Transform	08
	4.1	Need of Z-Transform, definition of unilateral and bilateral Z-Transform, Z-Transform of finite and infinite duration sequences, properties, Inverse Z-Transform, relation between discrete time Fourier Transform and Z-Transform, Z-Transform of standard signals, ROC for ZT, plotting poles and zeros of transfer function.	
	4.2	Analysis of discrete time LTI systems using Z-Transform: Transfer Function, causality and stability of systems, frequency response (impulse and step), relation between Laplace Transform and Z-Transform.	
5		State Space Analysis and Realization Structures	08
	5.1	State Variable Analysis: Introduction to the notion of 'state', systematic procedure for determining state equations, solution of state equations using Laplace transform, definition of $\exp(A)$ where A is a matrix, time domain solution of state equations.	
	5.2	Systems with finite duration and infinite duration, impulse response, recursive and non-recursive discrete time system, realization structures: direct form-I, direct form-II, Transpose, cascade, and parallel forms.	
6		Applications of Signals and Systems	06
	6.1	Signal Processing Applications: Speech and Audio Processing, Multimedia (image & video) processing, Underwater acoustic signal processing, Biological signal analysis	
	6.2	Communication and Control System Application: Modulation (Analog and Digital) process, Feedback/Feedforward Control system	

Textbooks :

1. NagorKani, "Signals and Systems", Tata McGraw Hill, Third Edition, 2011.
2. B.P. Lathi, "Principles of Linear Systems and Signals", Oxford, Second Edition, 2010.
3. S. L. Nalbalwar, A. M. Kulkarni and S. P. Sheth, "Signals and Systems", Synergy Knowledgeware, 2016.
4. Simon Haykin and Barry Van Veen, "Signals and Systems", John Wiley and Sons, Second Edition, 2004.

Reference Books:

1. Hwei. P Hsu, “*Signals and Systems*”, Tata McGraw Hill, Third edition, 2010
2. V. Krishnaveni and A.Rajeshwari, “*Signals and Systems*”, Wiley-India, First Edition 2012.
3. NarayanaIyer, “*Signals and Systems*”, Cenage Learning, First Edition 2011.
4. Michael J Roberts, “*Fundamentals of Signals and systems*”, Tata McGraw Hill, special Indian Economy edition, 2009.
5. Rodger E Ziemer, William H. Tranter and D. Ronald Fannin, “*Signals and Systems*”, Pearson Education, Fourth Edition 2009.
6. Alan V. Oppenheim, Alan S. Willsky and S. Hamid Nawab, “*Signals and Systems*”, Prentice-Hall of India, Second Edition, 2002.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC405	Principles of Communication Engineering	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC405	Principles of Communication Engineering	20	20	20	80	--	--	--	100

Course Pre-requisite:

- Applied Maths III
- Electronic Devices and Circuits I

Course Objectives:

1. To introduce students to various modulation and demodulation techniques of analog communication.
2. To analyze different parameters of analog communication techniques.
3. To study pulse modulation and demodulation.

Course Outcome:

After successful completion of the course student will be able to

1. Use different modulation and demodulation techniques used in analog communication
2. Identify and solve basic communication problems
3. Analyze transmitter and receiver circuits
4. Compare and contrast design issues, advantages, disadvantages and limitations of analog communication systems

Module No.	Unit No.	Detailed Content	Hours
1		Basics of Communication System	06
	1.1	Block diagram, electromagnetic spectrum, signal bandwidth and power, types of communication channels, Introduction to time and frequency domain.	
	1.2	Types of noise, signal to noise ratio, noise figure and noise temperature, Friss transmission formula.	
2		Amplitude Modulation and Demodulation	12
	2.1	Basic concepts, signal representation, need for modulation	
	2.2	Spectrum, waveforms, modulation index, bandwidth, voltage distribution and power calculations	
	2.3	DSBFC: Principles, modulating circuits, low level and high level transmitters DSB suppressed carrier :Multiplier modulator, nonlinear modulator and switching modulator	
	2.4	Amplitude demodulation: Diode detector, practical diode detector, square law detector	
	2.5	Comparison of different AM techniques, Applications of AM and use of VSB in broadcast television	
3		Angle Modulation and Demodulation	12
	3.1	Frequency modulation (FM): Basic concept, mathematical analysis, spectrum of FM wave, sensitivity, phase deviation and modulation index, deviation and percent modulated waves, bandwidth requirement of angle modulated waves, deviation ratio, narrowband FM and wideband FM	
	3.2	Varactor diode modulator, FET reactance modulator, stabilized AFC, Direct FM transmitter, indirect FM Transmitter, noise emphasis and de-emphasis	
	3.3	Phase modulation (PM): Principle and working of transistor direct PM modulator and relationship and comparison between FM and PM	
	3.4	FM demodulation: Balance slope detector, Foster-Seely discriminator, ratio detector, FM demodulator using Phase lock loop (PLL), amplitude limiting and thresholding, comparison between FM demodulators, comparison between AM, FM and PM	
	3.5	Applications of FM and PM	

4		Radio Receivers	06
	4.1	TRF, Super - heterodyne receiver, receiver parameters and choice of IF	
	4.2	AM receiver circuits and analysis, simple AGC, delayed AGC, forward AGC, and communication receiver	
	4.3	FM receiver circuits, comparison with AM receiver	
	4.4	Single and independent sideband (SSB and ISB) receivers	
5		Analog Pulse Modulation & Demodulation	08
	5.1	Sampling theorem for low pass signal, proof with spectrum, Nyquist criteria	
	5.2	Sampling techniques, aliasing error and aperture effect	
	5.3	PAM,PWM, PPM generation and detection	
	5.4	Applications of Pulse Communication	
6		Multiplexing & De-multiplexing	04
	6.1	Frequency Division Multiplexing transmitter & receiver block diagram	
	6.2	Time Division Multiplexing transmitter & receiver block diagram	
	6.3	Examples and applications of FDM and TDM	

Textbooks :

1. Kennedy and Davis, "*Electronics Communication System*", Tata McGraw Hill, Fourth edition.
2. B.P. Lathi, Zhi Ding "*Modern Digital and Analog Communication system*", Oxford University Press, Fourth edition.
3. Wayne Tomasi, "*Electronics Communication Systems*", Pearson education, Fifth edition.

Reference Books:

1. Taub, Schilling and Saha, "*Taub's Principles of Communication systems*", Tata McGraw Hill, Third edition.
2. P. Sing and S.D. Sapre, "*Communication Systems: Analog and Digital*", Tata McGraw Hill, Third edition.
3. Simon Haykin, Michel Moher, "*Introduction to Analog and Digital Communication*", Wiley, Second edition.

4. Dennis Roddy and John Coolen, "*Electronic Communication*", Prentice Hall, Third Edition.
5. Louis Frenzel, "*Communication Electronics*", Tata McGraw Hill, Third Edition.
6. Roy Blake, "*Electronic Communication Systems*", Delmar Publication, Second edition

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL401	Electronic Devices & Circuits-II Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL401	Electronic Devices & Circuits-II Laboratory	--	--	--	--	25	25	--	50

Laboratory plan

Minimum 8 practicals including **minimum 2 simulations** should be conducted.

Suggested list of experiments

1. Design and Analyze two stage BJT amplifier (Frequency response and performance parameters)
2. Design and Analyze two stage FET amplifier (Frequency response and performance parameters)
3. Design Multistage BJT amplifier and finding its parameters, Verify.
4. Design and Analyze Voltage series feedback amplifier using BJT/FET and verify its effect on frequency response. x
5. Design and Analyze Current series feedback using BJT/FET and verify its effect on frequency response.
6. Design Multistage JFET amplifier and finding its parameters, verify.
7. Design and Analyze RC Phase shift oscillator for different amplitude and frequency.
8. Design and Analyze Colpitt / Hartley oscillator for different amplitude and frequency.
9. Class C power amplifier and its efficiency

Minimum One project based on:

1. Simple Emergency light.
2. DC servo amplifier using MOSFET.
3. Audio tone control circuit.
4. Public address system.
5. Automatic Door Bell

6. Clapp Switch
7. Topic related to syllabus

Note :Small project should be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL402	Linear Integrated Circuits Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL402	Linear Integrated Circuits Laboratory	--	--	--	--	25	25	--	50

Laboratory plan

Minimum 8 practicals including **minimum 2 simulations** should be conducted.

Suggested list of experiments

1. Discrete Differential Amplifier
2. Inverting, Non inverting, Buffer, Summing & Difference amplifiers
3. Differentiator & Integrator
4. Instrumentation amplifier
5. I to V and V to I converters
6. V to F and F to V convertors
7. Active Filters
8. Wien Bridge Oscillator
9. RC Phase shift Oscillator
10. Inverting & Non inverting Schmitt trigger
11. Square & Triangular wave generator
12. Precision rectifiers
13. Peak detector & Sample & Hold Circuits
14. Analog to Digital converter

15. Digital to Analog converter
16. Multivibrators using IC 555
17. PPM, PWM and Schmitt trigger using 555
18. Frequency modulator using VCO IC 566.
19. FSK Demodulator using PLL IC 565.
20. Phase detector using multiplier IC 534.
21. Sinusoidal FSK generator using XR 2206
22. Voltage Regulators using 78XX/79XX, 317/337, 723

Minimum One project based on:

1. Variable Power Supply
2. Data Acquisition System
3. Function Generator
4. Topic related to syllabus

Note :Small project should be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL403	Principles of Communication Engineering Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL403	Principles of Communication Engineering Laboratory	--	--	--	--	25	25	--	50

Laboratory plan

Minimum 8 practicals including **minimum 2 simulations** should be conducted.

Suggested list of experiments

1. Generation and detection of AM (DSB-FC, DSB-SC,SSB) signal.
2. Generation and detection of FM signal.
3. Study of AM broadcast receiver (Super heterodyne).
4. Generation of PAM signal and verify the sampling theorem.
5. Generation of PPM, PWM signal.
6. Study of TDM and FDM multiplexing techniques.

Suggested list of Minimum projects

1. AM transmitter /receiver.
2. FM transmitter /receiver.
3. PAM,PPM,PWM circuits with IC 555
4. FM remote encoder/decoder circuits,
5. Transistor Intercom circuit
6. Walkie -Talkie Circuit
7. Arduino based communication circuits

8. Electronic voting machine.
9. Electronic Notice Board Using Android.
10. Home security system.

Note :Small project should be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

UNIVERSITY OF MUMBAI

No. UG/42 of 2018-19

CIRCULAR:-

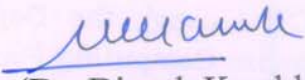
Attention of the Principals of the affiliated Colleges and Directors of the recognized Institutions in Science & Technology Faculty is invited to this office Circular No. UG/239 of 2010, dated 12th August, 2010 relating to syllabus of the Bachelor of Engineering (B.E.) degree course.

They are hereby informed that the recommendations made by the Ad-hoc Board of Studies in Electronics & Telecommunication Engineering at its meeting held on 9th April, 2018 have been accepted by the Academic Council at its meeting held on 5th May, 2018 **vide** item No. 4.53 and that in accordance therewith, the revised syllabus as per the (CBCS) for the T.E. & B.E. in Electronics & Telecommunication Engineering (Sem - V to VIII) has been brought into force with effect from the academic year 2018-19 and 2019-2020, accordingly. (The same is available on the University's website www.mu.ac.in).

MUMBAI - 400 032

25th June, 2018

To


(Dr. Dinesh Kamble)
I/c REGISTRAR

The Principals of the affiliated Colleges & Directors of the recognized Institutions in Science & Technology Faculty. (Circular No. UG/334 of 2017-18 dated 9th January, 2018.)

A.C/4.53/05/05/2018

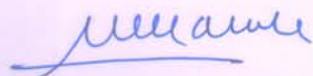
No. UG/42 -A of 2018

MUMBAI-400 032

25th June, 2018

Copy forwarded with Compliments for information to:-

- 1) The I/c Dean, Faculty of Science & Technology,
- 2) The Chairman, Ad-hoc Board of Studies in Electronics & Telecommunication Engineering,
- 3) The Director, Board of Examinations and Evaluation,
- 4) The Director, Board of Students Development,
- 5) The Co-Ordinator, University Computerization Centre,


(Dr. Dinesh Kamble)
I/c REGISTRAR

AC-_____

Item No. _____

UNIVERSITY OF MUMBAI



Revised syllabus (Rev- 2016) from Academic Year 2016 -17
Under

FACULTY OF TECHNOLOGY

Electronics and Telecommunication Engineering

Third Year with Effect from AY 2018-19

Final Year with Effect from AY 2019-20

As per **Choice Based Credit and Grading System**
with effect from the AY 2016–17

Co-ordinator, Faculty of Technology's Preamble:

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's). It is also resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Choice based Credit and Grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

Choice based Credit and grading system is implemented from the academic year 2016-17 through optional courses at department and institute level. This will be effective for SE, TE and BE from academic year 2017-18, 2018-19 and 2019-20 respectively.

Dr. S. K. Ukarande

Co-ordinator,

Faculty of Technology,

Member - Academic Council

University of Mumbai, Mumbai

Chairman's Preamble:

The curriculum in higher education is a living entity. It evolves with time; it reflects the ever changing needs of the society and keeps pace with the growing talent of the students and the faculty. The engineering education in India is expanding in manifolds and the main challenge is the quality of education. All stakeholders are very much concerned about it. The curriculum of Electronics & Telecommunication in Mumbai University is no exception. In keeping with the demands of the changing times, it contains innovative features. The exposure to the latest technology and tools used all over the world is given by properly selecting the subjects. It is designed in such a way to incorporate the requirements of various industries. The major emphasis of this process is to measure the outcomes of the program. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of post-graduation. So the curriculum must be refined and updated to ensure that the defined objectives and outcomes are achieved.

I, as Chairman Ad-hoc Board of Studies in Electronics and Telecommunication Engineering, University of Mumbai, happy to state here that, the heads of the department and senior faculty from various institutes took timely and valuable initiative to frame the Program Educational objectives as listed below.

Objectives:

1. To produce Electronics & Telecommunication engineers, having strong theoretical foundation, good design experience and exposure to research and development.
2. To produce researcher who have clear thinking, articulation and interest to carry out theoretical and/or applied research resulting in significant advancement in the field of specialization.
3. To develop an ability to identify, formulate and solve electronics and telecommunication engineering problems in the latest technology.
4. To develop the ability among students to synthesize data and technical concepts from applications to product design.

These are the suggested and expected main objectives, individual affiliated institutes may add further in the list. I believe that the small step taken in the right direction will definitely help in providing quality education to the stake holders.

This book of curricula is the culmination of large number of faculty members and supporting staff. It also reflects the creative contribution of hundreds of teachers – both serving and retired. I sincerely hope that the faculty and students of Electronics and Telecommunication in Mumbai University will take full advantage of dynamic features of curriculum and make teaching-learning process a truly sublime experience for all.

At the end I must extend my gratitude to all experts and colleagues who contributed to make curriculum competent at par with latest technological development in the field of Electronics & Telecommunication Engineering.

Dr. Uttam D. Kolekar

Chairman, Ad-hoc Board of Studies in Electronics and Telecommunication Engineering

Program Structure for
B.E. Electronics & Telecommunication Engineering (Rev. 2016)
University of Mumbai (With Effect from 2017-2018)
Semester V

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned		
		Theory	Pracs	Tut	Theory	TW/ Pracs	Total
ECC501	Microprocessor & Peripherals Interfacing	4	-	-	4	-	4
ECC502	Digital Communication	4	-	-	4	-	4
ECC503	Electromagnetic Engineering	4	-	1@	4	1	5
ECC504	Discrete Time Signal Processing	4	-	-	4	-	4
ECCDLO 501X	Department Level Optional Course I	4	-	-	4	-	4
ECL501	Microprocessor & Peripherals Interfacing Lab	-	2	-	-	1	1
ECL502	Digital Communication Lab	-	2	-	-	1	1
ECL503	Business Communication & Ethics Lab	-	2+2*	-	-	2	2
ECL504	Open Source Technology for Communication Lab	-	2	-	-	1	1
ECLDLO 501X	Department Level Optional Lab I	-	-	2#	-	1	1
Total		20	10	3	20	7	27

@ 1 hour to be taken as tutorial classwise #2 hours to be taken as either lab or tutorial based on subject requirement

*2 hours to be taken as tutorial batchwise

Course Code	Course Name	Examination Scheme							
		Theory					TW	Oral/ Prac	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
ECC501	Microprocessor & Peripherals Interfacing	20	20	20	80	03	--	--	100
ECC502	Digital Communication	20	20	20	80	03	--	--	100
ECC503	Electromagnetic Engineering	20	20	20	80	03	25	--	125
ECC504	Discrete Time Signal Processing	20	20	20	80	03	--	--	100
ECCDLO 501X	Department Level Optional Course I	20	20	20	80	03	--	--	100
ECL501	Microprocessor & Peripherals Interfacing Lab	--	--	--	--	--	25	25	50
ECL502	Digital Communication Lab	--	--	--	--	--	25	25	50
ECL503	Business Communication & Ethics Lab	--	--	--	--	--	50	--	50
ECL504	Open Source Technology for Communication Lab	--	--	--	--	--	25	25	50
ECLDLO 501X	Department Level Optional Lab I	--	--	--	--	--	25	--	25
Total				100	400		175	75	750

Course Code	Department Level Optional Course I
ECCDLO 5011	Microelectronics
ECCDLO 5012	TV & Video Engineering
ECCDLO 5013	Finite Automata Theory
ECCDLO 5014	Data Compression and Encryption

Semester VI

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned		
		Theory	Pracs	Tut	Theory	TW/ Pracs	Total
ECC601	Microcontrollers & Applications	4	-	--	4	--	4
ECC602	Computer Communication Networks	4	-	-	4	-	4
ECC603	Antenna & Radio Wave Propagation	4	-	-	4	-	4
ECC604	Image Processing and Machine Vision	4	-	--	4	--	4
ECCDLO 602X	Department Level Optional Course II	4	-	-	4	-	4
ECL601	Microcontroller & Applications Lab	-	2	-	-	1	1
ECL602	Computer Communication Network Lab	-	2	-	-	1	1
ECL603	Antenna & Radio Wave Propagation Lab	-	2	-	-	1	1
ECL604	Image Processing and Machine Vision Lab	-	2	-	-	1	1
ECLDLO 602X	Department Level Optional Lab II	-	2	-	-	1	1
Total		20	10	-	20	5	25

Course Code	Course Name	Examination Scheme							
		Theory					TW	Oral & Prac	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
ECC601	Microcontroller& Applications	20	20	20	80	03	--	--	100
ECC602	Computer Communication Network	20	20	20	80	03	--	--	100
ECC603	Antenna & Radio Wave Propagation	20	20	20	80	03	--	--	100
ECC604	Image Processing and Machine Vision Lab	20	20	20	80	03	--	--	100
ECCDLO 602X	Department Level Optional Course II	20	20	20	80	03	--	--	100
ECL601	Microcontroller & Applications Lab	--	--	--	--	--	25	25	50
ECL602	Computer Communication Network Lab	--	--	--	--	--	25	25	50
ECL603	Antenna & Radio Wave Propagation Lab	--	--	--	--	--	25	25	50
ECL604	Image Processing and Machine Vision Lab	--	--	--	--	--	25	25	50
ECLDLO 602X	Department Level Optional Lab II	--	--	--	--	--	25	--	25
Total				100	400		125	100	725

Course Code	Department Level Optional Course II
ECCDLO 6021	Digital VLSI Design
ECCDLO 6022	Radar Engineering
ECCDLO 6023	Database Management System
ECCDLO 6024	Audio Processing

Semester VII

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned		
		Theory	Pracs	Tut	Theory	TW/ Pracs	Total
ECC701	Microwave Engineering	4	-	-	4	-	4
ECC702	Mobile Communication System	4	-	-	4	-	4
ECC703	Optical Communication	4	-	--	4	-	4
ECCDLO 703X	Department Level Optional Course III	4	-	-	4	-	4
ILO701X	Institute Level Optional Course I	3	-	-	3	-	3
ECL701	Microwave Engineering Lab	-	2	-	-	1	1
ECL702	Mobile Communication System Lab	-	2	-	-	1	1
ECL703	Optical Communication Lab	-	2	-	-	1	1
ECLDLO 703X	Department Level Optional Lab III	-	2	-	-	1	1
ECL704	Project-I	-	6	-	-	3	3
Total		19	14	-	19	7	26

Course Code	Course Name	Examination Scheme							
		Theory					TW	Oral & Prac	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
ECC701	Microwave Engineering	20	20	20	80	03	--	--	100
ECC702	Mobile Communication System	20	20	20	80	03	--	--	100
ECC703	Optical Communication	20	20	20	80	03	--	--	100
ECCDLO 703X	Department Level Optional Course III	20	20	20	80	03	--	--	100
ILO701X	Institute Level Optional Course I	20	20	20	80	03	--	--	100
ECL701	Microwave Engineering Lab	--	--	--	--	--	25	25	50
ECL702	Mobile Communication System Lab	--	--	--	--	--	25	25	50
ECL703	Optical Communication Lab	--	--	--	--	--	25	25	50
ECLDLO 703X	Department Level Optional Lab III	--	--	--	--	--	25	25	50
ECL704	Project-I	--	--	--	--	--	50	50	100
Total				100	400		150	150	800

Course Code	Department Level Optional Course III	Course Code	Institute Level Optional Course I[#]
ECCDLO7031	Neural Networks and Fuzzy Logic	ILO7011	Product Lifecycle Management
ECCDLO7032	Big Data Analytics	ILO7012	Reliability Engineering
ECCDLO7033	Internet Communication Engineering	ILO7013	Management Information System
ECCDLO7034	CMOS Mixed Signal VLSI	ILO7014	Design of Experiments
ECCDLO7035	Embedded System	ILO7015	Operation Research
		ILO7016	Cyber Security and Laws
		ILO7017	Disaster Management and Mitigation Measures
		ILO7018	Energy Audit and Management
		ILO7019	Development Engineering

Common with all branches

Semester VIII

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned		
		Theory	Pracs	Tut	Theory	TW/ Pracs	Total
ECC801	RF Design	4	-	--	4	--	4
ECC802	Wireless Networks	4	-	-	4	-	4
ECCDLO 804X	Department Level Optional Course IV	4	-	-	4	-	4
ILO802X	Institute Level Optional Course II	3	-	-	3	-	3
ECL801	RF Design Lab	-	2	-	-	1	1
ECL802	Wireless Networks Lab	-	2	-	-	1	1
ECLDLO 804X	Department Level Optional Lab IV	-	2	-	-	1	1
ECL803	Project-II	-	12	-	-	6	6
Total		15	18	-	15	9	24

Course Code	Course Name	Examination Scheme							
		Theory					TW	Oral & Prac	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
ECC801	RF Design	20	20	20	80	03	--	--	100
ECC802	Wireless Networks	20	20	20	80	03	--	--	100
ECCDLO 804X	Department Level Optional Course IV	20	20	20	80	03	--	--	100
ILO802X	Institute Level Optional Course II	20	20	20	80	03	--	--	100
ECL801	RF Design Lab	--	--	--	--	--	25	25	50
ECL802	Wireless Networks Lab	--	--	--	--	--	25	25	50
ECLDLO 804X	Department Level Optional Lab IV	--	--	--	--	--	25	25	50
ECL803	Project-II	--	--	--	--	--	100	50	150
Total				80	320		175	125	700

Course Code	Department Level Elective Course IV	Course Code	Institute Level Elective Course II [#]
ECCDLO8041	Optical Networks	ILO8021	Project Management
ECCDLO8042	Advanced Digital Signal Processing	ILO8022	Finance Management
ECCDLO8043	Satellite Communication	ILO8023	Entrepreneurship Development and Management
ECCDLO8044	Network management in Telecommunication	ILO8024	Human Resource Management
		ILO8025	Professional Ethics and CSR
		ILO8026	Research Methodology
		ILO8027	IPR and Patenting
		ILO8028	Digital Business Management
		ILO8029	Environmental Management

Common with all branches

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC501	Microprocessors & Peripherals	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC501	Microproces sors & Peripherals	20	20	20	80	--	--	--	100

Course prerequisite:

- Digital System Design

Course objectives:

- To understand the basic concepts of microcomputer systems.
- To develop background knowledge and core expertise in 8086 microprocessor and co-processor 8087.
- To write assembly language programs for 8086 microprocessor
- To understand peripheral devices and their interfacing to 8086 and to study the design aspects of basic microprocessor based system.

Course outcomes:

After successful completion of the course student will be able to

- Understand the basic concepts of microcomputer systems.
- Understand the architecture and software aspects of microprocessor 8086.
- Write Assembly language program in 8086.
- Know the Co-processor configurations.
- Interface peripherals for 8086.
- Design elementary aspect of microprocessor based system.

Module No.	Unit No.	Topics	Hrs.
1.0		Introduction to Microcomputer System	06
	1.1	Block diagram of microprocessor based system: CPU, I/O Devices, Clock, Memory, Concept of Address, Data and Control Bus and Tristate logic.	
	1.2	Need of Assembly Language and its Comparison with higher level languages	
	1.3	Need of Assembler and Compiler and their comparison.	
2.0		Architecture of 8086 Microprocessor	06
	2.2	8086 Architecture and organization, pin configuration.	
	2.3	Minimum and Maximum modes of 8086.	
	2.4	Read and Write bus cycle of 8086.	
3.0		Instruction set and programming of 8086	10
	3.1	8086 Addressing modes.	
	3.2	8086 Instruction encoding formats and instruction set.	
	3.3	Assembler directives.	
	3.4	8086 programming and debugging of assembly language program. Programs related to: arithmetic, logical, delay, string manipulation, stack and subroutines. input. output. timer/counters.	
	3.5	Elementary DOS Programming: Introduction to int-21h services.	
4.0		Peripherals interfacing with 8086 and applications.	10
	4.1	8086-Interrupt structure.	
	4.2	Programmable peripheral Interface 8255.	
	4.3	Programmable interval Timer 8254.	
	4.4	Elementary features of 8259A and 8257 and interface.	
	4.5	Interfacing 8255, 8254 with 8086 and their applications	
5.0		ADC, DAC interfacing with 8086 and its application	08
	5.1	Analog to Digital Converter (ADC) 0809	
	5.2	Digital to Analog Converter (DAC) 0808	
	5.3	Interfacing ADC 0809, DAC 0808 with 8086 and their applications.	
	5.4	8086 based data Acquisition system.	
6.0		8086 Microprocessor interfacing	08
	6.1	8087 Math co-processor, its data types and interfacing with 8086.	
	6.2	Memory interfacing with 8086 microprocessor	
		Total	48

Text Books:

1. John Uffenbeck: “8086/8088 family: “Design, Programming and Interfacing”, Prentice Hall, 2nd Edition
2. B. B. Brey: “The Intel Microprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium and Pentium Pro Processor”, Pearson Pub, 8th Edition
3. Hall D.V: “Microprocessor and Interfacing Programming and Hardware”, Tata McGraw Hill, 2nd Edition.
4. Yu-Cheng Liu/Glenn A. Gibson: “Microcomputer Systems: The 8086/8088 Family Architecture, Programming and Design”, Phi Learning.

Reference Books:

1. Peter Abel: “IBM PC ASSEMBLY LANGUAGE & PROGRAMMING”, Phi Learning.
2. A. K. Ray and K. M. Burchandi: “Advanced Microprocessor and Peripherals, Architecture Programming and Interfacing”, Tata McGrawHill, 3rd Edition
3. Don Anderson, Tom Shanley: “Pentium Processor System Architecture”, MindShare Inc., 2nd Edition
4. National Semiconductor: Data Acquisition Linear Devices Data Book
5. Intel Peripheral Devices: Data Book.
6. The Intel 8086 family user manual.

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC502	Digital Communication	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC502	Digital Communication	20	20	20	80	--	--	--	100

Prerequisites:

- Analog Communication

Course objectives:

- To identify the signals and functions of its different components,
- To learn about theoretical aspects of digital communication system and Draw signal space diagrams, compute spectra of modulated signals,
- To learn about error detection and correction to produce optimum receiver.

Course outcomes:

After successful completion of the course student will be able to

- Understand random variables and random processes of signal,
- Apply the concepts of Information Theory in source coding,
- Evaluate different methods to eliminate Inter-symbol interference,
- Compare different band-pass modulation techniques,
- Evaluate performance of different error control codes.

Module No.	Unit No.	Topic	Hrs.
1.0		Probability Theory & Random Variables and	08
	1.1	Information, Probability, Conditional Probability of independent events, Relation between probability and probability Density, Raleigh Probability Density, CDF, PDF.	
	1.2	Random Variables, Variance of a Random Variable, correlation between Random Variables, Statistical Averages(Mean), Mean and Variance of sum of Random variables, Linear mean square Estimation, Central limit theorem, Error function and Complementary error function Discrete and Continuous Variable, Gaussian PDF, Threshold Detection, Statistical Average, Chebyshev In-Equality, Auto-correction.	
	1.3	Random Processes	
2.0		Information Theory and Source Coding	06
	2.1	Block diagram and sub-system description of a digital communication system, measure of information and properties, entropy and its properties	
	2.2	Mini Source Coding, Shannon's Source Coding Theorem, Shannon-Fano Source Coding, Huffman Source Coding	
	2.3	Differential Entropy, joint and conditional entropy, mutual information and channel capacity, channel coding theorem, channel capacity theorem	
3.0		Error Control Systems	12
	3.1	Types of error control, error control codes, linear block codes, systematic linear block codes, generator matrix, parity check matrix, syndrome testing, error correction, and decoder implementation	
	3.2	Systematic and Non-systematic Cyclic codes: encoding with shift register and error detection and correction	
	3.3	Convolution Codes: Time domain and transform domain approach, graphical representation, code tree, trellis, state diagram, decoding methods.	
4.0		Bandpass Modulation & Demodulation	10
	4.1	Band-pass digital transmitter and receiver model, digital modulation schemes	
	4.2	Generation, detection, signal space diagram, spectrum, bandwidth efficiency, and probability of error analysis of: Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK) Modulations, Binary Phase Shift Keying (BPSK) Modulation, Quaternary Phase Shift Keying QPSK, M-ary PSK Modulations, Quadrature Amplitude Modulation (QAM), Minimum Shift Keying (MSK)	

5.0		Baseband Modulation & Transmission	04
	5.1	Discrete PAM signals and it's power spectra	
	5.2	Inter-symbol interference, Nyquist criterion for zero ISI, sinusoidal roll-off filtering, correlative coding, equalizers, and eye pattern	
6.0		Optimum Reception of Digital Signal	08
	6.1	Baseband receiver	
	6.2	Probability of Error	
	6.3	Optimum Receiver and Filter	
	6.4	Matched Filter and its probability of error	
	6.5	Coherent Reception	
		Total	48

Text Books:

1. H. Taub, D. Schilling, and G. Saha, "Principles of Communication Systems," Tata Mc- Graw Hill, New Delhi, Third Edition, 2012.
2. Lathi B P, and Ding Z., "Modern Digital and Analog Communication Systems," Oxford University Press, Fourth Edition, 2009.
3. Haykin Simon, "Digital Communication Systems," John Wiley and Sons, New Delhi, Fourth Edition, 2014.

Reference Books:

1. Sklar B, and Ray P. K., "Digital Communication: Fundamentals and applications," Pearson, Dorling Kindersley (India), Delhi, Second Edition, 2009.
2. T L Singal, "Analog and Digital Communication," Tata Mc-Graw Hill, New Delhi, First Edition, 2012.
3. P Ramakrishna Rao, "Digital Communication," Tata Mc-Graw Hill, New Delhi, First Edition, 2011.
4. M F Mesiya, "Contemporary Communication systems", Mc-Graw Hill, Singapore, First Edition, 2013.

