दिल्ली प्रौद्योगिकी विश्वविद्यालय

DELHI TECHNOLOGICAL UNIVERSITY
(Formerly Delhi College of Engineering)

(Estd. By Govt. of NCT of Delhi vide Act 6 of 2009)

SCHEME OF TEACHING AND EXAMINATIONS

BACHELOR OF TECHNOLOGY

MATHEMATICS & COMPUTING

W.E.F 2015

DEPARTMENT OF APPLIED MATHEMATICS

Scheme of Teaching and Examinations
B. Tech. (MATHEMATICS & COMPUTING)
W.E.F. 2015

DELHI TECHNOLOGICAL UNIVERSITY

(Formerly Delhi College of Engineering)

CONTENTS

VISION

To be a world class university through education, innovation and research for the service of humanity.

MISSION

1. To establish centres of excellence in emerging areas of science, engineering, technology, management and allied areas.

2. To foster an ecosystem for incubation, product development, transfer of technology and entrepreneurship.

3. To create environment of collaboration, experimentation, imagination and creativity.

4. To develop human potential with analytical abilities, ethics and integrity.

5. To provide environment friendly, reasonable and sustainable solutions for local & global needs.

DEPARTMENT OF APPLIED MATHEMATICS

VISION

To emerge as a centre of excellence and eminence by imparting futuristic technical education with solid mathematical background in keeping with global standards, making our students technologically and mathematically competent and ethically strong so that they can readily contribute to the rapid advancement of society and mankind.

MISSION

1. To achieve academic excellence through innovative teaching and learning practices.

2. To improve the research competence to address social needs.

3. To inculcate a culture that supports and reinforces ethical, professional behaviors for a harmonious and prosperous society.

4. Strive to make students to understand, appreciate and gain mathematical skills and develop logic, so that they are able to contribute intelligently in decision making which characterizes our scientific and technological age.

Programme Educational Objectives (PEOs)

PEO-1   To prepare graduates with a solid foundation in Engineering, Mathematical Science and technology for a successful career in Mathematics & Computing/ Finance/Computer Engineering fields.

PEO-2   To prepare graduates to become effective collaborators/ innovators, who could ably address tomorrow's social, technical and engineering challenges.

PEO-3   To enrich graduates with integrity and ethical values so that they become responsible engineers.

DEPARTMENT OF APPLIED MATHEMATICS
BACHELOR OF TECHNOLOGY (MATHEMATICS & COMPUTING)

I Year: Odd Semester

S. No.	Subject Code	Course Title	Subject Area	Credit	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
		Teaching Scheme						**Contact Hours/ Week**		**Exam Duration (h)**		**Relative Weights (%)**		
Group A														
1	MA101	Mathematics - I	ASC	4	3	1	0	3	0	25	-	25	50	-
2	AP101	Physics – I	ASC	4	3	0	2	3	0	15	15	30	40	-
3	AC101	Chemistry	ASC	4	3	0	2	3	0	15	15	30	40	-
4	ME101	Basic Mechanical Engineering	AEC	4	4	0	0	3	0	25	-	25	50	-
5	ME103	Workshop Practice	AEC	2	0	0	3	0	3	-	50	-	-	50
6	HU101	Communication Skills	HMC	3	3	0	0	3	0	25	-	25	50	-
		Total		**21**	16	1	7							
Group B														
1	MA101	Mathematics - I	ASC	4	3	1	0	3	0	25	-	25	50	-
2	AP101	Physics – I	ASC	4	3	0	2	3	0	15	15	30	40	-
3	EE101	Basic Electrical Engineering	AEC	4	3	0	2	3	0	15	15	30	40	-
4	CO101	Programming Fundamentals	AEC	4	3	0	2	3	0	15	15	30	40	-
5	ME105	Engineering Graphics	AEC	2	0	0	3	0	3	-	50	-	-	50
6	EN101	Introduction to Environmental Science	AEC	3	3	0	0	3	0	25	-	25	50	-
		Total		**21**	15	1	9							

I Year: Even Semester

S. No.	Subject Code	Course Title	Subject Area	Credit	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
						Contact Hours/ Week			**Exam Duration**		**Relative Weights (%)**				
Group A														
1	MA102	Mathematics - II	ASC	4	3	1	0	3	0	25	-	25	50	-
2	AP102	Physics – II	ASC	4	3	0	2	3	0	15	15	30	40	-
3	EE102	Basic Electrical Engineering	AEC	4	3	0	2	3	0	15	15	30	40	-
4	CO102	Programming Fundamentals	AEC	4	3	0	2	3	0	15	15	30	40	-
5	ME102	Engineering Graphics	AEC	2	0	0	3	0	3	-	50	-	-	50
6	EN102	Introduction to Environmental Science	AEC	3	3	0	0	3	0	25	-	25	50	-
		Total		**21**	15	1	9							
Group B														
1	MA102	Mathematics – II	ASC	4	3	1	0	3	0	25	-	25	50	-
2	AP102	Physics – II	ASC	4	3	0	2	3	0	15	15	30	40	-
3	AC102	Chemistry	ASC	4	3	0	2	3	0	15	15	30	40	-
4	ME104	Basic Mechanical Engineering	AEC	4	4	0	0	3	0	25	-	25	50	-
5	ME106	Workshop Practice	AEC	2	0	0	3	0	3	-	50	-	-	50
6	HU102	Communication Skills	HMC	3	3	0	0	3	0	25	-	25	50	-
		Total		**21**	16	1	7							

II Year: Odd Semester

S.No.	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	CS251	Data Structure	AEC	4	3	0	2	3	0	15	15	30	40	-
2.	MC201	Discrete Mathematics	DCC	4	3	1	0	3	0	25	-	25	50	-
3.	MC203	Mathematics-III	DCC	4	3	0	2	3	0	15	15	30	40	-
4.	MC205	Probability & Statistics	DCC	4	3	0	2	3	0	15	15	30	40	-
5.	MC207	Engineering Analysis and Design (Differential Equations and Applications)	DCC	4	3	0	2	3	0	15	15	30	40	-
6.	MG201	Fundamentals of Management	HMC	3	3	0	0	3	0	25	-	25	50	-
		Total		**23**										

II Year: Even Semester

S.No.	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	CS262	Algorithm Design & Analysis	AEC	4	3	1	0	3	0	25	-	25	50	-
2.	MC202	Real Analysis	DCC	4	3	1	0	3	0	25	-	25	50	-
3.	MC204	Scientific Computing	DCC	4	3	0	2	3	0	15	15	30	40	-
4.	MC206	Computer Organization & Architecture	DCC	4	3	1	0	3	0	25	0	25	50	-
5.	MC208	Linear Algebra	DCC	4	3	1	0	3	0	25	-	25	50	-
6.	HU202	Engineering Economics	HMC	3	3	0	0	3	0	25	-	25	50	-
		Total		**23**										

III Year: Odd Semester

S.No.	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	MC301	Operating System	DCC	4	3	0	2	3	0	15	15	30	40	-
2.	MC303	Stochastic Processes	DCC	4	3	0	2	3	0	15	15	30	40	-
3.	MCxxx	Departmental Elective Course -1	DEC/ GEC	4	3	0/1	2/0	3	0	15/25	15/-	30/25	40/50	-
4.	MCxxx-	Departmental Elective Course-2	DEC/ GEC	4	3	0/1	2/0	3	0	15/25	15/-	30/25	40/50	-
5.	UExxx	Open Elective Course	OEC	3	3	0	0	3	0	25	-	25	50	-
6.	HU301	Technical Communication	HMC	2	2	0	0	2	0	25	-	25	50	-
		Total		21										

III Year: Even Semester

S.No.	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	MC302	Data Base Management System	DCC	4	3	0	2	3	0	15	15	30	40	-
2.	MC304	Theory of Computation	DCC	4	3	1	0	3	0	25	-	25	50	-
3.	MC306	Financial Engineering	DCC	4	3	1	0	3	0	25	-	25	50	-
4.	MCxxx	Departmental Elective Course -3	DEC/ GEC	4	3	0/1	2/0	3	0	15/25	15/-	30/25	40/50	-
5.	MCxxx	Departmental Elective Course -4	DEC/ GEC	4	3	0/1	2/0	3	0	15/25	15/-	30/25	40/50	-
6.	HU302	Professional Ethics and Human Values	HMC	2	2	0	0	2	0	25	-	25	50	-
		Total		22										

IV Year: (Odd Semester)

S. No.	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	MC401	B.Tech. Project-I	DCC	4										
2.	MC403	Training Seminar	DCC	2										
3.	MC405	Graph Theory	DCC	4	3	0	2	3	0	15	15	30	40	-
4.	MC407	Cryptography & Network Security	DCC	4	3	1	0	3	0	25	-	25	50	-
5.	MC409	Mathematical Modeling & Simulation	DCC	4	3	0	2	3	0	15	15	30	40	-
6.	MCxxx	Departmental Elective Course -5	DEC/ GEC	4	3	0/1	2/0	3	0	15/ 25	15/-	30 /25	40/ 50	-
		Total		22										

IV Year: (Even Semester)

S. No.	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	MC402	B.Tech. Project-II	DCC	8										
2.	MC4xxx	Departmental Elective Course - 6	DEC/ GEC	4	3	0/1	2/0	3	0	15/ 25	15/-	30 /25	40/ 50	-
3.	MC4xxx	Departmental Elective Course - 7	DEC/ GEC	4	3	0/1	2/0	3	0	15/ 25	15/-	30 /25	40/ 50	-
4.	MC4xxx	Departmental Elective Course- 8	DEC/ GEC	4	3	0/1	2/0	3	0	15/ 25	15/-	30 /25	40/ 50	-
		Total		20										

List of Departmental Electives Courses

S. No.	Subject Code	Subject	Elective No.
1.	MC305	Operations Research	DEC– 1
2.	MC307	Object Oriented programming	
3.	MC309	Number Theory	
4.	MC315	Modern Algebra	DEC– 2
5.	MC317	Numerical methods for ODE	
6.	MC319	Complex Analysis	
7.	MC308	Computer Networks	DEC – 3
8.	MC310	Software Engineering	
9.	MC312	Artificial Intelligence.	
10.	MC318	Computer Graphics	DEC– 4
11.	MC320	Web Technology	
12.	MC322	Cluster & Grid Computing	
13.	MC324	Big Data Analytics	
14.	MC411	Data Warehousing & Data Mining	DEC – 5
15.	MC413	Compiler Design	
16.	MC415	Wireless & Mobile Computing	
17.	MC417	Multimedia System	
18.	MC404	Matrix Computation	DEC– 6
19.	MC406	Partial Differential Equations	
20.	MC408	Quality Control & Decision Making	
21.	MC410	Topology	
22.	MC412	Functional Analysis	
23.	MC418	Optimization Techniques.	DEC– 7
24.	MC420	Information Theory & Coding	
25.	MC422	Finite element methods	
26.	MC424	Game Theory	
27.	MC426	Differential Geometry	
28.	MC432	Fuzzy set & Fuzzy logic	DEC– 8
29.	MC434	Numerical Methods for PDE	
30.	MC436	Petrinet Theory & Application	
31.	MC438	Tensor Calculus	
32.	MC440	Statistical Inference	

List of Open Elective Courses

S.No.	SUBJECT CODE	SUBJECTS
1.	CO351	Enterprise & Java Programming
2.	CO353	E-commerce & ERP
3.	CO355	Cryptography & Information Security
4.	CO357	Operating System
5.	CO359	Intellectual Property Rights & Cyber Laws
6.	CO361	Database Management System
7.	EC351	Mechatronics
8.	EC353	Computer Vision
9.	EC355	Embedded System
10.	EC 357	Digital Image Processing
11.	EC359	VLSI Design
12.	EE351	Power Electronic Systems
13.	EE353	Electrical Machines and Power Systems
14.	EE355	Instrumentation Systems
15.	EE357	Utilization of Electrical Energy
16.	EE359	Non-conventional Energy Systems
17.	EE361	Embedded Systems
18.	EN351	Environmental Pollution & E- Waste Management
19.	EN353	Occupational Health & Safety Management
20.	EN355	GIS & Remote Sensing
21.	EP351	Physics of Engineering Materials
22.	EP353	Nuclear Security
23.	HU351	Econometrics
24.	MA351	History Culture & Excitement of Mathematics
25.	ME351	Power Plant Engineering
26.	ME353	Renewable Sources of Energy
27.	ME355	Combustion Generated Pollution
28.	ME357	Thermal System

29.	ME359	Refrigeration & Air Conditioning
30.	ME361	Industrial Engineering
31.	ME363	Product Design & Simulation
32.	ME365	Computational fluid dynamics
33.	ME367	Finite Element Methods
34.	ME369	Total Life Cycle Management
35.	ME371	Value Engineering
36.	MG351	Fundamentals of Financial Accounting and Analysis
37.	MG353	Fundamentals of Marketing
38.	MG355	Human Resource Management
39.	MG357	Knowledge and Technology Management
40.	PE351	Advance Machining Process
41.	PE 353	Supply Chain Management
42.	PE355	Work Study Design
43.	PE357	Product Design & Simulation
44.	PE359	Total Life Cycle Management
45.	PE361	Total Quality Management
46.	PT361	High Performance Polymers
47.	PT363	Separation Technology
48.	PT365	Non-Conventional Energy
49.	PT367	Polymer Waste Management
50.	PT369	Nanotechnology in Polymers
51.	PT371	Applications of Polymer Blends and Composite
52.	IT 351	Artificial Intelligence and Machine Learning
53.	IT 353	Data Structures and Algorithms
54.	IT 355	Communication and Computing Technology
55.	IT 357	Internet and Web Programming
56.	IT 359	Java Programming
57.	CE351	Geoinformatics and its applications

SYLLABUS

1. Subject Code: **ME 101/104**   :   Course Title: **Basic Mechanical Engineering**

2. Contact Hours   :   L: 04   T: 00   P: 00

3. Examination Duration (Hrs.)   :   Theory: 3   Practical: 00

4. Relative Weight   :   CWS: 25   PRS: 00   MTE: 25   ETE: 50   PRE: 00

5. Credits   :   04

6. Semester   :   I / II

7. Subject Area   :   AEC

8. Pre-requisite   :   NIL

9. Objective   :   To familiarize the students with the concepts of thermodynamics, fluid mechanics, power plants, engineering materials, manufacturing processes and metrology.