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (O.2 to O.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC503	Electromagnetic Engineering	04	--	@1	04	--	01	05

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC503	Electromagnetic Engineering	20	20	20	80	25	--	--	125

@ 1 hour to be taken as tutorial class wise

Course prerequisite:

- Vector Algebra and vector Calculus
- Various Co-ordinate system
- Two port network

Course objectives:

- To learn electromagnetics, including static and dynamic electromagnetic fields and waves within and at the boundaries of media.
- To learn mathematical skills, including Vectors and phasors and Partial differential equations.
- To learn Electromagnetic radiation and propagation in space and within transmission lines

Course outcomes:

After successful completion of the course student will be able to explain and evaluate EM fields and key physical parameters for:

- Fields and energies in simple planar, cylindrical, and spherical geometries, Fields within conducting and anisotropic media
- Electric and magnetic forces on charges, wires, and media Sinusoids and transients on TEM lines with mismatched impedances and tuning

Module No.	Unit No.	Topics	Hrs.
1.0		Electrostatics	07
	1.1	Coulomb's Law & Electric Field Intensity, Electric Field due to point charge, line charge and surface charge distributions	
	1.2	Electric Flux Density, Gauss's Law and its Application to differential volume element, divergence, divergence theorem.	
	1.3	Electric potential, Relationship between Electric field & potential , Potential Gradient., electric dipole	
2.0		Electric Fields in Material Space	06
	2.1	Energy density in electrostatic field, Current and current Density, continuity equation, Polarization in dielectrics	
	2.2	Capacitance, capacitance of parallel plate; spherical; cylindrical capacitors with multiple di-electrics, Boundary conditions	
	2.3	Poisson's and Laplace's equation, General procedures for solving Poisson's and Laplace's equations.	
3.0		Steady Magnetic Field	07
	3.1	Biot-Savart's Law, Ampere's Circuital Law and its Applications, magnetic flux density, Magnetic Scalar and vectors potentials, Derivations of Biot-Savart's law and Ampere's law based on Magnetic Potential	
	3.2	Forces due to magnetic field, magnetic dipole, Classification of Magnetic Materials, Magnetic boundary conditions.	
4.0		Maxwell's Equation and Electromagnetic Wave Propagation	12
	4.1	Faraday's law, Displacement current, Maxwell's equations in point form and integral form, Boundary conditions for time varying field , magnetic vector potential, Time harmonic field, Introduction to the concept of Uniform Plane Wave and Helmholtz equation.	
	4.2	Wave Propagation in Free Space, Lossy and Lossless Dielectrics and in Good Conductors. Reflection of Plane Wave, Poynting Vector, Wave Power, Skin Effect, Wave Polarization and Standing Wave Ratio	
5.0		Transmission Lines	10
	5.1	Transmission line parameters, Transmission line equations, Input impedance, Standing wave ratio, Power, Transients on transmission lines.	
	5.2	Smith Chart, Applications of Smith Chart in finding VSWR ,and reflection coefficient, admittance calculations, impedance calculations over length of line.	

6.0		Applications of Electromagnetics	06
	6.1	Electrostatic discharge, Materials with high dielectric constant, Graphene, Inkjet printer, RF mems, Multidielectric systems, magnetic levitation, Memristor, Optical nanocircuits, Metamaterials, Microstrip lines and characterization of Data cables, RFID	
		Total	48

Text Books:

1. Engineering Electromagnetics, William H Hayt and John A Buck - Tata McGraw-Hill Publishing Company Limited, Seventh Edition
2. Principles of Electromagnetics, Matthew N. O.Sadiku ,S.V.Kulkarni- Oxford university press, Sixth edition

Reference Books:

1. Electromagnetics with applications by J.D.Krauss and Daniel Fleisch fifth edition
2. Electromagnetic Field Theory Fundamentals, Bhag Singh Guru, Hüseyin R. Hiziroglu Cambridge University Press, Second Edition.
3. Electromagnetics, Joseph Edminister, , Mahmood Nahvi, Schaum Outline Series, Fourth edition.
4. R. K. Shevgaonkar, "Electromagnetic Waves" Tata McGraw Hil

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC504	Discrete Time Signal Processing	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC504	Discrete Time Signal Processing	20	20	20	80	--	--	--	100

Course prerequisite:

- Signals & Systems

Course objectives:

- To develop a thorough understanding of DFT and FFT and their applications.
- To teach the design techniques and performance analysis of digital filters
- To introduce the students to digital signal processors and its applications.

Course outcomes:

After successful completion of the course student will be able to

- Understand the concepts of discrete-time Fourier transform and fast Fourier transform.
- Apply the knowledge of design of IIR digital filters to meet arbitrary specifications.
- Apply the knowledge of design of FIR digital filters to meet arbitrary specifications.
- Analyze the effect of hardware limitations on performance of digital filters.
- Apply the knowledge of DSP processors for various applications.

Module No.	Unit No.	Topics	Hrs.
1.0		Discrete Fourier Transform & Fast Fourier Transform	10
	1.1	Definition and Properties of DFT, IDFT, Circular convolution of sequences using DFT and IDFT. Filtering of long data sequences: Overlap-Save and Overlap-Add Method for computation of DFT	
	1.2	Fast Fourier Transforms (FFT), Radix-2 decimation in time and decimation in frequency FFT algorithms, inverse FFT, and introduction to composite FFT.	
2.0		IIR Digital Filters	10
	2.1	Types of IIR Filters (Low Pass, High Pass, Band Pass, Band Stop and All Pass), Analog filter approximations: Butterworth, Chebyshev I, Elliptic.	
	2.2	Mapping of S-plane to Z-plane, impulse invariance method, bilinear transformation method, Design of IIR digital filters (Butterworth and Chebyshev-I) from Analog filters with examples.	
	2.3	Analog and digital frequency transformations with design examples.	
3.0		FIR Digital Filters	10
	3.1	Characteristics of FIR digital filters, Minimum Phase, Maximum Phase, Mixed Phase and Linear Phase Filters. Frequency response, location of the zeros of linear phase FIR filters.	
	3.2	Design of FIR filters using Window techniques (Rectangular, Hamming, Hanning, Blackmann, Kaiser), Design of FIR filters using Frequency Sampling technique, Comparison of IIR and FIR filters.	
4.0		Finite Word Length effects in Digital Filters	06
	4.1	Quantization, truncation and rounding, Effects due to truncation and rounding, Input quantization error, Product quantization error, Co-efficient quantization error, Zero-input limit cycle oscillations, Overflow limit cycle oscillations, Scaling.	
	4.2	Quantization in Floating Point realization of IIR digital filters, Finite word length effects in FIR digital filters.	
5.0		DSP Processors	06
	5.1	Introduction to General Purpose and Special Purpose DSP processors, fixed point and floating point DSP processor, Computer architecture for signal processing, Harvard Architecture, Pipelining, multiplier and accumulator (MAC), Special Instructions, Replication, On-chip memory, Extended Parallelism.	

	5.2	General purpose digital signal processors, Selecting digital signal processors, Special purpose DSP hardware, Architecture of TMS320CX fixed and floating DSP processors.	
6.0		Applications of Digital Signal Processing	06
	6.1	Application of DSP for ECG signals analysis.	
	6.2	Application of DSP for Dual Tone Multi Frequency signal detection.	
	6.3	Application of DSP for Radar Signal Processing.	
		Total	48

Text Books:

1. Emmanuel C. Ifeakor, Barrie W. Jervis, “*Digital Signal Processing*”, A Practical Approach by, Pearson Education
2. Tarun Kumar Rawat, “*Digital Signal Processing*”, Oxford University Press, 2015

Reference Books:

1. Proakis J., Manolakis D., “*Digital Signal Processing*”, 4th Edition, Pearson Education.
2. Sanjit K. Mitra, Digital Signal Processing – A Computer Based Approach – 4th Edition McGraw Hill Education (India) Private Limited.
3. Oppenheim A., Schaffer R., Buck J., “*Discrete Time Signal Processing*”, 2nd Edition, Pearson Education.
4. B. Venkata Ramani and M. Bhaskar, “*Digital Signal Processors, Architecture, Programming and Applications*”, Tata McGraw Hill, 2004.
5. L. R. Rabiner and B. Gold, “*Theory and Applications of Digital Signal Processing*”, Prentice-Hall of India, 2006.

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 5011	Microelectronics	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 5011	Microelectronics	20	20	20	80	--	--	--	100

Course prerequisite:

- Electronics Devices and Circuits- I
- Electronics Devices and Circuits- II

Course objectives:

- To understand integrated circuit biasing using MOSFET.
- To analyze single stage active load MOS amplifier.
- To analyze active load differential amplifier
- To understand implementation of passive components in ICs.

Course outcomes:

After successful completion of the course student will be able to

- Analyze various constant current source circuit using MOS
- Design and implement active load MOS amplifier.
- Design and implement active load differential amplifier

Module No.	Unit No.	Topics	Hrs.
1.0		Basics of MOSFETs	08
	1.1	Introduction to various fabrication process(in brief) Fabrication of NMOS and PMOS transistors along with mask layout diagram, Multi finger transistor, Scaling of MOSFET, Various Short channel effects in MOSFET, Second order effects in MOSFET, MOS as controlled resistor, MOS device capacitances	
2.0		Integrated Circuit Biasing & Active Loads using MOSFET	08
	2.1	Current Mirror, cascade current source, Wilson current source, bias independent current source using MOSFET, DC analysis and small signal analysis of MOS active load, DC analysis and small signal analysis of MOS advanced active load	
3.0		Single Stage MOS Active Load amplifiers	08
	3.1	CS amplifier with current source load, CS amplifier with diode connected load, CS amplifier with current source load, Common gate circuit, Cascode amplifier, Double Cascoding, Folded Cascode.	
4.0		Active Load MOSFET Differential Amplifier	10
	4.1	Basic MOS Differential Amplifier, DC transfer characteristics, small signal equivalent analysis, MOS differential amplifier with active load, MOS differential amplifier with cascode active load,	
5.0		Passive Device Fabrication in IC	07
	5.1	Fabrication of inductors, fabrication of transformers, fabrication of varactors, and fixed value capacitors.	
6.0		Power Amplifiers	07
	6.1	Class A, class B, Class C, Class D, Class E, Class F using MOSFET	
		Total	48

Text Books:

1. A. Sedra, K. Smith, adapted by A. Chanorkar “Microelectronic Circuits-Theory and Application *Advanced engineering mathematics*”, Oxford Higher Education, 7th Edition
2. D. Neamen, “Electronic Circuits Analysis and Design”, McGraw Hill Education, 3rd Edition
3. B. Razavi, “Design of Analog Integrated Circuits”, McGraw Hill Education, Indian Edition

Reference Books:

1. B. Razavi, “R F Microelectronics”, Pearson Publication, 2nd Edition

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

3. Question paper will comprise of 6 questions, each carrying 20 marks.
4. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned				
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total	
ECCDLO 5012	TV & Video Engineering	04	--	--	04	--	--	04	
Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 5012	TV & Video Engineering	20	20	20	80	--	--	--	100

Course objectives:

- To understand basic concepts of TV system .
- To understand compression techniques
- To introduce to advanced systems and dvb standards

Course outcomes:

After successful completion of the course student will be able to

- Understand overview of TV system.
- Understand details of compression technique.
- Know about different dvb standards.
- Understand advanced digital systems

Module No.	Unit No.	Topics	Hrs.
1.0		Fundamentals of TV system	10
	1.1	Interlaced scanning, Composite video signal, VSB(Vestigial sideband transmission), Channel bandwidth, Study of transmitter and receiver block diagram of monochrome Television	
	1.2	Camera Tubes: Vidicon, Image Orthicon	
2.0		Colour Television	10
	2.1	Colour Fundamentals, Chromaticity diagram, Frequency interleaving, compatibility considerations	
	2.2	NTSC system characteristics, Encoder and Decoder block diagram, PAL system characteristics, Encoder and Decoder block diagram, Comparison of NTSC and PAL systems	
3.0		Digital Video	08
	3.1	Basics of digital video	
	3.2	Chroma subsampling:4:4:4,4:2:2,4:2:0,4:1:1 digital video formats	
	3.3	Video compression standards:MPEG2:DCT coding, codec structure. Introduction to H.264/MPEG-4 AVC, Introduction to H.265	
	3.4	Set-Top Box	
4.0		Digital Video Broadcasting	06
	4.1	Introduction to DVB-T,DVB-T2,DVB-H,DVB-S,DVB-C	
	4.2	Satellite Television	
5.0		Advanced Digital TV Systems	10
	5.1	MAC MACd2	
	5.2	HDTV,SUHDTV	
	5.3	Smart TV and its functions	
	5.4	Introduction to IPTV	
	5.5	Application of TV system as CCTV	
6.0		Displays & Streaming Media Device	04
	6.1	LCD,LED	
	6.2	Chromcast	
		Total	48

Text Books:

1. Monochrome and colour Television by R.R.Gulathi
2. Television and video engineering by A.M. Dhake

Reference Books:

1. Digital Television (Practical guide for Engineers) by Fischer

Websites:

1. <https://www.dvb.org/resources/public/factsheets>
2. https://en.wikipedia.org/wiki/Digital_Video_broadcasting

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End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned				
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total	
ECCDLO 5013	Finite Automata Theory	04	--	--	04	--	--	04	
Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 5013	Finite Automata Theory	20	20	20	80	--	--	--	100

Course prerequisite:

- Digital System Design

Course objectives:

This course provides in-depth knowledge of switching theory and the design techniques of digital circuits, which is the basis for design of any digital circuit. The main objectives are:

- To understand learn basic techniques for the design of digital circuits and fundamental concepts used in the design of digital systems.
- To design combinational logic circuits and its optimization and fault detection.
- To study Mealy and Moore synchronous and asynchronous sequential circuits design and their applications.

Course outcomes:

After successful completion of the course student will be able to

- Manipulate simple Boolean expressions using the theorems and postulates of Boolean algebra and to minimize combinational functions.
- Design and analyze small combinational circuits and to use standard combinational functions/building blocks to build larger more complex circuits.
- Design and analyze small sequential circuits and devices and to use standard sequential functions/building blocks to build larger more complex circuits.
- Design finite state machine understand the fundamentals and areas of applications for the integrated circuits.
- Perform symmetric and cascade threshold function and element

Module No.	Unit No.	Topics	Hrs.
1.0		Combinational Logic	09
	1.1	Notations of sets, Relations and Lattices, Venn diagram	
	1.2	Switching Algebra and functions, Boolean algebras and functions, Minimization of Boolean functions using map method and Tabulation Method, Prime implicant chart, Reduction of the chart, Branching method	
	1.3	Design of combinational Logic circuits, Contact networks, Functional decomposition and symmetric functions. Identification of symmetric functions	
2.0		Threshold Logic & Synthesis of Threshold Networks	06
	2.1	Threshold Logic, Threshold elements, Capabilities and limitations of threshold logic, elementary properties, Linear separability, Unate functions, Synthesis of threshold functions, Cascading of threshold elements.	
3.0		Testing of Combinational Circuits	09
	3.1	Reliable Design and fault Diagnosis, Fault Detection in combinational circuits, Fault location experiments, Fault Detection by Boolean Differences and path sensitization, Synthesis for testability, Multiple fault detection using map method, failure-Tolerant Design.	
4.0		Sequential Circuits	12
	4.1	Synchronous sequential circuits and iterative networks: Memory elements and their excitation functions; Synthesis of synchronous sequential circuits, Capabilities and limitations, State equivalence and Minimization, Minimization of completely specified and Incompletely specified sequential machines, Partition technique, Merger methods	
	4.2	Asynchronous sequential circuits: Hazards, Synthesis, State assignment and minimization	
	4.3	Finite state Machines – Mealy and Moore synchronous and asynchronous sequential circuits Design,	
5.0		Structure and testing of Sequential Circuits	08
	5.1	Structure of sequential Machines, Lattice of closed partitions, State Assignment using partitions, Reduction of output dependency, Input Independence and Autonomous clock.	
	5.2	Homing sequence, synchronizing sequence, Distinguishing sequence, Checking experiments, Machine identification, Recent Trends/Developments	

6.0		Algorithmic State Machine	04
	6.1	Introduction and components of ASM charts, Representation of sequential circuits using ASM charts, Example using ASM chart: 2 bit counter, binary multiplier, Weighing machine etc.	
		Total	48

Text Books:

1. Zvi Kohavi and Niraj K. Jha. “Switching and Finite Automata Theory”, 3 Editions, Cambridge University Press.
2. Zvi Kohavi, “Switching Theory and Finite Automata”, 2nd edition, Tata McGraw Hill
3. R. P. Jain, “Switching Theory and Logic Design”, Tata McGraw Hill Education, 2003.
4. Lee Samuel C., “Modern Switching Theory and Digital Design”, Prentice Hall PTR

Reference Books:

1. Morris Mano, “Digital Logic and Computer Design”, Pearson Education
2. Samuel Lee, “Digital Circuits and Logic design”, Prentice Hall.
3. William I. Fletcher, “An Engineering Approach to Digital Design”, Prentice Hall.
4. John F. Wakerly, “Digital Design - Principles and Practices”, Pearson Education
5. A. Anand Kumar, “Switching Theory and Logic Design”, PHI Learning private limited, 2014

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 5014	Data Compression & Encryption	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 5014	Data Compression & Encryption	20	20	20	80	--	--	--	100

Course objectives:

To teach the students

- Lossless and Lossy compression techniques for different types of data.
- Data Encryption Techniques.
- Network and Web Security.

Course outcomes:

After successful completion of the course student will be able to

- Implement text, audio and video compression techniques.
- Understand Symmetric and Asymmetric Key Cryptography schemes.
- Understand network security.

Module No.	Unit No.	Topics	Hrs.
1.0		Introduction to Data Compression	12
	1.1	Data Compression : Modelling and Coding, Statistical Modelling, Dictionary Schemes, LZ, Lossy Compression	
	1.2	Shannon – Fano Algorithm, Huffman Algorithm, Adaptive Huffman Coding	
	1.3	Difficulties in Huffman Coding, Arithmetic Coding – Decoding, Dictionary Based Compression, Sliding Window Compression: LZ-77, LZ-78, LZW	
2.0		Image Compression	06
	2.1	DCT, JPEG, JPEG – LS, Differential Lossless Compression, DPCM, JPEG – 2000 Standards	
3.0		Video and Audio Compression	08
	3.1	Analog Video, Digital Video, MPEG – 2, H – 261 Encoder and Decoder	
	3.2	Sound, Digital Audio, μ -Law and A-Law Companding, MPEG – 1 Audio Layer (MP3 Audio Format)	
4.0		Data Security	06
	4.1	Security Goals, Cryptographic Attacks, Techniques	
	4.2	Symmetric Key: Substitution Cipher, Transposition Cipher, Stream and Block Cipher	
	4.3	DES, AES	
5.0		Number Theory and Asymmetric Key Cryptography	08
	5.1	Prime Numbers, Fermat's and Euler's Theorem, Chinese Remainder Theorem, Discrete Logarithms	
	5.2	Principles of Public Key Crypto System, RSA	
	5.3	Key Management, Diffie-Hellman Key Exchange	
	5.4	Message Integrity, Message Authentication and Hash Functions, SHA, HMAC, Digital Signature Standards	
6.0		Network Security	08
	6.1	Email, PGP, S/MIME, Intrusion Detection System	
	6.2	Web Security Considerations, SSL Architecture, SSL Message Formats, TLS, Secure Electronic Transactions	
	6.3	Kerberos, X.509 Authentication Service, Public Key Infrastructure	
		Total	48

Text Books:

1. Mark Nelson, Jean-Loup Gailly, "The Data Compression Book", 2nd edition, BPB Publications
2. Khalid Sayood, "Introduction to Data Compression", 2nd Edition Morgan Kaufmann.
3. William Stallings, "Cryptography and Network Security Principles and Practices 5th Edition", Pearson Education.
4. Behrouz A. Forouzan, "Cryptography and Network Security", Tata McGraw-Hill.

Reference Books:

1. David Salomon, "Data Compression: The Complete Reference", Springer.
2. Matt Bishop, "Computer Security Art and Science", Addison-Wesley.

Internal Assessment:

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End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL501	Microprocessors & Peripherals Interfacing Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL501	Microproces sors & Peripherals Interfacing Laboratory	--	--	--	--	25	25	--	50

Suggested Experiment List

Experiments can be conducted on Assembler, Emulator or Hardware kits, in Assembly language.

- To write an assembly language program to perform 8-bit addition using multiple addressing modes, viz., direct, indirect, register, etc. addressing mode.
- To write an assembly language program to perform 16-bit Logical operations, viz., AND, OR, EOX, NAND, etc.
- To write an assembly language program to perform 32-bit Subtraction
- To write an assembly language program to generate 10 msec delay using software (register) and 8254
- To write an assembly language program to move 10 memory locations using String Instruction
- To write an assembly language subroutine (program) that takes a number as input and returns the square of it
- To write an assembly language program for interfaced 7 segment display or keypad or both, through 8255
- To write an assembly language program to read and save value from ADC
- To write an assembly language program to generate square / triangular / ramp waveforms using DAC
- To write an assembly language program for performing floating point division using 8087
- To write an assembly language program to use INT 21h DOS Functions, viz. read character, write character, get system date, etc

Note: Mini Project can be considered as a part of termwork (Topic based on syllabus)

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL502	Digital Communication Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme								
		Theory Marks				End Sem. Exam	Term Work	Practical & Oral	Oral	Total
		Internal assessment								
		Test 1	Test2	Avg. Of Test 1 and Test 2						
ECL502	Digital Communicat ion Laboratory	--	--	--	--	25	25	--	50	

Experiments should be performed on Bread-board or on experimentation kits.

Suggested Experiment List

- To understand sampling theorem and reconstruction
- To understand Various line codes
- To observe the performance of Return to Zero (RZ) types of line code
- To observe the performance of Non- Return to Zero (NRZ) types of line code
- Modulation and Demodulation of Binary Amplitude Shift Keying
- Modulation and Demodulation of Binary Frequency Shift Keying
- Modulation and Demodulation of Binary Phase Shift Keying
- Modulation and Demodulation of Quadrature Phase Shift Keying
- To observe the effect of signal Distortion using EYE-Diagram
- To Study and perform Linear Block codes
- To Study and perform cyclic codes

Note: Mini Project can be considered as a part of termwork (Topic based on syllabus)

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every

experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL503	Business Communication & Ethics Laboratory	2 (classwise)	2 (batch wise)	--	--	2	--	2

Subject Code	Subject Name	Examination Scheme								
		Theory Marks				End Sem. Exam	Term Work	Practical & Oral	Oral	Total
		Internal assessment								
		Test 1	Test2	Avg. Of Test 1 and Test 2						
ECL503	Business Communicat ion & Ethics Laboratory	--	--	--	--	50	--	--	50	

Course objectives:

To teach the students

- To inculcate professional and ethical attitude.
- To enhance effective communication and interpersonal skills.
- To build multidisciplinary approach towards all life tasks.

Course outcomes:

After successful completion of the course student will be able to

- Design a technical document using precise language, suitable vocabulary and apt style.
- Develop the life skills/ interpersonal skills to progress professionally by building stronger relationships.
- Demonstrate awareness of contemporary issues knowledge of professional and ethical responsibilities.
- Apply the traits of a suitable candidate for a job/higher education, upon being trained in the techniques of holding a group discussion, facing interviews and writing resume/SOP.
- Deliver formal presentations effectively implementing the verbal and non-verbal skills.

Module No.	Unit No.	Topics	Hrs.
1.0		Report Writing	05
	1.1	Objectives of Report Writing	
	1.2	Language and Style in a report	
	1.3	Types : Informative and Interpretative (Analytical, Survey and Feasibility) and Formats of reports (Memo, Letter, Short and Long Report)	
2.0		Technical Writing	03
	2.1	Technical Paper Writing (IEEE Format)	
	2.2	Proposal Writing	
3.0		Introduction to Interpersonal Skills	09
	3.1	Emotional Intelligence	
	3.2	Leadership and Motivation	
	3.3	Team Building	
	3.4	Assertiveness	
	3.5	Conflict Resolution and Negotiation Skills	
	3.6	Time Management	
	3.7	Decision Making	
4.0		Meetings & Documentations	02
	4.1	Strategies for conducting effective meetings	
	4.2	Notice, Agenda and Minutes of a meeting	
	4.3	Business meeting etiquettes	
5.0		Introduction to Corporate Ethics	02
	5.1	Professional and work ethics (responsible use of social media - Facebook, WA, Twitter etc.)	
	5.2	Introduction to Intellectual Property Rights	
	5.3	Ethical codes of conduct in business and corporate activities (Personal ethics, conflicting values, choosing a moral response and making ethical decisions)	
6.0		Employment Skills	07
	6.1	Group Discussion	
	6.2	Resume Writing	
	6.3	Interview Skills	
	6.4	Presentation Skills	
	6.5	Statement of Purpose	
		Total	28

References

1. Fred Luthans, “*Organizational Behavior*”, McGraw Hill, edition
2. Lesiker and Petit, “*Report Writing for Business*”, McGraw Hill, edition
3. Huckin and Olsen, “*Technical Writing and Professional Communication*”, McGraw Hill
4. Wallace and Masters, “*Personal Development for Life and Work*”, Thomson Learning, 12th edition
5. Heta Murphy, “*Effective Business Communication*”, Mc Graw Hill, edition
6. Sharma R.C. and Krishna Mohan, “*Business Correspondence and Report Writing*”, Tata McGraw-Hill Education
7. Ghosh, B. N., “*Managing Soft Skills for Personality Development*”, Tata McGraw Hill.
8. Lehman, Dufrene, Sinha, “BCOM”, Cengage Learning, 2nd edition
9. Bell, Smith, “*Management Communication*” Wiley India Edition, 3rd edition.
10. Dr. Alex, K., ”Soft Skills”, S Chand and Company
11. Subramaniam, R., “*Professional Ethics*” Oxford University Press.
12. Robbins Stephens P., “*Organizational Behavior*”, Pearson Education
13. <https://grad.ucla.edu/asis/agep/advsopestem.pdf>

List of Assignments:

1. Report Writing (Theory)
2. Technical Proposal
3. Technical Paper Writing (Paraphrasing a published IEEE Technical Paper)
4. Interpersonal Skills (Group activities and Role plays)
5. Interpersonal Skills (Documentation in the form of soft copy or hard copy)
6. Meetings and Documentation (Notice, Agenda, Minutes of Mock Meetings)
7. Corporate ethics (Case studies, Role plays)
8. Writing Resume and Statement of Purpose

Term Work:

Term work will consist of all assignments from the list. The distribution of marks for term Work will be as follows:

Book Report.....	(10) Marks
Assignments	(10) Marks
Project Report Presentation.....	(15) Marks
Group Discussion.....	(10) Marks
Attendance	(05) Marks
TOTAL:	(50) Marks

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL504	Open Source technology for Communication Lab	--	2	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL504	Open Source technology for Communication Lab	--	--	--	--	25	25	--	50

Prerequisites:

- Principals of Communication Engineering
- Digital System Design
- Signals and Systems
- Electronics Circuits and Devices

Course objectives:

- Introduction to open source tools for communication lab.
- To simulate and analyze the various parameters of communication systems.
- To understand and implement the communication system/sub system.

Course outcomes:

After successful completion of the course student will be able to

- Learn open source programming tools for communication technology.
- Simulate and analyze the performance of communication system.
- Implement the communication system/subsystem.

Sample List of Experiments:**Note: These are few examples of experiments; teachers may prepare their own list.**

Sr. No	Title	Resource
1	Installation of a. Python, NumPy and commPy or b. Octave or c. Scilab or d. Xilinx using HDL Or e. LT SPICE Or f. SEQUEL Note: Any one tool or a combination of tools .	See the E-resource Links
2	Write a program to represent analog signal to digital signal (A to D conversion)	http://www.scilab.in/files/textbooks/ProfSenthikumar/DC.pdf
3	Write a program to generate basic functions a. Unit Impulse Signal b. Unit Step Signal c. Generate Ramp Signal d. Exponential Sequence e. Generate Sine Sequence f. Cos Sequence	See the E-resource Links
4	Write a program to perform convolution and correlation on the given signal.	See the E-resource Links
5	Plot the ASK, FSK and PSk Waveforms using scilab/python	See the E-resource Links
6	Write a program to apply Low/High Pass Filter on the given signal.	See the E-resource Links
7	Write a program to read a speech signal and plot it and play it.	See the E-resource Links

8	Write a program to apply Low/High Pass Filter on the given signal.	See the E-resource Links
9	Write a code to design Butterworth/Chebyshev filter using Scilab/Octave/Python.	See the E-resource Links
10	Write a program to calculate Hamming distance using Scilab/python.	See the E-resource Links
11	Encoding and decoding of convolutional codes	1. https://github.com/veeresht/CommPy/blob/master/commPy/examples/cony_encode_decode.py 2. https://media.readthedocs.org/pdf/commPy/latest/commPy.pdf
12	Design and programming of 1-bit Full adder and testing using Testbench.	See the E-resource Links
13	Design and programming of 4-bit adder using Full adder and testing using Testbench	See the E-resource Links
14	Design and programming of 8:1 Mux and testing using Testbench	See the E-resource Links
15	Design and programming of 3:8 Decoder and testing using Testbench	See the E-resource Links
16	Design and programming of D Latch and D Flip Flop and testing using Testbench	See the E-resource Links
17	Design and programming of T FF and testing using Testbench	See the E-resource Links
18	Design and programming of Counter and testing using Testbench	See the E-resource Links
19	Design and programming of RAM and testing using Testbench	See the E-resource Links
20	Design and Programming of FSM and testing using	See the E-resource Links

	Testbench	
21	Design and Simulation of Basic diode Circuits like Clipper, Clapper, Voltage Doubler using Sequel or LT Spice	See the E-resource Links
22	Design and simulation of single stage and Multistage BJT amplifier using Sequel or LT SPICE	See the E-resource Links
23	Design and simulation of Differential amplifier and current mirror circuit using Sequel or LT SPICE	See the E-resource Links
24	Design and Simulation of Basic Op-circuits like Inverting amplifier , Non-Inverting amplifier, Difference amplifier, I to V convertor, V to I Convertor etc using Sequel ot LT SPICE.	See the E-resource Links
25	Design and Simulation of oscillators and Filters using Op-amp using LT SPICE or Sequel.	See the E-resource Links
26	Simulation of non-linear applications of Op-amp like Schmitt Trigger, Window Detector, Precision Rectifier, Square Wave Generator etc using LT SPICE or Sequel.	See the E-resource Links

List of Mini projects:

Note: These are few examples of mini projects; teachers may prepare their own list.

1. Implementing liner block code of (7,4).
2. Implementing FSK TX and RX.
3. Implementing Nyquist criteria with noisy environment.

Suggested List of Mini Projects on Xilinx using HDL Programming

4. 16 bit Multiplier
5. 32 Bit CLA adder
6. Shift and Add Multiplier
7. GCD Calculator
8. 3-bit FIR Filter design
9. 4 Bit ALU
10. 4-bit Comparator
11. 2's Complement adder

Suggested List of Mini Projects using LT SPICE or SEQUEL

12. Audio Equalizer using Op-amp.
13. Strain Gauge amplifier Circuit.
14. Synchronous DC-DC Buck Convertor.
15. RTD based 4 to 20mA transmitter circuit.