10. Details of Course   :

S. No.	Contents	Contact Hours
	PART A	
1	**Introduction:** Introduction to Thermodynamics, Concepts of systems, control volume, state, properties, equilibrium, quasi-static process, reversible & irreversible process, cyclic process. Zeroth Law and Temperature, Ideal Gas. Heat and Work.	05
2	First Law of Thermodynamics for closed & open systems. Non Flow Energy Equation. Steady State, Steady Flow Energy Equation. Second Law of Thermodynamics-Kelvin and Plank's Statements, Clausius inequality, Definition of Heat Engines, Heat pumps, Refrigerators. Concept of Energy and availability. Carnot Cycle; Carnot efficiency, Otto, Diesel, Dual cycle and their efficiencies.	12
3	Principles of power production, basic introduction about thermal power plant, hydroelectric power plant and nuclear power plant.	04

4	Properties & Classification of Fluids, Ideal & real fluids, Newton's law of viscosity, Pressure at a point, Pascal's law, Pressure variation in a static fluid, General description of fluid motion, stream lines, continuity equation, Bernoulli's equation, Steady and unsteady flow.	07
PART B		
5	Introduction to engineering materials for mechanical construction. Composition, mechanical and fabricating characteristics and applications of various types of cast irons, plain carbon and alloy steels, copper, aluminum and their alloys like duralumin, brasses and bronzes cutting tool materials, super alloys thermoplastics, thermosets and composite materials.	12
6	Introduction to Manufacturing processes for various machine elements. Introduction to Casting & Welding processes. Sheet metal and its operations. Introduction to machining processes – turning, milling, shaping, drilling and boring operations. Fabrication of large and small assembles – examples nuts and bolts, turbine rotors etc.	12
7	Introduction to quality measurement for manufacturing processes; standards of measurements, line standards, end standards, precision measuring instruments and gauges: vernier calliper, height gauges, micrometer, comparators, dial indicator, and limit gauges.	04
Total		**56**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
TEXT BOOKS:		
1	Engineering Thermodynamics, P. K. Nag, Tata McGrawa-Hill	2005
2	Fundamentals of Classical Thermodynamics, G. J. Van Wylen and R. E. Santag.	1994
3	Manufacturing Processes, Kalpakjian	2013
4.	Basic Mechanical Engineering,1/e, Pravin Kumar, Pearson Education, Delhi	2013

REFERENCE BOOKS:		
1	Introduction to Fluid Mechanics and Fluid Machines, S. K. Som and G. Biswas	2013
2	Fluid Mechanics and Hydraulic Machines, R. K. Bansal	2010
3	Workshop Practices, K. Hazara Chowdhary	2007
4	Workshop Technology, W. A. J. Chapman	1972
5	Production Engineering, R. K. Jain, Khanna Publishers	2001

1. Subject Code: **AC 101/102**   : Course Title: **Chemistry**

2. Contact Hours   : L: 03   T: 00   P: 02

3. Examination Duration (Hrs.)   : Theory: 03   Practical: 00

4. Relative Weight   : CWS: 15 PRS: 15 MTE: 30 ETE: 40   PRE: 00

5. Credits   : 04

6. Semester   : I / II

7. Subject Area   : ASC

8. Pre-requisite   : NIL

9. Objective   : To familiarize the students with the concepts of Engineering Chemistry, Material characterization and green Chemistry.

10. Details of Course   :

S. No.	Contents	Contact Hours
1.	**Conventional Analysis**: Volumetric Analysis, Types of Titrations, Theory of Indicators.	06
2.	**Spectral Methods of Analysis**: UV-visible, IR, NMR & MS: Principles and Applications.	08

3.	**Thermal Methods of Analysis**: Thermo-gravimetry, Differential thermal analysis and Differential Scanning Calorimetry: Principles and Applications.	04
4.	**Polymers & Plastics**: Functionality and Degree of Polymerization, Mechanism of Polymerization, Molecular Weights of Polymers, Methods of polymerization, Functional Polymers, Industrial applications of Polymers.	06
5.	**Electrochemistry**: Electrochemical cells, components, characteristics of batteries. Primary and Secondary battery systems, Zinc-Carbon cells, Lead storage and lithium batteries. Fuel Cells, Electro-deposition, Electrical and chemical requirements. Electroplating bath and linings. Agitation, Circulation and filtration equipment.	08
6.	**Phase Equilibrium**: Definitions of Phase, component and degree of freedom, Gibb's phase rule. One component systems: Water and sulphur. Two component systems: Pb-Ag and Cu-Ni.	06
7.	**Green Chemistry**: Principles of Green Chemistry, Examples of Green Methods of Synthesis, Reagents and Reactions, Evaluation of feedstocks, Future trends in Green Chemistry.	04
Total		**42**

11. Suggested Books:

S. No.	Name of Books/Authors/Publisher	Year of Publication/ Reprint
1	Introduction to Thermal Analysis/ Michael E. Brown/ Springer Netherlands	2001
2	Vogel's Quantitative Chemical Analysis/ J. Mendham, R.C. Denney, J. D. Barnes, M.J.K. Thomas / Prentice Hall/6 edition	2000
3	Green Chemistry: Theory & Practice/P.T. Anastas & J.C. Warner/ Oxford Univ Press	2000
4	Polymer Science and Technology/ Fried Joel R./ PHI; 2 edition	2005
5	Electrochemistry/ Philip H. Rieger / Springer	2009

1. Subject Code: **AP 101** : Course Title: **Physics – I**

2. Contact Hours : L: 03   T: 00   P: 02

3. Examination Duration (Hrs.) : Theory:03   Practical: 00

4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 00

5. Credits : 04

6. Semester : I

7. Subject Area : ASC

8. Pre-requisite : NIL

9. Objective : To impart knowledge of basic concepts in applied physics and make the students familiar with topics like interference, diffraction, polarization, fiber optics, lasers, wave mechanics, etc. This course is also aimed at enhancing the analytical capability of the engineering students.

10. Details of Course :

S. No.	Contents	Contact Hours
1.	**RELATIVITY**: Review of concepts of frames of reference and Galilean transformation equation, Michelson – Morley experiment and its implications, Einstein's special theory of relativity, Lorentz transformation equations, Law of addition of velocities, Mass variation with velocity, Concept of energy and momentum, Mass energy relation.	08
2.	**OSCILLATIONS & WAVES:** Damped and forced oscillations, Resonance (amplitude and power), Q – factor, Sharpness of resonance. Equations of longitudinal and transverse waves and their solutions, Impedance, Reflection and transmission of waves at a boundary, Impedance matching between two medium.	07

3.	**PHYSICAL OPTICS:** Interference by division of wave front and amplitude, Multiple beam interference and Fabry-Perot interferometer, Fresnel diffraction through a straight edge, Zone plate, Fraunhoffer diffraction, single slit and N-slit / grating, Resolving power of telescope, prism and grating. Polarization by reflection and by transmission, Brewster's law, Double refraction, elliptically and circularly polarized light, Nicol prism, Quarter and half wave plates.	12
4.	**OPTICAL INSTRUMENTS:** Cardinal points of co-axial lens systems, spherical and chromatic aberrations and their removal, Huygens and Ramsden's eyepiece.	05
5.	**Lasers:** Coherence and coherent properties of laser beams, Brief working principle of lasers, Spontaneous and stimulated Emission, Einstein's co-efficient, Ruby laser, He-Ne laser.	06
6.	**Optical Fiber:** Classification of optical fibers, Refractive index profile, Corecl adding refractive index difference, Numerical aperture of optical fiber, Pulse dispersion in optical fiber (ray theory).	04
Total		**42**

11. Suggested Books:

S.No.	Name of Books/Authors	Year of Publication/ Reprint
1.	Physics of Vibrations and Waves, by H.J. Pain.	2005/ John Wiley & Sons Ltd
2.	Vibrations and Waves, by A.P. French.	1971/CRC Press
3.	Perspective of Modern Physics, by Arthur Beiser	1981/ McGraw-Hill
4.	Optics, by A. Ghatak.	2006/Tata McGraw-Hill
5.	Berkley Physics Course Vol – 1.	2009/ Tata McGraw-Hill

1. Subject Code: **AP 102**   : Course Title: **Applied Physics-II**

2. Contact Hours   : L: 03   T: 00   P: 02

3. Examination Duration (Hrs.)   : Theory: 03   Practical: 00

4. Relative Weight   : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 00

5. Credits   : 04

6. Semester : II

7. Subject Area : ASC

8. Pre-requisite : NIL

9. Objective : This course gives a balance account of the fundamentals of Physics as well as some of recent developments in this area best suited to the Engineering applications in different branches and to provide the knowledge and methodology necessary for solving problems in the field of engineering.

10. Details of Course :

S.No.	Contents	Contact Hours
1.	**Quantum Physics :** Failure of classical physics ,Compton effect , Pair production, de-broglie relation, wave function, Probability density, Schrodinger wave equation, operators, expectation values and eigen-value equation, particle in a box, simple harmonic oscillator problem, concept of degeneracy.	10
2.	**Classical Statistics:** Microscopic-macroscopic systems, concept of phase space, basic postulates of statistical mechanics, Maxwell—Boltzmann distribution law.	05
3.	**Quantum Statistics:** Fermi—Dirac and Bose–Einstein Distribution, Fermi- Dirac probability function, Fermi energy level.	05
4.	**Nuclear Physics:** Nuclear properties, constituent of the nucleus, binding energy, stable nuclei, radioactive decay law (alpha and beta spectrum), Q-value of nuclear reaction , nuclear models: liquid drop and shell model, nuclear fission and fusion, elementary ideas of nuclear reactors.	06
5.	**Electrodynamics:** Maxwell's equations, concept of displacement current, Derivation of wave equation for plane electromagnetic wave, Poynting vector. Poynting theorem, Energy density, wave equation in dielectric & conducting media.	09

6	**Semiconductor Physics:** Concept of intrinsic and extrinsic semiconductors, Fermi level, characteristics of PN Junction, static and dynamic resistance, zenar diode and LED, diode as a rectifier, transistor (PNP and NPN) characteristics, current and voltage gain.	07
	Total	**42**

11. Suggested Books:

S.No.	Name of Books/Authors	Year of Publication/ Reprint
1.	Nuclear Physics, by Erwin Kaplan	2002/Narosa
2.	Concept of Nuclear Physics, by Bernard Cohen	2001/ McGraw-Hill
3.	Perspective of Modern Physics, by Arthur Beiser	1969/ McGraw-Hill US
4.	Electrodynamics, by Griffith	2012/PHI Learning
5.	Electricity & magnetism, by Rangawala& Mahajan.	2012/ McGraw-Hill

1. Subject Code: **EE-101/102** : Course Title: **Basic Electrical Engineering**

2. Contact Hours : L: 03   T: 00   P: 02

3. Examination Duration (Hrs.) : Theory: 03   Practical: 00

4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 00

5. Credits : 04

6. Semester : I / II

7. Subject Area : AEC

8. Pre-requisite : NIL

9. Objective : To familiarize the students with the concepts of electrical circuits, magnetic circuits, transformer and measuring instruments.

10. Details of Course   :

S. No.	Contents	Contact Hours
1	**Introduction:** Role and importance of circuits in Engineering, concept of fields, charge, current, voltage, energy and their interrelationships. V- I characteristics of ideal voltage and ideal current sources, various types of controlled sources, passive circuit components, V-I characteristics and ratings of different types of R, L, C elements. DC Network: Series and parallel circuits, power and energy, Kirchhoff's Laws, delta-star transformation, superposition theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem, Tellgen's theorem.	10
2	**Single Phase AC Circuits:** Single phase emf generation, average and effective values of sinusoids, complex representation of impedance, series and parallel circuits, concept of phasor, phasor diagram, power factor, complex power, real power, reactive power and apparent power, resonance in series and parallel circuits, Q-factor, bandwidth and their relationship, half power points.	10
3	**Three-Phase AC Circuits:** Three phase emf generation, delta and star connection, line and phase quantities, solution of three phase circuits: balanced supply and balanced load, phasor diagram, three phase power measurement by two wattmeter method.	05
4	**Magnetic Circuits and Transformers:** Amperes circuital law, B-H curve, concept of reluctance, flux and mmf, analogies between electrical and magnetic quantities, solution of magnetic circuits, hysteresis and eddy current losses, mutual inductance and dot convention, single phase transformer – construction and principle of working, auto transformer and their applications.	12
5	**Measuring Instruments:** Analog indicating instruments, PMMC ammeters and voltmeters, damping in indicating instruments, shunt and multipliers, moving iron ammeter and voltmeters, dynamometer type instruments, multimeters, AC watt-hour meters. digital voltmeters, ammeters and watt meters.	05
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1	Basic Electrical Engineering, A.E. Fitzgerald , David Higginbotham , Arvin Grabel, Tata McGraw-Hill Publishing Company; 5th Edition.	2009
2	Electrical and Electronic Technology, Edward Hughes, Ian Mckenzie Smith, John Hiley, Pearson Education, 10th edition.	2010
3	Linear Circuit Analysis: Time, Domain, Phasor and Laplace Transform Approaches Raymond A. De Carlo, Pen-Min Lin, Oxford University Press, 2nd Edition.	2001
4	Hayt, Kemmerly & Durbin, "Engineering Circuit Analysis", Tata McGraw Hill Publishing Company Ltd.	2007
5	Electrical Engineering Fundamental V. Del Toro, Prentice-Hall, 2nd Edition.	1989
6	Basic Electrical Engineering, C.L. Wadhwa, New Age International Pvt Ltd Publishers	2007
7	Introduction to Electrical Engineering, Mulukutla S. Sarma, Oxford University Press Inc.	2001

1. Subject Code: **ME-102/105**   : Course Title: **Engineering Graphics**

2. Contact Hours   : L: 00   T: 00   P: 03

3. Examination Duration (Hrs.)   : Theory: 0 Practical: 03

4. Relative Weight   : CWS: 00 PRS: 50 MTE: 00 ETE: 00   PRE: 50

5. Credits   : 02

6. Semester   : I / II

7. Subject Area   : AEC

8. Pre-requisite   : NIL

9. Objective   : To familiarize the students with drafting and engineering drawing practices.

10. Details of Course :

S. No.	Contents	Contact Hours
	PART A	
1	**General:** Importance, Significance and scope of engineering drawing Lettering, Dimensioning, Scales, Sense of Proportioning, Different types of Projections, B.I.S. Specification, line symbols, rules of printing.	03
2	**Projections of Points and Lines:** Introduction of planes of projection, Reference and auxiliary planes, projections of points and lines in different quadrants, traces, inclinations, and true lengths of the lines, projections on auxiliary planes, shortest distance, intersecting and non-intersecting lines.	03
3	**Planes Other than the Reference Planes:** Introduction of other planes (perpendicular and oblique), their traces, inclinations etc., projections of points lines in the planes, conversion of oblique plane into auxiliary plane and solution of related problems.	03
4	**Projections of Plane Figures:** Different cases of plane figure (of different shapes) making different angles with one or both reference planes and lines lying in the plane figures making different given angles (with one or both reference planes). Obtaining true shape of the plane figure by projection.	03
5	**Projection of Solids:** Simple cases when solid is placed in different positions, Axis, faces and lines lying in the faces of the solid making given angles.	03
6	**Isometric and Orthographic Views:** First and Third angle of system of projection, sketching of Orthographic views from pictorial views and vice –versa, Sectional views.	09
7	Principles of dimensioning.	03
8	Development of lateral surfaces of simple solids.	06
9	Introduction to available drafting softwares like AutoCAD	09
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
TEXT BOOKS:		
1	Engineering Graphics, Narayana, K.L. and Kannaiah, P, Tata McGraw Hill	2005
REFERENCE BOOKS:		
1	Engineering Graphics, Naveen Kumar and S C Sharma	2013
2	Engineering Graphics, Chandra, A.M. and Chandra Satish, CRC Press	2003

1. Subject Code: **EN-101/102**   : Course Title: **Introduction to Environmental Science**

2. Contact Hours   : L: 03   T: 00   P: 00

3. Examination Duration (Hrs.)   : Theory: 03   Practical: 0

4. Relative Weight   : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00

5. Credits   : 03

6. Semester   : I / II

7. Subject Area   : AEC

8. Pre-requisite   : NIL

9. Objective   : To introduce basic fundamentals of Environmental Science.

10. Details of Course :

S. No.	Contents	Contact Hours
1.	**Introduction to Environment** Definition, Scope, and importance of environmental studies; need for public awareness; Segments of environment- lithosphere, hydrosphere, atmosphere, and biosphere; Environmental degradation; Role of individual in environmental conservation; sustainable lifestyle.	06
2.	**Natural Resources** Forest Resources : Deforestation, mining, dams and their effects on forest and tribal people; Water resources: over-utilization, floods, drought, conflicts over water, dams-benefits and problems; Mineral resources: Use and exploitation, environmental effects; Food resources : World food problems, changes caused by modern agriculture, fertilizer-pesticide problems, water logging, salinity**;** Energy resources : Growing energy needs, renewable and non renewable energy sources; Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification.	09
3.	**Ecosystems and Biodiversity** Concept of an ecosystem, Structure and function, Energy flow, Ecological succession, ecological pyramids; Types, characteristic features, structure and function of the Forest, Grassland, Desert, and Aquatic ecosystems Concept of Biodiversity, definition and types, Bio-geographical classification of India; Value of biodiversity; Biodiversity at global, national and local levels; India as a mega-diversity nation; Hot-sports of biodiversity; Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity.	09
4.	**Environmental Pollution** Definition, Cause, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards Solid waste Management: Causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Pollution case studies, Disaster management: floods, earthquake, cyclone and landslides.	09

5.	**Social Issues and Environment** Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation, Consumerism and waste products, Environment Laws and Acts, Issues involved in enforcement of environmental legislation, Public awareness. Population growth, variation among nations, Family Welfare Programme.	09
Total		**42**

1. Subject Code: **MA-101**   :   Course Title: **Mathematics – I**

2. Contact Hours   :   L: 03   T: 01   P: 00

3. Examination Duration (Hrs.)   :   Theory: 03   Practical: 00

4. Relative Weight   :   CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00

5. Credits   :   04

6. Semester   :   I

7. Subject Area   :   ASC

8. Pre-requisite   :   NIL

9. Objective   :   To acquaint the students with the knowledge of series & sequence, single & multiple variable calculus, knowledge of vector calculus and their applications.