Online Repository Sites:

1. Google Drive
2. GitHub
3. Code Guru

E-Resources:

1. Spoken Tutorial : <http://spoken-tutorial.org/>
2. Scilab: <http://www.scilab.org/>
3. Octave: <https://www.gnu.org/software/octave/>
4. Python: <https://www.python.org/>
5. Xilinx using HDL: <https://www.xilinx.com/products/design-tools/ise-design-suite/ise-webpack.html>
6. LT SPICE : <http://www.linear.com/designtools/software/>
7. SEQUEL: <https://www.ee.iitb.ac.in/~sequel/>

Note: Mini Project can be considered as a part of termwork (Topic based on syllabus)

Term Work:

At least 08 Experiments covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 5011	Microelectronics Laboratory	--	--	02	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 5011	Microelectro nics Laboratory	--	--	--	--	25	--	--	25

Term Work:

At least 08 tutorials covering entire syllabus must be given during the “**Tutorial session batch wise**”

Term work assessment must be based on the overall performance of the student with every tutorial graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 5012	TV & Video Laboratory	--	--	02	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 5012	TV & Video Laboratory	--	--	--	--	25	--	--	25

Suggested List of Experiments

- To study CVS
- Measurement of horizontal and vertical scanning frequency
- To study sound section of TV receiver
- To study receiver sections by using fault simulation switches
- To study DTH receiver
- To study HDTV
- To study set top box trainer
- To study LCD display
- To study LED display

Term Work:

At least 8 Practicals/ Tutorials covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 5013	Finite Automata Theory	--	--	02	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 5013	Finite Automata Theory	--	--	--	--	25	--	--	25

List of Mini Projects:

1. Combinational circuits
2. Synchronous sequential circuits (Finite state machine)
3. Asynchronous sequential circuits (Finite state machine)
4. Algorithmic state machine

Note: Mini Project can be considered as a part of term-work.

Term Work:

At least 8 Tutorials covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 5014	Data Compression & Encryption	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 5014	Data Compression & Encryption	--	--	--	--	25	--	--	25

Suggested Practical List:

- Huffman Code.
- Adaptive Huffman Code.
- Arithmetic Code.
- LZW Compression and Decompression.
- Companding Implementation.
- Implementation of DCT.
- RSA and MD5 Algorithm.
- Packet Analyzer.
- PGP (Pretty Good Privacy).
- Vulnerability Scanner.
- Intrusion Detection System.
- Firewall.
- SSL

Note: Mini Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful,

interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned				
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total	
ECC601	Microcontrollers & Applications	04	--	--	04	--	--	04	
Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC601	Microcontrollers & Applications	20	20	20	80	--	--	--	100

Course objectives:

- To develop background knowledge and core expertise in microcontrollers.
- To understand peripheral devices and their interfacing to microcontrollers.
- To write programs for microcontrollers and their applications in Assembly and Embedded C Language.

Course outcomes:

After successful completion of the course student will be able to

- Understand the detailed architecture of 8051 and ARM7 microcontroller.
- Study the in-depth working of the microcontrollers and their Instruction set.
- Interface various peripheral devices to the microcontrollers.
- Write Assembly language and Embedded C program for microcontrollers.

Module No.	Unit No.	Topics	Hrs.
1.0		8051 Microcontroller	12
	1.1	Comparison between Microprocessor and Microcontroller	
	1.2	Features, architecture and pin configurations	
	1.3	CPU timing and machine cycle	
	1.4	Input / Output ports	
	1.5	Memory organization	
	1.6	Counters and timers	
	1.7	Interrupts	
	1.8	Serial data input and output	
2.0		8051 Programming	08
	2.1	Instruction set	
	2.2	Addressing mode	
	2.3	Assembler Directives	
	2.4	Programs related to: arithmetic, logical, delay, input, output, timer, counters, port, serial communication, and interrupts	
3.0		8051 Interfacing and Applications	06
	3.1	Interfacing of Display: LED, LCD and Seven Segment display	
	3.2	Stepper Motor and Relay	
	3.3	UART	
4.0		ARM7: A 32 bit Microcontroller	08
	4.1	The RISC and the CISC design philosophy	
	4.2	Concept of Cortex-A, the Cortex-R and the Cortex-M	
	4.3	Features of ARM Microcontroller	
	4.4	Pipeline Architecture	
	4.5	Registers	
	4.6	Exceptions, Interrupt and Vector Table	
	4.7	Memory Management	
5.0		ARM7 Programming	08
	5.1	Data Processing Instructions	
	5.2	Conditional and Branching Instructions	
	5.3	ARM-THUMB Interworking	
	5.4	Single-Register Load-Store Instructions	
	5.5	Stack Instructions	
	5.6	Software Interrupt Instructions	
6.0		ARM Programming with Embedded C	06
	6.1	General Purpose Input Output	
	6.2	Timer Mode	
	6.3	Pulse –Width Modulator Configuration	
		Total	48

Text Books:

1. M. A. Mazidi, J. G. Mazidi and R. D. Mckinlay, “*The 8051 Microcontroller & Embedded systems*”, Pearson Publications, Second Edition 2006.
2. C. Kenneth J. Ayala and D. V. Gadre, “*The 8051 Microcontroller & Embedded system using assembly & ‘C’*”, Cengage Learning, Edition 2010.
3. Satish Shah, “*The 8051 Microcontrollers*”, Oxford publication first edition 2010.
4. Andrew Sloss, Dominic Symes, and Chris Wright, “*ARM System Developer’s Guide*” Morgan Kaufmann Publishers, First Edition 2004.
5. Lyla Das, “*Embedded Systems: An Integrated Approach*”, Pearson Publication, First Edition 2013
6. James A. Langbridge, “*Professional Embedded Arm Development*”, Wrox, John Wiley Brand& Sons Inc., Edition 2014

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC602	Computer Communication Networks	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC602	Computer Communicati on Networks	20	20	20	80	--	--	--	100

Course Pre requisite:

- Analog Communication

Course objectives:

- To introduce analysis and design of computer and communication networks.
- To design and configure a network for an organization. To implement client-server socket programs.
- To analyse the traffic flow and the contents of protocol frames.

Course outcomes:

After successful completion of the course student will be able to

- Design a small or medium sized computer network including media types, end devices, and interconnecting devices that meets a customer's specific needs.
- Perform basic configurations on routers and Ethernet switches.
- Demonstrate knowledge of programming for network communications.
- Learn to simulate computer networks and analyse the simulation results.
- Troubleshoot connectivity problems in a host occurring at multiple layers of the OSI model.
- Develop knowledge and skills necessary to gain employment as computer network engineer and network administrator.

Module No.	Unit No.	Topics	Hrs.
1.0		Introduction	06
	1.1	Network Applications	
	1.2	Network Hardware	
	1.3	Network Software	
	1.4	Reference Models, overview of TCP/IP, layer Functions, services, sockets and ports, Encapsulation.	
2.0		Introduction to Physical layer Services and System	08
	2.1	Introduction to physical media, Coax, RJ 45 , fiber, twisted pair, DSL, HFC, WiMax, cellular, satellite, and telephone networks, bit transmission, frequency division multiplexing. time division multiplexing.	
3.0		The Data Link Layer	08
	3.1	Data link Layer Design Issues	
	3.2	Error Detection and Correction	
		Elementary Data Link Protocols, Sliding Window Protocols	
		Example Data Link Protocols: HDLC: High-Level Data Link Control, The Data Link Layer in The Internet.	
4.0		The Medium Access Sub- Layer	06
	4.1	Channel Allocation Problem.	
	4.2	Multiple Access Protocols.	
5.0		The Network Layer	10
	5.1	Network Layer Design Issues.	
	5.2	Routing Algorithms.	
	5.3	Congestion Control Algorithms, Quality of Service.	
	5.4	Internetworking.	
	5.5	The Network Layer In The Internet: The IP Protocol, IPv4 header, IP Addressing, Subnetting.	
	5.6	Internet Control Protocols, The Interior Gateway Routing Protocol: OSPF, The Exterior Gateway Routing Protocol: BGP.	
6.0		The Transport Layer	10
	6.1	The Transport Service.	
	6.2	Elements of Transport Protocols.	
	6.3	The Internet Transport Protocol: UDP	
	6.4	The Internet Transport Protocol: TCP:-Introduction to TCP, The TCP Service Model. The TCP Protocol.	
	6.5	The TCP Segment Header.	
	6.6	TCP Connection Establishment, TCP Connection Release.	
	6.7	Modeling TCP Connection Management.	
	6.8	TCP Transmission Policy.	
	6.9	TCP Congestion Control.	
	6.10	TCP Timer Management, Transactional TCP.	

		Total	48

Text Books:

1. A. S. Tanenbaum, "Computer Networks", 4th edition, Prentice Hall
2. B. F. Ferouzan, "Data and Computer Communication", Tata McGraw Hill.

Reference Books:

1. Peterson & Davie, "Computer Networks", 2nd Edition, Morgan Kaufmann.
2. Kurose, Ross, "Computer Networking", Addison Wesley
3. S. Keshav, "An Engg, Approach To Computer Networking", Addison Wesley.
4. W. Richard Stevens, "TCP/IP Volume1, 2, 3", Addison Wesley.
5. D. E. Comer, "Computer Networks And Internets", Prentice Hall.
6. B. F. Ferouzan, "TCP/IP Protocol Suite", Tata McGraw Hill.

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (O.2 to O.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC603	Antenna & Radio Wave Propagation	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC603	Antenna & Radio Wave Propagation	20	20	20	80	--	--	--	100

Prerequisites:

- Electromagnetic Field
- Two port network
- Transmission Line

Course objectives:

- To learn fundamental parameters of Antenna
- To learn about linear wire antenna elements and Antenna arrays
- To learn about Special types of Antennas
- To learn about Antenna measurements and radio wave propagation

Course outcomes:

After successful completion of the course student will be able to

- Define Basic antenna parameters like radiation pattern, directivity and gain.
- Derive the field equations for the basic radiating elements like linear wire antenna and loop antenna.
- Design of uniform linear and planar antenna arrays using isotropic and directional Sources.
- Implement special types of Antennas like microstrip antennas and reflectors.

Module No.	Unit No.	Topics	Hrs.
1.0		Antenna Fundamentals	08
	1.1	Introduction, Radiation Mechanism, basic antenna parameters, Radiation pattern, radiation power density, radiation intensity, Beamwidth, directivity, Antenna efficiency, Gain, beam efficiency, bandwidth, polarization, input impedance, antenna vector effective length and equivalent areas, Antenna radiation efficiency, Friis transmission equation	
	1.2	Basic concepts of Maxwell's equation, vector potential, wave equation, near field and far field radiation, dual equations for electric and magnetic current sources.	
2.0		Wire Elements: Dipoles, Monopoles, Loops and Helical	12
	2.1	Infinitesimal dipole, radiation fields, radiation resistance, radiation sphere, near field, far field directivity, small dipole, finite length dipole, half wave length dipole, linear elements near or on infinite perfect conductors, Monopole antenna, Folded dipole. Design of dipole and monopole antenna	
	2.2	Loop Antenna: Small circular loop, comparison of small loop with short dipole, Ferrite loop, radiation patterns its parameters and their application.	
	2.3	Helical Antennas: Input impedance matching, Axial mode and normal mode propagation, Circular polarization using Helical Antenna	
3.0		Arrays	12
	3.1	Linear arrays, Array of two isotropic point sources, linear arrays of N elements, principle of pattern multiplication applicable to non-isotropic sources, Phase scanning arrays, broadside and End-fire Array, Increased Directivity end fire array, Calculations of Directivity, Beam width, Maxima and null directions for N-element Array.	
	3.2	Introduction to planar and circular arrays	
	3.3	Design of Yagi antenna and Log Periodic antenna	
4.0		Aperture Antennas	06
	4.1	Horn Antennas :E-Plane Sectoral Horn, H-Plane Sectoral Horn, Pyramidal Horn, Conical Horn	
	4.2	Reflector Antennas: Introduction, Plane Reflector, Corner Reflector, Parabolic Reflector, Design considerations	
5.0		Patch Antenna	04
	5.1	Microstrip antenna (MSA): Introduction, Feeding Techniques, Regular Shape MSAs (Rectangular, Circular, Equilateral Triangular), Design of Regular shape MSAs	
6.0		Antenna Measurements & Wave Propagation	06

	6.1	Antenna Measurements: Measurement of Antenna parameters: Input Impedance, Radiation Pattern, Gain (Two and Three antenna method), Polarization.	
	6.2	Ground Wave Propagation: Ground waves, effect of Earth's Curvature on Ground wave propagation, impact of imperfect earth	
	6.3	Sky Wave Propagation Ionosphere and Earth magnetic field effect, Critical frequency, Angle of incidence, Maximum usable frequency, Skip distance, Virtual height, Variations in ionosphere and Attenuation and fading of waves in ionosphere	
	6.4	Space Wave Propagation	
		Total	48

Text Books:

1. C. A. Balanis, Antenna Theory: Analysis and Design (3rd eds.), John Wiley & Sons, Hoboken, NJ, 2005.
2. J. D. Kraus, R. J. Marhefka, A.S. Khan "Antennas & Wave Propagation", McGraw Hill Publications, 4th Edition, 2011
3. G. Kumar, K. P. Ray, Broadband Microstrip Antenna, Artech House, 2002.

Reference Books:

1. Stutzman, Theile, "Antenna Theory and Design", John Wiley and Sons, 3rd Edition
2. R. E. Collin, "Antennas and Radio Wave Propagation", International Student Edition, McGraw Hill.

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC604	Image Processing & Machine Vision	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC604	Image Processing & Machine Vision	20	20	20	80	--	--	--	100

Prerequisites:

- Signals and Systems
- Discrete Time Signal Processing

Course objectives:

- To cover the fundamentals and mathematical models in digital image processing and Machine Vision
- To develop time and frequency domain techniques for image enhancement.
- To expose the students to classification techniques in Machine Vision
- To develop Applications using image processing and Machine Vision

Course outcomes:

After successful completion of the course student will be able to

- Understand theory and models in image processing.
- Interpret and analyze 2D signals in Spatial and frequency domain through image transforms.
- Apply quantitative models of image processing for segmentation and restoration for various applications.
- Find shape using various representation techniques and classify the object using different classification methods.

Module No.	Unit No.	Topics	Hrs.
1.0		Digital Image Fundamentals	04
	1.1	Introduction – Origin – Steps in Digital Image Processing , Components, Elements of Visual Perception – Image Sensing and Acquisition, Image Sampling and Quantization – Relationships between pixels, Transformation: Orthogonal, Euclidean, Affine	
	1.2	Color Image Processing: Color Fundamentals Color models.	
2.0		Image Transforms	06
	2.1	1-D DFT, 2-D Discrete Fourier Transform and Its Inverse, Some Properties of 2D DFT ,Walsh -Hadamard, Discrete Cosine Transform, Haar Transform	
3.0		Image Enhancement	08
	3.1	Image Negative, Log Transform, Power Law transform, Histogram equalization and Histogram Specification	
	3.2	Spatial Domain: Basics of Spatial Filtering, The Mechanics of Spatial Filtering, Generating Spatial Filter Masks–Smoothing and Sharpening Spatial Filtering	
	3.3	Frequency Domain: , The Basics of Filtering in the Frequency Domain, Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Laplacian, Unsharp Masking and Homomorphic filters	
4.0		Morphological & Image Restoration	06
	4.1	Morphology: Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transformation.	
	4.2	Restoration :Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters	
5.0		Patch Antenna	12
	5.1	Point, Line, and Edge Detection: Detection of Isolated Points, Line detection, edge models, basic and advance edge detection, Edge linking and boundary detection , Canny's edge detection algorithm	
	5.2	Thresholding : Foundation, Role of illumination, Basic Global thresholding	
	5.3	Region Based segmentation: Region Growing, Region Splitting and merging	
	5.4	Region Identification , chain code, simple geometric border representation, Fourier Transform of boundaries, Boundary description using segment sequences, B-spline representation	
6.0		Boundary Description & Object Recognition	12

	6.1	Texture: Statistical Texture Description Methods- Methods based on spatial frequencies, co-occurrence matrices, edge frequency, primitive length, Law's texture energy measures	
	6.2	Object Recognition Knowledge representation, Classification Principles, Classifier setting, Classifier Learning, Support vector machine, cluster analysis	
		Total	48

Text Books:

1. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision" Cengage Engineering, 3rd Edition, 2013
2. Gonzales and Woods, "Digital Image Processing", Pearson Education, India, Third Edition,

Reference books:

1. Anil K.Jain, "Fundamentals of Image Processing", Prentice Hall of India, First Edition, 1989.
2. W Pratt, "Digital Image Processing", Wiley Publication, 3rd Edition, 2002

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (O.2 to O.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 6021	Digital VLSI Design	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 6021	Digital VLSI Design	20	20	20	80	--	--	--	100

Prerequisites:

- Digital System Design
- Microelectronics

Course objectives:

- To highlight the circuit design issues in the context of Digital VLSI technology
- A profound understanding of Digital VLSI design circuits using different design styles.
- To provides an exposure to RTL design and programming

Course outcomes:

After successful completion of the course student will be able to

- Understand the semiconductor technology, scaling and performance.
- Realize logic circuits with different design styles.
- To understand operation of memory, storage circuits and data path elements.
- Simulate and synthesize digital circuits using HDL language.
- Demonstrate an understanding of system level design issues such as protection, clocking, and routing.
- Learn the RTL design techniques and methodologies

Module No.	Unit No.	Topics	Hrs.
1.0		MOS Circuit Design Styles	10
	1.1	Static CMOS, Dynamic CMOS , Pseudo NMOS, Domino, C ² MOS, NORA logic, NP Domino logic	
	1.2	Realization of Multiplexer (upto 4:1 Mux) , Encoder, Decoder, SR Latch, JK FF, D FF, 1 Bit Shift Register with different design styles and their layouts	
2.0		Memory and Storage circuits	08
	2.1	ROM array, SRAM (operation, design strategy, leakage currents, read/write circuits), layout of SRAM	
	2.2	DRAM (Operation of 1T, 3T, operation modes, leakage currents, refresh operation, Input-Output circuits), layout of DRAM	
	2.3	Flash memory: NAND and NOR flash memory	
3.0		Data path design	08
	3.1	Full adder, Ripple carry adder, CLA adder, Carry Skip Adder, Carry Save Adder and carry select adder	
	3.2	Array Multiplier	
	3.3	Barrel shifter	
4.0		VLSI Clocking, Protection and Interconnect	06
	4.1	CMOS clocking styles, pipelined systems, Clock generation, stabilization and distribution	
	4.2	ESD protection, Input circuits, Output circuits, power distribution scheme	
	4.3	Interconnect delay model, interconnect scaling and crosstalk	
5.0		Design methods	08
	5.1	Semicustom, Full custom design, ASIC	
	5.2	PLA, PLD, PAL, FPGA	
	5.3	System based and Data path design using HDL	
6.0		RTL Design	08
	6.1	High Level state machines, RTL design process	
	6.2	Soda dispenser machine, laser based distance measure, Sum of absolute	
	6.3	FIR filter design	
		Total	48

Text Books:

1. Sung-Mo Kang and Yusuf Leblebici, “CMOS Digital Integrated Circuits Analysis and Design”, Tata McGraw Hill, 3rd Edition, 2012.
2. P. Uyemura, “Introduction to VLSI Circuits and Systems”, John Wiley & Sons.
3. Frank Vahid, “ Digital Design with RTL design, VHDL and VERILOG”, John Wiley and Sons Publisher 2011.

4. Neil H. E. Weste, David Harris and Ayan Banerjee, “*CMOS VLSI Design: A Circuits and Systems Perspective*”, Pearson Education, 3rd Edition.
5. Samir Palnitkar, “Verilog HDL: A Guide to Digital Design and Synthesis”, PHI, Second Edition
6. Douglas L. Perry “VHDL: Programming by Example”, McGrawHill, 4th Edition

Reference Books:

1. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, “Digital Integrated Circuits: A Design Perspective”, Pearson Education, 2nd Edition..
2. Volnei A. Pedroni, “Circuit Design and Simulation with VHDL”, MIT Press, 2nd Edition

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (O.2 to O.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned				
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total	
ECCDLO 6022	Radar Engineering	04	--	--	04	--	--	04	
Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 6022	Radar Engineering	20	20	20	80	--	--	--	100

Prerequisites:

- Communication Fundamentals
- Electromagnetic field
- Transmission Lines and Antenna

Course objectives:

- To interpret Radar equations
- To explain different types of radar
- To design RADAR transmitters and receivers for given conditions

Course outcomes:

After successful completion of the course student will be able to

- Explain generalized concept of RADAR.
- Solve problems using radar equations.
- Describe different types of radar for specific application.
- Explain concept of tracking radar.
- Evaluate the design constraints for transmitter.
- Evaluate the design constraints for receiver.

Module No.	Unit No.	Topics	Hrs.
1.0		Introduction to Radar	04
	1.1	Basics Radar, Radar equation	
	1.2	Block Diagram, Radar Frequencies	
	1.3	Applications of Radar	
2.0		Radar Equation	08
	2.1	Detection of signal in noise	
	2.2	Receiver Noise and Signal-to-noise Ratio	
	2.3	Probability of detection and false alarm: Simple, complex Targets	
	2.4	Pulse Repetition Frequency	
3.0		MTI and Pulse Doppler Radar	12
	3.1	Introduction to Doppler and MTI radar, Doppler frequency shift	
	3.2	Simple CW Doppler radar, MTI radar block diagram	
	3.3	Delay line canceler	
	3.4	Moving-target-detection	
	3.5	Pulse Doppler radar	
4.0		Tracking Radar	08
	4.1	Monopulse tracking	
	4.2	Conical scan and sequential lobbing	
	4.3	Limitation of tracking accuracy	
	4.4	Low angle tracking	
5.0		Radar Transmitters	10
	5.1	Radar RF power sources: Klystron, Travelling wave tube	
	5.2	Solid state RF power source: low power transmitter, high power transmitter, Advantages of solid state RF power source	
	5.3	Magnetron: coaxial magnetron	
	5.4	Crossed field amplifiers: CFA operation, modulating a CFA, system implementation	
6.0		Radar Receivers	06
	6.1	Receiver noise figure	
	6.2	Superheterodyne Receiver	
	6.3	Radar Display: Types of displays	
		Total	48

Text Books:

1. Merrill Skolnik, –Introduction to RADAR Systems, Tata McGraw Hill, Third Edition
2. Merrill Skolnik, –Radar Handbook, Tata McGraw Hill, Second Edition

Reference books:

1. Mark A. Richards, James A. Scheer, William A. Holm, “Principles of Modern Radar Basic Principals”, Scitech Publishing.
2. Simon Kingsley, Shaun Quegon, “Understanding Radar Systems”, Scitech Publishing Inc.
3. G. S. N. Raju, “Radar Engineering and Fundamentals of Navigational Aids”, I. K International publishing House Pvt. Ltd.

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 6023	Database Management System	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 6023	Database Management System	20	20	20	80	--	--	--	100

Prerequisites:

- Basic knowledge of programming

Course objectives:

- Learn and practice data modeling using the entity-relationship and developing database designs.
- Understand the use of Structured Query Language (SQL) and learn SQL syntax.
- Understand the needs of database processing and learn techniques for controlling the consequences of concurrent data access

Course outcomes:

After successful completion of the course student will be able to

- Understand the different issues involved in the design and implementation of a database system.
- Transform an information model into a relational database schema and to use a data definition language and/or utility to implement the schema using a DBMS.
- Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database.
- Understand the concepts of constraints, views, concurrency control, deadlock

Module No.	Unit No.	Topics	Hrs.
1.0		Introduction to Databases and Transactions	02
	1.1	Introduction to databases, History of database system, Benefits of Database system over file system, relational databases, database architecture, transaction management	
2.0		Data Models	06
	2.1	The importance of data models, Basic building blocks, Business rules, Evolution of data models (hierarchical, Network, Relational, Entity relationship and object model), Degrees of data abstraction.	
3.0		Database Design, ER-Diagram and Unified Modeling Language	10
	3.1	Database design and ER Model: overview, ER-Model, Constraints, ER-Diagrams, ERD Issues, weak entity sets, Codd's rules, Relational Schemas, Introduction to UML Relational database model: Logical view of data, keys, integrity rules. Relational Database design: features of good relational database design, atomic domain and Normalization (1NF, 2NF, 3NF, BCNF).	
4.0		Relational Algebra and Calculus	10
	4.1	Relational algebra: introduction, Selection and projection, set operations, renaming, Joins, Division, syntax, semantics. Operators, grouping and ungrouping, relational comparison. Calculus: Tuple relational calculus, Domain relational Calculus, calculus vs algebra, computational capabilities.	
5.0		Constraints, Views and SQL	10
	5.1	What is constraints, types of constraints, Integrity constraints, Views: Introduction to views, data independence, security, updates on views, comparison between tables and views SQL: data definition, aggregate function, Null Values, nested sub queries, Joined relations. Triggers.	
6.0		Transaction management and Concurrency control	10
	6.1	Transaction management: ACID properties, serializability and concurrency control, Lock based concurrency control (2PL, Deadlocks), Time stamping methods, optimistic methods, database recovery management.	
		Total	48

Text Books:

1. A Silberschatz, H Korth, S Sudarshan, “Database System and Concepts”, Fifth Edition McGraw-Hill
2. Rob, Coronel, “Database Systems”, Seventh Edition, Cengage Learning.
3. Ramez Elmasri, Shamkant B. Navathe, “Fundamentals of Database System”, Seventh Edition, Person.
4. G. K. Gupta: “Database Management Systems”, McGraw – Hill.

Reference Books:

1. Peter Rob and Carlos Coronel, “Database Systems Design, Implementation and Management”, Thomson Learning, 5th Edition.
2. P.S. Deshpande, “SQL and PL/SQL for Oracle 11g, Black Book”, Dreamtech Press
3. Mark L. Gillenson, Paulraj Ponniah, “Introduction to Database Management”, Wiley
4. Raghu Ramkrishnan and Johannes Gehrke, “Database Management Systems”, TMH
5. Debabrata Sahoo “Database Management Systems” Tata McGraw Hill, Schaum’s Outline

E-Resources:

1. <https://www.tutorialspoint.com/dbms/index.htm>
2. <https://www.studytonight.com/dbms/>
3. <https://beginnersbook.com/2015/04/dbms-tutorial/>
4. <https://www.w3schools.in/dbms/>
5. <https://www.tutorialcup.com/dbms>

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned				
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total	
ECCDLO 6024	Audio Processing	04	--	--	04	--	--	04	
Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 6024	Audio Processing	20	20	20	80	--	--	--	100

Prerequisites

- Signal System

Course objectives:

- To understand basic concepts and methodologies for the analysis and modeling of speech signal.
- To characterize the speech signal as generated by a speech production model.
- To understand the mechanism of speech and audio perception.
- To understand the digital representation of the speech waveform.
- To perform the analysis of speech signal using STFT.
- To extract the information of the speech or audio signals.
- To provide a foundation for developing application in this field.

Course outcomes:

After successful completion of the course student will be able to

- Demonstrate advanced Knowledge in Digital model representation of speech signal.
- Design and implement algorithms for processing speech and audio signals considering the properties of acoustic signals and human hearing.
- Analyze speech signal to extract the characteristic of vocal tract (formants) and vocal cords (pitch).
- Formulate and design a system for speech recognition and speaker recognition.
- Acquired knowledge about audio and speech signal estimation and detection.

Module No.	Unit No.	Topics	Hrs.
1.0		Introduction	06
	1.1	Review of digital signal and systems, Transforms representations of signal and systems, Sampling Theorem, Goertzel algorithm, Chirp algorithm.	
2.0		Digital Models for Speech signals	06
	2.1	Speech production and acoustic tube modeling, acoustic phonetics, anatomy, and physiology of the vocal tract and ear, hearing and perception.	
3.0		Digital Representations of the Speech Waveform	08
	3.1	Sampling speech signals, Instantaneous quantization, Adaptive quantization, Differential quantization, Delta Modulation, Differential PCM, Comparison of systems, Direct digital code conversion.	
4.0		Time Domain Models for Speech Processing	12
	4.1	Time dependent processing of speech, Short time energy and average magnitude, Short time average zero crossing rate, Speech V/S silence discrimination using energy & Zero crossings, Pitch period estimation, Short time autocorrelation function, Short time average magnitude difference function, Pitch period estimation using autocorrelation function, Median smoothing.	
5.0		Short time Fourier Transform	10
	5.1	Introduction- Definition and Properties, Fourier Transform Interpretation ,Linear Filtering Interpretation ,Sampling rates of X_n ($e^{j\omega}$) in Time and Frequency ,Filter Bank Summation Method of Short -Time Synthesis ,Overlap Addition Method for Short -Time Synthesis.	
6.0		Speech and Audio Processing	06
	6.1	Vocoder- Voice excited channel vocoder, Voice excited and error signal excited LPC vocoders. Adaptive predictive coding of speech, Auditory Modeling. Audio signal processing for Music applications. Speech recognition pattern comparison techniques, Artificial Neural Network.	
		Total	48

Text Books:

1. L R Rabiner and S W Schafer, "Digital processing of speech signals", Pearson Education, 2009.
2. L R Rabiner, B H Juang, B Yegnanarayana, "Fundamentals of speech Recognition", Pearson Education, 1993.

Reference Books

1. Thomas F Quateri, "Discrete Time Speech Signal Processing" Pearson Edition, 2006.
2. Ben Gold and Nelson Morgan, "Speech & Audio Signal Processing", Wiley, 2007.
3. Douglas O Shaughnessy, "Speech Communications", 2nd Edition, Oxford university press, 2000.

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL601	Microcontroller & Applications Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme								
		Theory Marks				End Sem. Exam	Term Work	Practical & Oral	Oral	Total
		Internal assessment								
		Test 1	Test2	Avg. Of Test 1 and Test 2						
ECL601	Microcontrol ler & Applications Laboratory	--	--	--	--	25	25	--	50	

Suggested Experiment List

1. Perform Arithmetic and Logical Operations
2. Transfer of data bytes between Internal and External Memory
3. Experiments based on General Purpose Input-Output, Timers, Interrupts, Delay, etc
4. Interfacing of LED,LCD, Stepper Motor, UART

Mini project based on any application related to 8051 or ARM7 can be implemented.

Note: Mini Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL602	Computer Communication Network Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL602	Computer Communicatio n Network Laboratory	--	--	--	--	25	25	--	50

Suggested Experiment List

1. Create a Virtual Network using NETKIT emulator and use networking commands like route, arp, netstat, traceroute, ping on created topology.
2. To study installation and configuration of NS 2.35 simulator.
3. Design a connectionless and connection oriented network topology for static routing and dynamic routing with the help of NS2 simulator.
4. To study three way handshaking process as well as working process for connection oriented Protocols like FTP, TELNET and analysing packets generated by using packet capturing tool like tcpdump
5. To implement stream socket that can serve multiple clients at the same time.
6. To study requirements and scope of Subnetting and Network Translation by using Netkit Emulator.
7. Case Study: To study installation of linux operating system by using DHCP, TFTP and any repository server like HTTP, FTP or NFS.

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL603	Antenna & Radio Wave Propagation Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme								
		Theory Marks				End Sem. Exam	Term Work	Practical & Oral	Oral	Total
		Internal assessment								
		Test 1	Test2	Avg. Of Test 1 and Test 2						
ECL603	Antenna & Radio Wave Propagation Laboratory	--	--	--	--	25	25	--	50	

Suggested Experiment List

- Introduction to different Antenna parameters and its importance
- Introduction to Different Antenna Types
- Study of Radiation pattern of dipole, folded dipole and Monopole antenna
- Study of Antenna Arrays – N element array for given angle, Parametric study for various arrays parameters
- Study of Yagi-Uda Antenna
- Study of Aperture Antennas – Horn / Reflector Antennas
- Design, implementation and Pattern measurement of Regular shape MSA
- Case Study of Recent reported variations of Antenna types (Paper from reputed journal is to be referred and thoroughly study and present the report, maximum four students per group)

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL604	Image Processing and Machine Vision Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL604	Image Processing and Machine Vision Laboratory	--	--	--	--	25	25	--	50

Suggested Experiment List

- At least 8 programs written in C/MATLAB software

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 6021	Digital VLSI Design Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 6021	Digital VLSI Design Laboratory	--	--	--	--	25	--	--	25

Suggested Experiment List

- At least **08** experiments covering entire syllabus of Digital VLSI should be set to have well predefined inference and conclusion.
- The first 05 experiments as described below can be conducted by using Free or Professional tools
 - 01** experiments on Layouts of NAND and NOR gates to understand design rules
 - 01** experiment on Layout design of logical expression
 - 01** experiments on NAND/NOR gate implementation using at least 03 design styles
 - 02** experiment on Multiplexer/Decoder/Flip flop/Memory etc design
- Last **03** experiments on HDL

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 6022	Radar Engineering Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme								
		Theory Marks				End Sem. Exam	Term Work	Practical & Oral	Oral	Total
		Internal assessment								
		Test 1	Test2	Avg. Of Test 1 and Test 2						
ECLDLO 6022	Radar Engineering Laboratory	--	--	--	--	25	--	--	25	

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 6023	Database Management System Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme								
		Theory Marks				End Sem. Exam	Term Work	Practical & Oral	Oral	Total
		Internal assessment								
		Test 1	Test2	Avg. Of Test 1 and Test 2						
ECLDLO 6023	Database Management System Laboratory	--	--	--	--	25	--	--	25	

Suggested Experiment List

- Design a Database and create required tables. For e.g. Bank, College Database
- Apply the constraints like Primary Key, Foreign key, NOT NULL to the tables.
- Write a sql statement for implementing ALTER, UPDATE and DELETE
- Write the queries to implement the joins
- Write the query for implementing the following functions: MAX (), MIN (), AVG (), COUNT ()
- Write the query to implement the concept of Integrity constraints
- Write the query to create the views
- Perform the queries for triggers
- Perform the following operation for demonstrating the insertion, updation and deletion using the referential integrity constraints
- Write the query for creating the users and their role

List of Mini projects:

Note: These are few examples of mini projects; teachers may prepare their own list.

1. Library Management System
2. Hospital Management System
3. Pharmacy Management System
4. Human Resource Database Management System in Java
5. Student Database Management System
6. Employee Management System
7. Inventory Control Management Database

8. Pay Roll Management System
9. Railway System Database
10. Airline Reservation System
11. Blood Donation System
12. School Management System

Online Repository Sites:

1. Google Drive
2. GitHub
3. Code Guru

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 6024	Audio Processing Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme								
		Theory Marks				End Sem. Exam	Term Work	Practical & Oral	Oral	Total
		Internal assessment								
		Test 1	Test2	Avg. Of Test 1 and Test 2						
ECLDLO 6024	Audio Processing Laboratory	--	--	--	--	25	--	--	25	

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC701	Microwave Engineering	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC701	Microwave Engineering	20	20	20	80	--	--	--	100

Prerequisites:

- Electromagnetic Engineering
- Antenna and Radio Wave Propagation
- Communication Engineering

Course objectives:

- To learn fundamentals of microwave systems.
- To learn to make system level design decisions.
- To learn passive and active device characteristics

Course outcomes:

After successful completion of the course student will be able to

- Characterize devices at higher frequencies.
- Design and analyze microwave circuits.
- Design and analyze amplifiers and oscillators at microwave frequencies.
- Demonstrate skills of planning, design and deployment of microwave networks.

Module No.	Unit No.	Topics	Hrs.
1.0		Introduction to Microwaves	08
	1.1	Microwave Frequency Bands in Radio Spectrum, Characteristics, Advantages and Applications of Microwaves.	
	1.2	Scattering parameters: Characteristics and Properties.	
	1.3	Strip lines, Microstrip lines and coupled lines: Analysis and design.	
	1.4	Design of Impedance matching network using lumped and distributed parameters.	
2.0		Waveguides and Passive Devices	08
	2.1	Rectangular and circular waveguides: Construction, Working and Mode analysis.	
	2.2	Resonators, Re-entrant cavities, Tees, Hybrid ring, Directional couplers, Phase shifters, Terminations, Attenuators and Ferrite devices such as Isolators, Gyrotors, and Circulators.	
3.0		Microwave Tubes	10
	3.1	Two Cavity Klystron, Multi-Cavity Klystron and Reflex Klystron.	
	3.2	Helix Travelling Wave Tube and Cross Field Amplifier.	
	3.3	Backward Wave Oscillator, Cylindrical Magnetron and Gyrotron.	
4.0		Microwave Semiconductor Devices	10
	4.1	Diodes: Varactor, PIN, Tunnel, Point Contact, Schottky Barrier, Gunn, IMPATT, TRAPATT, and BARITT.	
	4.2	Transistors: BJT, Hetero junction BJT, MESFET, and HEMT	
	4.3	Parametric Amplifiers and Applications.	
5.0		Microwave Measurements	06
	5.1	VSWR, Frequency, Power, Noise, Q-Factor, Impedance, Attenuation, Dielectric Constant, Antenna Gain.	
6.0		Microwave Integrated Circuits (MIC)	06
	6.1	MIC Materials.	
	6.2	Types of MIC: Hybrid and Monolithic MIC.	
	6.3	Chip Mathematics.	
		Total	48

Text Books :

1. Samuel Liao, "Microwave Devices and Circuits", Prentice Hall
2. David Pozar, "Microwave Engineering", Wiley Publication, Fourth Edition
3. Matthew M. Radmanesh, "Radio Frequency and Microwave Electronics", Pearson Education.
4. Annapurna Das and S. K Das, "Microwave Engineering", McGraw Hill Education, Third Edition.

References:

1. Colin, Foundations of Microwave Engineering, Second Edition, Wiley Interscience, 2nd Edition.
2. Devendra Misra, "Radio Frequency and Microwave Communication Circuits- Analysis and Design", John Wiley & Sons, 2nd Edition

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (O.2 to O.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC702	Mobile Communication System	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC702	Mobile Communication System	20	20	20	80	--	--	--	100

Prerequisites:

- Analog Communication
- Digital Communication
- Computer Communication and Networks

Course objectives:

- To understand the cellular fundamentals and different types of radio propagation models.
- To study the system architecture of 2G, 2.5 G and 3G.
- To develop the concepts of emerging technologies for 4 G standards and beyond.

Course outcomes:

After successful completion of the course student will be able to

- Explain the cellular fundamentals and estimate the coverage and capacity of cellular systems.
- Classify different types of propagation models and analyze the link budget.
- Illustrate the fundamentals and system architecture of GSM, 2.5G and IS-95.
- Apply the concepts of 3G technologies of UMTS and CDMA 2000.
- Elaborate the principles of 3GPP LTE.
- Identify the emerging technologies for upcoming mobile communication systems.

Module No.	Unit No.	Topics	Hrs.
1.0		Fundamentals of Mobile Communication	08
	1.1	Introduction to wireless communication: Mobile radio telephony, Examples of Wireless Communication Systems, Related design problems.	
	1.2	The Cellular Concept System Design Fundamentals: Frequency Reuse, Channel Assignment Strategies, Interference and System Capacity, Trunking and Grade of Service, Improving Coverage and Capacity in Cellular Systems	
2.0		Mobile Radio Propagation	08
	2.1	Large scale fading: Free space propagation model, the three basic propagation mechanisms, reflection, ground reflection (two-ray) model, diffraction, scattering, practical Link budget design using path loss models	
	2.2	Small scale fading: Small scale multipath propagation, parameters of mobile multipath channels, types of small-scale fading, Rayleigh and Ricean distributions.	
	2.3	Features of all conventional multiple access techniques: Frequency division multiple access(FDMA), time division multiple access(TDMA),space spectrum multiple access (SSMA), space division multiple access (SDMA),OFDM-PAPR,OFDMA	
3.0		2G Technologies	10
	3.1	GSM: GSM Network architecture, GSM signalling protocol architecture, identifiers used in GSM system, GSM channels, frame structure for GSM, GSM speech coding, authentication and security in GSM, GSM call procedures, GSM hand-off procedures, GSM services and features	
	3.2	GSM evolution: GPRS And EDGE- architecture, radio specifications, channels.	
	3.3	IS-95: Architecture of CDMA system, CDMA air interface, power control in CDMA system, power control, handoff, rake receiver	
4.0		3G Technology	06
	4.1	UMTS: Objectives, standardisation and releases, network architecture, air interface specifications, channels, security procedure, W-CDMA air interface, attributes of W-CDMA system, W-CDMA channels	
	4.2	Cdma2000 cellular technologies: Forward And Reverse Channels, Handoff And Power Control.	
5.0		3GPP LTE	08

	5.1	Introduction, system overview: Frequency bands and spectrum flexibility, network structure, protocol structure	
	5.2	Physical layer: Frames, slots, and symbols, modulation, coding, multiple-antenna techniques	
	5.3	Logical and Physical Channels: Mapping of data onto (logical) sub-channels.	
	5.4	Physical layer procedures: Establishing a connection, retransmissions and reliability, scheduling, power control, handover.	
6.0		Advanced techniques for 4G deployment	08
	6.1	Multi-antenna Techniques: Smart antennas, multiple input multiple output systems	
	6.2	Cognitive radio: Architecture, spectrum sensing	
	6.3	Relaying multi-hop and cooperative communications: Principles of relaying, fundamentals of relaying	
		Total	48

Text Books :

1. Theodore S. Rappaport “wireless communications - principles and practice”, PEARSON , Second edition.
2. T L Singal “wireless communications”, Mc Graw Hill Education.
3. Andreas F. Molisch “wireless communications” WILEY INDIA PVT LTD, Second edition.

References:

1. Upena Dalal “Wireless and Mobile Communications”, Oxford university Press.
2. Vijay K.Garg “Wireless Communications and Networking”,Morgan–Kaufmann series in Networking-Elsevier

E-Resources:

1. MIT Open Course ware : <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-452-principles-of-wireless-communications-spring-2006/>
2. NPTEL: <http://nptel.ac.in/courses/117104099/>
3. Virtual Lab : <http://vlab.co.in/>

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC703	Optical Communication	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC703	Optical Communication	20	20	20	80	--	--	--	100

Prerequisites:

- Physics
- Electromagnetic wave propagation
- Electronics devices and circuits
- Principles of communication

Course objectives:

- List, write and explain fundamentals and transmission characteristics of optical fiber communication
- List, write and explain principles and characteristics of various sources ,detectors and various fiber optic components
- Calculate parameters for optical link budgeting and analyze the link

Course outcomes:

After successful completion of the course student will be able to

- List, write and explain fundamentals and transmission characteristics of optical fiber Communication.
- List, write and explain principles and characteristics of various sources ,detectors and various fiber optic components
- Calculate parameters for optical link budgeting and analyze the link

Module No.	Unit No.	Topics	Hrs.
1.0		Optical Fiber and their properties	10
	1.1	Historical development, general system, advantages, disadvantages, and applications of optical fiber communication, optical fiber waveguides, Ray theory, cylindrical fiber (no derivations), single mode fiber, cutoff wave length, and mode field diameter. Wave guiding principles, Theory of optical wave propagation, Types and classification of optical fibers, loss and bandwidth	
2.0		Transmission Characteristics of Optical Fiber	12
	2.1	Attenuation, absorption, linear and nonlinear scattering losses, bending losses, modal dispersion, waveguide dispersion, dispersion and pulse broadening, dispersion shifted and dispersion flattened fibers. General Overview of nonlinearities, Stimulated Raman Scattering, Stimulated Brillouin Scattering, Self Phase modulation, Cross-Phase modulation, Four wave mixing and its mitigation, Solitons. Measurements of attenuation, dispersion and OTDR	
3.0		Optical Sources	06
	3.1	Working principle and characteristics of sources (LED, LASER), Tunable lasers Quantum well lasers, Charge capture in Quantum well lasers, Multi Quantum well Laser diodes, Surface Emitting Lasers: Vertical cavity Surface Emitting Lasers	
4.0		Optical Detectors	06
	4.1	Working principle and characteristics of detectors (PIN, APD), Material requirement for RCEPD, Resonant cavity enhancement (RCE) Photo Detector, Noise analysis in detectors, coherent and non-coherent detection, receiver structure, bit error rate of optical receivers, and receiver performance	
5.0		Fiber Optic Components	08
	5.1	Fiber fabrication (VAD, MCVD), fiber joints, fiber connectors, splices Couplers, multiplexers, filters, fiber gratings, Fabry Perot filters, switches and wavelength converters, Optical amplifiers, basic applications and types, semiconductor optical amplifiers, EDFA.	
6.0		Optical Link	06
	6.1	Introduction, Point to point links, system considerations, link power budget, and rise time budget. RF over fiber, key link parameters, Radio over fiber links, microwave photonics.	
		Total	48

Text Books :

1. Optical Fiber Communication – Gerd Keiser, 4th Ed., MGH, 2008.
2. Optical Fiber Communications– – John M. Senior, Pearson Education. 3rd Impression, 2007.

References:

1. Fiber optics communications-Harold Kolimbiris
2. Introduction to optical fibers, Cheri, McGraw Hill.
3. An introduction to fiber optics, A. Ghatak and K.Thyagrajan, Cambridge Univ, press 10
4. Optical fiber communication and sensors-M. Arumugam Agencies, 20002 optic sensors.
5. Fiber optic communication– Joseph C Palais: 4th Edition, Pearson Education.

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 7031	Neural networks & Fuzzy Logic	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 7031	Neural networks & Fuzzy Logic	20	20	20	80	--	--	--	100

Prerequisites:

- Numerical Methods
- Optimization Techniques

Course objectives:

- To introduce the concepts and understanding of artificial neural networks
- To provide adequate knowledge about supervised and unsupervised neural networks
- To introduce neural network design concepts
- To expose neural networks based methods to solve real world complex problems
- To teach about the concept of fuzziness involved in various systems and provide adequate knowledge about fuzzy set theory, and fuzzy logic
- To provide knowledge of fuzzy logic to design the real world fuzzy systems

Course outcomes:

After successful completion of the course student will be able to

- Comprehend the concepts of biological neurons and artificial neurons
- Analyze the feed-forward and feedback neural networks and their learning algorithms.
- Calculate Comprehend the neural network training and design concepts
- Analyze the application of neural networks to non linear real world problem
- Comprehend the concept of fuzziness involved in various systems, fuzzy set theory and fuzzy logic
- Apply fuzzy logic to real world problems.

Module No.	Unit No.	Topics	Hrs.
1.0		Introduction to Neural Networks and their basic concepts:	07
	1.1	Biological neurons and Artificial neuron, McCulloch-Pitts models of neuron, Types of activation functions and Neural Network architectures, Pre-requisites for training of neural networks. Linearly separable and linearly non-separable systems with examples, Features and advantages of Neural Networks over statistical techniques, Knowledge representation, Terminologies related to artificial neural networks, Concepts of Supervised learning, Unsupervised learning, Reinforcement	
2.0		Supervised Learning Neural Networks:	08
	2.1	Perceptron - Single Layer, Multilayer and their architecture, Error back propagation algorithm, Generalized delta rule, Concept of Training, Testing and Cross-validation data sets for design and validation of networks. Over-fitting. Stopping criterion for training.	
3.0		Unsupervised Learning Neural Networks:	09
	3.1	Competitive Learning Networks – Maxnet, Mexican Hat Net, Kohonen Self-Organizing Networks – architecture, training algorithm, K-means and LMS algorithms, Radial Basis Function (RBF) neural network – architecture and algorithm, and Discrete Hopfield networks. Introduction to the concept of Support Vector Machine based classifier.	
4.0		Applications of Neural Networks:	06
	4.1	Applications of Neural networks in pattern classification, Character Recognition, Face recognition, Image compression and Decompression	
5.0		Fuzzy logic:	12
	5.1	Introduction to fuzzy logic, Basic Fuzzy logic theory, Fuzzy sets - properties & operations, Fuzzy relation - Operations on fuzzy relations, Fuzzy Membership functions, Fuzzy Rules and Fuzzy Reasoning, Fuzzification and Defuzzification methods, Fuzzy Inference Systems, Mamdani Fuzzy Models, Fuzzy knowledge based controllers.	
6.0		Applications of Fuzzy Logic and Fuzzy Systems:	06
	6.1	Fuzzy pattern recognition, fuzzy image processing, Simple applications of Fuzzy knowledge based controllers like washing machines, home heating system, and train break control.	
		Total	48

Text Books :

1. S. N. Sivanandam and S. N. Deepa *Introduction to Soft computing*, Wiley India Publications
2. Timothy J. Ross, *Fuzzy Logic with Engineering Applications*, Wiley India Publications
3. John Yen and Reza Langari, *Fuzzy Logic- Intelligence, Control and Information*, Pearson Publications.
4. S. Rajasekaran and G. A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic, and Genetic Algorithms*, PHI
5. Satish Kumar, *Neural Networks: A classroom Approach*, Tata McGraw-Hill.
6. Meherotra Kishan, Mohan C. K., Ranka Sanjay, *Elements of artificial neural networks*, Penram Publications

References:

1. Hagan, Demuth, and Beale, *Neural Network Design*, Thomson Learning
2. Simon Haykin, *Neural Network- A Comprehensive Foundation*, Pearson Education
3. Christopher M Bishop, *Neural Networks For Pattern Recognition*, Oxford University Press
4. William W Hsieh, *Machine Learning Methods in the Environmental Sciences Neural Network and Kernels*, Cambridge Publications
5. S. N. Sivanandam, S. Sumathi, and S. N. Deepa, *Introduction to Neural Network Using Matlab* Tata McGraw-Hill Publications
6. Bart Kosko, *Neural networks and Fuzzy Systems*, Pearson Education
7. J. S. R. Jang, C.T. Sun, and E. Mizutani, *Neuro-Fuzzy and Soft Computing*, PHI
8. J. M. Zurada, *Introduction to Artificial Neural Systems*, Jaico publishers

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 7032	Big Data Analytics	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 7032	Big Data Analytics	20	20	20	80	--	--	--	100

Prerequisites:

- Data Base Management System

Course objectives:

- To Provide an Overview of an exciting growing field of Big Data Analytics.
- To introduce the tools required to manage and analyze big data like Hadoop, NoSql, Map Reduce.
- To teach the fundamental techniques in achieving big data analytics with scalability and streaming capability.

Course outcomes:

After successful completion of the course student will be able to

- Understand the key issues in big data management.
- Acquire fundamental enabling techniques using tools in big data analytics.
- Achieve adequate perspectives of big data analytics in various applications like sensor, recommender systems, social media applications etc.

Module No.	Unit No.	Topics	Hrs.
1.0		Introduction to Big Data Analytics	06
	1.1	Introduction to Big Data, Big Data characteristics, types of Big Data, Traditional vs. Big Data business approach.	
	1.2	Technologies Available for Big Data, Infrastructure for Big Data, Big Data Challenges, Case Study of Big Data Solutions.	
2.0		Hadoop	06
	2.1	Introduction to Hadoop. Core Hadoop Components, Hadoop Ecosystem, Physical Architecture, Hadoop limitations.	
3.0		NoSQL	08
	3.1	Introduction to NoSQL, NoSQL business drivers, NoSQL case studies.	
	3.2	NoSQL data architecture patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores, Variations of NoSQL architectural patterns.	
	3.3	Using NoSQL to manage big data: What is a big data NoSQL solution? Understanding the types of big data problems; Analyzing big data with a shared-nothing architecture; Choosing distribution models: master-slave versus peer-to-peer; Four ways that NoSQL systems handle big data problems	
4.0		MapReduce	08
	4.1	MapReduce and The New Software Stack: Distributed File Systems, Physical Organization of Compute Nodes, Large Scale File-System Organization.	
		MapReduce: The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution, Coping With Node Failures.	
		Algorithms Using MapReduce: Matrix-Vector Multiplication by MapReduce, Relational-Algebra Operations by MapReduce, Matrix Operations, Matrix Multiplication by MapReduce.	
5.0		Techniques in Big Data Analytics	12
	5.1	Finding Similar Item: Nearest Neighbor Search, Similarity of Documents	
	5.2	Mining Data Streams: Data Stream Management Systems, Data Stream Model, Examples of Data Stream Applications: Sensor Networks, Network Traffic Analysis	
	5.3	Link Analysis: PageRank Definition, Structure of the web, dead ends, Using Page rank in a search engine, Efficient computation of Page Rank: Page Rank Implementation Using MapReduce	
	5.4	Frequent Itemset Mining : Market-Basket Model, Apriori Algorithm, Algorithm of Park-Chen-Yu	
6.0		Big Data Analytics Applications	08

	6.1	Recommendation Systems: Introduction, A Model for Recommendation Systems, Collaborative-Filtering System: Nearest-Neighbor Technique, Example.	
	6.2	Mining Social-Network Graphs: Social Networks as Graphs, Types of Social-Network. Clustering of Social Graphs: Applying Standard Clustering Techniques, Counting triangles using MapReduce.	
		Total	48

Text Books :

1. Radha Shankarmani and M Vijayalakshmi “Big Data Analytics”, Wiley
2. Alex Holmes “Hadoop in Practice”, Manning Press, Dreamtech Press.
3. Dan McCreary and Ann Kelly “Making Sense of NoSQL” – A guide for managers and the rest of us, Manning Press.

References:

1. Bill Franks , “Taming The Big Data Tidal Wave: Finding Opportunities In Huge Data Streams With Advanced Analytics”, Wiley
2. Chuck Lam, “Hadoop in Action”, Dreamtech Press

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 7033	Internet Communication Engineering	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 7033	Internet Communication Engineering	20	20	20	80	--	--	--	100

Prerequisites:

- Analog communication
- Digital Communication
- Computer Communication and Networks

Course objectives:

- To focus on Internet protocol, standards, services and administration.
- To discuss the Internet security protocol and security services
- To discuss multimedia communication standards and compression techniques
- To discuss the Multimedia communication across the networks

Course outcomes:

After successful completion of the course student will be able to

- Explain the operation of the components of a router including, DHCP, NAT/PAT, Routing function, Switching function.
- Describe how DNS works in the global Internet including caching and root servers.
- Understand the current state-of-the-art developments in Internet technologies for multimedia communications.
- Understand the security protocol and services In the Internet
- Appreciate the principles used in designing multimedia protocols, and so understand why standard protocols are designed the way that they are.
- Understand the system design principles of multimedia communications systems.
- Solve problems and design simple networked multimedia systems.

Module No.	Unit No.	Topics	Hrs.
1.0		Introduction to Internet	06
	1.1	What is the Internet, ,Evolution of the Internet, Brief History and Growth of Internet , service description, Network protocol, the network edge	
	1.2	Overview of TCP/IP, layer functions,	
	1.3	Application Layer- Host configuration, DHCP Domain Name System (DNS),Multicast DNS	
	1.4	Remote Login, TELNET and SSH , HTTPs, electronic mail	
2.0		Transport Layer	10
	2.1	Properties of reliable stream delivery, Overview of TCP segment, TCP connection	
	2.2	Flow control, error control, congestion control	
	2.3	User datagram protocol(UDP) header, pseudo header	
	2.4	SCTP, introduction, Packet format ,	
	2.5	Flow control, error control, congestion control	
3.0		Internetworking layer	08
	3.1	Overview of Internet protocol (IP) datagram, IP address classes, subnets and supernets	
	3.2	Private IP addresses, classless inter domain routing (CIDR), CIDR subnet addressing, variable length in CIDR subnet addressing, ICMP	
	3.3	Internet Protocol version 6 (IPv6), Packet format, Transition from IPv4 to IPv6, ICMPv6	
4.0		Internet Security	06
	4.1	Network layer security(AH, ESP, IPsec),	
	4.2	Transport layer security(SSL), Application layer security(secure E mail-PGP, S/MIME),	
	4.3	VPN Firewall, Intrusion Detection System.	
5.0		Multimedia Communications	10
	5.1	Information Representation- text, images, audio and video, Text and image compression, Audio and video compression, video	
	5.2	compression standards: H.261, H.263, P1.323, MPEG 1, MPEG 2, Other coding formats for text, speech, image and video	
	5.3	Multimedia Communication Across Networks- Layered video coding, error resilient video coding techniques,	

	5.4	multimedia transport across IP networks and relevant protocols such as RSVP, RTP, RTCP, DVMP, Signalling Protocols: Real-Time Streaming Protocol (RTSP) ,Multimedia across wireless- (Mobiles Networks – Broadcasting Networks – Digital Television infrastructure for interactive multimedia services)	
6.0		Quality of Services (QoS)	08
	6.1	Integrated services (intserv): Architecture and Service Model, Resource Reservation Protocol (RSVP), Packet Scheduling Disciplines in the Internet	
	6.2	Differentiated Services (diffserv): Framework and Concept, Assured and Expedited Services, Packet Classification, Routers Internals and Packet Dropping Techniques	
		Total	48

Text Books :

1. B. Forouzan, —*TCP/IP Protocol Suite*ll, 4th Edition, McGraw-Hill Publication
2. K. R. Rao, Zaron S. Bojkovic, Dragorad A. Milocanovic, Multimedia Communication Systems, Prentice Hall India, 2002. ISBN: 81-203-2145-6.

References:

1. Steve Heath, Multimedia and Communication Technology, Second Edition, Focal Press, 2003.
2. ISBN: 81-8147-145-8. Ted Wallingford, —*Switching to VoIP*ll, Oreilly Publication
3. Fred Halsall, “Multimedia Communications”, Pearson education, 2001
4. K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, “Multimedia Communication Systems”, Pearson education, 2004
5. Raif steinmetz, Klara Nahrstedt, “Multimedia: Computing, Communications and Applications”, Pearson education, 2002
6. Tay Vaughan, “Multimedia: Making it Work”, 6th edition, Tata McGraw Hill, 2004
7. Pallapa Venkataram, “Multimedia information systems”, Pearson education (InPress),2005.
8. Multimedia Communication Techniques and Standards

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 7034	CMOS Mixed Signal VLSI	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 7034	CMOS Mixed Signal VLSI	20	20	20	80	--	--	--	100

Prerequisites:

- Electronic Devices and Circuits I
- Electronic Devices and Circuits II
- Linear Integrated Circuits
- Microelectronics
- Digital VLSI

Course objectives:

- Importance of CMOS and Mixed Signal VLSI design in the field of Electronics and Telecommunication.
- Underlying methodologies for analysis and design of fundamental CMOS Mixed signal Circuits like Data Converters.
- The issues associated with high performance Mixed Signal VLSI Circuits

Course outcomes:

After successful completion of the course student will be able to

- Analyze and design single stage MOS Amplifiers.
- Analyze and design Operational Amplifiers.
- Analyze and design data converter circuits.
- Identify design requirements of analog and mixed signal circuits
- Analyze and design CMOS based switched capacitor circuits
- Understand Oscillators and Phase Locked Loops.

Module No.	Unit No.	Topics	Hrs.
1.0		Fundamentals of MOS Amplifiers	10
	1.1	MOS Single-stage Amplifiers: Basic concepts of common source stage, source follower, common gate stage, Differential Amplifiers:	
	1.2	Current mirrors: Basic current mirror, cascode current mirror, active current mirror, Wilson and Widlar current mirrors, voltage and current references.	
2.0		Design of MOS operational amplifier	08
	2.1	General considerations, One-Stage Op amps, Two-Stage Op amps, Gain Boosting, Input Range Limitation.	
	2.2	Frequency Response and Compensation, Slew Rate.	
3.0		Oscillators and Phase Locked Loops	08
	3.1	General Considerations, Ring Oscillators, LC Oscillators, Voltage Controlled Oscillators (VCO), tuning range, tuning linearity Mathematical Model of VCO.	
	3.2	Simple PLL-phase detector, Charge-pump PLL's, Non ideal effects in PLL, Delay locked Loops, applications of PLL.	
4.0		Switched Capacitor circuits	06
	4.1	Theory of sampled data systems, Basic sampling circuits for analog signal sampling, performance metrics of sampling circuits, design and analysis of switched capacitor circuits.	
	4.2	Switched capacitor amplifiers (SC), switched capacitor integrators, first and second order switched capacitor circuits.	
5.0		Data converters	06
	5.1	Analog versus digital discrete time signals, converting analog signals to data signals, sample and hold characteristics. DAC specifications, ADC specifications.	
	5.2	Mixed signal Layout issues, Floor planning, power supply and Ground issues, other interconnect Considerations.	
6.0		Data Converter Architectures	10
	6.1	DAC architectures: R-2R ladder networks, current steering, charge scaling DACs, Cyclic DAC, pipeline DAC, Switched capacitor based DAC design.	
	6.2	ADC architectures: flash, 2-step flash ADC, pipeline ADC, integrating ADC, and successive approximation ADC, Switched capacitor based ADC design	
		Total	48

Text Books :

1. Razavi, “Design of analog CMOS integrated circuits”, McGraw Hill, Edition 2002.
2. Jacob Baker, “CMOS Mixed-Signal circuit design”, IEEE Press, 2009.
3. P. E. Allen and D R Holberg, “*CMOS Analog Circuit Design*”, second edition, Oxford University Press, 2002.
4. Baker, Li, Boyce, “CMOS: Circuit Design, layout and Simulation”, PHI, 2000.
5. Sedra/Smith, “Microelectronic Circuits”, Oxford University Press.

Internal Assessment:

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End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned				
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total	
ECCDLO 7035	Embedded Systems	04	--	--	04	--	--	04	
Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 7035	Embedded Systems	20	20	20	80	--	--	--	100

Course objectives:

- To develop background knowledge Embedded Systems.
- To understand communication techniques.
- To write programs for embedded systems and real time operating systems

Course outcomes:

After successful completion of the course student will be able to

- Understand the detailed processor design techniques and methods of communication.
- Study the in-depth program modelling concepts.
- Study the concepts of Real time operating systems and write programs
- Design embedded system applications using RTOS

Module No.	Unit No.	Topics	Hrs.
1.0		Introduction:-	08
	1.1	Definition of Embedded System, Embedded Systems Vs General Computing Systems, Classification, Major Application Areas	
	1.2	Characteristics and quality attributes (Design Metric) of embedded system. Real time system's requirements, real time issues, interrupt latency. Embedded Product development life cycle	
	1.3	Program modeling concepts: DFG, FSM, Petri-net, UML	
2.0		Processor	08
	2.1	Overview of Custom Single-Purpose Processors, General-Purpose Processors,	
	2.2	Parallel Port example, Standard Single-Purpose Processors	
	2.3	RISC and CISC architectures	
	2.4	GCD example	
3.0		Communication	06
	3.1	CAN bus, I2C, MOD bus, SPI,	
	3.2	Examples on Parallel Communication, Serial Communication, Wireless Communication	
4.0		Real Time Operating Systems[RTOS]	07
	4.1	Operating system basics	
	4.2	Types of OS	
	4.3	Tasks, process,Threads	
	4.4	Multiprocessing and ,Multitasking	
	4.5	Task scheduling	
	4.6	Threads, Process , Scheduling :- Putting them all together	
5.0			07
	5.1	Task communications,	
	5.2	Task synchronization	
	5.3	Device drivers	
	5.4	How to choose RTOS	
	5.5	Examples of RTOS	
6.0		Design examples and case studies of program model and programming with RTOS	12
	6.1	Digital Camera:-Introduction to simple digital camera, Requirements and specifications, Design using Microcontroller and Microcontroller and CCDPP	
	6.2	Automatic Chocolate Vending Machine	
	6.3	Adaptive Cruise Control in car	
		Total	48

Text Books :

1. Frank Vahid, and Tony Givargis, “Embedded System Design: A unified Hardware/Software Introduction”, Wiley Publication.
2. Raj Kamal,” Embedded Systems Architecture, Programming and design”, Tata MCgraw-Hill Publication.
3. Iyer, Gupta,” Embedded real systems Programming”, TMH
4. David Simon, “Embedded systems software primer”, Pearson
5. Shibu K.V,” Introduction to Embedded Systems”, Mc Graw Hill, 2nd edition.
6. K.V.K.K. Prasad, “Embedded Real Time Systems: Concepts, Design & Programming”, Dreamtech Publication.