10. Details of Course   :

S. No.	Contents	Contact Hours
1.	**Infinite series**: Tests for convergence of series (Comparison, Ratio, Root, Integral, Raabe's, logarithmic), Alternating series, Absolute convergence, Conditional convergence.	06
2.	**Differential & Integral Calculus of single variable:** Taylor's & MaClaurin's expansion, Radius of curvature, Tracing of some standard curves, Applications of definite integral to Area, Arc length, Surface area and volume (in cartesian, parametric and polar co-ordinates).	07
3.	**Calculus of several variables**: Partial differentiation, Euler's theorem, Total differential, Taylor's theorem, Maxima-Minima, Lagrange's method of multipliers, Application in estimation of error and approximation.	07
4.	**Multiple Integrals**: Double integral (Cartesian and polar co-ordinates), Change of order of integration,Triple integrals (Cartesian, cylindrical and spherical co-ordinates), Beta and Gamma functions, Applications of multiple integration in area and volume.	08
5.	**Vector Differential Calculus**: Continuity and differentiability of vector functions, Scalar and Vector point function, Gradient, Directional Derivative, Divergence, Curl and their applications.	07
6.	**Vector Integral Calculus**: Line integral, Surface integral and Volume integral, Applications to work done by the force, Applications of Green's, Stoke's and Gauss divergence theorems.	07
Total		**42**

11. Suggested Books:

S. No.	Name of Books/Authors Publishers	Year of Publication/ Reprint
1.	Advanced engineering mathematics: Kreyszig; Wiley-India. 9th Edition ISBN : 978-81-265-3135-6	2011
2.	Advanced engineering mathematics: Jain/Iyenger; Narosa. 2nd Edition. ISBN: 81-7319-541-2	2003

3.	Advanced engineering mathematics: Taneja; I K international ISBN: 978-93-82332-64-0	2014
4.	Advanced engineering mathematics: Alan Jeffery; Academic Press ISBN: 978-93-80501-50-5	2010
5.	Calculus and analytic geometry: Thomas/Finney; Narosa. ISBN : 978-81-85015-52-1	2013

1. Subject Code: **MA-102**   :   Course Title: **Mathematics – II**

2. Contact Hours   :   L: 03   T: 01   P: 00

3. Examination Duration (Hrs.)   :   Theory: 03   Practical: 00

4. Relative Weight   :   CWS: 25   PRS: 00   MTE: 25   ETE: 50   PRE: 00

5. Credits   :   04

6. Semester   :   II

7. Subject Area   :   ASC

8. Pre-requisite   :   NIL

9. Objective   :   To impart knowledge of matrices and applications closed form and series solutions of Differential equations, Laplace Transform, Fourier series, Fourier Transform & their applications.

10. Details of Course   :

S. No.	Contents	Contact Hours
1.	**Matrices**: Rank of a matrix, Inverse of a matrix using elementary transformations, Consistency of linear system of equations, Eigen-values and Eigenvectors of a matrix, Cayley Hamilton theorem, Diagonalization of matrix.	07

2.	**Ordinary differential equations:** Second & higher order linear differential equations with constant coefficients, General solution of homogenous and non - homogenous equations, Method of variation of parameters, Euler-Cauchy equation, Simultaneous linear equations, Applications to simple harmonic motion.	08
3.	**Special Functions**: Power series method, Frobenious method, Legendre equation, Legendre polynomials, Bessel equation, Bessel functions of first kind, Orthogonal property.	08
4.	**Laplace Transforms**: Basic properties, Laplace transform of derivatives and integrals, Inverse Laplace transform, Differentiation and Integration of Laplace transform, Convolution theorem, Unit step function, Periodic function, Applications of Laplace transform to initial and boundary value problems.	08
5.	**Fourier series** : Fourier series, Fourier Series of functions of arbitrary period, Even and odd functions, half range series, Complex form of Fourier Series, Numerical Harmonic analysis.	06
6.	**Fourier Transforms**: Fourier Transforms, Transforms of derivatives and integrals, Applications to boundary value problem in ordinary differential equations (simple cases only).	05
Total		**42**

11. Suggested Books:

S. No.	Name of Books/Authors Publishers	Year of Publication/ Reprint
1.	Advanced engineering mathematics: Kreyszig; Wiley. ISBN : 978-81-265-3135-6	2011
2.	Advanced engineering mathematics: Jain/Iyenger; Narosa. ISBN: 81-7319-541-2	2003
3.	Advanced engineering mathematics: Taneja; I K international ISBN: 978-93-82332-64-0	2014
4.	Advanced engineering mathematics: Alan Jeffery; Academic Press ISBN: 978-93-80501-50-5	2010

5.	Advanced engineering mathematics: Peter V. O'Neil Cengage Learning. ISBN : 978-81-315-0310-2	2007

1. Subject Code: **HU 101/102**   : Course Title: **Communication Skills**

2. Contact Hours   : L: 03   T: 00   P: 00

3. Examination Duration (Hrs.)   : Theory: 03   Practical: 00

4. Relative Weight   : CWS: 25 PRS: 00   MTE: 25 ETE: 50   PRE: 00

5. Credits   : 03

6. Semester   : I / II

7. Subject Area   : HMC

8. Pre-requisite   : NIL

9. Objective   : To impart essential skills required for effective communication in English language.

10. Details of Course   :

Sl. No.	Contents	Contact Hours
1	Communication Communication: Process, Features, Barriers Language, Technology and Communication	02
2	Unit II: Grammar and Usage Vocabulary-Words/Word Formation, Confusing Word Pairs Sentence Construction, Sentence Types, Direct/Indirect Speech Punctuation, Error Spotting, Idioms and Phrases	06
3	Unit III: Oral Communication Phonetics of English, Vowels, Consonants, syllables, transcription of words and simple sentences using IPA: Speech Sounds and their articulation; phonemes, Syllable, Stress, Transcription of words and Simple Sentences Language Lab Practice for Oral Communication: Project Presentations, Group Discussions, Debates, Interviews etc.	12

4	Unit IV: Written Technical Communication Composition- Descriptive, Explanatory, Analytical and Argumentative Writing Paragraphs (Essay, Summary, Abstract) Reading and Comprehension, Providing working mechanism of instruments, appliances, description of processes, their operations and descriptions; Drawing Inferences from graphs, charts, Diagrams etc.	12
5	Unit V: Texts for Appreciation and Analysis Improve your Writing by V. N. Arora and Lakshmi Chandra (OUP) Vijay Seshadri. *3 Sections* (2014) **or** *Gestures: Poetry from SAARC Countries* Ed. K. Satchidanandan. Sahitya Akademi: New Delhi ISBN- 81-260-0019-8 Ursula K. Leguin. *The Telling*, Harcourt Inc. 2000 **or** *Animal Farm* by George Orwell (1945) ISBN: 9781502492791 **or** *Frankenstein* by Mary Shelley (1818) Harper Collins India Ltd.: NOIDA ISBN: 9780007350964	10
Total		**42**

Text Books:

Sl.No.	Name of Books, Authors, Publishers	Year of Publication/ Reprint
1.	*Improve your Writing* by V.N.Arora and Lakshmi Chandra OUP: Delhi ISBN 13: 978-0-19-809608-5	1981, 2013 (Revised Edition)
2.	*Technical Communication: Principles and Practice* by Meenakshi Raman and Sangeeta Sharma OUP: Delhi. ISBN-13: 9780-19-806529-6	2011, Reprinted in 2014
3.	*English Phonetics and Phonology: A Practical Course*. By Peter Roach. Cambridge: Cambridge University Press. (Fourth Edition) ISBN: 978-0-521-14921-1	2009, 2014 (Reprinted)
4.	Vijay Seshadri. *3 Sections*, Harper Collins India Ltd.: India. ISBN: 9789351367734. **or** *Gestures: Poetry from SAARC Countries* Ed. K. Satchidanandan. Sahitya Akademi: New Delhi ISBN- 81-260-0019-8	2014 1996, Reprint 2007

Sl.No.		Year of Publication / Reprint
5.	Ursula K. Leguin. *The Telling*, Harcourt Inc. 2000 **or** *Animal Farm* by George Orwell (1945) ISBN: 9781502492791 **or** *Frankenstein* by Mary Shelley (1818) Harper Collins India Ltd.: Noida ISBN: 9780007350964	2000 1945/ 2014 Reprint 1818/ Latest Reprint 2012

11. Suggested Books

Sl.No.	Name of Books, Authors, Publishers	Year of Publication / Reprint
1.	Maison, Margaret M. *Examine Your English.* Orient Blackswan: Delhi,	2009
2.	Sharma, Sangeeta & Binod Sharma. *Communication Skills for Engineers & Scientists*, PHI.	2012
3.	Swan, Michael, Catherine Walter. *Oxford English Grammar Course. OUP: Delhi,*	2011
4.	Kumar, E Suresh & P Sreehari *A Handbook for English Language Laboratories*, 2nd Edition, Cambridge University Press,Foundation Books,	2014
5.	Dutt, P Kiranmai, Geetha Rajeevan & CLN Prakash *A Course in Communication Skills. Cambridge University Press (*Foundation Books).	2013
6.	Mitra, Barun K. *Personality Development and Soft Skills*.OUP: Delhi.	2011
7.	Apps for Phonetics- Advanced English Dictionary for Windows phone & OALD for Android phone	Latest

1.   Subject Code: **CO 101/102**   :   Course Title: **Programming Fundamentals**

2.   Contact Hours   :   L: 03   T: 00   P: 02

3.   Examination Duration (Hrs.)   :   Theory : 3   Practical : 00

4.   Relative Weight   :   CWS: 15 PRS: 15 MTE: 30 ETE: 40   PRE: 00

5.   Credits   :   04

6. Semester : I / II

7. Subject Area : AEC

8. Pre-requisite : NIL

9. Objective : To introduce fundamentals of Programming using C and C++, concepts of program development and object Oriented Programming.

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Introduction: Concepts of algorithm, flow chart, Introduction to different Programming Languages like C, C++, Java etc. Elementary Programming in C: Data types, assignment statements, Arithmetic, unary, logical, bit-wise, assignment and conditional operators, conditional statements and input/output statements.	06
2.	Iterative programs using loops- While, do-while, for statements, nested loops, if else, switch, break, Continue, and goto statements, comma operators. Concept of subprograms.	06
3.	Array representation, Operations on array elements, using arrays, multidimensional arrays. Structures & Unions: Declaration and usage of structures and Unions. Defining and operations on strings.	06
4.	Pointers: Pointer and address arithmetic, pointer operations and declarations, using pointers as function argument. File: Declaration of files, different types of files. File input/ output and usage-, File operation: creation, copy, delete, update, text file, binary file..	08
5.	Concept of macros and pre-processor commands in C, Storage types: Automatic, external, register and static variables. Sorting and searching algorithms: selection sort, bubble sort, insertion sort, merge sort, quick sort and binary search.	08
6.	Introduction to Object Oriented Programming: OOPS concepts: class, encapsulation, inheritance, polymorphism, overloading etc. C++ introduction, Concept of class, methods, constructors, destructors, inheritance.	08
Total		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	The C Programming Language, 2nd Edition, Brian W. Kernighan, Dennis M. Ritchie, PHI, (ISBN-978-8120305960)	1988
2.	Let Us C, 13th Edition, YashavantKanetkar, BPB Publications, (ISBN: 978-8183331630)	2013
3.	Mastering C, Venugopal K R, Sudeep R Prasad, Edition 1,McGraw Hill Education. (ISBN- 9780070616677)	2006
4.	Programming in ANSI C , Sixth Edition, McGraw Hill Education (India) Private Limited E Balagurusamy (ISBN: 978-1259004612)	2012
5.	Object Oriented Programming with C++, Sixth edition , E. Balagurusamy, McGraw Hill Education (India) Private Limited (ISBN: 978-1259029936)	2013

1. Subject Code: **ME 103/106**   : Course Title: **Workshop Practice**

2. Contact Hours   : L: 00   T: 00   P: 03

3. Examination Duration (Hrs.)   : Theory : 00   Practical : 03

4. Relative Weight   : CWS: 00 PRS: 50 MTE: 00 ETE: 00 PRE: 50

5. Credits   : 02

6. Semester   : I / II

7. Subject Area   : AEC

8. Pre-requisite   : NIL

9. Objective   : To familiarize the students with manufacturing shops like Carpentry, Foundry, Welding, Machining, Fitting and Smithy.

10. Details of Course   :

Sl. No.	Shop	Description	Contact Hours
1.	Carpentry	Study of Different Carpentry Tools and Pattern Making of a given job (pulley/screw jack body)	03
2.	Foundry	Study of Different Foundry Tools and Furnaces Making a green sand mould of a given pattern (pulley/ screw jack body) and its casting	06
3.	Welding	Arc welding of butt joint, T-joint and lap joint Study of other welding/ joining Techniques	09
4.	Machining	Study of lathe, milling, drilling machine, shaper, planer and grinding machine. Demonstration of a job on lathe	09
5.	Fitting	Study of various fitting hand tools, marking and measuring devices Preparation of a given job (box / funnel)	09
6.	Smithy	Study of different forming tools and power press Preparation of a given job (bolt / chisel)	06
Total			**42**

1. Subject Code: **CS251**   Course Title: **DATA STRUCTURE**

2. Contact Hours   : L-3   T-0   P-2

3. Examination Duration (Hrs.)   : Theory: 3   Practical: 0

4. Relative Weightage   : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0

5. Credits   : 4

6. Semester   : III

7. Subject Area   : AEC

8. Pre-requisite   : NIL

9. Objective   : To introduce the concept of complexity of algorithms and to introduce different kinds of data structures with their respective operations.