Internal Assessment:

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End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (O.2 to O.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 7011	Product Lifecycle Management	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 7011	Product Lifecycle Management	20	20	20	80	--	--	--	100

Course objectives:

- To familiarize the students with the need, benefits and components of PLM
- To acquaint students with Product Data Management & PLM strategies
- To give insights into new product development program and guidelines for designing and developing a product
- To familiarize the students with Virtual Product Development

Course outcomes:

After successful completion of the course student will be able to

- Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
- Illustrate various approaches and techniques for designing and developing products.
- Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
- Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

Module No.	Unit No.	Topics	Hrs.
1.0		Introduction to Product Lifecycle Management (PLM)	10
	1.1	Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications	
	1.2	PLM Strategies: Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	
2.0		Product Design	09
	2.1	Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	
3.0		Product data Management	05
	3.1	Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	
4.0		Virtual Product Development Tools	05
	4.1	For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	
5.0		Integration of Environmental Aspects in product Design	05
	5.1	Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	
6.0		Life Cycle Assessment and Life Cycle Cost Analysis	05

	6.1	Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	
		Total	39

References :

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, Antonino Risitano, "Product Design for the environment-A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229
3. Saaksvuori Antti, Immonen Anselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265

Internal Assessment:

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End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (O.2 to O.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 7012	Reliability Engineering	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 7012	Reliability Engineering	20	20	20	80	--	--	--	100

Course objectives:

- To familiarize the students with various aspects of probability theory
- To acquaint the students with reliability and its concepts
- To introduce the students to methods of estimating the system reliability of simple and complex systems
- To understand the various aspects of Maintainability, Availability and FMEA procedure

Course outcomes:

After successful completion of the course student will be able to

- Understand and apply the concept of Probability to engineering problems
- Apply various reliability concepts to calculate different reliability parameters
- Estimate the system reliability of simple and complex systems
- Carry out a Failure Mode Effect and Criticality Analysis

Module No.	Unit No.	Topics	Hrs.
1.0		Probability Theory	08
	1.1	Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. Probability Distributions: Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. Measures of Dispersion: Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	
2.0			08
	2.1	Reliability Concepts: Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. Failure Data Analysis: Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. Reliability Hazard Models: Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	
3.0		System Reliability	05
	3.1	System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	
4.0		Reliability Improvement	08
	4.1	Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	
5.0		Maintainability and Availability	05
	5.1	System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	
6.0		Failure Mode, Effects and Criticality Analysis	05
	6.1	Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fault tree analysis and Event tree Analysis	
		Total	39

References :

1. L. S. Srinath, "Reliability Engineering", Affiliated East-West Press (P) Ltd., 1985.

2. Charles E. Ebeling, “Reliability and Maintainability Engineering”, Tata McGraw Hill.
3. B. S. Dhillon, C. Singh, “Engineering Reliability”, John Wiley & Sons, 1980.
4. P.D.T. Connor, “Practical Reliability Engg.”, John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, “Reliability in Engineering Design”, John Wiley & Sons.
6. Murray R. Spiegel, “Probability and Statistics”, Tata McGraw-Hill Publishing Co. Ltd.

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned				
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total	
ECCILO 7013	Management Information System	03	--	--	03	--	--	03	
Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 7013	Management Information System	20	20	20	80	--	--	--	100

Course objectives:

- The course is blend of Management and Technical field.
- Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
- Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
- Identify the basic steps in systems development

Course outcomes:

After successful completion of the course student will be able to

- Explain how information systems Transform Business
- Identify the impact information systems have on an organization
- Describe IT infrastructure and its components and its current trends
- Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
- Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

Module No.	Unit No.	Topics	Hrs.
1.0		Introduction To Information Systems (IS)	04
	1.1	Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS.	
2.0		Data and Knowledge Management	07
	2.1	Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results	
3.0		Ethical issues and Privacy	07
	3.1	Information Security. Threat to IS, and Security Controls	
4.0		Social Computing (SC)	07
	4.1	Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	
5.0			06
	5.1	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	
6.0		Information System within Organization	08
	6.1	Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	
		Total	39

References :

1. Kelly Rainer, Brad Prince, Management Information Systems, Wiley
2. K. C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 7014	Design of experiments	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 7014	Design of experiments	20	20	20	80	--	--	--	100

Course objectives:

- To understand the issues and principles of Design of Experiments (DOE)
- To list the guidelines for designing experiments
- To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

Course outcomes:

After successful completion of the course student will be able to

- Plan data collection, to turn data into information and to make decisions that lead to appropriate action
- Apply the methods taught to real life situations
- Plan, analyze, and interpret the results of experiments

Module No.	Unit No.	Topics	Hrs.
1.0		Introduction	06
	1.1	Strategy of Experimentation	
	1.2	Typical Applications of Experimental Design	
	1.3	Guidelines for Designing Experiments	
	1.4	Response Surface Methodology	
2.0		Fitting Regression Models	08
	2.1	Linear Regression Models	
	2.2	Estimation of the Parameters in Linear Regression Models	
	2.3	Hypothesis Testing in Multiple Regression	
	2.4	Confidence Intervals in Multiple Regression	
	2.5	Prediction of new response observation	
	2.6	Regression model diagnostics	
	2.7	Testing for lack of fit	
3.0		Two-Level Factorial Designs	07
	3.1	The 2^2 Design	
	3.2	The 2^3 Design	
	3.3	The General 2^k Design	
	3.4	A Single Replicate of the 2^k Design	
	3.5	The Addition of Center Points to the 2^k Design,	
	3.6	Blocking in the 2^k Factorial Design	
	3.7	Split-Plot Designs	
4.0		Two-Level Fractional Factorial Designs	07
	4.1	The One-Half Fraction of the 2^k Design	
	4.2	The One-Quarter Fraction of the 2^k Design	
	4.3	The General 2^{k-p} Fractional Factorial Design	
	4.4	Resolution III Designs	
	4.5	Resolution IV and V Designs	
	4.6	Fractional Factorial Split-Plot Designs	
5.0		Response Surface Methods and Designs	07
	5.1	Introduction to Response Surface Methodology	
	5.2	The Method of Steepest Ascent	
	5.3	Analysis of a Second-Order Response Surface	
	5.4	Experimental Designs for Fitting Response Surfaces	
6.0		Taguchi Approach	04
	6.1	Crossed Array Designs and Signal-to-Noise Ratios	
	6.2	Analysis Methods	
	6.3	Robust design examples	
		Total	39

References :

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition, John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss

Internal Assessment:

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End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 7015	Operations Research	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 7015	Operations Research	20	20	20	80	--	--	--	100

Course objectives:

- Formulate a real-world problem as a mathematical programming model.
- Understand the mathematical tools that are needed to solve optimization problems.
- Use mathematical software to solve the proposed models

Course outcomes:

After successful completion of the course student will be able to

- Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.
- Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
- Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
- Understand the applications of integer programming and a queuing model and compute important performance measures

Module No.	Unit No.	Topics	Hrs.
1.0		Introduction to Operations Research	14
	1.1	Introduction, , Structure of the Mathematical Model, Limitations of Operations Research	
	1.2	Linear Programming: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method,	
	1.3	Duality , Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis	
	1.4	Transportation Problem: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method.	
	1.5	Assignment Problem: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem	
	1.6	Integer Programming Problem: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.	
2.0		Queuing Models	05
	2.1	Queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	
3.0		Simulation	05
	3.1	Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	
4.0		Dynamic programming	05
	4.1	Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	
5.0		Game Theory	05

	5.1	Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	
6.0		Inventory Models	05
	6.1	Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	
		Total	39

References :

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009
3. Hiller, F. S. and Lieberman, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons

Internal Assessment:

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End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
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3. Question No.1 will be compulsory and based on entire syllabus.
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Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 7016	Cyber Security and Laws	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 7016	Cyber Security and Laws	20	20	20	80	--	--	--	100

Course objectives:

- To understand and identify different types cybercrime and cyber law
- To recognized Indian IT Act 2008 and its latest amendments
- To learn various types of security standards compliances

Course outcomes:

After successful completion of the course student will be able to

- Understand the concept of cybercrime and its effect on outside world
- Interpret and apply IT law in various legal issues
- Distinguish different aspects of cyber law
- Apply Information Security Standards compliance during software design and development

Module No.	Unit No.	Topics	Hrs.
1.0		Introduction to Cybercrime	04
	1.1	Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the	
2.0		Cyber Offenses & Cybercrime	09
	2.1	How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	
3.0		Tools and Methods Used in Cyberline	06
	3.1	Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	
4.0		The Concept of Cyberspace	08
	4.1	E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law , The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	
5.0		Indian IT Act	06
	5.1	Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	
6.0		Information Security Standard compliances	06
	6.1	SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	
		Total	39

References :

1. Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai

5. Nina Godbole, *Information Systems Security*, Wiley India, New Delhi
6. Kenneth J. Knapp, *Cyber Security & Global Information Assurance* Information Science Publishing.
7. William Stallings, *Cryptography and Network Security*, Pearson Publication
8. Websites for more information is available on : The Information Technology ACT, 2008-TIFR : <https://www.tifrh.res.in>
9. Website for more information , A Compliance Primer for IT professional
<https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538>

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End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
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3. Question No.1 will be compulsory and based on entire syllabus.
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Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 7017	Disaster Management and Mitigation Measures	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 7017	Disaster Management and Mitigation Measures	20	20	20	80	--	--	--	100

Course objectives:

- To understand physics and various types of disaster occurring around the world
- To identify extent and damaging capacity of a disaster
- To study and understand the means of losses and methods to overcome /minimize it.
- To understand role of individual and various organization during and after disaster
- To understand application of GIS in the field of disaster management
- To understand the emergency government response structures before, during and after disaster

Course outcomes:

After successful completion of the course student will be able to

- Get to know natural as well as manmade disaster and their extent and possible effects on the economy.
- Plan of national importance structures based upon the previous history.
- Get acquainted with government policies, acts and various organizational structure associated with an emergency.
- Get to know the simple do's and don'ts in such extreme events and act accordingly.

Module No.	Unit No.	Topics	Hrs.
1.0		Introduction	03
	1.1	Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change	
2.0		Natural Disaster and Manmade disasters	09
	2.1	Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion	
	2.2	Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters	
3.0		Disaster Management, Policy and Administration	06
	3.1	Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management	
	3.2	Policy and administration: Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	
4.0		Institutional Framework for Disaster Management in India	06
	4.1	Importance of public awareness, Preparation and execution of emergency management program. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations.	
		Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	
5.0		Financing Relief Measures	09
	5.1	Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams.	
	5.2	International relief aid agencies and their role in extreme events	
6.0		Preventive and Mitigation Measures	06

	6.1	Pre-disaster, during disaster and post-disaster measures in some events in general	
	6.2	Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication	
	6.3	Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans	
	6.4	Do's and don'ts in case of disasters and effective implementation of relief aids.	
		Total	39

References :

1. 'Disaster Management' by Harsh K.Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elsevier Publications.
4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
5. 'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
7. Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications.

(Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

Internal Assessment:

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End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 7018	Energy Audit and Management	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 7018	Energy Audit and Management	20	20	20	80	--	--	--	100

Course objectives:

- To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
- To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
- To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Course outcomes:

After successful completion of the course student will be able to

- To identify and describe present state of energy security and its importance.
- To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
- To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
- To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
- To analyze the data collected during performance evaluation and recommend energy saving measures

Module No.	Unit No.	Topics	Hrs.
1.0		Energy Scenario	04
	1.2	Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	
2.0		Energy Audit Principles	08
	2.1	Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Benchmarking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring & targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI). Internal rate of return (IRR)	
3.0		Energy Management and Energy Conservation in Electrical System	10
	3.1	Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. Energy efficiency measures in lighting system, Lighting control: Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	
4.0		Energy Management and Energy Conservation in Thermal Systems	10
	4.1	Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	
5.0		Energy Performance Assessment	04
	5.1	On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	
6.0		Energy conservation in Buildings	03

	6.1	Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	
		Total	39

References :

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. www.energymanagertraining.com
9. www.bee-india.nic.in

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Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 7019	Development Engineering	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 7019	Development Engineering	20	20	20	80	--	--	--	100

Course objectives:

- To understand the characteristics of rural Society and the Scope, Nature and Constraints of rural Development.
- To study Implications of 73rd CAA on Planning, Development and Governance of Rural Areas
- An exploration of human values, which go into making a 'good' human being, a 'good' professional, a 'good' society and a 'good life' in the context of work life and the personal life of modern Indian professionals
- To understand the Nature and Type of Human Values relevant to Planning Institutions

Course outcomes:

After successful completion of the course student will be able to

- Apply knowledge for Rural Development.
- Apply knowledge for Management Issues.
- Apply knowledge for Initiatives and Strategies
- Develop acumen for higher education and research.
- Master the art of working in group of different nature.
- Develop confidence to take up rural project activities independently

Module No.	Unit No.	Topics	Hrs.
1.0			08
	1.1	Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services.	
2.0			04
	2.1	Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee - linkage between Panchayati Raj, participation and rural development	
3.0			06
	3.1	Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development.	
4.0			04
	4.1	Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.	
5.0			10

	5.1	Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education. Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom.	
6.0			04
	6.1	Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education	
		Total	36

References :

1. ITPI, Village Planning and Rural Development, ITPI, New Delhi
2. Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai
3. GoI, Constitution (73rd GoI, New Delhi Amendment) Act, GoI, New Delhi
4. Planning Commission, Five Year Plans, Planning Commission
5. Planning Commission, Manual of Integrated District Planning, 2006, Planning Commission New Delhi
6. Planning Guide to Beginners
7. Weaver, R.C., The Urban Complex, Doubleday.
8. Farmer, W.P. et al, Ethics in Planning, American Planning Association, Washington.
9. How, E., Normative Ethics in Planning, Journal of Planning Literature, Vol.5, No.2, pp. 123-150.
10. Watson, V. , Conflicting Rationalities: -- Implications for Planning Theory and Ethics, Planning Theory and Practice, Vol. 4, No.4, pp.395 – 407

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1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (O.2 to O.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL701	Microwave Engineering Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL701	Microwave Engineering Laboratory	--	--	--	--	25	25	--	50

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL702	Mobile Communication System Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL702	Mobile Communication System Laboratory	--	--	--	--	25	25	--	50

Suggested Experiment List

- To observe the effect of velocity and direction of arrival of a vehicle on Doppler frequency
- To observe the effect of N on C/I ratio and comment on the voice quality
- To observe the effect of incidence angle on reflection coefficient using MATLAB
- To observe the effect of different propagation models on coverage distance
- To observe the effect of C/I ratio in a sectorised cell site and perform worst case analysis for different values of N and degree of sectorisation
 - A) Worst case C/I in a 3 sector cellular system for K=7
 - B) Worst case C/I in a 3-sector cellular system for K=4
 - C) Worst case C/I in a 6 sector cellular system for K=7
 - D) Worst case C/I in a 6 sector cellular system for K=4
- To generate Pseudo noise code used in a CDMA system
- To generate Walsh Codes using Hadamard Matrix.
- To plot Knife edge diffraction gain as a function of Fresnel diffraction parameter
- To plot channel capacity versus SNR for different MIMO systems
- Simulation of OFDMA system
- Simulation of spectrum sensing using energy detection method in cognitive radio

List of Mini projects:

Note: These are few examples of mini projects; teachers may prepare their own list.

1. Developing automated Notification based System using GSM

2. Mobile Communication Based App development
3. Creating Virtual Lab Experiments.

Software Tools:

1. Ns-2: <http://www.isi.edu/nsnam/ns/>
2. Virtual Lab : <http://vlab.co.in/>
3. Scilab Experiments Book:
http://www.scilab.in/textbook_companion/generate_book/2081

Online Repository Sites:

1. Google Drive
2. GitHub
3. Code Guru

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL703	Optical Communication Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL703	Optical Communication Laboratory	--	--	--	--	25	25	--	50

Suggested Experiment List

- Calculation of Numerical aperture
- Calculation of dispersion for given fiber
- Calculation of link Loss for given link
- Performance analysis of Single mode fiber
- Performance Analysis of Optical Link with Different Sources
- Performance Analysis of Optical Link with Different Detectors
- Performance Analysis of Optical Amplifier
- Calculation of link Loss for given link with nonlinearities

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 7031	Neural networks & Fuzzy Logic Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 7031	Neural networks & Fuzzy Logic Laboratory	--	--	--	--	25	25	--	50

Suggested List of Experiments

- Write a program for implementing perceptron based linear functions AND and OR function. Conclude about the noise tolerance of the function.
- Write a program for implementing optimal neural network based XOR functions. Conclude about the noise tolerance of the function
- Write a program for training and testing of Multilayer Perceptron for pattern classification application
- Write a program for training and testing of Multilayer Perceptron for interpolation application
- Program for Support vector Machine based classifiers and compare result with that of Multilayer Perceptron based neural network classification
- Program for application of Multilayer perceptron for character recognition
- Program to develop Fuzzy Inference System for Speed control of DC motor
- Program for fuzzy logic based train brake control with suitable input variable assumptions
- Program to develop Fuzzy Inference System for fuzzy control of washing machines

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project

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can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 7032	Big Data Analytics Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 7032	Big Data Analytics Laboratory	--	--	--	--	25	25	--	50

Suggested Experiment List

- Study of Hadoop ecosystem
- Programming exercises on Hadoop
- Programming exercises in No SQL
- Implementing simple algorithms in Map- Reduce - Matrix multiplication, Aggregates.

List of Mini project

1. Design and implementation of any case study/ applications based on standard Datasets available on the web
 - a. Twitter data analysis
 - b. Fraud Detection
 - c. Text Mining etc. using modern tools.

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades

will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 7033	Internet Communication Engineering Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 7033	Internet Communication Engineering Laboratory	--	--	--	--	25	25	--	50

Suggested Experiment List

- Simulation study on congestion control
- Multimedia networking
- Multimedia streaming
- Assignments / Practicals can be given on writing the programs to encode and decode the various kinds of data by using the algorithms. Students can collect several papers from journals/conferences/Internet on a specific area of Internet and multimedia communications and write a review paper and make a presentation.
- Form small groups to complete projects in audio, image and video coding. The use of C/C++ is encouraged
- Conduct network simulations using OPNET and protocol analysis using Wireshark.

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECLDLO 7034	CMOS Mixed Signal VLSI Laboratory	--	--	02	--	--	01	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 7034	CMOS Mixed Signal VLSI Laboratory	--	--	--	--	25	25	--	50

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 7035	Embedded System Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 7035	Embedded System Laboratory	--	--	--	--	25	25	--	50

Suggested Experiment List

- Interfacing of I2C,CAN,SPI,zigbee etc with ARM
- Simulation of multitasking using RTOS
- Simulation of mutex using RTOS
- Simulation of mailboxes using RTOS
- Interprocess communication using semaphore in RTOS
- Simulation of message queues using RTOS

Minimum One project based on any application related to RTOS and embedded system can be implemented.

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL704	Project Stage-I	--	06	--	--	3	--	3

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL704	Project Stage-I	--	--	--	--	50	50	--	100

Objective: The Project work enables the students to develop the required skills and knowledge gained during the programme by applying them for the analysis of a specific problem or issue, via a substantial piece of work which is carried out over an extended period. It also enables the students to demonstrate the proficiency in the design of a research project, application of appropriate research methods, collection and analysis of data and presentation of results.

Guidelines:

1. Project Topic:

- To proceed with the project work it is very important to select a right topic. Project can be undertaken on any domain of electronics and telecommunication programme. Research and development projects on problems of practical and theoretical interest should be encouraged.
- Project work must be carried out by the group of at least two students and maximum four and must be original.
- Students can certainly take ideas from anywhere, but be sure that they should evolve them in the unique way to suit their project requirements.
- The project work can be undertaken in a research institute or organization/company/any business establishment.
- Student must consult internal guide along with external guide (if any) in selection of topic.
- Head of department and senior staff in the department will take decision regarding selection of projects.
- Student has to submit weekly progress report to the internal guide and whereas internal guide has to keep track on the progress of the project and also has to maintain attendance report. This progress report can be used for awarding the term work marks.

- In case of industry projects, visit by internal guide will be preferred.

2. **Project Report Format:**

At the end of semester a project report should preferably contain at least following details:-

- Abstract
- Introduction
- Literature Survey
 - a) Survey Existing system
 - b) Limitation of the Existing system or research gap
 - c) Problem Statement and Objective
 - d) Scope
- Proposed System
 - a) Analysis/Framework/ Algorithm
 - b) Details of Hardware & Software
 - c) Design details
 - d) Methodology (your approach to solve the problem)
- Implementation Plan for next semester
- Conclusion
- References

3. **Term Work:**

Distribution of marks for term work shall be as follows:

- a) Weekly Attendance on Project Day
- b) Contribution in the Project work
- c) Project Report (Spiral Bound)
- d) Term End Presentation (Internal)

The final certification and acceptance of TW ensures the satisfactory performance on the above aspects.

4. **Oral & Practical :**

Oral & Practical examination of Project-I should be conducted by Internal and External examiners approved by University of Mumbai. Students have to give presentation and demonstration on the Project- I.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC801	RF Design	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC801	RF Design	20	20	20	80	--	--	--	100

Prerequisites:

- Electromagnetic Engineering
- Antenna & Radio Wave Propagation
- Communication Engineering
- Microwave Engineering

Course objectives:

- To learn RF circuit fundamentals for designing various circuit building blocks in a typical RF transceiver
- To learn importance of EMI/EMC

Course outcomes:

After successful completion of the course student will be able to

- Design impedance matching networks and passive RF filters.
- Design and appraise RF amplifiers and oscillators.
- Analyze EMI and EMC in RF circuits.

Module No.	Unit No.	Topics	Hrs.
1.0		RF Filter Design	10
	1.1	Image parameter method	
	1.2	Insertion loss method- Maximally flat low pass prototype, Equal ripple low pass prototype, Filter transformation and filter implementation	
2.0		Amplifier Design	08
	2.1	Two-port power gain stability	
	2.2	Single stage amplifier design: Design for maximum gain, design for specified gain, low noise amplifier design	
	2.3	Power amplifier design.: Characteristics of power amplifier and classes of amplifiers, design of class A power amplifier	
3.0		Frequency Generation & Mixer	08
	3.1	One-port and two-port microwave oscillator design.	
	3.2	Analysis of phase noise in oscillators.	
	3.3	Mixers: Characteristics, Various types of Mixers: Single ended diode mixers, FET mixers, Balanced mixers, Image reject mixers and other types of mixers.	
4.0		Frequency Synthesizers	06
	4.1	Direct Frequency Synthesis, Frequency Synthesis by Phase Lock, Effects of Reference Frequency on Loop Performance,	
	4.2	Variable-Modulus Dividers, Down Conversion, Methods for Reducing Switching Time, Direct Digital Synthesis, Synthesizer Design .	
	4.3	Phase Noise: A Model for Oscillator Phase Noise, Phase Noise in Phase-Locked Loops, Effect of Frequency Division and Multiplication on Phase Noise.	
5.0		Electromagnetic Interference in RF circuits	08
	5.1	Introduction. Natural and Nuclear Sources of EMI, EMI From Apparatus and Circuits. Quantification Of Communication System EMI	
	5.2	Elements Of Interference, Including Antennas, Transmitters, Receivers And Propagation. Electronic Equipment And System EMI Concepts. Examples Of EMI Coupling Modes	
	5.3	Equipment Emissions And Susceptibilities- Types of coupling: Common-Mode Coupling: Common-Mode Coupling Mechanisms Including Field To Cable, Ground Impedance, Ground Loop And Coupling Reduction Techniques Differential-Mode Coupling : Differential-Mode Coupling Mechanisms Including Field To Cable, Cable To Cable And Coupling Reduction Techniques.	
	5.4	Other Coupling mechanisms: Power Supplies And Victim Amplifiers	

6.0		Electromagnetic Compatibility	08
	6.1	The Importance Of Grounding For Achieving EMC. Grounding, Including The Reasons (I.E., Safety, Lightning Control, EMC, Grounding Schemes (Single Point, Multi-Point And Hybrid), Shield Grounding And Bonding. Shielding Effectiveness, Shielding Considerations (Reflective And Absorptive), Shielding Compromises (I.E., Apertures, Gaskets, Waveguide Beyond Cut-Off)	
	6.2	EMI Diagnostics And Fixes: Techniques Used In EMI Diagnostics And Fixes	
	6.3	EMC Specifications, Standards And Measurements. A Discussion Of The Genesis Of EMC Documentation Including A Historical Summary, The Rationale, And A Review Of MIL-Stds, FCC And CISPR Requirements.	
		Total	48

Text Books

1. David M Pozar, Microwave Engineering, John Wiley and Sons, 2005
2. Ludwig R. and Bogdanov G, RF Circuit Design, Prentice Hall, 2007.
3. Jack Smith, Modern Communication circuits, Tata McgrawHill.
4. W. Prasad Kodali, Engineering Electromagnetic Compatibility: Principles, Measurements, Technologies, and Computer Models, 2nd Edition, ISBN: 978-0-7803-4743-4, January 2001, Wiley-IEEE Press
5. David. A. Weston, Electromagnetic Compatibility-principles and applications, Second Edition, Publisher: Marcel Dekker, Inc. 2001, ISBN 0-8247-8889-3

References:

1. Guillermo Gonzalez, 'Microwave Transistor Amplifiers Analysis and Design', Prentice Hall, 2nd Edition.
2. Devendra Misra, 'Radio Frequency and Microwave Communication Circuits-Analysis and Design', John Wiley & Sons, 2nd Edition.
3. Clayton R. Paul, 'Electromagnetic Compatibility', John Wiley & Sons, 2nd Edition.

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC802	Wireless Networks	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC802	Wireless Networks	20	20	20	80	--	--	--	100

Prerequisites:

- Mobile Communication

Course objectives:

- Introduction to wireless Body Networks and study emerging technologies like Bluetooth and Zigbee
- To study Wireless LAN, PAN & MAN.
- Understanding Ultra Wideband communication.
- Introduction to Femtocells

Course outcomes:

After successful completion of the course student will be able to

- Explain the working of different wireless technologies like bluetooth and zigbee.
- Understand the working of wireless LAN, PAN & MAN
- Analyze the different types of Wireless Networks like LAN,PAN & MAN
- Comprehend the working of Femtocells.

Module No.	Unit No.	Topics	Hrs.
1.0		Wireless Body Area Networks	12
	1.1	Introduction to WBAN, Network Architecture, Network Components	
	1.2	Network Protocol: Physical Layer, Data Link layer, Media Access Control (MAC) Layer, Network Layer	
	1.3	WBAN Technologies: Bluetooth: Concept of Piconet, Scatternet, Protocol Stack Connection establishment Zigbee: Components, Protocol Stack, Architecture & Network Topologies	
2.0		Wireless LAN	10
	2.1	Introduction to wireless LAN, Transmission Techniques	
	2.2	Medium Access Control Protocol Issues: Hidden Terminal Problem, Reliability, Collision Avoidance, Congestion Avoidance, Congestion Control, Energy Efficiency	
	2.3	IEEE 802.11 Standard for Wireless LAN: Network Architecture, Physical Layer, MAC Layer, Security, System design and considerations	
	2.4	Enhancements to IEEE 802.11 MAC: Power Control, Spatial Reusability & QoS Provisioning	
3.0		Wireless PAN	08
	3.1	Introduction to wireless PAN, Need of Wireless PAN	
	3.2	Bluetooth Technology: History & Applications, Technical Overview, Bluetooth Specifications, Piconet Synchronization, master-slave switch, Bluetooth security.	
	3.3	Enhancements to Bluetooth: Bluetooth Interface issues, Intra & Inter Piconet Scheduling, Scatternet Formation, QoS Assignment	
	3.4	IEEE 802.15 Working group for WPAN, IEEE 802.15.3 & IEEE 802.15.4	
	3.5	Comparison between WPAN System & Comparison between WLAN & WPAN	
4.0		Wireless MAN	08
	4.1	Introduction to Wireless Metropolitan Area Networks, IEEE 802.16 Standards Advantages of IEEE 802.16	
	4.2	WMAN Network Architecture: Network Components, features of WiMAX, WiMAX Mobility Support	
	4.3	Network Protocols : Physical Layer, MAC Layer	
		WMAN Applications: Banking Networks, Educational Networks, Public Safety	
5.0		Ultra wideband Communication	06
	5.1	Introduction, UWB indoor channel, UWB capacity	

	5.2	Pulsed UWB: Pulse shape, Modulation & Multiple access techniques, Pulsed UWB transceivers,	
	5.3	Multiband UWB: Modulation of pulsed multiband UWB, MB-OFDM UWB	
6.0		Femtocells	04
	6.1	Introduction to Femtocell, Femtocell Attributes, Femtocell Standards,	
	6.2	Concept of Femtocells, Types of Femtocells	
	6.3	Applications of Femtocells.	
		Total	

Text Books & References :

1. Carlos de Morais Cordeiro, Dharma Prakash Agrawal, “AD HOC & Sensor Networks – Theory & Applications”, Cambridge University Press India Pvt. Ltd.
2. KE- LIN DU & M. N. S. Swamy, “Wireless Communication Systems”, Cambridge University Press India Pvt. Ltd.
3. D. E. Comer, “Femtocells- Opportunity & Challenges for Business & Technology”, Wiley Publications.
4. Dr. Sunilkumar S. Manvi, Mahabaleshwar S. kakkasageri, “Wireless & Mobile Networks: Concepts and Protocols”.

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 8041	Optical Networks	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 8041	Optical Networks	20	20	20	80	--	--	--	100

Prerequisites:

- Principles of Communication Engineering
- Digital Communication
- Antenna Wave Propagation
- Optical Communication

Course objectives:

- The issues related to signal degradation due to linear impairment
- High data rate WDM optical transport networks
- Link budget and optical networks, design and management.

Course outcomes:

After successful completion of the course student will be able to

- Identify the issues related to signal degradation and multiplexing.
- Explore concepts of designing and operating principles of modern optical communication systems and networks.
- Apply the knowledge developed in-class to contemporary optical fiber communication research and industrial areas.

Module No.	Unit No.	Topics	Hrs.
1.0		Introduction to Optical Components and Networks	06
	1.1	OPTICAL Components - Couplers, Isolators and Circulators, Multiplexes and Filters Optical Amplifiers. Transmitters, Detectors, Switches, Wavelength Converters	
	1.2	OPTICAL Networks - Telecommunication networks, First generation optical networks, Multiplexing techniques, Second generation optical networks, System and network evolution	
2.0		Optical Networks Architecture	08
	2.1	SONET/SDH, Computer interconnects, MANs, Layered architecture for SONET and second generation networks.	
	2.2	Broadcast and Select Networks – Topologies for Broadcast Networks, Media-Access Control Protocols,	
	2.3	Operational principle of WDM, WDM network elements and Architectures, Introduction to DWDM, Solitons	
3.0		Packet Switching and Access Networks	08
	3.1	Photonic Packet Switching – OTDM, Multiplexing and Demultiplexing,	
	3.2	Synchronization, Broadcast OTDM networks, Switch-based networks	
	3.3	Access Networks – Network Architecture overview, Future Access Networks,	
	3.4	Optical Access Networks Architectures; and OTDM networks	
4.0		Wavelength Routing Networks	10
	4.1	Optical layer, Node design, Network design and operation, routing and wavelength assignment architectural variations	
	4.2	Optical Network Routing Principles - Impairment Aware Routing Optical Circuit Switching ,Optical Packet Switching Optical Burst Switching	
	4.3	Energy Awareness in Optical Networking ,Network Modeling Tools Network Design Guidelines	
5.0		Design of Optical Networks	10
	5.1	Core Optical Networks, Metro Optical networks, Access Optical Networks	
	5.2	Wavelength Routing and Assignment, Traffic Grooming and Protection, Multilayer Network Structure	
	5.3	Transmission system model, power penalty-transmitter, receiver optical amplifiers, crosstalk, dispersion, wavelength stabilization	
6.0		Virtual topology, Network Control and Management	06
	6.1	Virtual topology design problem, Combines SONET/WDM network design, an ILP formulation, Regular virtual topologies,	

	6.2	Control and management, Network management configuration management, Performance management, fault management. Network management functions, Optical safety	
		Total	48

Text Books :

1. Kumar Sivarajan and Rajiv Ramaswamy, Morgan Kauffman, Optical Networks: A Practical Perspective, Elsevier Publication Elsevier India Pvt. Ltd, 3rd Edition, 2010.
2. Harry G. Parros, Communication Oriented Networks, Wiley
3. G. Agrwal, Fiber Optic Communication Systems, John Wiley and Sons, 3rd Edition, New York, 2014.