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Introduction:** Introduction to Algorithm, Complexity- Time-Space Trade off. Introduction to abstract data types, design, implementation and applications. Introduction to List data structure. **Arrays and Strings:** Representation of Arrays in Memory: one dimensional, Two dimensional and Multidimensional, Accessing of elements of array, performing operations like Insertion, Deletion and Searching. Sorting elements of arrays. Strings and String Operations. **Stacks and Queues:** Introduction to data structures like Stacks and Queues. Operations on Stacks and Queues, Array representation of Stacks Applications of Stacks: recursion, Polish expression and their compilation conversion of infix expression to prefix and postfix expression, Operations of Queues, Representations of Queues Applications of Queues, Priority queues.	10

2.	**Linked Lists:** Singly linked lists, Representation of linked list, Operations of Linked list such as Traversing, Insertion and Deletion, Searching, Applications of Linked List. Concepts of Circular linked list and Doubly linked list and their Applications. Stacks and Queues as linked list.	6
3.	**Trees:** Basic Terminology, Binary Trees and their representation, binary search trees, various operations on Binary search trees like traversing, searching, Insertion and Deletion, Applications of Binary search Trees, Complete Binary trees, Extended binary trees. General trees, AVL trees, Threaded trees, B trees, B+ trees.	8
4.	**Sorting:** Insertion Sort, Quick sort, Merge sort, Heap sort, sorting on different keys, External sorting.	7
5.	**Graphs:** Terminology and Representations, Graphs & Multi-graphs, Directed Graphs, Representation of graphs and their Transversal, Spanning trees, shortest path and Transitive Closure, Activity Networks, Topological Sort and Critical Paths.	7
6.	**File Structure:** File Organization, Indexing & Hashing, Hashing Functions, Collision Resolution Techniques.	4
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
Text Books		
1.	Horowitz and Sahni, "Fundamentals of Data structures", Galgotia publications.	1984
2.	Tannenbaum, "Data Structures", PHI	1990
3.	An introduction to data structures and application by Jean Paul Tremblay & Pal G. Sorenson (McGraw Hill).	1984
Reference Books		
4.	R.L. Kruse, B.P. Leary, C.L. Tondo, "Data Structure and Program Design in C", PHI	2009

1. Subject Code: **MC201**   Course Title: **DISCRETE MATHEMATICS**

2. Contact Hours   : L-3   T-1   P-0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: NIL

4. Relative Weightage   : CWS: 25 PRS:-   MTE:25 ETE:50 PRE:-

5. Credits   : 4

6. Semester   : III

7. Subject Area   : DCC

8. Pre-requisite   : NIL

9. Objective   : To provide knowledge of combinatorial problems, algebraic structure, logic and graph theory required for building mathematical foundation of mathematics and computing.

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Set theory:** Basic concepts of set theory, operations on sets, Cartesian products, relations, equivalence relation, equivalence classes, operations on relations, partial order relation, Hasse diagram, functions, recursive functions.	8
2.	**Logic:** Proposition, compound propositions, well-formed formulae, truth tables, tautology, contradiction, equivalence, algebra of proposition, normal forms, theory of inference, predicate logic: predicates, quantifiers, free and bound variables, theory of inference for predicates.	8
3.	**Combinatorics:** Permutations, combinations, recurrence relations, generating functions. Algebraic structures: Definition and their properties, introduction to semigroups, monoids and groups, homomorphisms, Rings and their homomorphisms.	10

4.	**Lattices and Boolean algebra:** Definition of lattice, properties of lattices, bounded, complemented, distributive and complete lattice, Introduction, axioms and theorems of Boolean algebra, algebraic manipulation of Boolean expressions.	8
5.	**Graph Theory:** Graphs, digraphs, adjacency matrix, incidence matrix, connectivity, subgraphs, trees, spanning tree, complete graphs, walk, path, cycle.	6
Total		**40**

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	J. P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw-Hill	1997
2.	C. L. Liu, Elements of Discrete Mathematics, 2nd Edition, Tata McGraw-Hill	2000
3.	Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw-Hill	2001

1. Subject Code: **MC-203**   Course Title: **MATHEMATICS-III**

2. Contact hours   : L-3   T-0   P-2

3. Examination Duration(Hrs) : Theory: 3   Practical : Nil

4. Relative Weightage   : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0

5. Credits   4

6. Semester   : III

7. Subject Area   : DCC

8. Pre-requisite   : NIL

9. Objective   : To import knowledge of Improper Integrals, function of complex variables, conformal mapping.

10. Details of Course

S. No.	Contents	Contact hours
1.	Improper real integrals of first and second kinds, test for convergence of improper integrals of the first kind, comparison tests, limit comparison test for improper integrals of second kind, absolute convergence of improper integrals, convergence of Beta and Gamma functions.	10
2.	Function of complex variables: differentiability for function of complex variable, Analytic function, Cauchy-Riemann equations, Harmonic functions, Linear rotational and Inverse transformation,Conformal mapping, Bilinear transformation, Schwarz- Christoffel transformations	12
3.	Complex integration: Line integral, Cauchy's integral theorem, Cauchy's integral formula, Cauchy's formula for derivative of analytic functions, Taylor's series, Laurent's series, Singularities, kinds of singularity, zeros, Residues, Cauchy's residue theorem, Evaluation of real integrals.	12
4.	Z-transformations, Inverse z-transforms, Convolution theorem, Introduction to difference equations, application of z-transform for solving difference equations.	8
Total		**42**

11. Suggested Books

S. No.	Name of Books/ authors Publishers	Year of Publication
1.	E Kreyszig: Advanced Engineering Mathematics, John wiley.	2014
2.	R.K. Jain & S K Iyenger: Advanced Engineerign Mathematics, 3rd edition, Narosa publishing House.	2012
3.	Churchil& Brown: Complex Analysis, 8th edition, Mc Graw –Hill.	2008
4.	Complex Analysis and Applications, Second Edition, Alan Jeffrey , CRC press	2005

5.	Pal Srimant&Bhunia: Engineering mathematics, Oxford University Press.	2015
6.	complex analysis by Schaum series	2010

1. Subject Code: **MC205**   Course Title: **PROBABILITY AND STATISTICS**

2. Contact Hours   : L-3   T-0   P-2

3. Examination Duration (Hrs.)   : Theory: 3   Practical: NIL

4. Relative Weightage   : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0

5. Credits   : 4

6. Semester   : III

7. Subject Area   : DCC

8. Pre-requisite   : NIL

9. Objective   : To acquire knowledge on descriptive statistics, random variables, specific probability distributions and their real life applications specifically in science and engineering. Acquaintance with the tools for the large and small sample testing.

10. Details of Course

S. No.	Contents	Contact Hours
1.	Descriptive statistics**,** Axioms on probability, Conditional probability, Addition and multiplication rules, Bayes' Theorem. Random variables: Discrete and Continuous, Probability mass and density functions, Joint marginal and conditional distributions.	8
2.	Mathematical expectation, Covariance, Variance, Moment generating function, Markov's inequality, Chebyshev's inequality. Correlation and Regression, Rank Correlation.	8

3.	Binomial, Multinomial, Poisson, Geometric, Negative binomial, Hyper geometric, Normal, Exponential, Gamma, Weibull, Erlang and Beta distributions	8
4.	Central limit theorem. Types of sampling, Parameter and statistic. Sampling distribution, Hypothesis testing, Sampling of attributes and variables, Tests of significance for large sample testing.	8
5.	Exact sampling distributions: Chi-square, Student's t, Snedecor's F and their applications. ANOVA: one and two-way classification.	8
Total		**40**

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	Meyer, Introductory Probability and Statistical Application, Oxford and IBH Publishing.	2002
2.	Kishor S. Trivedi, Probability and Statistics with Reliability, Queuing and Computer Science Application, Wiley.	2006
3.	Sheldon M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, Academic Press.	2009
4.	Frank Beichelt, Stochastic Processes in Science Engineering and Finance, Taylor & Francis Group, LLC.	2006
5.	Probability and statistics for Engineers, Richard A. Johnson, Irwin Miller, John Freund, PHI	2010

1. Subject Code: **MC-207**   Course Title: **Engineering Analysis & Design (Differential Equations and Applications)**

2. Contact Hours   : L-3   T-0   P-2

3. Examination Duration (Hrs)   : Theory: 3   Practical: NIL

4. Relative Weightage   : CWS: 15 PRS: 15 MTE: 30 ETE:40   PRE:0

5. Credits   : 4

6. Semester : III

7. Subject Area : DCC

8. Pre-requisite : NIL

9. Objective : To impart knowledge of ODE & PDE and their applications

10. Details of Course

S. No.	Contents	Contact Hours
1.	Ordinary differential equations(ODE): Matrix method for homogeneous linear system with constant coefficients, Boundary value problems for second order equations-Sturm Liouville's problem, Eigen values and Eigen functions, saddle points, attractor, repellent.	9
2.	Partial differential equations (PDE): Formation, solution of linear PDE of first order (Lagrange's method), Solution of first order non-linear PDE: standard forms, charpit's method.	12
3.	Linear PDE with constant coefficients-Homogenous and Non-homogeneous. Classification of second order PDE, method of separation of variables, Cauchy's problem, and boundary value problems.	10
4.	Initial boundary value problems involving wave equation, heat equation and Laplace equation. Method of separation of variables and application of Fourier transformations for Laplace, wave and heat equation.	11
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	Elements of Partial Differential Equation, I.N. Snnedon, Dover Publications, Inc.	2006

2.	Advanced Engineering Mathematics, Kreyszig, John Wiley, 10th edition	2015
3.	An introduction to ordinary differential equations, Coddington, Dover.	2012
4.	Differential equations & their applications, Braun, Springer – Verlag.	1993
5.	Differential equations by Shepley L. Rose, Wiley, 3rd edition	2014
6.	Partial Differential Equations: An Introduction byWalter A. Strauss, Wiley; 2 edition.	2007

1. Subject Code: **CS262**   Course Title: **Algorithm Design and Analysis**

2. Contact Hours   : L-3   T-1   P-0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: 0

4. Relative Weightage   : CWS: 25 PRS: 0   MTE: 25 ETE: 50   PRE: 0

5. Credits   : 4

6. Semester   : IV

7. Subject Area   : AEC

8. Pre-requisite   : Data Structure

9. Objective   : To introduce the concept of algorithmic efficiency by analyzing various algorithms such as Searching, Sorting, Divide-and-Conquer algorithms and to know detail about Greedy Paradigm, Principle of Dynamic Programming, Back Tracking, Branch and Bound, and Computational Complexity.

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Introduction:** Concept of algorithmic efficiency, run time analysis of algorithms, Asymptotic Notations. Growth of Functions, Master's Theorem.	4
2.	**Searching and Sorting:** Structure of divide-and-conquer algorithms; examples: binary search, quick sort, Stassen Multiplication; merge sort, heap sort and Analysis of divide and conquer run time recurrence relations.	4
3.	**Greedy Method**: Overview of the greedy paradigm examples of exact optimization solution: minimum cost spanning tree, approximate solutions: Knapsack problem, Kruskal's algorithm and Prim's algorithm for finding Minimum cost, Dijkstra's and Bellman Ford Algorithm.	10
4.	**Dynamic programming**: Principle of dynamic programming. Applications: Floyd-Wars hall algorithm, 0/1 Knapsack Problem, Matrix chain multiplication, Traveling salesman Problem, longest Common sequence(LCS), **Back tracking:** Overview, 8-queen problem, and 0/1 Knapsack problem, Subset Sum Problem, Traveling Salesman problem.	10
5.	**Branch and bound**: LC searching Bounding, FIFO branch and bound, LC branch and bound application: 0/1 Knapsack problem.	6
6.	**ComputationalComplexity**:Complexity measures, Polynomial Vs non-polynomial time complexity; NP-hard and NP-complete classes, examples: Circuit Satisfiablity, Vertex cover, Subset Sum problem, Randomized Algorithms, String Matching, NP-Hard and NP-Completeness, Approximation Algorithms, Sorting Network, Matrix Operations, Polynomials and FFT, Number Theoretic Algorithms.	8

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	T .H . Cormen, C . E . Leiserson, R .L .Rivest "Introduction to Algorithms", PHI.	2009

2.	E. Horowitz, S. Sahni, and S. Rajsekaran, "Fundamentals of Computer Algorithms," Galgotia Publication	2010
3.	Sara Basse, A. V. Gelder, "Computer algorithms : Introduction to design and analysis," Addison Wesley	1999

1. Subject Code: **MC202**   Course Title: **Real Analysis**

2. Contact Hours   : L-3   T-1   P-0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: NIL

4. Relative Weightage   : CWS: 25 PRS: 0   MTE: 25 ETE: 50 PRE: 0

5. Credits   : 4

6. Semester   : IV

7. Subject Area   : DCC

8. Pre-requisite   : NIL

9. Objective   : To impart knowledge of real valued functions, Sequences, Metric Spaces and Riemann Integration

10. Details of Course

S. No.	Contents	Contact Hours
1.	**The systems of Real Numbers**: Real Numbers R, Peano's Postulate/Axiom,: Real valued functions,Image and Inverse Image, Composition of Functions,countable and uncountable sets, concepts of bounds,least upper bound & greatest lower bound, order and completeness properties of **R,** Archimedean Property of Real Numbers.	9

2.	**Real Sequences**: Definition, range of Sequence, Equality of Sequence, Constant Sequence, Subsequence,sub-sequence, BoundedSequence, Convergence of the Sequence (Limit of Sequence), Monotonic Sequence, non-increasing, non-decreasing, strictly increasing, strictly decreasing sequences, Monotone sequences and their Convergence, Operations onconvergent and divergent sequences, Bolzano-weierstrass Theorem, Cauchy Sequence, Cauchy's general principle for convergence	12
3.	**Metric Spaces**: Definition and examples, Euclidean space R^n, Limits in metric spaces, Continuous functions on a metric space, open balls and open sets, closed sets. Convergent sequences in metric space, Cauchy Sequence, continuity and inverse images of open or closed sets, Continuity of the inverse function.	10
4.	**The Riemann Integral**: Concept of sets of measure zero, upper and lower sums, upper integral and lower integrals. Introduction to Riemann integral, basic properties of Riemann integral.	11
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	Richard R. Goldberg, Methods of Real Analysis, Oxford & IBH publishing Co. Pvt. Ltd.	1970
2.	Bartle, R.G. and Sherbert, D.R., Introduction to real analysis (2nd edition), John Wiley & Sons, Inc., NewYork.	2000
3.	Mathematical Analysis, Apostol, Narosa pub. House (2nd Edi.).	2002
4.	Mathematical Analysis, S.C. Malik and Savita Arora (4th Edi.) New age international publishers.	2010

1. Subject Code: **MC204**   Course Title: **SCIENTIFIC COMPUTING**

2. Contact Hours   : L-3   T-0   P-2

3. Examination Duration (Hrs.)   : Theory: 3   Practical: NIL

4.	Relative Weightage	: CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0
5.	Credits	: 4
6.	Semester	: IV
7.	Subject Area	: DCC
8.	Pre-requisite	: NIL
9.	Objective	: The course will develop numerical methods aided by technology to solve algebraic, transcendental, and differential equations, and to calculate derivatives and integrals. The course will also develop an understanding of the elements of error analysis for numerical methods and certain proofs. The course will further develop problem solving skills.

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Solution of Transcendental and polynomial equation:** types of error in numerical methods, significant digits. Bisection method, Fixed point iteration method, Secant method, Regula Falsi Method, Newton Raphson method and their convergence. Solution of system of nonlinear equations using Newton Raphson method.	5
2.	**System of Linear Algebraic equations and Eigen value problems:** Ill conditioned equations, Methods for solving system of equations: Direct and Iterative methods, convergence of iterative methods, power method.	8
3.	**Interpolation**: Finite difference operators and their properties, Interpolation of equal spacing intervals: Newton and Gauss forward and backward formula, Interpolation of Unequal intervals: Newton's Divided difference, Central difference formulae: Bessel's and Sterling's Interpolation formulae, Lagrange's method, Hermite interpolation, Piecewise and quadratic Spline Interpolation.	10

4.	**Numerical Differentiation & Integration**: Optimum choice of step length, Differentiation: Newton forward and backward formulae, derivatives with unequal intervals, Integration: Newton's Cotes formula, Gauss Quadrature Formula, Trapezoidal formula, Simpson's $\frac{1}{3}$ and error estimates, methods of undetermined coefficients, Romberg integration, Richardson extrapolation.	7
5.	**Numerical solution of ODE**: Initial Value Problems: Picard's method, Taylor series method, Convergence of Numerical methods and Routh Hurwitz criterion for stability, Euler's and Modified Euler's method, Classical RungeKutta method, Predictor Corrector method, Milne's method, Adams Moulton method.	12
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	Numerical Methods for Scientific and Engineering Computation,by M. K. Jain and S.R.K. Iyengar, New Age International Publishers.	2007
2.	Applied Numerical Analysis, Gerald & Wheatley, Addison – Wesley.	2003
3.	Elementary Numerical Analysis, S.D. Conte, & C. Deboor, Tata Mc-Graw hill.	2005
4.	*A First Course in Numerical Methods, By* **Uri Ascher, SIAM**	2011

1. Subject Code: **MC206** Course Title: **COMPUTER ORGANIZATION & ARCHITECTURE**

2. Contact Hours : L-3 T-1 P-0

3. Examination Duration (Hrs.) : Theory: 3 Practical: Nil

4. Relative Weightage : CWS:25 PRS: 0 MTE: 25 ETE: 50 PRE: 0

5. Credits : 4

6. Semester : IV

7. Subject Area : DCC

8. Pre-requisite : NIL

9. Objective : To provide knowledge about the principles, concepts and applications of Computer Organization and Architecture

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Introduction:**Fundamentals of Gates and Flip Flop**s,**Digital computer generation, computer types and classifications, functional units and their interconnections, bus architecture, types of buses and bus arbitration. Register, bus and memory transfer. REGISTER TRANSFER LANGUAGE: Data movement around registers. Data movement from/to memory, arithmetic and logic micro operations. Concept of bus and timing in register transfer.	10
2.	**Central Processing Unit:** Addition and subtraction of signed numbers look ahead carry adders. Multiplication: Signed operand multiplication, Booths algorithm and array multiplier. Division and logic operations. Floating point arithmetic operation, Processor organization, general register organization, stack organization and addressing modes.	8
3.	**Control Unit:** Instruction types, formats, instruction cycles and sub-cycles (fetch and execute etc), micro-operations, execution of a complete instruction. Hardwired and microprogrammed control: microprogramme sequencing, wide branch addressing, and micro-instruction with next address field, pre-fetching microinstructions, concept of horizontal and vertical microprogramming.	8
4.	**Memory: Basic** concept and hierarchy, Main memory, Auxiliary memory, Associative memory, Cache memories: concept and design issues, associative mapping, direct mapping, set-associative mapping, cache writing and initialization.	8

5.	Input/Output organization: Peripheral devices, I/O interface, I/O ports, Interrupts: interrupt hardware, types of interrupts and exceptions, Modes of Data Transfer: Programmed I/O, interrupt initiated I/O and Direct Memory Access. I/O channels and processors. Serial Communication: Synchronous & asynchronous communication, standard communication interfaces.	8
	Total	**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	Patterson, Computer Organisation and Design, Elsevier Pub.	2009
2.	Morris Mano, Computer System Architecture, PHI	2007
3.	William Stalling, Computer Organization and Architecture: Designing for Performance, PHI	2009

1. Subject Code: **MC-208**   Course Title: **Linear Algebra**

2. Contact Hours   : L-3   T-1   P-0

3. Examination Duration (HRS)   : Theory: 3   Practical : Nil

4. Relative Weightage   : CWS: 25 PRS: 0   MTE: 25 ETE: 50 PRE: 0

5. Credits   : 4

6. Semester   : IV

7. Subject Area   : DCC

8. Pre –requisite   : NIL

9. Objective   : Linear algebra is that branch of mathematics which treats the common properties of algebraic systems consisting of a set. The objective of this paper is to impart knowledge of vector space, linear transformation, bilinear form and Inner Product of vector spaces.

10. Details of Course

S. No.	Contents	Contact Hours
1.	Introduction to algebraic structure: groups, ring and field, Vector spaces, properties of vector spaces, subspaces, linear dependence and independence, Linear span, Bases and dimension, direct sums.	7
2.	Linear transformations, Range and null spaces, rank –nullity theorem and its application, projections, Inverse linear transformation, representation of linear transformations by matrices, change of basis, Dual space, Dual bases,	10
3.	Trace and determinant of linear transformation, Transpose of a linear transformation, Eigen values and eigen vectors, Minimal polynomials, Cayley –Hamilton theorem, diagonalization, Jordan canonical form, matrix norms.	10
4.	Inner product spaces, norm of a vector, orthogonality, orthonormal set, orthonormal basis, Gram-Schmidt orthonormalization, orthogonal projections, Linear functional and adjoints, Hermitian, self-adjoint, Unitary and normal operators.	10
5.	Bilinear forms, symmetric and skew-symmetric bilinear forms, real quadratic forms, positive definiteness.	5
Total		**42**

11. Suggested Books

S. No.	Name of books / Authors Publishers	Year of Publication
1.	K. Hoffman and R. Kunze, Linear Algebra, 2nd edition, Pearson education.	2015
2.	G. Hadley, Linear Algebra, Narosa	2002
3.	Gilbert Strang, Linear Algebra and its applications, Cengage Learning, 4th edition	2007

4.	Serge Lang, Introduction to Linear Algebra, Springer	2004
5.	Linear Algebra, Fourth edition, Schaum's outlines	2015

1. Subject Code: **MC – 301**   Course Title: **Operating System**

2. Contact Hours   L-3   T-0   P-2

3. Examination Duration (Hrs.)   : Theory: 3   Practical: Nil

4. Relative Weightage   : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE:

5. Credits   : 4

6. Semester   : V

7. Subject Area   : DCC

8. Pre-requisite   : NIL

9. Objective   : To familiarize with the fundamental principles of the operating system, its services and functionalities, the concepts of processes, synchronization and scheduling, memory management and need for protection in computer systems.

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Introduction:** Evolution of operating system, Batch, Interactive, Time Sharing and Real Time System, System protection. **Operating System Structure:** System Components, System structure, Operating System Services.	6
2.	**Concurrent Processes:** Process concept, Principle of Concurrency, Producer Consumer Problem, Critical Section problem, Semaphores, Classical problems in Concurrency, Inter Process Communication, Process Generation, Process Scheduling. **CPU Scheduling:** Scheduling Concept, Performance Criteria Scheduling Algorithm, Evolution, Multiprocessor Scheduling.	10

3.	**Deadlock:** System Model, Deadlock Characterization, Prevention, Avoidance and Detection, Recovery from deadlock .	6
4.	**Memory Management:** Resident monitor, Multiprogramming with fixed partition, Multiprogramming with variable partition, Multiple base register, Paging, Segmentation, Virtual memory concept, Demand paging, Performance, Page replacement algorithms, Thrashing, Cache memory, Organization and its Impact on performance.	8
5.	**I/O Management & Disk Scheduling:** I/O devices and organization, I/O functions, I/O Buffering, Disk Scheduling Algorithms. **File System:** File Concept, File Organization and Access Mechanism, File Directories, File Sharing, Implementation Issues	6
6.	**Case Studies:** Windows, Linux and Unix.	6

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	Silverschwatz, "Operating System Concepts", Willey.	2004
2.	Milenekovic, "Operating System Concepts", McGraw Hill	
3.	Tannenbaum, "Operating system design and implementation", PHI.	2006

1. Subject Code: **MC-303**   Course Title: **Stochastic Process**

2. Contact Hours   : L-3   T-0   P-2

3. Examination Duration (Hrs.)   : Theory: 3   Practical: Nil

4. Relative Weightage   : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 0

5. Credits   : 4

6. Semester   : V

7.	Subject Area	:	DCC
8.	Pre-requisite	:	NIL
9.	Objective	:	This course develops the mathematical theory of random variables and random processes for Telecom Engineers. The goal is to teach the theoretical concepts and techniques for solving problems that arises in practice. Beginning with the random variables, this course leads to the concept of stochastic process and linear filtering of random processes.

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Stochastic processes:** Introduction, Classification and examples of stochastic processes, Bernoulli process, Poisson process, Gaussian process, Renewal process, Stationary process, Brownian motion.	8
2.	**Random Walk:** Introduction and examples, simple random with unrestricted, two absorbing barriers, one absorbing barrier, two reflecting barriers and one reflecting barrier.	6
3.	**Discrete time Markov chain:** Definition, n-step transition probability, States classification, Limiting probabilities, Distribution of times between states, Irreducible finite chains with aperiodic states, Reducible chains (Finite Markov chains with absorbing states).	8
4.	**Continuous time Markov chain:** Definition, Chapman-Kolmogorov equation, Birth-Death process, Special cases of Birth-Death process, Markov chains with absorbing states.	6
5.	**Renewal process:** Definition, Examples, Renewal equation, Renewal theorems, Application of renewal process.	6
6.	**Queuing Models:** Introduction to queueing models, M/M/1; M/M/c and Erlang loss models. Steady state solutions. State dependent parameters.	6

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	Kishor S. Trivedi, Probability and Statistics with Reliability, Queueing and Computer Science Applications, Wiley.	2001
2.	Frank Beichelt, Stochastic Processes in Science, Engineering and Finance, Chapman & Hall.	2006
3.	Sheldon Ross, Stochastic Processes, Wiley.	1995
4.	Cox and Miller, Theory of Stochastic Processes, Chapman & Hall.	1977

1. Subject code: **MA351**   Course Title: **History Culture and Excitement of Mathematics**

2. Contact Hours   : L-3   T-0   P-0

3. Examination Duration (Hrs) : Theory: 3

4. Relative weightage   : CWS: 25 PRS: -   MTE: 25 ETE: 50   PRE: 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre requisite   : NIL

9. Objective   : To be capable in learning the history and culture on the Mathematics subjects

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Ancient, Medieval and Modern Indian Mathematics: Aryabhata, Brahmagupta, Bhaskar, Lilavati, Ramanujan	7

2	Introduction to Ancient books of Indian Mathematicians: Sidhantas, Sulvasutras, Vedic Mathematics	7
3	Contribution of Indian Mathematicians in the field of Mathematics: Value of Pi, The symbol zero, Number theory, Trigonometry, and Mensuration, Hindu Multiplication, Long Division, Indeterminate equation	7
4	Mathematicians Around the world: Newton, Leibnitz, Cauchy, Lagrange in the field of Geometry, Calculus, Algebra, Probability	7
5	Algebra in the Renaissance: Solution of cubic equation, Ferrari's Solution in the quartic equation, Irreducible Cubics and complex numbers	7
6	Paradoxes, Fallacies and Pitfalls of Mathematics	7
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	History of Mathematics, by carl B Boyer, Wiley International edition	1968
2.	Mathematics of Music, Susan Kelly, UW-L Journal of under graduate research, Vol-XIV	2011

1. Subject Code: **MC – 302**   Course Title: **Database Management System**

2. Contact Hours   : L-3   T-0   P-2

3. Examination Duration (Hrs.) : Theory: 0   Practical: Nil

4. Relative Weight age   : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE:

5. Credits   : 4

6. Semester   : VI

7. Subject Area   : DCC

8. Pre-requisite   : NIL

9. Objective   : To provide knowledge about the principles, concepts and applications of Database Management System.

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Introduction:** Data base system concepts and its architecture, Data models, schema and instances, Data independence and data base language and interface, Data definition languages, DML. **Data modeling using Entity Relationship Model:** ER model concept, notation for ER diagrams mapping constraints, Keys, Concept of super key, candidate key, primary key generalizations, Aggregation, transforming ER diagrams to tables, extended ER model.	7
2.	**Relational Data Model and Language:** Relational data model concepts, integrity constraints, Keys domain constraints, referential integrity, assertions, triggers, Database language, Relational algebra, relational calculus, domain and tuple calculus, SQL data definition queries and updates in SQL.	8
3.	**Data Base Design:** Functional dependencies, normal forms, 1NF, 2NF, 3NF and BCNF, multi-valued dependencies, fourth normal form, join dependencies and fifth normal forms, loss less join decompositions, normalization using FD, MVD and JDs.	8
4.	**File Organization, Indexing and Hashing**: Basic concepts, Static Hashing, Dynamic Hashing, Ordered indices, Multi-level indexes, B-Tree index files, B+- Tree index files, Buffer management.	6

5.	**Transaction processing concepts:** Transaction processing system, schedule and recoverability, Testing of serializability, Serializability of schedules, conflict & view serializable schedule, recovery from transaction failures, deadlock handling. **Concurrency Control Techniques:** Locking Techniques, time stamping protocols, multiple granularities and multi-version schemes.	9
6.	**Case Studies:** Commercial databases, Oracle, Postgress, MySQL **.**	4

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	Elmasri, Navathe, "Fundamentals of Database systems", Addison Wesley	2010, 6th Edition
2.	Korth, Silbertz, Sudarshan, "Data base concepts", McGraw-Hill.	
3.	Ramakrishna, Gehkre, "Database Management System", McGraw-Hill	2003, 3rd Edition

1. Subject Code: **MC – 304**   Course Title: **Theory of Computation**

2. Contact Hours   : L-3   T-1   P-0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: Nil

4. Relative Weightage   : CWS: 25 PRS: 0   MTE: 25 ETE: 50 PRE: 0

5. Credits   : 4

6. Semester   : VI

7. Subject Area   : DCC

8. Pre-requisite   : NIL

9. Objective   : To introduce students to the mathematical foundations of computation including automata theory, theory of formal languages that are needed to study and practice computer science.