References:

1. C. Siva Ram Moorthy and Mohan Gurusamy, WDM Optical Networks: Concept, Design and Algorithms, Prentice Hall of India, 1st Edition, 2002.
2. Biswajit Mukherjee, Optical Communication Networks, TMG1998.
3. Jane M. Simoons, Optical Network Design and Planning, Second Edition, Springer
4. Ulysees Black, Optical Networks, Pearson education 2007.
5. Milorad Cvijetic, Ivan B. Djordjevic, Advanced Optical Communication Systems and Networks, Artech House Applied Photonics, 2012.

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 8042	Advanced Digital Signal Processing	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 8042	Advanced Digital Signal Processing	20	20	20	80	--	--	--	100

Prerequisites:

- Discrete Time Signal Processing

Course objectives:

The aim of this course is to provide in-depth treatment on methods and techniques on

- Multirate Signal Processing, Power Spectrum Estimation, Adaptive Filtering and Wavelet Transform.
- Application of signal processing to real world problems.

Course outcomes:

After successful completion of the course student will be able to

- Demonstrate an understanding of multirate sampling and its mechanism.
- Study and apply the techniques of power spectrum estimation and wavelet theory for various applications.
- Implement adaptive filters for given applications.
- Apply signal processing tools to Biomedical and Telecommunication Applications

Module No.	Unit No.	Topics	Hrs.
1.0		Multirate Digital Signal Processing	08
	1.1	Advantages of Multirate Signal Processing	
	1.2	Interpolation and Decimation	
	1.3	Sampling Rate Conversion by Non Integer Factor	
	1.4	Multistage Interpolation and Decimation	
	1.5	Polyphase Decomposition	
	1.6	Digital Filter Banks	
	1.7	Applications of Multirate Signal Processing	
2.0		Power Spectrum Estimation	10
	2.1	Non Parametric Method of Power Spectrum Estimation: Periodogram, Modified Periodogram, Barlett Method, Welch's Method, Blackman-Tukey Approach	
	2.2	Parametric Methods of Power Spectrum Estimation: Autoregressive Spectrum Estimation, Model Parameters-Yule-Walker Equation, Least Square Method and Linear Prediction, Moving Average Spectrum Estimation, Autoregressive Moving Average Spectrum Estimation	
	2.3	Eigen Analysis Algorithm for Spectrum Estimation	
3.0		Linear Prediction and Optimum Linear Filters	10
	3.1	Representation of Stationary Random Process	
	3.2	Forward and Backward Linear Prediction	
	3.3	Solution of Normal Equation(Levinson-Durbin and Schur Algorithm)	
	3.4	AR Lattice and ARMA Lattice Ladder Filters	
	3.5	Weiner Filters for Filtering and Prediction	
4.0		Adaptive Filters	10
	4.1	Applications of Adaptive Filters: System Identification, Adaptive Channel Equalization, Echo Cancellation, Adaptive Noise Cancellation, Suppression of Narrowband Interference in Wideband Signals, Adaptive Arrays.	
	4.2	Adaptive Algorithms: LMS Algorithm, RLS Algorithm, Lattice Ladder Algorithm	
5.0		Wavelet Transform	06
	5.1	Introduction to Time Frequency Analysis	
	5.2	Short Time Fourier Transform	
	5.3	Continuous Wavelet Transform	
	5.4	Discrete Wavelet Transform	
	5.5	Multiresolution Analysis	

	5.6	Applications	
6.0		Application Of Signal Processing	04
	6.1	Biomedical Applications	
	6.2	Audio Applications	
	6.3	Telecommunication Applications(Radar)	
		Total	48

Textbooks

1. John G. Proakis, Dimitris G. Monolakis “ Digital Signal Processing”, PHI 2007.
2. Emmanuel C. Ifeachor, Barrie W. Jervis, “Digital Signal Processing A Practical Approach”, Pearson Education 2008.

Reference Books

1. Simon Haykin, “Adaptive Filter Theory”, Pearson Education 2013.
2. Tarun Kumar Rawat, “Digital Signal Processing”, Oxford University Press.
3. Raghuveer M. Rao and Ajit S. Bopardikar, “Wavelet Transforms”, “Introduction to Theory and Applications”, Pearson Education Asia 2000.

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (O.2 to O.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 8043	Satellite Communication	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 8043	Satellite Communication	20	20	20	80	--	--	--	100

Prerequisites:

- Analog Communication
- Digital Communication

Course objectives:

- To understand the basics of satellite communications and different satellite communication orbits
- Provide an in-depth understanding of satellite communication system operation, launching techniques, satellite link design and earth station technology
- To explain the tools necessary for the calculation of basic parameters in a satellite communication system.
- Review the state of the art in new research areas such as speech and video coding, satellite networking and satellite personal communications, mobile satellite communication, Laser satellite

Course outcomes:

After successful completion of the course student will be able to

- Explain basics of satellite communication, space segment and earth segment
- Understand different satellite orbits and orbital parameters
- Explain and analyze link budget of satellite signal for proper communication
- Understand various applications of satellite communications

Module No.	Unit No.	Topics	Hrs.
1.0		Overview of Satellite Systems, Orbits and Launching	09
	1.1	An overview of space and satellite, Frequency allocation for satellite communication, Polar orbiting satellites, Kepler's First, second and third law, orbital elements, apogee, perigee heights, orbital perturbations, effects of a non-spherical earth, atmospheric drag	
	1.2	Wave Propagation & Polarization, Atmospheric Losses, Ionospheric Effects, Rain Attenuation, Other impairments, Antenna Polarization, Polarization of Satellite signals, Cross polarization discrimination, Ionospheric depolarization, Rain depolarization, Ice depolarization	
	1.3	Sub-satellite Point, predicting satellite position, antenna look angles, polar mount antenna, limits of visibility, near geostationary orbits, earth eclipse of satellite, sun transit outage	
	1.4	Selection of launching site, launch window, zero and non-zero degree latitude launching, sea launch, launch vehicles; satellite launch vehicle (SLV), augmented satellite launch vehicle (ASLV), polar SLV, geostationary satellite launch vehicle (GSLV)	
2.0		Space Segment	06
	2.1	Satellite configuration, Transponder sub-system, Antenna sub-system, AOC Sub-system, TT&C Sub-system, power sub-system, Thermal sub-system, reliability and quality Assurance.	
3.0		Earth station	05
	3.1	Design consideration	
	3.2	General configuration- Block diagram, Receive only type earth, transmit-receive type earth station, Antenna system, Feed system, Tracking system, LNA, HPA	
4.0		Satellite Links	10
	4.1	Isotropic radiated power, transmission losses, free-space transmission, feeder losses, antenna misalignment losses, fixed atmospheric and ionospheric losses, link power budget	
	4.2	System noise, antenna noise, amplifier noise temperature, amplifiers in cascade, noise factor, noise temperature of absorptive networks, overall system noise temperature, carrier to noise ratio	
	4.3	Uplink: Saturation flux density, input back off, earth station HPA, Downlink: Output back off, satellite TWTA output	
	4.4	Effects of rain, uplink rain-fade margin, downlink rain-fade margin, combined uplink and downlink C/N ratio, inter-modulation noise	
5.0		The Space Segment Access and Utilization	08
	5.1	Space segment access methods, pre-assigned FDMA, demand assigned FDMA, SPADE system, bandwidth-limited and power-limited TWT amplifier operation	

	5.2	TDMA: Reference Burst; Preamble and Postamble, carrier recovery, network synchronization, unique word detection, traffic data, frame efficiency, channel capacity, preassigned TDMA, demand assigned TDMA, satellite switched TDMA	
	5.3	Code Division Multiple Access: Direct-sequence spread spectrum-acquisition and tracking, spectrum spreading and despreading – CDMA throughput	
6.0		Satellite Applications	10
	6.1	VSAT systems: Advantages, configurations, frequency bands, elements, Applications	
	6.2	Broadcast services: Television broadcast systems, DAB,	
	6.3	Mobile satellite communication: INMARSAT, LMSS, mobile satellite systems with non GEO satellites	
	6.4	Satellite navigation systems	
	6.5	Laser Satellite Communication: Link analysis, optical satellite link transmitter, optical satellite link receiver, satellite beam acquisition, tracking & positioning, deep space optical communication link	
	6.6	Recent applications	
	6.7	Modern development and future trends	
		Total	48

Text Books & References :

1. Dennis Roddy, “Satellite Communications”, 4th Ed., Mc. Graw-Hill International Ed. 2009.
2. M. Richharia, “Satellite Communication Systems Design Principles”, Macmillan Press Ltd. Second Edition 2003.
3. R. N. Mutangi, “Satellite Communication”, Oxford university press, 2016.
4. Gerard Maral and Michel Bousquet, “Satellite Communication Systems”, 4th Edition Wiley Publication
5. Gerard Maral, “VSAT Networks”, John Willy & Sons
6. Timothy Pratt, Charles Bostian, and Jeremy Allmuti, “Satellite Communications”, John Willy & Sons (Asia) Pvt. Ltd. 2004
7. Wilbur L. Pritchard, Henri G. Suyderehoud, and Robert A. Nelson, “Satellite Communication systems Engineering”, Pearson Publication

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 8044	Network Management in TeleCommunication	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 8044	Network Management in TeleCommuni cation	20	20	20	80	--	--	--	100

Prerequisites:

- Computer Communication and Networks,
- Operating System
- Basic Programming skills

Course objectives:

- To understand the concept of Telecommunication, network management, architecture and protocol

Course outcomes:

After successful completion of the course student will be able to

- Explain the need for interoperable network management & analyze the trends and development of the Telecommunications Network Management.
- Demonstrate broad knowledge of fundamental principles and technical standards underlying.
- Describe the concepts and architecture behind standards based network management associated with SNMP and CMIP.
- Apply basic of telecommunication, networking and information technologies and architect and implement networked informative systems.
- Continuously improve their technology knowledge and communication skills.

Module No.	Unit No.	Topics	Hrs.
1.0		Introduction of Network Management	10
	1.1	Introducing Network Design Concepts: Network designers ensure that our communications networks can adjust and scale to the demands for new services. To support our network-based economy, designers must work to create networks that are available nearly 100 percent of the time. Challenges of IT managers.	
	1.2	Network Management: Goals, organization and functions	
	1.3	Network management architecture and organization network management perspectives	
2.0		OSI Network Management	04
	2.1	Network management standards	
	2.2	Network management models	
	2.3	Organization model	
	2.4	Information model	
	2.5	Communication model and functional model	
	2.6	Abstract syntax notation – encoding structure, macros functional model CMIP/CMISE	
3.0		Internet Management	12
	3.1	SNMP-organizational model-	
	3.2	System overview.	
	3.3	Information model, communication model, functional model	
	3.4	SNMP proxy server, Management information, Protocol	
	3.5	SNMPv1,v2 and V3	
	3.6	Remote monitoring. RMON	
4.0		Telecommunication Management Networks(TMN)	04
	4.1	Need for TMN , Conceptual TNM model	
	4.2	TMN Network Management Architecture	
	4.3	TMN management services architecture and TMN implementation	
5.0		Network Management Tools and Applications	12
	5.1	System Utilities for network management	
	5.2	Network statistics and measurements	
	5.3	NMS Design, NMS components, NMS Server Architecture	
	5.4	Network Management Systems and FCAPS	
	5.5	Automatic Fault Management and Event correlation Techniques	
	5.6	Security Management	
6.0		Broadband Network Management	06
	6.1	Broadband networks and services, ATM Technology – VP, VC, ATM Packet, Integrated service, ATM LAN emulation, Virtual LAN	

	6.2	ATM Network Management – ATM network reference model, integrated local management interface. ATM management information base, role of SNMP and ILMI in ATM.	
	6.3	M1, M2, M3, M4 interface. ATM digital exchange interface management	
		Total	48

Text Books & References :

1. Mani Subramaniam, —Network Management Principles and Practise”, Addison Wisely, New York, 2000.
2. Designing and Supporting Computer Networks, CCNA Discovery Learning Guide By Kenneth Stewart, Aubrey Adams, Allan Reid, Jim Lorenz, Cisco Press
3. Network Management: Concepts and Practice, A Hands-On Approach by J. Richard Burke, Pearson Publications.
4. Network Management: Accounting and Performance Strategies by Benoit Claise - CCIE No. 2686; Ralf Wolter CISCO Press
5. Network Management Fundamentals, Alexander Clemm, Cisco Press, December 2006, ISBN-13: 978-158720137
6. Python for Software Design by Allen B. Downey, Cambridge University Press, March 2009, ISBN-13: 978-0521725965. A free manuscript is available at the author's website.

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (O.2 to O.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 8021	Project Management	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 8021	Project Management	20	20	20	80	--	--	--	100

Course objectives:

- To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
- To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Course outcomes:

After successful completion of the course student will be able to

- Apply selection criteria and select an appropriate project from different options.
- Write work break down structure for a project and develop a schedule based on it.
- Identify opportunities and threats to the project and decide an approach to deal with them strategically.
- Use Earned value technique and determine & predict status of the project.
- Capture lessons learned during project phases and document them for future reference

Module No.	Unit No.	Topics	Hrs.
1.0		Project Management Foundation	05
	1.1	Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager, Negotiations and resolving conflicts, Project management in various organization structures, PM knowledge areas as per Project Management Institute (PMI)	
2.0		Initiating Projects	06
	2.1	How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	
3.0		Project Planning and Scheduling	08
	3.1	Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart, Introduction to Project Management Information System (PMIS).	
4.0		Planning Projects	06
	4.1	Crashing project time, Resource loading and levelling, Goldratt's critical chain, Project Stakeholders and Communication plan Risk Management in projects: Risk management planning, Risk identification and risk register, Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	
5.0			08
	5.1	Executing Projects: Planning monitoring and controlling cycle, Information needs and reporting, engaging with all stakeholders of the projects, Team management, communication and project meetings	
	5.2	Monitoring and Controlling Projects: Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep, Project audit	
	5.3	Project Contracting Project procurement management, contracting and outsourcing,	
6.0			06
	6.1	6.1 Project Leadership and Ethics: Introduction to project leadership, ethics in projects, Multicultural and virtual projects	

	6.2	Closing the Project: Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	
		Total	39

References:

1. Project Management: A managerial approach, Jack Meredith & Samuel Mantel, 7th Edition, Wiley India
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Project Management, Gido Clements, Cengage Learning
4. Project Management, Gopalan, Wiley India
5. Project Management, Dennis Lock, 9th Edition, Gower Publishing England

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 8022	Finance Management	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 8022	Finance Management	20	20	20	80	--	--	--	100

Course objectives:

- Overview of Indian financial system, instruments and market
- Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
- Knowledge about sources of finance, capital structure, dividend policy

Course outcomes:

After successful completion of the course student will be able to

- Understand Indian finance system and corporate finance
- Take investment, finance as well as dividend decisions

Module No.	Unit No.	Topics	Hrs.
1.0			06
	1.1	Overview of Indian Financial System Characteristics, Components and Functions of Financial System. Financial Instruments: Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. Financial Markets: Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market Financial Institutions: Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	
2.0			06
	2.1	Concepts of Returns and Risks: Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. Time Value of Money: Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	
3.0			09
	3.1	Overview of Corporate Finance: Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. Financial Ratio Analysis: Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	
4.0			10
	4.1	Capital Budgeting: Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) Working Capital Management: Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	

5.0			05
	5.1	Sources of Finance: Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. Capital Structure: Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure	
6.0			03
	6.1	Dividend Policy: Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	
		Total	39

References:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (O.2 to O.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 8023	Entrepreneurship Development and Management	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 8023	Entrepreneurship Development and Management	20	20	20	80	--	--	--	100

Course objectives:

- To acquaint with entrepreneurship and management of business
- Understand Indian environment for entrepreneurship
- Idea of EDP, MSME

Course outcomes:

After successful completion of the course student will be able to

- Understand the concept of business plan and ownerships
- Interpret key regulations and legal aspects of entrepreneurship in India
- Understand government policies for entrepreneurs

Module No.	Unit No.	Topics	Hrs.
1.0			04
	1.1	Overview Of Entrepreneurship: Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	
2.0			09
	2.1	Business Plans And Importance Of Capital To Entrepreneurship: Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur Entrepreneurship And Business Development: Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	
3.0			05
	3.1	Women's Entrepreneurship Development, Social entrepreneurship- role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	
4.0			08
	4.1	Indian Environment for Entrepreneurship: key regulations and legal aspects , MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	
5.0			08
	5.1	Effective Management of Business: Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	
6.0			05
	6.1	Achieving Success In The Small Business: Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	
		Total	39

References:

1. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
2. T N Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
3. C N Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
4. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
5. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
6. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. Laghu Udyog Samachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 8024	Human Resource Management	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 8024	Human Resource Management	20	20	20	80	--	--	--	100

Course objectives:

- To introduce the students with basic concepts, techniques and practices of the human resource management
- To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations
- To familiarize the students about the latest developments, trends & different aspects of HRM
- To acquaint the student with the importance of inter-personal & inter-group behavioural skills in an organizational setting required for future stable engineers, leaders and managers

Course outcomes:

After successful completion of the course student will be able to

- Understand the concepts, aspects, techniques and practices of the human resource management.
- Understand the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.
- Gain knowledge about the latest developments and trends in HRM.
- Apply the knowledge of behavioural skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

Module No.	Unit No.	Topics	Hrs.
1.0		Introduction to HR	05
	1.1	Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions	
	1.2	Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues	
2.0		Organizational Behaviour (OB)	07
	2.1	Introduction to OB Origin, Nature and Scope of Organizational Behaviour, Relevance to Organizational Effectiveness and Contemporary issues	
	2.2	Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness	
	2.3	Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behaviour	
	2.4	Motivation: Theories of Motivation and their Applications for Behavioural Change (Maslow, Herzberg, McGregor)	
	2.5	Group Behaviour and Group Dynamics: Work groups formal and informal groups and stages of group development, Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team	
	2.6	Case study	
3.0		Organizational Structure & Design	06
	3.1	Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress.	
	3.2	Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership.	
	3.3	Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.	
4.0		Human resource Planning	05
	4.1	Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale	
	4.2	Performance Appraisal Systems: Traditional & modern methods, Performance Counselling, Career Planning	
	4.3	Training & Development: Identification of Training Needs, Training Methods	
5.0		Emerging Trends in HR	06

	5.1	Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes & transformation in HR. Organizational Change, Culture, Environment	
	5.2	Cross Cultural Leadership and Decision Making: Cross Cultural Communication and diversity at work, Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation	
6.0			10
	6.1	HR & MIS: Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries	
	6.2	Strategic HRM: Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals	
	6.3	Labor Laws & Industrial Relations: Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act	
		Total	39

References:

1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15th edition, 2015
5. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (O.2 to O.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 8025	Professional Ethics and Corporate Social Responsibility (CSR)	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 8025	Professional Ethics and Corporate Social Responsibility (CSR)	20	20	20	80	--	--	--	100

Course objectives:

- To understand professional ethics in business
- To recognized corporate social responsibility

Course outcomes:

After successful completion of the course student will be able to

- Understand rights and duties of business
- Distinguish different aspects of corporate social responsibility
- Demonstrate professional ethics
- Understand legal aspects of corporate social responsibility

Module No.	Unit No.	Topics	Hrs.
1.0			04
	1.1	Professional Ethics and Business : The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	
2.0			08
	2.1	Professional Ethics in the Marketplace: Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy Professional Ethics and the Environment: Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	
3.0			06
	3.1	Professional Ethics of Consumer Protection: Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy Professional Ethics of Job Discrimination: Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	
4.0			05
	4.1	Introduction to Corporate Social Responsibility: Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	
5.0			08
	5.1	Corporate Social Responsibility: Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	
6.0			08
	6.1	Corporate Social Responsibility in Globalizing India: Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	
		Total	39

References:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.

2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
4. Corporate Social Responsibility in India (2015) by Bidyut Chakrabarty, Routledge, New Delhi.

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 8026	Research Methodology	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 8026	Research Methodology	20	20	20	80	--	--	--	100

Course objectives:

- To understand Research and Research Process
- To acquaint students with identifying problems for research and develop research strategies
- To familiarize students with the techniques of data collection, analysis of data and interpretation

Course outcomes:

After successful completion of the course student will be able to

- Prepare a preliminary research design for projects in their subject matter areas
- Accurately collect, analyze and report data
- Present complex data or situations clearly
- Review and analyze research findings

Module No.	Unit No.	Topics	Hrs.
1.0		Introduction and Basic Research Concepts	09
	1.1	Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology	
	1.2	Need of Research in Business and Social Sciences	
	1.3	Objectives of Research	
	1.4	Issues and Problems in Research	
	1.5	Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	
2.0		Types of Research	07
	2.1	Basic Research	
	2.2	Applied Research	
	2.3	Descriptive Research	
	2.4	Analytical Research	
	2.5	Empirical Research	
	2.6	Qualitative & Quantitative Approaches	
3.0		Research Design and Sample Design	07
	3.1	Research Design – Meaning, Types and Significance	
	3.2	Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	
4.0		Research Methodology	08
	4.1	Meaning of Research Methodology	
	4.2	Stages in Scientific Research Process: a. Identification and Selection of Research Problem b. Formulation of Research Problem c. Review of Literature d. Formulation of Hypothesis e. Formulation of research Design f. Sample Design g. Data Collection h. Data Analysis i. Hypothesis testing and Interpretation of Data j. Preparation of Research Report	
5.0		Formulating Research Problem	04
	5.1	Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	
6.0		Outcome of Research	04

	6.1	Preparation of the report on conclusion reached	
	6.2	Validity Testing & Ethical Issues	
	6.3	Suggestions and Recommendation	
		Total	39

References:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C. R., 1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nd ed.), Singapore, Pearson Education

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 8027	IPR and Patenting	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCIO 8027	IPR and Patenting	20	20	20	80	--	--	--	100

Course objectives:

- To understand intellectual property rights protection system
- To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
- To get acquaintance with Patent search and patent filing procedure and applications

Course outcomes:

After successful completion of the course student will be able to

- Understand Intellectual Property assets
- Assist individuals and organizations in capacity building
- Work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

Module No.	Unit No.	Topics	Hrs.
1.0			05
	1.1	Introduction to Intellectual Property Rights (IPR): Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc. Importance of IPR in Modern Global Economic Environment: Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	
2.0			07
	2.1	Enforcement of Intellectual Property Rights: Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement Indian Scenario of IPR: Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	
3.0			05
	3.1	Emerging Issues in IPR: Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	
4.0			07
	4.1	Basics of Patents: Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	
5.0			08
	5.1	Patent Rules: Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	
6.0			07
	6.1	Procedure for Filing a Patent (National and International): Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication, Time frame and cost, Patent Licensing, Patent Infringement Patent databases: Important websites, Searching international databases	
		Total	39

References:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. Lous Harns, 2012, The enforcement of Intellectual Property Rights: A Case Book, 3rd Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi, IPR: Drafting, Interpretation of Patent Specifications and Claims, New India Publishing Agency
14. Vivien Irish, 2005, Intellectual Property Rights for Engineers, IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 8028	Digital Business Management	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 8028	Digital Business Management	20	20	20	80	--	--	--	100

Course objectives:

- To familiarize with digital business concept
- To acquaint with E-commerce
- To give insights into E-business and its strategies

Course outcomes:

After successful completion of the course student will be able to

- Identify drivers of digital business
- Illustrate various approaches and techniques for E-business and management
- Prepare E-business plan

Module No.	Unit No.	Topics	Hrs.
1.0			09
	1.1	Introduction to Digital Business- Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy, Drivers of digital business- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) Opportunities and Challenges in Digital Business,	
2.0			06
	2.1	Overview of E-Commerce E-Commerce- Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	
3.0			06
	3.1	Digital Business Support services: ERP as e –business backbone, knowledge Tope Apps, Information and referral system Application Development: Building Digital business Applications and Infrastructure	
4.0			06
	4.1	Managing E-Business- Managing Knowledge, Management skills for e-business, Managing Risks in e –business Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	
5.0			04
	5.1	E-Business Strategy- E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	

6.0			08
	6.1	Materializing e-business: From Idea to Realization -Business plan preparation Case Studies and presentations	
		Total	39

References:

1. A textbook on E-commerce, Er Arunrajan Mishra, Dr W K Sarwade, Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, Vinocenzo Morabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective- DoI:10.1787/9789264221796-en OECD Publishing

Internal Assessment:

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End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (O.2 to O.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 8029	Environmental Management	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 8029	Environmental Management	20	20	20	80	--	--	--	100

Course objectives:

- Understand and identify environmental issues relevant to India and global concerns
- Learn concepts of ecology
- Familiarise environment related legislations

Course outcomes:

After successful completion of the course student will be able to

- Understand the concept of environmental management
- Understand ecosystem and interdependence, food chain etc.
- Understand and interpret environment related legislations

Module No.	Unit No.	Topics	Hrs.
1.0			10
	1.1	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities, Environmental issues relevant to India, Sustainable Development, the Energy scenario	
2.0			06
	2.1	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	
3.0			05
	3.1	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	
4.0			10
	4.1	Scope of Environment Management, Role and functions of Government as a planning and regulating agency Environment Quality Management and Corporate Environmental Responsibility	
5.0			05
	5.1	Total Quality Environmental Management, ISO-14000, EMS certification	
6.0			03
	6.1	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	
		Total	39

References:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management **V Ramachandra and Vijay Kulkarni, TERI Press**
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Macmillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC University of Mumbai, B. E. (Electronics & Telecommunication Engineering), Rev 2016

Press

7. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015

Internal Assessment:

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End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL801	RF Design Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL801	RF Design Laboratory	--	--	--	--	25	25	--	50

Suggested List of experiments

- Calibration of Network analyser for measurements.
- Characterization of RF low pass filter.
- Characterization of RF high pass filter.
- Characterization of RF band pass filter.
- Design of passive matching networks.
- Stability circles for microwave transistor
- Gain and Noise circles for transistor amplifier design
- Measurement of radiated emission using EMI Probes for DOT.
- Measurement of conducted radiations.
- Grounding & shielding for EMC.
- Testing of various emission standards like MIL CESPARE.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL801	Wireless Networks Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL801	Wireless Networks Laboratory	--	--	--	--	25	25	--	50

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 8041	Optical Networks Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 8041	Optical Networks Laboratory	--	--	--	--	25	25	--	50

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 05 Experiments, 02 tutorials and 1 mini project covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 8042	Advanced Digital Signal Processing Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 8042	Advanced Digital Signal Processing Laboratory	--	--	--	--	25	25	--	50

Suggested List of Experiments

- Write a program to implement multirate sampling technique for Interpolation.
- Write a program to implement multirate sampling techniques for Decimation.
- Design Anti-aliasing and Anti-Imaging filters.
- Write a program to demonstrate LMS algorithm for noise cancellations.
- Write a program to demonstrate RLS algorithm to calculate it's error function.
- Demonstrate application of Wavelet Transform for denoising.
- Analyse the frequency contents in EEG record.
- Write a program to generate ECG signal and isolate the QRS complex.

Instructions:

1. Minimum 4 experiments and 4 assignments must be submitted by each student.
2. Assignments can be designed on problem based learning from the content of the syllabus.
3. Simulation tools like Matlab/Scilab can be used.

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 8043	Satellite Communication Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 8043	Satellite Communication Laboratory	--	--	--	--	25	25	--	50

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 8044	Network Management in TeleCommunication Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 8044	Network Management in TeleCommuni- cation Laboratory	--	--	--	--	25	25	--	50

Suggested List of Experiments

- Network Monitoring tools
 - a) Status b)Route c)Traffic Tools
- Network Audit using NMAP Gui
- Monitoring and management network using SNMP
 - a) Basic SNMP b) Advanced SNMP v3 Authentication/Encryption and ACL
 - c) SNMP Trap Daemon Implementation
- Configuration SNMP Protocol on Cisco Router using Packet Tracer
- Install and configure SNMP MIB browser
 - a) qtmib b)snmpB c) OpManager MIB browser
- Configuration manageable Switch: Dlink DES 3026 24 Port L2 Switch
- Network Statistics and measurement

a] LAN Traffic Monitoring b) Protocol statistics

- LAN Troubleshooting using Wireshark
- Monitoring of services and Servers using Observium\
- Monitoring of services and Servers using Cacti
- Install and configure NAGIOS and monitor server
- Installation and Configuration of OpenNMS as a NMS.
- Implementation of Centralized Log Management System: Syslog-ng
- Study of commercial network management tools: HPOpenView, OpManager, GFI Languard and IBM NMS.

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments covering entire syllabus must be given during the “**Laboratory session batch wise**”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System**” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL803	Project Stage-II	--	12	--	--	6	--	6

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL803	Project Stage-II	--	--	--	--	100	50	--	150

Objective: The primary objective is to meet the milestones formed in the overall project plan decided in Project - I. The idea presented in Project -I should be implemented in Project -II with results, conclusion and future work. The project will culminate in the production of a thesis by each individual student.

Guidelines:

Project Report Format:

At the end of the semester the student needs to prepare a project report which should be prepared as per the guidelines issued by the University of Mumbai. Along with the project report a CD containing: project documentation, Implementation code, required utilities, Software's and user Manuals need to be attached.

Term Work:

Student has to submit weekly progress report to the internal guide and the internal guide has to keep a track on the progress of the project and also has to maintain the attendance report. This progress report can be used for awarding the term work marks. In case of industry projects, visit by internal guide will be preferred to get the status of project. Distribution of marks for term work shall be as follows:

- Weekly Attendance on Project Day
- Project work contributions as per objective
- Project Report (Hard Bound)
- Term End Presentation (Internal)

The final certification and acceptance of TW ensures the satisfactory performance on the above aspects.

Oral & Practical:

Oral & Practical examination of Project- II should be conducted by Internal and External examiners approved by University of Mumbai. Students have to give presentation and demonstration on the Project-II.

AC 14/7/2016, Item No. 4.64

UNIVERSITY OF MUMBAI



Bachelor of Engineering

First Year Engineering (Semester I & II), Revised course
(REV- 2016) from Academic Year 2016 – 17,
(Common for All Branches of Engineering)

(As per Choice Based Credit and Grading System
with effect from the academic year 2016–2017)

From Coordinator's Desk:-

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) give freedom to affiliated Institutes to add few (PEO's) course objectives course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, developed curriculum accordingly. In addition to outcome based education, **Choice Based Credit and Grading System** is also introduced to ensure quality of engineering education.

Choice Based Credit and Grading System enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes Faculty of Technology has devised a transparent credit assignment policy adopted ten points scale to grade learner's performance. Credit grading based system was implemented for First Year of Engineering from the academic year 2016-2017. Subsequently this system will be carried forward for Second Year Engineering in the academic year 2017-2018, for Third Year Final Year Engineering in the academic years 2018-2019, 2019-2020, respectively.