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Automata**: Definition of an Automaton, Description of a Finite Automaton, Transition system & its properties, Acceptability of a string by a finite Automaton, Nondeterministic Finite Automaton (NDFA), Equivalence of DFA and NDFA, Minimization of finite automaton, Moore & Mealy machines.	8
2.	**Formal Languages**: Definition of a Grammar, Derivations, Language generated by a grammar, Chomsky classification of languages & their relation, operations on languages.	8
3.	**Regular Sets:** Regular expressions, Ardens theorem, Transition system containing $\wedge\wedge$ - moves, Kleene's theorem, Algebraic method using Arden's theorem, construction of finite automata equivalent to a regular expression, Equivalence of two finite automata, Pumping lemma for regular sets, closure Properties of regular sets.	8
4.	**Context Free Languages**: Definition of CFL, Derivation trees, Ambiguity in CFG, Simplification of CFG, Normal forms (CNF & GNF), Pumping lemma for CFL, Decision algorithms for CFL	8
5.	**Pushdown Automata:** Definition & Description of pda, Instantaneous description, Move relation, Acceptance by pda,	5
6.	**Turing Machines:** Basic model, Definition & representation, Instantaneous description, Representation by transition table & transition diagram Language accepted by Turing Machine, Design of Turing Machine	5

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	K.L.P. Mishra and N. Chandrasekaran, "Theory of Computer Science Automata, Languages and Computation", PHI	2012

2.	Martin J.C., "Introduction to Languages and Theory of Computations", TMH	2005

1. Subject Code: **MC306**   Course Title: **Financial Engineering**

2. Contact Hours   : L-3   T-1   P-0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: Nil

4. Relative Weightage   : CWS: 25   PRS: Nil   MTE: 25   ETE: 50   PRE: Nil

5. Credits   : 4

6. Semester   : VI

7. Subject Area   : DCC

8. Pre-requisite   : A course in Statistics with sound knowledge of random variable, expectation and variance, m.g.f. and probability distribution.

9. Objective   : Knowledge of financial market, risk attached, and derivative on underlying asset. Knowledge and Optimization of portfolio.

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Introduction:** Some basic definitions and terminology: Basic Notions and Assumptions, No-Arbitrage Principle, One-Step Binomial Model, Risk and Return, Forward Contracts, Call and Put Options, Managing Risk with Options	10
2.	Basic Theory of Option Pricing: Single and Multi-Period Binomial Pricing Models, Cox Ross-Rubinstein (CRR) Model, Black-Scholes Formula for Option Pricing as a Limit of CRR Model.	10
3.	Introduction to Brownian and Geometric Brownian Motion, Theory of Martingales. Stochastic Calculus, Stochastic Differential Equations, Ito's Formula to Solve SDE's.Feymann Kac Theorem. Applications of Stochastic Calculus in Option Pricing. Black-Scholes Partial Differential Equation and Black-Scholes Formula.	12

S. No.	Mean-Variance Portfolio Theory: Markowitz Model of Portfolio Optimization and Capital Asset Pricing Model (CAPM). Limitations of Markowitz Model and New Measures of Risk.	10
4.	Mean-Variance Portfolio Theory: Markowitz Model of Portfolio Optimization and Capital Asset Pricing Model (CAPM). Limitations of Markowitz Model and New Measures of Risk.	10

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	Mathematics for Finance: An Introduction to Financial Engineering, M. Capińsky and T. Zastawniak ,Springer.	2004
2.	Investment Science, D. G. Luenberger , Oxford University Press.	1999
3.	Elementary Stochastic Calculus with Finance in view, Thomas Mikosch , World Scientific.	2006
4.	Stochastic Calculus for Finance, Vol. I & Vol. II, S. E. Shreve, Springer.	2004

1. Subject Code: **MC401**   Course Title: **B.Tech Project-I**

2. Contact Hours   : -

3. Examination Duration (Hrs.)   : -

4. Relative Weightage   : -

5. Credits   : 4

6. Semester   : VII

7. Subject Area   : DCC

8. Pre-requisite   : NIL

9. Objective   : To familiarize the students to work in group and develop an independent understanding of engineering and analysis of engineering systems. He should also be able to write and present the work done during the course.

1. Subject Code: **MC403**   Course Title: **Training Seminar**

2. Contact Hours   : -

3. Examination Duration (Hrs.)   : -

4. Relative Weightage   : -

5. Credits   : 2

6. Semester   : VII

7. Subject Area   : DCC

8. Pre-requisite   : NIL

9. Objective   : To familiarize the students to work in industry and working culture of the industrial system. He should also be able to write and present the work done during the course.

1. Subject Code: **MC-405**   Course Title: **Graph Theory**

2. Contact Hours   : L-3   T-0   P-2

3. Examination Duration (Hrs.)   : Theory: 3   Practical: Nil

4. Relative Weightage   : CWS: 15 PRS: 15 MTE: 30 ETE: 40   PRE: 0

5. Credits   : 4

6. Semester   : VII

7. Subject Area   : DCC

8. Pre-requisite   :

9. Objective   : To explain basic concepts in graph theory, define new graphs serve as models for many standard problem.

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Introduction:** Graphs, Subgraphs, Some basic properties of graphs and subgraphs, Isomorphism, Various types of graphs and their subgraphs, trails, walks, paths, circuits and cycles, connected graphs, disconnected graphs and components, various operations on graphs, Eulerian graphs, Hamiltonian paths and cycles, Adjacency and incidence matrices of a graph, shortest path, algorithms to find shortest path.	10
2.	**Hamiltonian and Eulerian Graphs:** Necessary conditions for Hamiltonian graphs, sufficient conditions for Hamiltonian graphs, traveling salesman problem, characterization of Eulerian graphs, construction of Eulerian tour, The Chinese postman problem.	8
3.	**Trees**: Characterization of trees, rooted and binary trees, spanning trees and their properties, spanning trees in weighted graphs, minimum spanning tree, algorithms for minimum spanning tree.	8
4.	**Cut Vertices and Edge Connectivity**: Cut vertices, cut sets and their properties, the max-flow min-cut theorem, max-flow algorithm, connectivity and edge connectivity, Menger's theorem (without proof), max-flow algorithm.	8
5.	**Coloring of Graphs**: Coloring, proper coloring, chromatic number, chromatic partitioning, a maximal independent set, matching, maximum matching in bipartite graphs and in general graphs.	8
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	G. Chatrand, and O.R. Ollermann, Applied and Algorithmic Graph theory, McGraw Hill	1993
2.	Narishgh Deo, Graph theory with applications to engineering and computer science, PHI, New Delhi.	1979

3.	Geir Agnarsson and R. Gveenlaw, Graph theory: Modeling applications and Algorithms, Pearson edu., Inc.	2009
4.	L.R. Foulds, Graph theory applications, Narosa Pub. House	1992
5.	Corman, Leiserson and Rivest, Introduction to Algorithms, PHI	1998

1. Subject Code: **MC-407**   Course Title: **CRYPTOGRAPHY AND NETWORK SECURITY**

2. Contact Hours   L-3   T-1   P-0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: Nil

4. Relative Weightage   : CWS: 25 PRS: 0   MTE: 25 ETE: 50 PRE: 0

5. Credits   : 4

6. Semester   : VII

7. Subject Area   : DCC

8. Pre-requisite   : NIL

9. Objective   : To study various cryptographic techniques, mathematics related to cryptography and some network security protocols.

10. Details of Course

S. No.	Contents	Contact Hours
1.	Introduction: Introduction to security attacks, services and mechanism, introduction to cryptography, classical encryption techniques- substitution ciphers and transposition ciphers, cryptanalysis, steganography, stream and block ciphers, Intruders, Viruses and related threads.	6

2.	Modern Block Ciphers: Block ciphers principles, Shannon's theory of confusion and diffusion, fiestal, Data ciphers encryption standard(DES), strength of DES, crypt analysis of DES, triple DES, IDEA encryption and decryption, strength of IDEA, key distribution algorithm.	6
3.	Introduction to graph, ring and field, prime and relative prime numbers, modular arithmetic, Fermat's and Euler's theorem, primarily testing, Euclid's Algorithm, Chinese Remainder theorem, discrete logarithms, Principals of public key crypto systems, RSA algorithm, security of RSA, key management, Diffle-Hellman key exchange algorithm, introductory idea of Elliptic curve cryptography, Elganel encryption.	8
4.	Message Authentication and Hash Function: Authentication requirements, authentication functions, message authentication code (MAC), hash functions, message digest algorithm(MD5), Secure hash algorithm(SHA), Public Key Infrastructure(PKI): Digital Certificate, private key management, Digital Signatures: Digital Signatures, authentication protocols, digital signature standards (DSS), proof of digital signature algorithm.	6
5.	Authentication Applications: Kerberos and X.509, directory authentication service, password, challenge-response, biometric authentication, electronic mail security-pretty good privacy (PGP), S/MIME.	8
6.	IP Security: Architecture, Authentication header, Encapsulating security payloads, combining security associations, key management. Web Security: Secure Socket Layer(SSL) and transport layer security, TSP, Secure Electronic Transaction (SET), Electronic money, WAP security, firewall design principals, Virtual Private Network (VPN) security.	8

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
	Text Books:	
1.	William Stallings, "Cryptography and Network Security: Principals and Practice", Prentice Hall, New Jersy.	1997
2.	AtulKahate, "Cryptography and Network Security", TMH.	2003
3.	Behrouz A. Forouzan, "Cryptography and Network Security", TMH.	2003
	Reference Books:	
1.	Johannes A. Buchmann, "Introduction to Cryptography", Springer-Verlag.	2001
2.	Bruce Schiener, "Applied Cryptography".	1994

1. Subject Code: **MC-409**   Course Title: **Mathematical modeling and simulation**

2. Contact Hours   : L-3   T-0   P-2

3. Examination Duration (Hrs.)   : Theory: 3   Practical: Nil

4. Relative Weightage   : CWS: 15 PRS: 15 MTE :30 ETE: 40 PRE:

5. Credits   : 4

6. Semester   : VII

7. Subject Area   : DCC

8. Pre-requisite   : Basic knowledge of differential equations and statistics

9. Objective   : To learn how to model and solve real life problems

10. Details of Course

S. No.	Contents	Contact Hours
1.	History of Mathematical Modeling, latest development in Mathematical Modeling, Merits and Demerits of Mathematical Modeling, Quantitative and Qualitative approach of modeling, Conceptual and Physical models, stationary and in stationary models, distributed and lumped models, models in real world problem.	6
2.	Introduction to difference equations, Non-linear Difference equations, Steady state solution and linear stability analysis. Discrete dynamical systems: equilibrium and long term behavior, Linear Models, Growth models, Decay models, Drug Delivery Problem, Linear Prey-Predator models, Volterra's principle, Lanchester combat model.	12
3.	Introduction to Continuous Models, Drug Distribution in the Body, Epidemic Models (SI, SIR, SIRS, SIS, SEIR), Steady State solutions, Linearization and Local Stability Analysis, logistic, prey-predator model, Competition models.	12
4.	Spline, Random numbers, Generating discrete and continuous random variables, Multiple Regression, Variance reduction techniques, Statistical validation techniques, Markov chain, Monte Carlo methods and applications.	12
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	"Mathematical Modeling with Excel", Albright, B., Jones and Bartlett Publishers.	2010
2.	"Mathematical Modeling", Kapur, J. N., New Age International.	2005
3.	"Introduction to Mathematical Modeling using Discrete Dynamical Systems", Marotto, F. R., Thomson Brooks/Cole.	2006
4	Mathematical modelling and simulation: introduction for scientist and engineers, Willy, Kai Velten	2008

1. Subject Code: **MC-402**   Course Title: **B.Tech project-II**

2. Contact Hours   : -

3. Examination Duration (Hrs.)   : -

4. Relative Weightage   : -

5. Credits   : 8

6. Semester   : VIII

7. Subject Area   : DCC

8. Pre-requisite   : Nil

9. Objective   : To familiarize the students to work in group and develop an independent understanding of engineering and analysis of engineering systems. He should also be able to write and present the work done during the course.

DEPARTMENTAL ELECTIVE COURSES

1. Subject Code: **MC-305**   Course Title: **Operations Research**

2. Contact Hours   : L-3   T-0   P-2

3. Examination Duration (Hrs)   : Theory: 3   Practical: Nil

4. Relative weightage   : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE:0

5. Credits   : 4

6. Semester   : V

7. Subject Area   : DEC

8. Pre-requisite   : NIL

9. Objective   : Identify and develop operational research models from the verbal description of the real system. Understand the mathematical tools that are needed to solve optimization problems. Use mathematical software to solve the proposed models.

10. Details of Courses:

S.No	Contents	Contact Hours
1	Introduction to Operations Research, Linear Programming Problems: basic concepts, general and standard forms of LPP, Mathematical formulation, Convex feasible region extreme points and basic feasible solutions, Optimal solution determination by using Graphical method and Simplex method, Two phase method, Big M method, application of simplex algorithm case studies.	12
2	Duality in LPP: Dual problem, Duality theorems, Complementary slackness, Economic interpretation of duality, Dual simplex method, Sensitivity analysis.	10
3	Integer programming Problems: Problem formulation, Branch and bound method, Cutting plane algorithm, Applications of LPP.	04

S No	Description	
4	Transportation and assignment models: Transportation Problem, Duality of Transportation problem, Degeneracy in transportation problem, Solution of Transportation problem (by stepping stone and modified distribution methods), Transhipment problem, assignment problem, Hungarian method, Travelling salesman Problem.	09
5	Network Scheduling: Network and basic components, Network construction, Critical path method (CPM), Program evaluation and review techniques (PERT), Cost of completing project	05

11. Suggested Books

S No	Name of Books /Authors Publishers	Year of Publication
1	Operations Research: An Introduction Hamdy A. Taha, Pearson Education Inc.	2007
2	Numerical Optimization with Applications, Suresh Chandra, Jayadeva and Aparna Mehra, Narosa Publication	2008
3	Practical Optimization and Engineering Application, Antonions amd L.W. Sheng, New Age Publications	2010
4	Introduction to Operations Research, Frederick S. Hiller & Gerald J. Lieberman, McGraw-Hill	2009
5	Linear Programming, G Hadley, Narosa Publications	1963

1. Subject Code: **MC307**   Course Title: **OBJECT ORIENTED PROGRAMMING**

2. Contact Hours   : L-3   T-0   P-2

3. Examination Duration (Hrs.)   : Theory: 3   Practical: 0

4. Relative Weightage   : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: -

5. Credits   : 4

6. Semester   : V

7. Subject Area   : DEC

8. Pre-requisite   : Programming Fundamentals

9. Objective   :   To introduce object oriented paradigm using C++ and
                                             Java including exception handling and file operations.
                                             This also includes Java applets and Java swings.

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Object oriented paradigm & C++ at a glance:** Evolution of programming paradigm, structured versus object-oriented development, elements of object-oriented programming, Objects, classes, methods, popular OOP languages, software reuse. **Classes and objects:** Introduction, Class revisited, constant objects and constructor, static data members with constructors and destructors, constructor overloading, nested classes, objects as arguments, returning objects, friend functions and friend classes, constant parameters and member functions, static data and member functions.	8
2.	**Dynamic objects:** Introduction, pointers to objects, array of objects, pointers to object members, this pointer, self-referential classes **Operator overloading and Inheritance:** overloading of new and delete operators, conversion between objects and basic types, conversion between objects of different classes, overloading with friend functions, abstract classes, inheritance types, virtual base classes, virtual functions, pointer to derived class objects, and base class objects, pure virtual functions, virtual destructors. **Generic programming with templates:** Introduction, function templates, overloaded function templates, class templates, inheritance of class template, class template containership, class template with overloaded operators.	8
3.	Introduction to byte code, security and portability, Data Types, variables, operators, arrays, type conversion and casting, type promotion, Control statements, standard input output, Designing Classes, constructors, methods, access specifiers: public, private, protected, inheritance, packages and interfaces, Math, String, Vectors, and Array List classes, polymorphism: function and operator overloading, function overriding, abstract classes.	7
4.	**Exception Handling:** exception types, nested try-catch, throw, throws and finally statements, Multithread Programming: thread creation, synchronization and priorities.	6

5.	**Input-output and file operations:** Java.io, stream classes, Byte streams, character streams, serialization. Networking concepts: Client server and socket programming, TCP/IP client and server sockets.	5
6.	**Applets and Java Swing:** Applet design, AWT packages, Applet event handling, parameters to applets, AWT controls, layout manager, Frames, container classes, Introduction to Java Beans, Swing and Servlets.	5
7.	**Latest Research in OOPS:** Static analyser for finding dynamic programming error, Accurate interprocedural null deference analysis in Java.	3
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
Text Books		
1.	Patrick Naughton, Herbert Schildt: "The Complete Reference: Java ", TMH.	2011
2.	C Thomas Wu : "An Introduction to OO programming with Java", TMH,	2009
3.	Balaguruswami, "Object oriented with C++", TMH.	2013
Reference Books		
4.	Budd, "Introduction to Object Oriented Programming", Addison Wesley	2008
5.	K.R Venugopal Rajkumar : "Mastering C++" TMH.	2013
6.	Lip man and Lajole: "C++ Primer" Addison Wesley.	2007
7.	Maria litvin, Gary litvin,"Programming in C++", VPH.	
8.	D Samantha, "Object oriented Programming in C++ and Java ", PHI.	

1. Subject Code: **MC-309**   Course Title: **Number Theory**

2. Contact Hours   :   L-3   T-1   P-0

3. Examination Duration (HRS)   :   Theory: 3

4. Relative Weightage   :   CWS: 25 PRS: 0   MTE: 25 ETE: 50   PRE: 0

5. Credits   :   4

6. Semester   :   V

7. Subject Area   :   DEC

8. Pre –requisite   :   Elementary number theory, abstract algebra including groups, ring, field.

9. Objective   :   Even though number theory is one of the oldest disciplines in mathematics, it has recently contributed to many practical problems such as coding theory, cryptography, hashing functions or other tools in modern information technology. The aim is to impart knowledge of numbers theory and its applications.

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Divisibility and factorization:** Division algorithm, greatest common divisor, Euclid's algorithm, linear equations and its theorem, fundamental theorem of arithmetic.	7
2.	**Congruences:** Linear congruence theorem, solution of linear congruence, simultaneous linear congruences, Chinese Remainder theorem, Wilson's theorem, Fermat's theorem, Euler's theorem.	8
3.	**Arithmetic functions:** Arithmetic function, multiplicative functions Moebius function, Moebius inversion formula, Euler phi function, Euler's formula, number- of -divisors, sum -of -divisors functions, perfect numbers, characterization of even perfect numbers.	9

4.	**Prime numbers and Quadratic reciprocity** : Prime number, Euclid's theorem, infinitely many prime theorem, Fermat primes, Mersenne primes, Dirichlet's theorem on primes, estimates for pi(x), Legendre and Jacobi symbols, Euler's criterion, Gauss's lemma, law of quadratic reciprocity.	9
5.	**Diophantine approximations and Cryptology:** Linear Diophantine equations, Pell's equation, Fermat's equation, Diophantine approximations, character cipher, public key encryption, some algorithm for encrypts and decrypt, RSA crypto system.	9
	Total	**42**

11. Suggested Books

S. No.	Name of books / Authors Publishers	Year of Publication
1.	Joseph H. Silverman: A friendly Introductory Number Theory, 3rd edition, Pearson	2009
2.	K.H. Rosen: Elementary Number Theory, and its Application, 5ht edition, McGraw Hill ISBN 0-21-87073-8	2005
3.	G.A. Jones and J.M. Jones: Elementary Number Theory, Springer	1998
4.	I Niven, H. Zuckerman, and H. Montgomery: An Introduction to the Number Theory, 5th edition, Wiley ESBN: 0-471625469	1991
5.	G.E. Andrews: Number Theory, Dover Publications	1994

1. Subject Code: **MC-315**   Course Title: **Modern Algebra**

2. Contact Hours   : L-3   T-1   P-0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: NIL

4. Relative Weightage   : CWS: 25 PRS: 0   MTE: 25 ETE: 50   PRE: 0

5. Credits   : 4

6. Semester   : V

7.	Subject Area	:	DEC
8.	Pre-requisite	:	Discrete Mathematics
9.	Objective	:	To impart knowledge Groups, Rings, Integral domains, Fields, Euclidian domain, Principal Ideal domain and unique factorization domain, etc.

10. Details of Course

S. No.	Contents	Contact Hours
1.	Groups, Abelian groups, Subgroups, Order of a group and an element, Coset, Lagrange's Theorem, Cyclic groups, Cyclic subgroups of prime order.	10
2.	Normal subgroup, quotient group, homomorphism, isomorphism, kernel of homomorphism, fundamental theorem of homomorphism. Permutation groups, alternating group, Cayley's theorem. Important examples such as S_3 and K_4 (Klein4 –group).	12
3.	Ring, subring, quotient rings, ring homomorphism elementary properties, ideal of a ring, Maximal Ideals, Prime ideals, Characteristic of a ring.	10
4.	Integral domain, Field, Imbedding theorem, Principal ideal domain, Euclidian domain, Unique factorization domain.	10
	Total	**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	Herstein, I.N., Topics in algebra (2nd edition), Wiley eastern limited	2008
2.	Vijay K. Khanna, Bhambri, S.K., A course in Abstract Algebra (3rd edition), Vikas Publishing House Pvt. Ltd.	1999

1. Subject Code: **MC- 317**   Course Title: **NUMERICAL METOHDS FOR ODE**

2. Contact Hours   : L-3   T-0   P-2

3. Examination Duration (Hrs.)   : Theory: 3   Practical: Nil

4. Relative Weightage   : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE:

5. Credits   : 4

6. Semester   : V

7. Subject Area   : DEC

8. Pre-requisite   : Some knowledge of numerical methods, ODE and Matlab

9. Objective   : To learn how to solve real life problems.

10. Details of Course

S. No.	Contents	Contact Hours
1.	Initial Value Problems: Duhamel's principle, Lipschitz continuity, Existence and uniqueness of solutions, significance of the Lipschitz constant, RungeKutta methods, Embedded methods and error estimation, Linear multistep methods, Local truncation error, Predictor-corrector methods.	10
2.	Zero-Stability and Convergence for Initial Value Problems: Convergence, One-step methods, Euler's method on linear problems, Euler's method on nonlinear problems, General one-step methods. Zero-stability of linear multistep methods, Solving linear difference equations	12
3.	Absolute Stability for Ordinary Differential Equations: Unstable computations with a zero-stable method, Absolute stability, Stability regions for linear multistep methods, Systems of ordinary differential equations. Stiff Ordinary Differential Equations: Numerical difficulties, Characterizations of stiffness, Numerical methods for stiff problems, A-stability, L-stability,	12

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
4.	Finite difference method for two point boundary value problems, eigenvalue problems and their convergence.	8

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	Finite difference methods for ordinary and partial diff. equations, Randall Leveque.	SIAM, 2007
2.	A first course in the Numerical analysis of differential equations, A. Iserles.	Cambridge, 2008
3.	Numerical methods for Scientific and Engineering. Comp.	Jain &Iyengar

1. Subject Code: **MC-319**   Course Title: **Complex Analysis**

2. Contact Hours   : L-3   T-1   P-0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: NIL

4. Relative Weightage   : CWS: 25 PRS: 0   MTE: 25 ETE: 50   PRE: 0

5. Credits   : 4

6. Semester   : V

7. Subject Area   : DEC

8. Pre-requisite   : NIL

9. Objective   : To impart knowledge Harmonic Functions, Power Series expansions, Entire functions, Normal families, Elliptic Functions, etc.

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Harmonic Functions:** Definitons and basic properties, The Mean value property, Poisson's formula, Schwarz's theorem. **Power Series Expansions:** Weierstrass's theorem, The Taylor series, The Laurent series.	10
2.	**Partial fractions and factorization:** Partial fractions, Infinite products, Canonical products, The Gamma function,Stirling's formula. **Entire functions:** Jensen's formula, Hadamard's theorem.	12
3.	**Normal Families:** Equicontinuity, Normality and Compactness, Arzela's Theorem, Families ofAnalytic Functions. **The Riemann Mapping Theorem:** Statement and proof, Boundary Behavior, Use of the Reflection Principle,Analytic arcs.	10
4.	**A Closer look at Harmonic Functions:** Functions with the mean-value Property, Harnack's Principle. **Elliptic Functions:** Simply Periodic Functions- Representationby Exponentials,The FourierDevelopment, Functions of Finite Order.	10
Total		42

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	"Complex Analysis" by L.V. Ahlfors, McGraw Hill, Third Edition.	1979
2.	Functions of One Complex Variable, J.B. Conway, Springer-Verlag,	1973

1. Subject Code: **MC-308**   Course Title: **COMPUTER NETWORKS**

2. Contact Hours   : L-3   T-1   P-0

3. Examination Duration (Hrs.)   : Theory : 3   Practical : 0

4. Relative Weightage   : CWS: 25 PRS: 0   MTE: 25 ETE: 50 PRE: -0

5. Credits   : 4

6. Semester   : VI

7. Subject Area   : DEC

8. Pre-requisite   : NIL

9. Objective   : To introduce the layered concept of Computer network and protocols associated with TCP/IP.

10. Details of Course

S. No.	Contents	Contact Hours
1.	Introduction Concepts: Goals and Applications of Networks, Network structure and architecture,The OSI reference model, services, Network Topology Design - Delay Analysis, Physical Layer Transmission Media, Switching methods,ISDN.	8
2.	Medium Access sub layer: Medium Access sub layer - Channel Allocations, LAN protocols -ALOHA protocols - Overview of IEEE standards - FDDI.Data Link Layer - Elementary DataLink Protocols, Sliding Window protocols, Error Handling.	10
3.	Network Layer: Network Layer - Point - to Pont Networks, routing, Congestion control, Internetworking -TCP / IP, IP packet, IP address, IPv6.	6
4.	Transport Layer: Transport Layer - Design issues, connection management, session Layer-Designissues, remote procedure call.	6
5.	Presentation Layer- Data compression techniques.	6

S. No.		Year of Publication/Reprint

6.	Application Layer: Application Layer: File Transfer, Access and Management, Electronic mail,Virtual Terminals, Internet and Public Networks.	6

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
	Text Books:	
1.	S. Tananbaum, "Computer Networks", 3rd Ed, PHI.	1999
2.	U. Black, "Computer Networks-Protocols, Standards and Interfaces", PHI.	1996
3.	Laura Chappell (ed), "Introduction to Cisco Router Configuration", Techmedia.	1999
	Reference Books:	
1.	W. Stallings, "Computer Communication Networks", PHI.	1999
2.	William A. Shay, "Understanding Data Communications & Networks", Vikas Publication.	1999
3.	Michael A. Miller, "Data & Network Communications", Vikas Publication.	1998

1. Subject Code: **MC-310**　　　　　Course Title: **SOFTWARE ENGINEERING**

2. Contact Hours　　　　　　　　: L-3　　　T-1　　　P-0

3. Examination Duration (Hrs.)　　: Theory : 3　　　Practical : 0

4. Relative Weightage　　　　　　: CWS: 25　PRS: 0　　MTE: 25　ETE: 50　PRE: 0

5. Credits　　　　　　　　　　　: 4

6. Semester　　　　　　　　　　: VI

7. Subject Area　　　　　　　　　: DEC

8. Pre-requisite : NIL

9. Objective : To introduce fundamentals of software engineering including requirement specifications, software design, testing and maintenance.

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Introduction:** Introduction to software Engineering, Software characteristics, Software components, Software applications, Software Engineering Principles, Software metrics and measurement, monitoring and control. **Software development life-cycle Models:**Software development life-cycle**,** Water fall model, prototyping model, Incremental model, Iterative enhancement Model, Spiral model.	8
2.	**Software Requirement Specification:**Requirements Elicitation Techniques, Requirements analysis, Models for Requirements analysis, requirements specification, requirements validation.	8
3.	**System Design:**Design Principles: Problem partitioning, abstraction. Top down and bottom up – design, structured approach. Functional versus object oriented approach of design, design specification, Cohesiveness and Coupling. Overview of SA/SD Methodology, structured analysis, data flow diagrams, extending DFD to structure chart.	6
4.	**Software project Management:**Project planning and Project scheduling.Software Metrics**:**Size Metrics like LOC, Token Count, Function Count. Cost estimation using models like COCOMO. Risk management activities.	5
5.	**Software Reliability and Quality Assurance:** Reliability issues, Reliability metrics, reliability models, Software quality, ISO 9000 certification for software industry, SEI capability maturity model.	5

| 6. | **Testing:**Verification and validation, code inspection, test plan, test case specification. Level of testing: Unit, Integration Testing, Top down and bottom up integration testing, Alpha and Beta testing, System testing and debugging.functional testing, structural testing, Software testing strategies.
Software Maintenance: Structured Vs unstructured maintenance, Maintenance Models, Configuration Management, Reverse Engineering, Software Re-engineering. | 10 |

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
Text Books:		
1.	R. S. Pressman, "Software Engineering – A practitioner's approach", 3rd ed., McGraw Hill Int. Ed..	1992
2.	Sommerville, "Software Engineering", Addison Wesle.	2001
3.	K. K. Aggarwal & Yogesh Singh, "Software Engineering", 2nd Ed., New Age International.	2005
Reference Books:		
1.	P. Jalote, "An Integrated approach to Software Engineering", Narosa.	1991
2.	Stephen R. Schach, "Classical & Object Oriented Software Engineering", IRWIN, TMH.	1996
3.	James Peter, W. Pedrycz, "Software Engineering: An Engineering Approach", John Wiley & Sons.	2004
4.	K. Chandrasehakhar, "Software Engineering & Quality Assurance", BPB.	2005

1. Subject Code: **MC-312**　　　　　　　Course Title: **ARTIFICIAL INTELLIGENCE**

2. Contact Hours　　　　　　　　　: L-3　　T-1/0　　P-0/2

| 3. | Examination Duration (Hrs.) | : Theory : 3 | Practical : 0 |

3. Examination Duration (Hrs.) : Theory : 3   Practical : 0

4. Relative Weightage : CWS:25/15 PRS:0/15 MTE:25/30 ETE:50/40 PRE:0

5. Credits : 4

6. Semester : VI

7. Subject Area : DEC

8. Pre-requisite : NIL

9. Objective : To introduce basic Knowledge representation, problem solving, and learning methods of Artificial Intelligence and understand the role of knowledge representation, problem solving, and learning in intelligent system engineering.