Dr. S. K. Ukarande
Co-ordinator,
Faculty of Technology,
Member - Academic Council
University of Mumbai, Mumbai

**Program Structure for
First Year Engineering (Semester I & II)
Mumbai University
(With Effect from 2016-2017)**

Semester I

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total	
FEC101	Applied Mathematics-I	04	-	01	04	-	01	05	
FEC102	Applied Physics-I	03	01	-	03	0.5	-	3.5	
FEC103	Applied Chemistry -I	03	01	-	03	0.5	-	3.5	
FEC104	Engineering Mechanics	05	02	-	05	01	-	06	
FEC105	Basic Electrical Engineering	04	02	-	04	01	-	05	
FEC106	Environmental studies	02	-	-	02	-	-	02	
FEL101	Basic Workshop Practice-I	-	04	-	-	02	-	02	
Total		21	10	01	21	05	01	27	
Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Avg					
FEC101	Applied Mathematics-I	20	20	20	80	25	-	-	125
FEC102	Applied Physics-I	15	15	15	60	25	-	-	100
FEC103	Applied Chemistry –I	15	15	15	60	25	-	-	100
FEC104	Engineering Mechanics	20	20	20	80	25	-	25	150
FEC105	Basic Electrical Engineering	20	20	20	80	25	-	25	150
FEC106	Environmental studies	15	15	15	60	-	-	-	75
FEL101	Basic Workshop Practice-I	-	-	-	-	50	-	-	50
Total				105	420	175		50	750

Semester II

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total	
FEC201	Applied Mathematics-II	04	-	01	04	-	01	05	
FEC202	Applied Physics-II	03	01	-	03	0.5	-	3.5	
FEC203	Applied Chemistry -II	03	01	-	03	0.5	-	3.5	
FEC204	Engineering Drawing	03	04	-	03	02	-	05	
FEC205	Structured Programming Approach	04	02	-	04	01	-	05	
FEC206	Communication Skills	02	02	-	02	01	-	03	
FEL201	Basic Workshop Practice-II	-	04	-	-	02	-	02	
Total		19	14	01	19	07	01	27	
Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Avg					
FEC201	Applied Mathematics-II	20	20	20	80	25	-	-	125
FEC202	Applied Physics-II	15	15	15	60	25	-	-	100
FEC203	Applied Chemistry -II	15	15	15	60	25	-	-	100
FEC204	Engineering Drawing	15	15	15	60	25	50	-	150
FEC205	Structured Programming Approach	20	20	20	80	25	25	-	150
FEC206	Communication Skills	10	10	10	40	25	-	-	75
FEL201	Basic Workshop Practice-II	-	-	-	-	50	-	-	50
Total				95	380	200	75	-	750

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
FEC101	Applied Mathematics-I	04	-	01	04	-	01	05

Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Av of Test 1 & 2					
FEC101	Applied Mathematics-I	20	20	20	80	25	-	-	125

Objectives

1. To provide students with sound foundation in applied mathematics to solve real life problems in industry.
2. To provide hands on experience in using Scilab software to handle real life problems.

Outcomes: Learner will be able to...

1. Apply the concepts of complex numbers to the engineering problems.
2. Apply the knowledge of n th order derivatives of standard functions to engineering problems.
3. Apply the principles of basic operations of matrices to the engineering problems.
4. Apply the basic principles of partial differentiation to engineering problems.
5. Apply concepts of partial differentiation (maxima and minima, Jacobian), expansion of functions as an application of successive differentiation.
6. Apply SCILAB programming techniques to model problems based on solution of simultaneous linear algebraic equations.

Module	Detailed Contents	Hrs.
01	Complex Numbers	
	Pre-requisite: Review of Complex Numbers-Algebra of Complex Number, Different representations of a Complex number and other definitions, D'Moivre's Theorem.	
	1.1. Powers and Roots of Exponential and Trigonometric Functions.	3
	1.2. Expansion of $\sin^n \theta$, $\cos^n \theta$ in terms of sines and cosines of multiples of θ and Expansion of $\sin n\theta$, $\cos n\theta$ in powers of $\sin \theta$, $\cos \theta$	2
	1.3. Circular functions of complex number and Hyperbolic functions. Inverse Circular and Inverse Hyperbolic functions. Separation of real and imaginary parts of all types of Functions.	4
02	Logarithm of Complex Numbers , Successive Differentiation	
	2.1 Logarithmic functions, Separation of real and Imaginary parts of Logarithmic Functions.	4
	2.2 Successive differentiation: n th derivative of standard functions. Leibnitz's Theorem (without proof) and problems	4
03	Matrices Pre-requisite: Inverse of a matrix, addition, multiplication and transpose of a matrix Types of Matrices (symmetric, skew-symmetric, Hermitian, Skew Hermitian, Unitary, Orthogonal Matrices and properties of Matrices). Rank of a Matrix using Echelon forms, reduction to normal form, PAQ in normal form, system of homogeneous and non – homogeneous equations, their consistency and solutions. Linear dependent and independent vectors. Application of inverse of a matrix to coding theory.	9
04	Partial Differentiation 4.1 Partial Differentiation: Partial derivatives of first and higher order. Total differentials, differentiation of composite and implicit functions.	6

	4.2. Euler's Theorem on Homogeneous functions with two and three independent variables (with proof).Deductions from Euler's Theorem	3
05	Applications of Partial Differentiation , Expansion of Functions 5.1 Maxima and Minima of a function of two independent variables, Jacobian. 5.2 Taylor's Theorem (Statement only) and Taylor's series, Maclaurin's series (Statement only).Expansion of e^x , $\sin(x)$, $\cos(x)$, $\tan(x)$, $\sinh(x)$, $\cosh(x)$, $\tanh(x)$, $\log(1+x)$, $\sin^{-1}(x)$, $\cos^{-1}(x)$, $\tan^{-1}(x)$, Binomial series.	4 4
06	Indeterminate forms, Numerical Solutions of Transcendental Equations and System of Linear Equations 6.1 Indeterminate forms, L- Hospital Rule, problems involving series. 6.2 Solution of Transcendental Equations: Solution by Newton Raphson method and Regula –Falsi Equation. 6.3 Solution of system of linear algebraic equations, by (1) Gauss Elimination Method, (2) Gauss Jacobi Iteration Method, (3) Gauss Seidal Iteration Method. (Scilab programming for above methods is to be taught during lecture hours)	2 4 3

Term Work:

General Instructions:

1. Batch wise tutorials are to be conducted. The number of students per batch should be as per University pattern for practicals.
2. Students must be encouraged to write Scilab Programs in tutorial class only. Each Student has to write at least 4 Scilab tutorials (including print out) and at least 6 class tutorials on entire syllabus.
3. SciLab Tutorials will be based on (i) Gauss Elimination Method (ii) Gauss Seidal Iteration method (iii) Gauss Jacobi Iteration Method (iv) Newton Raphson Method (v) Regula –Falsi method (vi) Maxima and Minima of functions of two variables

The distribution of Term Work marks will be as follows -

1. Attendance (Theory and Tutorial) : 05 marks
2. Class Tutorials on entire syllabus : 10 marks
3. SciLab Tutorials : 10 marks

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of 2 to 5 marks will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hrs as mentioned in the syllabus.

References:

1. A text book of Applied Mathematics, P.N.Wartikar and J.N.Wartikar, Vol – I and –II by Pune VidyarthiGraha.
2. Higher Engineering Mathematics, Dr.B.S.Grewal, Khanna Publication
3. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley EasternLimited, 9thEd.
4. Matrices, Shanti Narayan.S. Chand publication
5. Numerical Methods, Dr. P. Kandasamy , S. Chand Publication
6. Howard Anton and Christ Rorres. Elementary Linear Algebra Application Version. 6th edition. John Wiley & Sons, INC.
7. Eisenberg, Murray. Hill Ciphers and Modular Linear Algebra. 3 Nov 1999 (accessed November - 2 December 2001)
8. <<http://www.math.umass.edu/~murray/Hillciph.pdf>>

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
FEC102	Applied Physics – I	03	01	--	03	0.5	--	3.5

Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Av of Test 1 & 2					
FEC102	Applied Physics – I	15	15	15	60	25	--	--	100

Objectives

1. To impart knowledge of basic concepts in applied physics.
2. To provide the knowledge and methodology necessary for solving problems in the field of engineering.

Outcomes: Learner will be able to...

1. Apply the concepts of crystallography and to use XRD techniques for analysis of crystal structure .
2. Apply the knowledge of Quantum mechanics to uncertainty principle and motion of free particle.
3. To comprehend the basic concepts of semiconductor physics and apply the same to electronic devices.
4. Apply the knowledge of superconductivity to SQUID and Magnetic levitation.
5. Apply the reasons for Acoustic defects and use this in the proper design of a Hall/Auditorium.
6. Use the knowledge of Piezoelectric and Magnetostriction effect for production of ultrasonic waves and its application in various fields.

Module	Detailed Contents	Hrs.
01	CRYSTAL STRUCTURE Introduction to crystallography; Study of characteristics of unit cell of Diamond, ZnS, NaCl and HCP; Miller indices of crystallographic planes & directions; interplanar spacing; X-ray diffraction and Bragg's law; Determination of Crystal structure using Bragg's diffractometer; Frenkel and Schotkey crystal defects; Ionic crystal legacy (3,4,6,8); Liquid crystal phases.	07
02	QUANTUM MECHANICS Introduction, Wave particle duality; de Broglie wavelength; experimental verification of de Broglie theory; properties of matter waves; wave packet, phase velocity and group velocity; Wave function; Physical interpretation of wave function; Heisenberg's uncertainty principle; Electron diffraction experiment and Gama ray microscope experiment; Applications of uncertainty principle; Schrodinger's time dependent wave equation; time independent wave equation; Motion of free particle; Particle trapped in one dimensional infinite potential well.	09
03	SEMICONDUCTOR PHYSICS Splitting of energy levels for band formation; Classification of semiconductors(direct & indirect band gap, elemental and compound); Conductivity, mobility, current density (drift & diffusion) in semiconductors(n type and p type); Fermi Dirac distribution function; Fermi energy level in intrinsic & extrinsic semiconductors; effect of impurity concentration and temperature on fermi level; Fermi Level diagram for p-n junction(unbiased, forward bais, reverse bias); Breakdown mechanism (zener&avalanchy), Hall Effect	14

	Applications of semiconductors: Rectifier diode, LED, Zener diode, Photo diode, Photovoltaic cell, BJT, FET, SCR., MOSFET	
04	SUPERCONDUCTIVITY Introduction, Meissner Effect; Type I and Type II superconductors; BCS Theory (concept of Cooper pair); Josephson effect Applications of superconductors- SQUID, MAGLEV	03
05	ACOUSTICS Conditions of good acoustics; Reflection of sound(reverberation and echo); absorption of sound; absorption coefficient; Sabine's formula; Acoustic Design of a hall; Common Acoustic defects and acoustic materials	03
06	ULTRASONICS Ultrasonic Wave generation; Magnetostriction Oscillator; Piezoelectric Oscillator; Applications of ultrasonic: Eco sounding; NDT; ultrasonic cleaning(cavitation); ultrasonic sensors; Industrial applications of ultrasonic(soldering, welding, cutting, drilling)	03

Suggested Experiments: (Any five)

1. Study of Diamond, ZnS, NaCl crystal structure.
2. Study of HCP structure.
3. Study of Miller Indices, Plane and direction.
4. Study of Hall Effect.
5. Determination of energy band gap of semiconductor.
6. Study of Ultrasonic Distance Meter.
7. Study of I / V characteristics of Zener diode.
8. Determination of 'h' using Photo cell.
9. Study of I / V characteristics of semiconductor diode

The distribution of Term Work marks will be as follows –

1. Attendance (Theory and Practical) : 05 marks
2. Assignments : 10 marks
3. Laboratory work (Experiments and Journal) : 10 marks

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 15 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 15 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of 2 to 3 marks will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. In question paper weightage of each module will be proportional to number of respective lecture hrs as mentioned in the syllabus.

References:

1. A text book of Engineering Physics-Avadhanulu&Kshirsagar, S.Chand
2. Applied Solid State Physics –Ranikant, Wiley India
3. Solid State Electronic Devices- B. G. Streetman, Prentice Hall Publisher
4. Physics of Semiconductor Devices- S. M. Sze, John Wiley & sons publisher
6. Modern Engineering Physics – Vasudeva, S.Chand
7. Concepts of Modern Physics- ArtherBeiser, Tata McGraw Hill
8. Engineering Physics- V. Rajendran, Tata McGraw Hill
9. Introduction to Solid State Physics- C. Kittel, John Wiley & Sons publisher
10. Engineering Physics-H. K. Malik, McGraw Hill

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
FEC103	Applied Chemistry – I	03	01	--	03	0.5	--	3.5

Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Av of Test 1 & 2					
FEC103	Applied Chemistry – I	15	15	15	60	25	--	--	100

Objectives

1. To provide necessary background in applied chemistry relevant to chemical industries.
2. To provide exposure in conducting experiments and interpret and report the results in professional format.

Outcomes: Learner will be able to...

1. Apply the knowledge of types of hardness of water and its estimation.
2. Apply the knowledge of various softening and disinfecting methods.
3. Apply the knowledge of various polymers, their synthesis, properties and uses along with their fabrication techniques.
4. Apply the knowledge of thermodynamics in studying different chemical systems in equilibrium obeying Gibb's phase rule.
5. Apply the knowledge of lubricants, types, properties and mechanisms to avoid frictional resistance.
6. Demonstrate the knowledge of Portland cement and carbon nanomaterials.

Module	Detailed Contents	Hrs.
01	Water Impurities in water, Hardness of water, Determination of Hardness of water by EDTA method and problems, Softening of water by Hot and Cold lime Soda method and numerical problems. Zeolite process and numerical problems. Ion Exchange process and numerical problems. Potable water standard as per BIS w.r.t. i) pH, ii) Alkalinity, iii) TDS, iv) Hardness; Drinking water or Municipal water -Treatments removal of microorganisms by adding Bleaching powder, Chlorination (no breakpoint chlorination), Disinfection by Ozone, Electrodialysis, Reverse osmosis, and Ultra filtration. BOD, COD- definition & significance, sewage treatment (only activated sludge process), Numerical problems related to COD.	12
02	Polymers Introduction to polymers, Classification, Types of polymerization, Thermoplastic and Thermosetting plastic; Compounding of plastic, Fabrication of plastic by Compression, Injection, Transfer and Extrusion moulding. Preparation, properties and uses of Phenol formaldehyde, PMMA, Kevlar. Effect of heat on the polymers (Glass transition temperature), Viscoelasticity. Conducting polymers, Engineering Plastics, Polymers in medicine and surgery. Rubbers : Natural rubber- latex, Drawbacks of natural rubber, Vulcanization of rubber, Preparation, properties and uses of Buna-S, Silicone and Polyurethane rubber.	12
03	Lubricants Introduction, Definition, Mechanism of lubrication, Classification of lubricants, Solid lubricants (graphite & Molybdenum disulphide), Semisolid lubricants, Liquid lubricants, Additives in blended Oils. Important properties of lubricants - Definition and significance of - Viscosity, Viscosity index, Flash and fire points, Cloud and pour points, Oiliness,	07

	Emulsification, Acid value and numerical problems, Saponification value and numerical problems.	
04	Phase Rule Gibb's Phase Rule, Terms involved with examples, One Component System (Water), Reduced Phase Rule, Two Component System (Pb- Ag), Advantages and Limitations of Phase Rule.	04
05	Important Engineering Materials Cement – Manufacture of Portland Cement, Chemical Composition and Constitution of Portland Cement, Setting and Hardening of Portland Cement, Concrete, RCC and Decay. Nanomaterials, preparation (Laser and CVD) method, properties and uses of CNTS, Fullerene - properties and uses.	05

Suggested Experiments:

- 1) To determine total, temporary and permanent hardness of water sample.
- 2) Removal of hardness using ion exchange column.
- 3) To determine acid value of a lubricating oil.
- 4) To determine free acid pH of different solutions using pHmeter
- 5) To determine metal ion concentration using colorimeter.
- 6) To determine flash point and fire point of a lubricating oil
- 7) To determine Chloride content of water by Mohr's Method.
- 8) To determine melting point and /or glass transition temperature of a polymer
- 9) Molecular weight determination of polymers by Oswald Viscometer.
- 10) To determine the percentage of lime in cement.
- 11) Hardening and setting of cement using Vicat's apparatus
- 12) Determination of Viscosity of oil by Redwood Viscometer.

Term Work shall consist of minimum five experiments. The distribution of marks for term work shall be as follows:

1	Attendance (Practical and Theory)	: 05 marks
2	Laboratory Work (Experiments and journal)	: 10 marks
3	Assignments and Viva on practical's	: 10 marks

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 15 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 15 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of 3 marks will be asked.
4. Remaining questions will be mixed in nature.(e.g. Suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
5. In question paper weightage of each module will be proportional to number of respective lecture hrs as mentioned in the syllabus.

References:

1. Engineering Chemistry - Jain& Jain (DhanpatRai)
2. Engineering Chemistry – Dara&Dara (S Chand)
3. Engineering Chemistry - Wiley India (ISBN – 9788126519880)
4. A Text Book of Engineering Chemistry – Shashi Chawla (DhanpatRai)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
FEC104	Engineering Mechanics	05	02	-	05	01	-	06

Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Av of Test 1 & 2					
FEC104	Engineering Mechanics	20	20	20	80	25	--	25	150

Objectives

1. To acquaint the concept of equilibrium in two and three dimensional system.
2. To study and analyse motion of moving bodies.

Outcomes: Learner will be able to...

1. Illustrate the concept of force, moment and apply the same along with the concept of equilibrium in two and three dimensional systems with the help of FBD.
2. Demonstrate the understanding of Centroid and its significance and locate the same.
3. Correlate real life application to specific type of friction and estimate required force to overcome friction.
4. Establish relation between velocity and acceleration of a particle and analyse the motion by plotting the relation
5. Illustrate different types of motions and establish Kinematic relations for a rigid body
6. Analyse body in motion using force and acceleration, work-energy, impulse-momentum principles

Module	Detailed Contents	Hrs.
01	1.1 System of Coplanar Forces: Resultant of concurrent forces, parallel forces, non-concurrent Non-parallel system of forces, Moment of force about a point, Couples, Varignon's Theorem. Force couple system. Distributed Forces in plane.	05
	1.2 Centroid for plane Laminas.	04
02	2.1 Equilibrium of System of Coplanar Forces: Condition of equilibrium for concurrent forces, parallel forces and non-concurrent non-parallel general forces and Couples.	06
	2.2 Types of support: Loads, Beams, Determination of reactions at supports for various types of loads on beams. (Excluding problems on internal hinges)	03
	2.3 Analysis of plane trusses: By using Method of joints and Method of sections. (Excluding pin jointed frames).	05
03	3.1 Forces in space: Resultant of Non-coplanar Force Systems: Resultant of concurrent force system, parallel force system and non-concurrent non-parallel force system.	05
	Equilibrium of Non-coplanar Force Systems: Equilibrium of Concurrent force system, parallel force system and non-concurrent non-parallel force system.	
	3.2 Friction: Introduction to Laws of friction, Cone of friction, Equilibrium of bodies on inclined plane, Application to problems involving wedges, ladders.	07
	1.3 Principle of virtual work: Applications on equilibrium mechanisms, pin jointed frames.	04

04	4.1 Kinematics of a Particle: -Rectilinear motion, Velocity & acceleration in terms of rectangular co-ordinate system, Motion along plane curved path, Tangential& Normal component of acceleration, Motion curves (a-t, v-t, s-t curves), Projectile motion.	10
05	5.1 Kinematics of a Rigid Body :- Introduction to general plane motion, Instantaneous center of rotation for the velocity, velocity diagrams for bodies in plane motion.	06
06	6.1 Kinetics of a Particle: Force and Acceleration: -Introduction to basic concepts, D'Alemberts Principle, Equations of dynamic equilibrium, Newton's second law of motion.	04
	6.2 Kinetics of a Particle: Work and Energy: Principle of work and energy, Law of conservation of energy.	03
	6.3 Kinetics of a Particle: Impulse and Momentum: Principle of linear impulse and momentum. Law of conservation of momentum. Impact and collision.	03

List of Experiments:-

1. Polygon law of coplanar forces.
2. Non-concurrent non-parallel (General).
3. Bell crank lever.
4. Support reaction for beam.
5. Inclined plane (to determine coefficient of friction).
6. Collision of elastic bodies (Law of conservation of momentum).
7. Kinematics of particles
8. Kinetics of particles

Any other experiment based on above syllabus.

Term work:-

Term work shall consist of minimum six experiments (at least one experiments on Dynamics), assignments consisting numerical based on above syllabus, at least 3 numerical from each module.

The distribution of marks for term work shall be as follows:

1. Attendance (Theory and Practical)	: 05 marks
2. Laboratory work (Experiment/ programs and journal)	: 10 marks
3. Assignments	: 10 marks

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of 2 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.(e.g. Suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
5. In question paper weightage of each module will be proportional to number of respective lecture hrs as mentioned in the syllabus.

Oral Examination: - Oral examination will be based on entire syllabus

References:

1. Engineering Mechanics by R. C. Hibbeler.²
2. Engineering Mechanics by Beer & Johnston, Tata McGraw Hill
3. Engineering Mechanics by F. L. Singer, Harper & Row Publication
4. Engineering Mechanics by Macklin & Nelson, Tata McGraw Hill
5. Engineering Mechanics by Shaum Series,
6. Engineering Mechanics by A K Tayal, Umesh Publication.
7. Engineering Mechanics by Kumar, Tata McGraw Hill
8. Engineering Mechanics (Statics) by Meriam and Kraige, Wiley Books
9. Engineering Mechanics (Dynamics) by Meriam and Kraige, Wiley Books

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
FEC105	Basic Electrical Engineering	04	02	-	04	01	-	05

Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Av of Test 1 & 2					
FEC105	Basic Electrical Engineering	20	20	20	80	25	--	25	150

Objectives

1. To provide knowledge on fundamentals of D.C. circuits and its applications.
2. To impart knowledge on fundamentals of 1- Φ A.C. circuits and its applications.
3. To inculcate knowledge on the basic operation and the performance of 1- Φ transformer.
4. To impart knowledge on fundamentals of 3- Φ A.C. circuits and its applications.
5. To provide knowledge on fundamentals of DC machines.

Outcomes: Learner will be able to...

1. To evaluate D.C. circuits using network theorems.
2. To evaluate 1- Φ AC circuits.
3. To illustrate constructional features and operation of 1- Φ transformer.
4. To evaluate 3- Φ AC circuits.
5. To illustrate working principle of DC machines.
6. To conduct experiments on D.C. circuits and AC circuits.

Module	Detailed Contents	Hrs.
01	DC Circuits(Only Independent Sources): Kirchhoff 's laws, Ideal and practical voltage and current source, Mesh and Nodal analysis, Super node and Super mesh analysis, Source transformation, Star-delta transformation, Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, (Source transformation not allowed for Superposition theorem, Mesh and Nodal analysis).	18
02	AC Circuits: Generation of alternating voltage and currents, RMS and Average value, form factor, crest factor, AC through resistance, inductance and capacitance, R-L, R-C and R-L-C series and parallel circuits, phasor diagrams, power and power factor, series and parallel resonance, Q factor and bandwidth.	12
03	Three Phase Circuits: Three phase voltage and current generation, star and delta connections(balanced load only), relationship between phase and line currents and voltages, Phasor diagrams, Basic principle of wattmeter, measurement of power by one and two wattmeter methods.	06
04	Single Phase Transformer: Construction, working principle, emf equation, ideal and practical transformer, transformer on no load and on load, phasor diagrams, equivalent circuit, OC and SC test, regulation and efficiency.	12
05	DC Machines: Principle of operation of DC motors and DC generators, construction and classification of DC machines, emf equation.	04

Term work:

Term work consists of performing minimum 06 practical mentioned as below.

Final certification and acceptance of the term work ensures satisfactory performance of laboratory work.

The distribution of marks for term work shall be as follows:

Attendance (Theory and Practical)	: 05 marks
Laboratory work (Experiment/journal)	: 10 marks
Assignments	: 10 marks

List of laboratory experiments (Minimum Six):

1. Mesh and Nodal analysis.
2. Verification of Superposition Theorem.
3. Verification Thevenin's Theorem.
4. Study of R-L series and R-C series circuit.
5. R-L-C series resonance circuit
6. R-L-C parallel resonance circuit.
7. Relationship between phase and line currents and voltages in three phase system (star & delta)
8. Power and phase measurement in three phase system by one wattmeter method.
9. Power and phase measurement in three phase system by two wattmeter method.
10. OC and SC test on single phase transformer

Assessment:**Internal Assessment Test:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of 2 to 3 marks will be asked.
4. Remaining questions will be mixed in nature.(e.g. Suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
5. In question paper weightage of each module will be proportional to number of respective lecture hrs as mentioned in the syllabus.

Text Books

1. V. N. Mittal and Arvind Mittal "Basic Electrical Engineering" Tata McGraw Hill, (Revised Edition)
2. Electrical Engineering Fundamentals" by Vincent Del Toro, PHI Second edition, 2011
3. Edward Hughes: Electrical and Electrical Technology, Pearson Education (Tenth edition)
4. D P Kothari and I J Nagrath "Theory and Problems of Basic Electrical Engineering", PHI 13th edition 2011.

Reference Books:

1. B.L.Theraja "Electrical Engineering " Vol-I and II,
2. S.N.Singh, "Basic Electrical Engineering" PHI , 2011 Book name and author

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
FEC106	Environmental Studies	02	--	--	02	--	--	02

Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Av of Test 1 & 2					
FEC106	Environmental Studies	15	15	15	60	--	--	--	75

Objectives

1. Creating the awareness about environmental problems among students.
2. Imparting basic knowledge about the environment and its allied problems.
3. Developing an attitude of concern for the environment.
4. Motivating students to participate in environment protection and environment improvement.
5. Acquiring skills to help the concerned individuals in identifying and solving environmental problems.

Outcomes: Learner will be able to...

1. Illustrate Depleting Nature of Environmental Resources, Global Environmental Crisis, Ecosystem concept.
2. Adapt to 3R (Reuse, Recovery, Recycle).
3. Study different control measures related to Environmental Pollution.
4. Illustrate and analyse various Case Studies related to Environmental Legislation.
5. Demonstrate the working of Renewable energy sources & Equipments.
6. Illustrate the Techniques of Disaster Management and Green Building.

Module	Detailed Contents	Hrs.
01	Overview of Environmental Aspects: • Definition, Scope and Importance of Environmental Study • Need for Public awareness of environmental education • Introduction to depletion of natural resources: Soil, Water, Minerals and Forests. • Global crisis related to – Population, water, sanitation & Land. Ecosystem: • Study of ecosystems : Forest, desert and aquatic (in brief). • Energy flow in Ecosystem, overview of Food Chain, Food Web and Ecological Pyramid. • Concept of ecological succession and its impact on human beings (in brief). Case Study on Chipko Movement (Uttarakhand, India), (began in 1973).	4
02	Aspects of Sustainable Development: • Concept and Definition of Sustainable Development. • Social, Economical and Environmental aspects of sustainable development. • Control measures: 3R (Reuse, Recovery, Recycle), • Resource utilization as per the carrying capacity (in brief). Case Study on Narmada BachaoAndolan (Gujarat, India, in the mid and late 1980s).	2

03	Types of Pollution: - Water pollution: Sources of water pollution and Treatment of Domestic and industrial waste water (with flow-diagram of the treatment), - Land Pollution: Solid waste, Solid waste management by land filling, composting and incineration - Air pollution: Sources of air pollution, Consequences of air pollution :- Greenhouse effect (Explanation with schematic diagram), Photochemical Smog (Explanation with chemical reaction). Cleaning of gaseous effluents to reduce air contaminants namely dust particle or particulate matters by using:- (i) Electrostatic precipitators (ii) Venturi scrubber (Schematic diagram and working). - Noise pollution: Sources, effects, threshold limit for different areas and control methods. - E-Pollution: Definition, Sources and effects. - Nuclear pollution: Sources and effects. Case study on Water Pollution of Ganga River. Case study on London smog (U. K.)(December, 1952). Case Study of Fukushima Disaster (March, 2011).	8
04	Pollution Control Legislation: - Functions and powers of Central and State Pollution Control Board. - Environmental Clearance, Consent and Authorization Mechanism. Case Study of Dombivali MIDC- Boiler Blast Tragedy (Thane, Maharashtra, India), (May, 2016).	3
05	Renewable Sources of Energy: - Importance of renewable sources of energy. - Principle and working with schematic diagram of :- (i) Solar Energy: (a) Flat plate collector and (b) Photovoltaic cell. (ii) Wind Energy: Wind Turbines. (iii) Hydropower: Hydropower generation from water reservoir of the dam. (iv) Geothermal Energy: Utilisation of underground sources of steam for power generation.	4
06	Technological Advances to overcome Environmental problems: - Concept of Green Buildings, - Various indoor air pollutants and their effects on health. - Carbon Credit: Introduction and general concept. - Disaster Management: Techniques of Disaster Management to cope up with (i) Earthquake and (ii) Flood. Case Study on Earthquake in Latur (Maharashtra, India), (September,1993). Case Study on Cloudburst and Landslides at Kedarnath (Uttarakhand, India), (June, 2013).	5

Assessment:

Internal Assessment Test:

- Each test will be of 15 marks.
- At least one question will be based on case study. Candidate is expected to explain the salient features of the incident and suggest preventive measures.

End Semester Theory Examination:

- Question paper will comprise of total six question, each carrying 15 marks.
- Total four questions need to be solved.
- Question Number One will be compulsory and it will be based on entire syllabus wherein sub-questions of 2 to 3 marks will be asked.
- Remaining questions i.e. Q.2 to Q.6 will be mixed in nature and will be divided in three parts (a), (b) & (c) and they will belong to different modules.
- In question paper, weight of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

References:

1. Environmental Studies by Benny Joseph, TataMcGraw Hill.
2. Environmental Studies by R.Rajagopalan, Oxford University Press.
3. Environmental Studies by. AnanditaBasak, Pearson Education.
4. Essentials of Environmental Studies by Kurian Joseph &Nagendran, Pearson Education.
5. Fundamentals of Environmental Studies by Varadbal G. Mhatre, Himalaya Publication House.
6. Perspective of Environmental Studies, by Kaushik and Kaushik,New Age International.
7. Renewable Energy by Godfrey Boyle, Oxford Publications.
8. Textbook of Environmental Studies by Dave and Katewa, Cengage Learning.
9. Textbook of Environmental studies by ErachBharucha, University Press.
10. Environmental pollution control engineering by C.S. Rao, New Age International (P) Limited Publishers.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
FEL101	Basic Workshop Practice - I	--	04	--	--	02	--	02

Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Av of Test 1 & 2					
FEL101	Basic Workshop Practice - I	--	--	--	--	50	--	--	50

	Detailed Contents	Hrs.
Note:	The syllabus and the Term- work to be done during semester I and Semester II is given together. Individual Instructor for the course is to design the jobs for practice and demonstration and spread the work over entire two semesters. The objective is to impart training to help the students develop engineering skill sets. This exercise also aims in inculcating respect for physical work and hard labor in addition to some amount of value addition by getting exposed to interdisciplinary engineering domains. The two compulsory trades (Trade 1 – Fitting and Trade 2 – Carpentry) shall be offered in separate semesters. Select any four trade topics (two per semester) out of the topic at trade 3 to 11. Demonstrations and hands on experience to be provided during the periods allotted for the same. Report on the demonstration including suitable sketches is also to be included in the term – work	
Trade 1	Fitting (compulsory) - Use and setting of fitting tools for chipping, cutting, filing, marking, center punching, drilling, tapping. - Term work to include one job involving following operations : filing to size, one simple male- female joint, drilling and tapping	30
Trade 2	Carpentry (compulsory) - Use and setting of hand tools like hacksaws, jack planes, chisels and gauges for construction of various joints, wood tuning and modern wood turning methods. - Term work to include one carpentry job involving a joint and report on demonstration of a job involving wood turning	30
Trade 3	Forging (Smithy) At least one workshop practice job (Lifting hook and handle) is to be demonstrated.	15
Trade 4	Welding Edge preparation for welding jobs. Arc welding for different job like, Lap welding of two plates, butt welding of plates with simple cover, arc welding to join plates at right angles.	15
Trade 5	Machine Shop At least one turning job is to be demonstrated.	15
Trade 6	Electrical board wiring House wiring, staircase wiring, wiring diagram for fluorescent tube light, Godown wiring and three phase wiring for electrical motors.	15
Trade 7	PCB Laboratory Exercises Layout drawing, Positive and negative film making, PCB etching and drilling, Tinning and soldering technique.	15
Trade 8	Sheet metal working and Brazing Use of sheet metal, working hand tools, cutting , bending , spot welding	15

Trade 9	Plumbing • Use of plumbing tools, spanners, wrenches, threading dies, demonstration of preparation of a domestic line involving fixing of a water tap and use of coupling, elbow, tee, and union etc.	15
Trade 10	Masonry • Use of masons tools like trowels, hammer, spirit level, square, plumb line and pins etc. demonstration of mortar making, single and one and half brick masonry , English and Flemish bonds, block masonry, pointing and plastering.	15
Trade 11	Hardware and Networking: • Dismantling of a Personal Computer (PC), Identification of Components of a PC such as power supply, motherboard, processor, hard disk, memory (RAM, ROM), CMOS battery, CD drive, monitor, keyboard, mouse, printer, scanner, pen drives, disk drives etc. • Assembling of PC, Installation of Operating System (Any one) and Device drivers, Boot-up sequence. Installation of application software (at least one) • Basic troubleshooting and maintenance • Identification of network components: LAN card, wireless card, switch, hub, router, different types of network cables (straight cables, crossover cables, rollover cables) Basic networking and crimping. NOTE: Hands on experience to be given in a group of not more than four students.	15

Term work:

Term work shall consist of respective reports and jobs of the trades selected the distribution of marks for term work shall be as follows.

- 1 Laboratory work (Job and Journal) : 40 marks
- 2 Attendance (Practical and Theory) : 10 marks

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
FEC201	Applied Mathematics-II	04	--	01	04	--	01	05

Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Av of Test 1 & 2					
FEC201	Applied Mathematics-II	20	20	20	80	25	--	--	125

Objectives

1. To provide students with sound foundation in applied mathematics to solve real life problems in industry.
2. To provide hands on experience in using Scilab software to handle real life problems.

Outcomes: Learner will be able to...

1. Apply the concepts of First Order and first degree Differential equation to the engineering problems.
2. Apply the concepts of Higher Order Linear Differential equation to the engineering problems.
3. Apply concepts of Beta and Gamma function to the engineering Problems.
4. Apply SCILAB programming techniques to solve differential equation to model complex engineering activities.
5. Apply concepts of Double integral of different coordinate systems to the engineering problems.
6. Apply concepts of triple integral of different coordinate systems to the engineering problems.

Module	Detailed Contents	Hrs.
01	Differential Equations of First Order and First Degree	
	1.1 Exact differential Equations, Equations reducible to exact form by using integrating factors.	4
	1.2 Linear differential equations (Review), equation reducible to linear form, Bernoulli's equation.	3
	1.3: Simple application of differential equation of first order and first degree to electrical and Mechanical Engineering problem (no formulation of differential equation)	2
02	Linear Differential Equations With Constant Coefficients and Variable Coefficients Of Higher Order	
	2.1. Linear Differential Equation with constant coefficient- complementary function, particular integrals of differential equation of the type $f(D)y = X$ where X is e^{ax} , $\sin(ax+b)$, $\cos(ax+b)$, x^n , $e^{ax}V$, xV .	6
	2.2. Cauchy's homogeneous linear differential equation and Legendre's differential equation, Method of variation of parameters.	3
03	Numerical solution of ordinary differential equations of first order and first degree, Beta and Gamma Function	
	3.1. (a)Taylor's series method (b)Euler's method (c) Modified Euler method (d) Runge-Kutta fourth order formula (SciLab programming is to be taught during lecture hours)	4
	3.2 .Beta and Gamma functions and its properties.	4
04	Differentiation under Integral sign, Numerical Integration and Rectification	
	4.1. Differentiation under integral sign with constant limits of integration.	2
	4.2. Numerical integration- by (a) Trapezoidal (b) Simpson's 1/3rd (c) Simpson's 3/8th rule (all with proof). (SciLab programming on (a) (b) (c) (d) is to be taught during lecture hours)	3
	4.3. Rectification of plane curves.	3

05	Double Integration 5.1. Double integration-definition, Evaluation of Double Integrals. 5.2. Change the order of integration, Evaluation of double integrals by changing the order of integration and changing to polar form.	2 7
06	Triple Integration and Applications of Multiple Integrals. 6.1. Triple integration definition and evaluation (Cartesian, cylindrical and spherical polar coordinates). 6.2. Application of double integrals to compute Area, Mass, Volume. Application of triple integral to compute volume.	3 6

Term Work:

General Instructions:

1. Batch wise tutorials are to be conducted. The number of students per batch should be as per University pattern for practical.
2. Students must be encouraged to write Scilab Programs in tutorial class only. Each Student to write atleast 4 Scilab tutorials (including print out) and at least 6 class tutorials on entire syllabus.
3. SciLab Tutorials will be based on (i) Curve Tracing (ii) Taylor's series method, Euler's method Modified Euler method, RungeKutta fourth order formula (iii) Ordinary Differential Equation and (iv) Trapezoidal Simpson's 1/3rd and Simpson's 3/8th rule.

The distribution of Term Work marks will be as follows -

Attendance (Theory and Tutorial): 05 marks

Class Tutorials on entire Syllabus: 10 marks

SciLab Tutorials : 10 marks

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of 3 to 4 marks will be asked.
4. Remaining questions will be mixed in nature.(e.g. Suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
5. In question paper weightage of each module will be proportional to number of respective lecture hrs as mentioned in the syllabus.

References:

1. A text book of Applied Mathematics, P.N.Wartikar and J.N.Wartikar, Vol – I and –II by Pune VidyarthiGraha.
2. Higher Engineering Mathematics, Dr.B.S.Grewal, Khanna Publication
3. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited, 9thEd.
4. Numerical methods by Dr. P. Kandasamy ,S.Chand Publications

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
FEC202	Applied Physics – II	03	01	--	03	0.5	--	3.5

Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Av of Test 1 & 2					
FEC202	Applied Physics – II	15	15	15	60	25	--	--	100

Objectives

1. To impart knowledge of basic concepts in applied physics.
2. To provide the knowledge and methodology necessary for solving problems in the field of engineering.

Outcomes: Learner will be able to...

1. Comprehend principles of interference and diffraction.
2. Illustrate the principle, construction and working of various LASERS and its applications.
3. Identify various applications of optical fibres.
4. Comprehend the concepts of electrodynamics and Maxwell's equations and their use in telecommunication systems.
5. Apply the concepts of electromagnetism in focusing systems and CRO.
6. Comprehend the significance of nanoscience and nanotechnology, its applications.

Module	Detailed Contents	Hrs.
01	INTERFERENCE AND DIFFRACTION OF LIGHT Interference by division of amplitude and by division of wave front; Interference in thin film of constant thickness due to reflected and transmitted light; origin of colours in thin film; Wedge shaped film (angle of wedge and thickness measurement); Newton's rings Applications of interference - Determination of thickness of very thin wire or foil; determination of refractive index of liquid; wavelength of incident light; radius of curvature of lens; testing of surface flatness; Anti-reflecting films and Highly reflecting film. Diffraction of Light – Fraunhofer diffraction at single slit, Fraunhofer diffraction at double slit, Diffraction Grating, Resolving power of a grating, dispersive power of a grating Application of Diffraction - Determination of wavelength of light with a plane transmission grating	14
02	LASERS Quantum processes as absorption, spontaneous emission and stimulated emission; metastable states, population inversion, pumping, resonance cavity, Einstein's equations; Helium Neon laser; Nd:YAG laser; Semiconductor laser, Applications of laser- Holography (construction and reconstruction of holograms) and industrial applications (cutting, welding etc), Applications in medical field	04
03	FIBRE OPTICS Total internal reflection; Numerical Aperture; critical angle; angle of acceptance; V number; number of modes of propagation; types of optical fiber; Losses in optical fibre (Attenuation and dispersion) Applications of optical fibre - Fibre optic communication system; sensors (Pressure, temperature, smoke, water level), applications in medical field	04

04	ELECTRODYNAMICS Cartesian, Cylindrical and Spherical Coordinate system, Scaler and Vector field, Physical significance of gradient, curl and divergence, Determination of Maxwell's four equations. Applications-design of antenna, wave guide, satellite communication etc.	08
05	CHARGE PARTICLE IN ELECTRIC AND MAGNETIC FIELDS Fundamentals of Electromagnetism, Motion of electron in electric field (parallel ,perpendicular, with some angle); Motion of electron in magnetic field (Longitudinal and Transverse); Magnetic deflection; Motion of electron in crossed field; Velocity Selector; Velocity Filter, Electron refraction; Bethe's law; Electrostatic focusing; Magnetostatic focusing; Cathode ray tube (CRT);Cathod ray Oscilloscope (CRO) Application of CRO: Voltage (dc,ac), frequency, phase measurement.	05
06	NANOSCIENCE AND NANOTECHNOLOGY Introduction to nano-science and nanotechnology, Surface to volume ratio, Two main approaches in nanotechnology -Bottom up technique and top down technique; Important tools in nanotechnology such as Scanning Electron Microscope, Transmission Electron Microscope, Atomic Force Microscope. Nano materials: Methods to synthesize nanomaterials (Ball milling, Sputtering, Vapour deposition, solgel), properties and applications of nanomaterials.	04

Suggested Experiments: (Any five)

1. Determination of radius of curvature of a lens using Newton's ring set up
2. Determination of diameter of wire/hair or thickness of paper using Wedge shape film method.
3. Determination of wavelength using Diffraction grating. (Hg/ Ne source)
4. Determination of number of lines on the grating surface using LASER Source.
5. Determination of Numerical Aperture of an optical fibre.
6. Determination of wavelength using Diffraction grating. (Laser source)
7. Use of CRO for measurement of frequency and amplitude.
8. Use of CRO for measurement of phase angle.
9. Study of divergence of laser beam
10. Determination of width of a slit using single slit diffraction experiment (laser source)

The distribution of Term Work marks will be as follows –

4. Attendance (Theory and Practical) : 05 marks
5. Assignments : 10 marks
6. Laboratory work (Experiments and Journal) : 10 marks

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 15 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 15 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of 2 to 3marks will be asked.
4. Remaining questions will be mixed in nature.(e.g. Suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
5. In question paper weightage of each module will be proportional to number of respective lecture hrs as mentioned in the syllabus.

References:

1. A text book of Engineering Physics-Avadhanulu&Kshirsagar, S.Chand
2. Fundamentals of Optics by Jenkins and White, McGraw-Hill
3. Optics - Ajay Ghatak, Tata McGraw Hill
4. Concepts of Modern Physics- ArtherBeiser, Tata Mcgraw Hill
5. A textbook of Optics - N. Subramanyam and Brijlal, S.Chand
6. Engineering Physics-D. K. Bhattacharya, Oxford
7. Concepts of Modern Physics- ArtherBeiser, Tata Mcgraw Hill
8. Classical Electrodynamics – J. D. Jackson, Wiley
9. Introduction to Electrodynamics- D. J. Griffiths, Pearson publication
10. Introduction to Nanotechnology- Charles P. Poole, Jr., Frank J. Owens, Wiley India edition
11. Nano: The Essential – T. Pradeep, McGraw-Hill Education

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
FEC203	Applied Chemistry – II	03	01	--	03	0.5	--	3.5

Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Av of Test 1 & 2					
FEC203	Applied Chemistry – II	15	15	15	60	25	--	--	100

Objectives

1. To provide necessary background in applied chemistry relevant to chemical industries.
2. To provide exposure in conducting experiments and interpret and report the results in professional format.

Outcomes: Learner will be able to...

1. Identify types of corrosion and factors affecting it related to problems affecting all industries.
2. Identify different types of corrosion control methods to study corrosion control in various industries.
3. Apply the knowledge of different types of fuels, including their production and refining methods and combustion mechanisms.
4. Illustrate composition and properties of different types of alloys and the process of powder metallurgy
5. Illustrate principles of green chemistry.
6. Illustrate properties and applications of different types of composite materials.

Module	Detailed Contents	Hrs.
01	Corrosion: Introduction: Types of Corrosion- (I) Dry or Chemical Corrosion-i) Due to oxygen ii) Due to other gases (II) Wet or Electrochemical corrosion- Mechanism i) Evolution of hydrogen type ii) Absorption of oxygen. Types of Electrochemical Corrosion- Galvanic cell corrosion, Concentration cell corrosion (differential aeration), Pitting corrosion, Intergranular corrosion, Stress corrosion. Factors affecting the rate of corrosion- Nature of metal, position of metal in galvanic series, potential difference, overvoltage, relative area of anodic and cathodic parts, purity of metal, nature of the corrosion product, temperature, moisture, influence of pH, concentration of the electrolytes. Methods to decrease the rate of corrosion- Material selection, Proper designing, Use of inhibitors, Cathodic protection- i) Sacrificial anodic protection ii) Impressed current method, Anodic protection method, Metallic coatings- hot dipping- galvanizing and tinning, metal cladding, metal spraying, Electroplating, Cementation. Organic coatings – Paints (only constituents and their functions).	11
02	Alloys Introduction, purpose of making alloys, Ferrous alloys, plain carbon steel, heat resisting steels, stainless steels (corrosion resistant steels), effect of the alloying element- Ni, Cr, Co, Mn, Mo, W and V; Non-Ferrous alloys- Composition, properties and uses of- Alloys of Aluminium- i) Duralumin ii) Magnalium. Alloys of Cu- (I) Brasses-i) Commercial brass ii) German silver, (II) Bronzes- i) Gun metal ii) High phosphorous bronze. Alloys of Pb- i) Wood's metal ii)	07

	Tinmann's solder. Powder Metallurgy- Introduction, (1)Methods of powder metal formation- i) Mechanical pulverization ii) Atomization iii) Chemical reduction iv) Electrolytic process v) Decomposition (2) Mixing and blending. (3) Sintering (4) Compacting- i) Cold pressing ii) Powder injection moulding (iii) Hot compaction. Applications of powder metallurgy. Shape Memory Alloys- Definition, properties and Uses.	
03	Fuels Definition, classification of fuels-solid, liquid and gaseous. Calorific value- Definition, Gross or Higher calorific value & Net or lower calorific value, units of heat (no conversions), Dulong's formula & numerical for calculations of Gross and Net calorific values. Characteristics of a good fuel. Solid fuels- Analysis of coal- Proximate and Ultimate Analysis with Significance and numericals. Liquid fuels- Crude petroleum oil, its composition and classification and mining (in brief). Refining of crude oil- i) Separation of water ii) Separation of 'S' & iii) Fractional Distillation with diagram and composition and uses table. Cracking- Definition, Types of cracking- I) Thermal cracking – (i) Liquid phase thermal cracking (ii) Vapour phase thermal cracking. II) Catalytic cracking- (i) Fixed-bed catalytic cracking (ii) Moving-bed catalytic cracking. Advantages of Catalytic cracking. Petrol- Refining of petrol, unleaded petrol (use of MTBE), Catalytic converter, Power alcohol, Knocking, Octane number, Cetane number, Antiknocking agents. Combustion- Calculations for requirement of only oxygen and air (by weight and by volume only) for given solid & gaseous fuels. Biodiesel- Method to obtain Biodiesel from vegetable oils (Trans-esterification), advantage and disadvantages of biodiesel. Fuel cell- Definition, types and applications.	12
04	Composite Materials Introduction, Constitution- i) Matrix phase ii) Dispersed phase. Characteristic properties of composite materials. Classification- (A) Particle - reinforced composites- i) Large – particle reinforced composites ii) Dispersion – strengthened composites. (B) Fiber – reinforced composites- i) Continuous – aligned ii) Discontinuous – aligned (short)- (a) aligned (b) randomly oriented (C) Structural Composites- i) Laminates (ii) Sandwich Panels.	04
05	Green Chemistry Introduction, Twelve Principles of Green chemistry, numerical on atom economy, Conventional and green synthesis of Adipic acid, Indigo, Ibuprofen and Carbaryl. Green solvents (water, supercritical CO₂) and products from natural materials.	06

Suggested Experiments: (Any five)

1. Estimation of Zn- Complexometric titration.
2. Estimation of Ni- Complexometric titration.
3. Estimation of Al- Complexometric titration.
4. Flue gas analysis using Orsat's apparatus.
5. Estimation of Fe from plain carbon steel
6. Estimation of Ni by gravimetric method.
7. Estimation of Sn iodometrically.
8. Preparation of Biodiesel from edible oil.
9. Estimation of Cu- Iodometrically.
10. Estimation of percentage moisture in coal.
11. Estimation of percentage ash in coal.
12. To estimate the emf of Cu-Zn system by potentiometry.
13. Demonstration of Electroplating.

Term work

Term Work shall consist of minimum five experiments. The distribution of marks for term work shall be as follows:

1. Attendance (Practical and Theory) : 05 marks
2. Laboratory Work (Experiments and journal) : 10 marks
3. Assignments and Viva on practicals : 10 marks

Assessment:**Internal Assessment Test:**

Assessment consists of two class tests of 15 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 15 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of 3 marks will be asked.
4. Remaining questions will be mixed in nature.(e.g. Suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
5. In question paper weightage of each module will be proportional to number of respective lecture hrs as mentioned in the syllabus.

References:

1. Engineering Chemistry - Jain &Jain (DhanpatRai)
2. Engineering Chemistry – Dara & Dara (S Chand)
3. Engineering Chemistry - Wiley India (ISBN – 9788126519880)
4. A Text Book of Engineering Chemistry - ShashiChawla (DhanpatRai)
5. A Text Book of Green Chemistry – V.K. Ahluwalia (Springer)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
FEC204	Engineering Drawing	03	04	--	03	02	--	05

Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Av of Test 1 & 2					
FEC204	Engineering Drawing	15	15	15	60	25	50	--	150

Objectives

1. To impart and inculcate proper understanding of the theory of projection.
2. To impart the knowledge of reading a drawing.
3. To improve the visualization skill.
4. To teach basic utility of computer aided drafting (CAD) tool.

Outcomes: Learner will be able to...

1. Apply the basic principles of projections in 2D drawings.
2. Apply the basic principles of projections in converting 3D view to 2D drawing.
3. Read a given drawing.
4. Visualize an object from the given two views.
5. Use CAD tool to draw different views of a 3D object.
6. Use CAD tool to draw an object in 3D.

Module	Detailed Contents	Hrs.
01	Introduction to Engineering Drawing:- Types of Lines, Dimensioning Systems as per IS conventions. Engineering Curves:- Basic construction of Cycloid, Involute and Helix (of cylinder) only. ** Introduction to Auto CAD:- Basic Drawing and Editing Commands. Knowledge of setting up layers, Dimensioning, Hatching, plotting and Printing.	3
02	Projection of Points and Lines:- Lines inclined to both the Reference Planes (Excluding Traces of lines) and simple application based problems on Projection of lines. @Projection of Planes:- Triangular, Square, Rectangular, Pentagonal, Hexagonal and Circular planes inclined to either HP or VP only. (Exclude composite planes)	6
03	Projection of Solids:- (Prism, Pyramid, Cylinder, Tetrahedron, Hexahedron and Cone only) Solid projection with the axis inclined to HP and VP. (Exclude Spheres, Composite, Hollow solids and frustum of solids). Use change of position or Auxiliary plane method Section of Solids:- Section of Prism, Pyramid, Cylinder, Tetrahedron, Hexahedron & Cone cut by plane perpendicular to at least one reference plane. (Exclude Curved Section Plane). Use change of position or Auxiliary plane method Development of Lateral Surfaces of Sectioned Solids:- Lateral surface development of Prism, Pyramid, Tetrahedron, Hexahedron, Cylinder, Cone with section plane inclined to HP or VP only. (Exclude DLS of a solid with a hole in it and Reverse Development). (Exclude Reverse Development)	14
04	Orthographic and Sectional Orthographic Projections:- • Different views of a simple machine part as per the first angle projection method recommended by I.S. • Full or Half Sectional views of the Simple Machine parts. • **Drawing of orthographic projections using Auto CAD.	12

05	<u>Isometric Views:-</u> Isometric View/Drawing of blocks of plain and cylindrical surfaces using plain/natural scale only. (Exclude Spherical surfaces). • **Drawing of Isometric views using Auto CAD. • @Reading of Orthographic Projections. [Only for Practical Exam (AutoCAD) and Term Work] • **Orthographic Reading using Auto CAD. <u>**Introduction to 3D in AutoCAD</u> Working in 3-dimensions, Viewing 3D Objects, Basic wireframe models, Extruding, simple revolved objects. Boolean operations.	10

****Should be covered during Auto CAD practical sessions.**

@ Should be covered only in Term work. (i.e. Questions will not be asked for the End semester Examination).

TERM WORK:

Component – 1

Drawing Sheet – 1: Projection of Solids (3 Problems)

Drawing Sheet – 2: Section of Solids and Development of lateral surfaces (2 Problems)

Drawing Sheet – 3: Orthographic Projection without section (2 Problems)

Drawing Sheet – 4: Orthographic Projection with section (2 Problems)

Drawing Sheet – 5: Isometric Views (3 Problems)

Component -2

One A-3 size sketch book consisting of:-

- 1) Two problems each from Engineering Curves, Projection of Lines, Planes and Solids. One problem from Section of solids without DLS and one problem from section of solids with DLS of that sectioned Solid.
- 2) Two problems from Orthographic Projections (with Section), One problem on Reading of Orthographic projections and Two problems on Isometric views.

Component-3

Printouts (**preferably on A3 size sheet**) of each from:

1. Orthographic Projections with Section – 3 problems.
2. Isometric Views – 4 problems
3. Reading of Orthographic Projections – 1 problem.

Note:- 2 hrs /week Auto CAD Practical is essential for completing the Auto CAD Drawings and take required printouts.

AUTO CAD PRACTICAL EXAMINATION: (2hrs – 50 marks):

- 1) Minimum 1 problem from **1 OR 3** of **Component-3 for 30 marks.**
(All three views with at least 12 dimensions must be asked in the exam)
AND
- 2) Minimum 1 problem from **2** of **Component-3 for 20 marks.**

Note:- Print out of the Answers have to be taken **preferably in A3 size sheets** and should be **Assessed by External examiner only**. Knowledge of concepts and accuracy of drawing should be considered during evaluation.

INTERNAL ASSESSMENT TEST: (1 hr - 15 marks)

Out of the two tests, one test must be conducted by **conventional way** and another test must be **Practical Exam** (using AutoCAD software). Average of the two tests must be considered for Internal Assessment.

END SEMESTER EXAMINATION: (3 hrs – 60 marks)

- 1) Question paper will comprise of 6 questions, each carrying 15 marks.
- 2) Any 4 questions need to be solved. **There won't be any compulsory Question.**
- 3) Marks of each topic should be proportional to number of hours assigned to each Module.

Text Books.

- 1 N.D. Bhatt, "Engineering Drawing (Plane and solid geometry)", Charotar Publishing House Pvt. Ltd.
- 2 N.D. Bhatt & V.M. Panchal, "Machine Drawing", Charotar Publishing House Pvt. Ltd.

References.

- 1 M.B Shah & B.C Rana, "Engineering Drawing", Pearson Publications.
- 2 P.J. Shah, "Engineering Graphics", S Chand Publications.
- 3 Dhananjay A Jolhe, "Engineering Drawing" Tata McGraw Hill.
- 4 Prof. Sham Tickoo (Purdue University) & Gaurav Verma, "(CAD Soft Technologies) : Auto CAD 2012 (For engineers and Designers)", Dreamtech Press New Delhi.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
FEC205	Structured Programming Approach	04	02	--	04	01	--	05

Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Av of Test 1 & 2					
FEC205	Structured Programming Approach	20	20	20	80	25	25	--	150

Objectives

1. To familiarise the logic of structured programming approach.
2. To provide exposure in developing algorithm, flowchart and thereby writing efficient codes for user defined problem.

Outcomes: Learner will be able to...

1. Illustrate the basic terminology used in computer programming.
2. Illustrate the concept of data types, variables and operators using C.
3. Design and Implement control statements and looping constructs in C.
4. Apply function concept on problem statements.
5. Demonstrate the use of arrays, strings, structures and files handling in C.
6. Demonstrate the dynamics of memory by the use of pointers to construct various data structures.

Module	Topic	Detailed Contents	Hrs.
01	Introduction to Computer, Algorithm And Flowchart	1.1 Basics of Computer: Turing Model, Von Neumann Model, Basics of Positional Number System, Introduction to Operating System and component of an Operating System. 1.2 Algorithm & Flowchart : Three construct of Algorithm and flowchart: Sequence, Decision (Selection) and Repetition	06
02	Fundamentals of C-Programming	2.1 Character Set, Identifiers and keywords, Data types, Constants, Variables. 2.2 Operators -Arithmetic, Relational and logical, Assignment, Unary, Conditional, Bitwise, Comma, other operators. Expression, statements, Library Functions, Preprocessor. 2.3 Data Input and Output – getchar(), putchar(), scanf(), printf(), gets(), puts(), Structure of C program .	06
03	Control Structures	3.1 Branching - If statement, If-else Statement, Multiway decision. 3.2 Looping – while , do-while, for 3.3 Nested control structure - Switch statement, Continue statement Break statement, Goto statement.	12
04	Functions and Parameter	4.1 Function -Introduction of Function, Function Main, Defining a Function, Accessing a Function, Function Prototype, Passing Arguments to a Function, Recursion. 4.2 Storage Classes –Auto , Extern , Static, Register	06

05	Arrays , String Structure and Union	5.1 Array -Concepts, Declaration, Definition, Accessing array element, One-dimensional and Multidimensional array. 5.2 String - Basic of String, Array of String , Functions in String.h 5.3 Structure - Declaration, Initialization, structure within structure, Operation on structures, Array of Structure. 5.4 Union - Definition , Difference between structure and union , Operations on a union	14
06	Pointer and Files	6.1 Pointer :Introduction, Definition and uses of Pointers, Address Operator, Pointer Variables, Dereferencing Pointer, Void Pointer, Pointer Arithmetic, Pointers to Pointers, Pointers and Array, Passing Arrays to Function, Pointers and Function, Pointers and two dimensional Array, Array of Pointers, Dynamic Memory Allocation. 6.2 Files : Types of File, File operation- Opening, Closing, Creating, Reading, Processing File.	08

Laboratory Assignments:

1. Students are expected to solve and execute at least 20 programming problems based on above Syllabus.
2. Journal work should comprise of writing the problem definition, solution of problem either as algorithm and flow chart and source code in C (Advisable hand written) for all the 20 problems.

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of 3 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.(e.g. Suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
5. In question paper weightage of each module will be proportional to number of respective lecture hrs as mentioned in the syllabus.

Text Books:

- 1 “MASTERING C” by K.R.Venugopal and SudeepR.Prasad , Tata McGraw-Hill Publications.
- 2 “A Computer Science –Structure Programming Approaches using C ”, by BehrouzForouzan , Cengage Learning .
- 3 Schaum’s outlines “Programming with C”, by Byron S. Gottfried, Tata McGraw-Hill Publications.

Reference Books:

- 1 “Basics of Computer Science”, by BehrouzForouzan , Cengage Learning .
- 2 “Programming Techniques through C”, by M. G. Venkateshmurthy, Pearson Publication.
- 3 “Programming in ANSI C”, by E. Balaguruswamy, Tata McGraw-Hill Education.
- 4 “Programming in C”, by Pradeep Day and Manas Gosh, Oxford University Press.
- 5 “Let Us C”, by YashwantKanetkar, BPB Publication.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
FEC206	Communication Skills	02	02	--	02	01	--	03

Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Av of Test 1 & 2					
FEC206	Communication Skills	10	10	10	40	25	--	--	75

Objectives

1. To acquaint the students with appropriate language skills with the purpose of improving the existing ones – LSRW
2. To make the learners understand the importance and effective use of non-verbal communication
3. To make the learner proficient in public speaking and presentation skills
4. To guide and teach the students to utilize the principles of professional business and technical writing for effective communication in the global world
5. To make the learner capable of creating official content digitally for further communication in the corporate environment

Outcomes: Learner will be able to...

1. Understand and evaluate information they listen to and express their ideas with greater clarity
2. Speak and respond effectively along the various channels of communication in a business organization
3. Speak convincingly before an audience with the help of an expanded vocabulary and enhanced digital content
4. Read and summarize effectively
5. Communicate through result oriented writing both within and outside the organization.
6. Write a set of effective and easy to understand technical description, instructions and convey the same using global information technology

Module	Detailed Contents	Hrs.
01	Communication Theory: Concept and Meaning, Communication cycle, Objectives, Barriers to communication (linguistic and semantic, psychological, physical, mechanical, cultural), Methods of communication (verbal and non-verbal), Networks of communication (formal and informal), Language skills (listening, speaking, reading, writing), Corporate communication: Digital Content Creation.	13
02	Business Correspondence: Principles of Business Correspondence, Parts of a business letter, Formats (Complete block and Modified block), Types of letters: Enquiry, Reply to enquiry, Claim, Adjustment and Sales letter.	05
03	Grammar and Vocabulary: Common errors, Concord (subject- verb agreement), Pairs of confused words, Lexicon (Enriching vocabulary through one-word substitutes, synonyms, antonyms, etc.)	02

04	Summarization and Comprehension: Passages to test the analytical skills and expression	02
05	Technical writing : Techniques to define an object, writing instructions, language exercises based on types of expositions (description of an object, explanation of a process)	02
06	Information Communication Technology (ICT) enabled communication media: E-mail, Blog and Website.	02

The distribution of Term Work marks will be as follows -

Attendance : 05 marks
Assignments : 20 marks

List of assignments:

1. Communication theory: 02
2. Business Correspondence: 02
3. Grammar and vocabulary: 01
4. Summarization & Comprehension: 01
5. Technical writing: 01
6. ICT enabled communication media: 01

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 10 marks each. The first test should be conducted in the form of a three-minute public speech. The second test should be based on theory and application exercises as mentioned in the syllabus.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 10 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of 3 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.(e.g. Suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
5. In question paper weightage of each module will be proportional to number of respective lecture hrs as mentioned in the syllabus.
6. The first module (Communication Theory) will carry 40 % weightage.

References:

1. Communication in Organizations by Dalmar Fisher, Jaico Publishing House
2. Communication Skills by Meenakshi Raman & Sangeeta Sharma,
3. Oxford University Press.
4. Business Correspondence & Report-writing by R.C. Sharma& Krishna Mohan, Tata McGraw-Hill Education.
5. Effective Technical Communication by Ashraf Rizvi, Tata McGraw-Hill.
6. Technical Writing & Professional Communication for non-native speakers of English by Thomas N. Huckin & Leslie A. Olsen, McGraw –Hill.
7. Mastering Communication by Nicky Stanton, Palgrave Master Series
8. www.buisnesscommunicationskills.com
9. www.kcitraing.com
10. www.mindtools.com
11. Journal of Business Communication

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
FEL201	Basic Workshop Practice - II	--	04	--	--	02	--	02

Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Av of Test 1 & 2					
FEL201	Basic Workshop Practice - II	--	--	--	--	50	--	--	50

Detailed Syllabus is given in Basic Workshop Practice-I

Term work:

Term work shall consist of respective reports and jobs of the trades selected the distribution of marks for term work shall be as follows:

Laboratory work (Job and Journal) : 40 marks

Attendance (Practical and Theory) : 10 marks

The final certification and acceptance of term – work ensures the satisfactory performance of laboratory work.