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Introduction:** AI Problems, Task Domains of AI, AI Techniques: search knowledge, abstraction. Introduction to Intelligent program and Intelligent agents. **Problem Solving:**Basic Problem solving Method: state space search, problem characteristics, Production systems characteristics, issues in design of Intelligent search algorithm	6
2.	**Heuristic search Techniques:**Hill climbing techniques, Best First search, A* Search, Problem Reduction: AO* Search, Constraint Satisfaction, Means-End Analysis. **Game Playing:**Game Tree, Searching procedure Minimax, alpha-beta pruning	7
3.	**Knowledge Representation:** Knowledge Representation issues. Knowledge Representation using Predicate Logic: Unification, resolution.Rule based Systems : Forward versus backward reasoning, conflict resolution. Structured Knowledge Representation: Semantic Nets, Frames, conceptual dependency, scripts.	7

4.	**Programming Languages**: Fundamental and concepts of Programming languages like Prolog or Lisp. Relationship of languages with Knowledge representation and inferences	6
5.	**Handling uncertainty,** Non-Monotonic Reasoning, Probabilistic reasoning, use of certainty factors, fuzzy logic. **Learning**Concept of learning, learning automation, genetic algorithm, learning by inductions, neural nets.	8
6.	**Applications:** Expert Systems: Architecture,Domain Knowledge, Knowledge Acquisition,Case Studies: MYCIN, RI, Natural language Processing: Syntactic, Semantic and Pragmatic Analysis, Robotics etc.	8

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
	Text Books:	
1.	Artificial Intelligence, E. Rich and K. Knight, TMH, 2nd ed..	1992
2.	Principles of AI, N.J. Nilsson, ,Narosa Publ. House.	1990
3.	Artificial Intelligence - an Engineering Approach, R.J. Schalkoff, McGraw Hill Int Ed., Singapore.	1992
	Reference Books:	
1.	*Artificial Intelligence: Structures and Strategies for Complex Problem Solving* (5th Edition), George F. Luger. Addison-Wesley.	2005
2.	*Artificial Intelligence: A Guide to Intelligent Systems* (2nd Edition). Michael Negnevitsky. Addison-Wesley.	2005
3.	"Neural Networks in Computer Intelligence" by KM Fu, McGraw Hill	1994
4.	AI: A modern approach" by Russel and Norvig, Pearson Education	2002
5.	Introduction to AI and Expert Systems", D.W. Patterson, , PHI.	1992

1. Subject Code: **MC – 318**   Course Title: **Computer Graphics**

2. Contact Hours   : L-3   T-1/0   P-0/2

3. Examination Duration (Hrs.)   : Theory : 3   Practical : 0

4. Relative Weightage   : CWS:25/15 PRS:0/15 MTE:25/30 ETE:50/40 PRE:0

5. Credits   : 4

6. Semester   : VI

7. Subject Area   : DEC

8. Pre-requisite   : NIL

9. Objective   : The objective of the course is to help students learn broad introduction to the theory and practice of computer graphics.

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Overview of Computer Graphics:** Usage of Graphics and their applications, Over view of Graphics systems: Refreshing display devices, Random and raster scan display devices, Colour Models: RGB, HSV etc., Tablets, Joysticks, Track balls, Mouse and light pens, plotters, printers, digitizers.	6
2.	**Output primitives:** DDA Line drawing algorithm, Bresenham's Line Drawing Algorithm, Mid-point circle algorithm, Mid-point Ellipse algorithms, filling algorithms, boundary fill and flood fill algorithms, scan-line filling, character generation, line attributes, fill styles, anti-aliasing.	8
3.	**Transformations:** Basic 2D Transformations, Matrix representations & Homogeneous Coordinates, Matrix Representations for basic 2D and 3D transformations, Composite Transformations, reflection and shear transformations, affine transformation, transformations between coordinate systems.	6
4.	**Two dimensional viewing**: The viewing Pipeline, Viewing Coordinate Reference Frame, Window-to-Viewport Coordinate Transformation, Two Dimensional Viewing Functions, Barky line clipping algorithm, Algorithm for polygon clipping, Sutherland-Hodgeman polygon clipping, Wailer-Atherton polygon clipping, curve clipping, Text clipping.	8

5.	**Curves and Surfaces:** Representation of surfaces, polygon meshes, plane equations, parametric cubic curves, Hermite Curves, Bezier Curves, 4 point and 5 point Bezier curves using Bernstein Polynomials, Conditions for smoothly joining curve segments, Bezier bi-cubic surface patch, B-Spline Curves, Cubic B-Spline curves using uniform knot vectors, Testing for first and second order continuities	6
6.	**Projection:** Parallel Projection, Oblique Projection on XY plane, Isometric Projection, Perspective Projection, One Vanishing Point (V.P.) projection, Generation of 2 V.P. Projection, planar geometric projections. **Shading and Hidden Surface Removal:** Shading, Illumination Model for diffused Reflection, Effect of ambient lighting, distances, Specular Reflection Model, Computing Reflection Vector, Curved Surfaces, Polygonal Approximations, Guard Shading, Phong Model, Hidden Surface Removal, Back Face Detection, Depth Buffer (Z-Buffer, A-Buffer) Method, Scan Line Method, Depth Sorting Method, Area Subdivision Method.	8

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	D. Hearn and P. Baker, "Computer Graphics", Prentice Hall.	**1986**
2.	R. Plastock and G. Kalley, "Theory and Problems of Computer Graphics", Schaum's Series, McGraw Hill.	**1986**
3.	Foley et al., "Computer Graphics Principles & practice", Addison Wesley.	**1999**

1. Subject Code: **MC-320**   Course Title: **Web Technology**

2. Contact Hours   : L-3   T-1/0   P-0/2

3. Examination Duration (Hrs.)   : Theory : 3   Practical: 0

4. Relative Weightage   : CWS:25/15 PRS:0/15 MTE:25/30 ETE:50/40 PRE:0

5. Credits   : 4

6.   Semester   :   VI

7.   Subject Area   :   DEC

8.   Pre-requisite   :   NIL

9.   Objective   :   To understand the Internet & the Web phenomena. Comprehend the evolution, development and research in the area of Web

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Inter-Networking:** Internet, Growth of Internet, Owners of the Internet, Anatomy of Internet, APRANET and Internet history of the World Web, Basic Internet Terminology, Net etiquette. Working of Internet: Packet switching technology, Internet Protocols: TCP/IP, Router. Internet Addressing Scheme: Machine Addressing (IP address), E-mail Address, Resource Addresses.	6
2.	**Internet Applications:** E-mail, file transfer (FTP), telnet, usenet, Internet chat, Web.	4
3.	**Evolution of Web:** Web 1.0: Hypertext & linking documents, HTTP, Client-Server, peer-to-peer; Web Browser (Lynx, Mosiac, Netscape, Internet Explorer, Firefox, and Safari, the mobile web); Impact: Opportunities & Challenges. Web 2.0: From 1.0 to 2.0; Framework; Technologies: Client-side & server-side; Web 2.0 development technologies; Examples: social networking sites, blogs, wikis, video sharing sites, hosted services(web services, location-based services), web applications, mashups & folksonomies; Practical Usage. Web 3.0: From 2.0 to 3.0; Semantic Web: What, How, Why; From Web 3.0 to Web 4.0	10

4.	**Web Development:** Phases; Web Page, Website, and Web Application: Example, Technology Framework for development.cClient-side technology: HTML (HTML 5).Client-side scripting: JavaScript. Server-side technology: PHP.Server-side scripting: Server-side JavaScript.Web application development frameworks: Django& Ruby on Rails. Web Database: Database Connectivity: JDBC, ODBC; Database-to-web connectivity.	14
6.	**Web Search and Mining:**Web IR System: Search Engines, Web Crawling, Search Engine Optimization, Web Analytics, Web Mining Taxonomy; Web Mining Framework; Social Web Mining.Text Mining: Opinion Mining, Recommendation System, Topic Detection and Tracking.	8
TOTAL		**42**

11. Suggested Books

S. No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
Text Books		
1.	Internet and Web Technologies by Raj Kamal, Tata McGraw Hill edition. (ISBN: 9780070472969)	2002
2.	An Introduction to Search Engines and Web Navigation, Mark Levene, Pearson Education. (ISBN: 978047052684)	2010
3.	Modeling the Internet and the Web,PierreBaldi,PaoloFrasconi, Padhraic Smyth, John Wiley and Sons Ltd. (ISBN: 978-0-470-84906-4)	2003
Reference Books		
4.	HTML: A Beginner's Guide by Wendy Willard, Tata McGraw-Hill (ISBN: 9780070677234)	2009
5.	PHP and MySQL for Dynamic Web Sites, Ullman, Larry, PeachpitPress.1 (ISBN: 978-0-321-78407-0)	2012

1. Subject Code: **MC-322** Course Title: **Cluster and Grid Computing**

2. Contact Hours : L-3 T-1 P-0

3. Examination Duration (Hrs.) : Theory : 3 Practical : 0

4. Relative Weightage : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: -0

5. Credits : 4

6. Semester : VI

7. Subject Area : DEC

8. Pre-requisite : Data Structures

9. Objective : The course will provide an insight for achieving cost efficient high performance systems and how to deal with design and architecture of grid and cluster computing

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Cluster Computing** Introduction to concepts in Cluster based distributed computing Hardware technologies for cluster computing and software for cluster computing, and different Software Architecture for Cluster Computing.	5
2.	**Programming;**Programming Models and Paradigms, features and performance of standard MPI variants, Derived data types, communicators.	8
3.	**Resource management and scheduling** Managing, cluster resources: single system images, system level middleware, distributed task scheduling, monitoring and administering system resources Parallel I/O and Parallel Virtual File System. Scheduling: Condor, Maui Scheduler, Portable Batch System (PBS).	7

4.	**Grid Computing**:Grids and Grid Technologies, Programming models and Parallelization Techniques, Grid Security Infrastructure, Setting up Grid, deployment of Grid software and tools, and application execution.	8
5.	Standard application development tools and paradigms Performance evaluation tools, HINT, netperf, netpipe, ttcp, Iperf.message	8
6.	**Data Management**Application Case Study: Molecular Modeling for Drug Design and Brain Activity Analysis, Resource management and scheduling.	5

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
	Text Books:	
1.	Beowulf Cluster Computing with Linux, 2nd edition, William Gropp, Ewing Lusk, Thomas Sterling, MIT Press.	2001
2.	Introduction to grid computing - Bart Jacob, Michael Brown	2005
3.	In Search of Clusters: The ongoing battle in lowly parallel computing, Second Edition, by Gregory F. Pfister, Prentice Hall Publishing Company,	1998
	Reference Books:	
1.	MPI The Complete Reference - 2nd Ed by Marc Snir, et. al., The MIT Press.	1998
2.	Parallel Programming with MPI by Peter Pacheco, Morgan Kaufmann.	1998
3.	Using MPI-2, Advanced Features of the Message Passing Interface, William Gropp, Ewing Lusk, Rajeev Thakur, The MIT Press.	1999
4.	How to Build a Beowulf – A Guide to the Implementation and Application of PC Clusters, by Thomas Sterling, John Salmon, Donald J. Becker and Daniel F. Savarese, MIT Press.	1999

1. Subject Code: **MC 324**   Course Title: **Big Data Analytics**

2. Contact Hours   : L-3   T-1   P-0

3. Examination Duration (Hrs.) : Theory: 3   Practical: 0

4. Relative Weightage   : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PR: 00

5. Credits   : 4

6. Semester   : VI

7. Subject Area   : DEC

8. Pre-requisite   : Database management systems.

9. Objective   : Understand the fundamentals of various big data analysis techniques, Hadoop structure, environment and framework.

10. Details of Course

S. No.	Contents	Contact Hours
1.	**INTRODUCTION TO BIG DATA:** Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis vs Reporting - Modern Data Analytic Tools - Statistical Concepts: Sampling Distributions - Re-Sampling - Statistical Inference - Prediction Error.	8
2.	**MINING DATA STREAMS:** Introduction To Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform(RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.	8

3.	**HADOOP:** History of Hadoop- The Hadoop Distributed File System – Components of Hadoop- Analyzing the Data with Hadoop- Scaling Out- Hadoop Streaming- Design of HDFS-Java interfaces to HDFS-Basics-Developing a Map Reduce Application-How Map Reduce Works-Anatomy of a Map Reduce Job run-Failures-Job Scheduling-Shuffle and Sort – Task execution - Map Reduce Types and Formats-Map Reduce Features	10
4.	**HADOOP ENVIRONMENT:** Setting up a Hadoop Cluster - Cluster specification - Cluster Setup and Installation - Hadoop Configuration-Security in Hadoop - Administering Hadoop – HDFS - Monitoring-Maintenance-Hadoop benchmarks- Hadoop in the cloud	8
5.	**FRAMEWORKS:** Applications on Big Data Using Pig and Hive – Data processing operators in Pig – Hive services – HiveQL – Querying Data in Hive - fundamentals of HBase and ZooKeeper - IBM InfoSphere BigInsights and Streams. Visualizations - Visual data analysis techniques, interaction techniques; Systems and applications.	8
Total		**42**

11. Suggested Books

S. No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
Text Books:		
1.	Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.	2007
2	Tom White " Hadoop: The Definitive Guide" Third Edition, O'reilly Media, 2012.	2012
3	Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", McGrawHill Publishing, 2012	2012
4	Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.	2012
Reference books:		

1.	Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons, 2012.	2012
2.	Glenn J. Myatt, "Making Sense of Data", John Wiley & Sons, 2007	2007
3.	Pete Warden, "Big Data Glossary", O'Reilly, 2011.	2011
4.	Jiawei Han, Micheline Kamber "Data Mining Concepts and Techniques", Second Edition, Elsevier, Reprinted 2008.	2008
5.	Da Ruan,Guoquing Chen, Etienne E.Kerre, Geert Wets, Intelligent Data Mining, Springer,2007	2007
6.	Paul Zikopoulos ,Dirk deRoos , Krishnan Parasuraman , Thomas Deutsch , James Giles , David Corrigan , Harness the Power of Big Data The IBM Big Data Platform, Tata McGraw Hill Publications, 2012	2012
7.	Michael Minelli (Author), Michele Chambers (Author), Ambiga Dhiraj (Author) , Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses,Wiley Publications,2013.	2013
8.	Zikopoulos, Paul, Chris Eaton, Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, Tata McGraw Hill Publications, 2011	2011

1. Subject Code: **MC-411**   Course Title: **Data Warehousing & Mining**

2. Contact Hours   : L-3   T-1   P-0

3. Examination Duration (Hrs.) : Theory : 3   Practical : Nil

4. Relative Weightage   : CWS: 25 PRS: 0   MTE: 25 ETE: 50 PRE: 0

5. Credits   : 4

6. Semester   : VII

7. Subject Area   : DEC

8. Pre-requisite   : Database Management Systems

9. Objective   : To introduce the concept of Data Warehousing

and Data Mining, respective techniques and applications in real world scenario.

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Data Warehousing: -** Basic concepts in data warehousing, Collecting the requirements of data warehouse, Data Warehouse Architecture, Design, Implementation& Maintenance, OLAP in data warehouse, Data warehousing and the web, Data Cube Technology, From Data Warehousing to Data Mining.	8
2.	**Data Mining Concepts:** Data mining primitives, Basics of data mining, Query language, Architectures of data mining systems	6
3.	**Mining Association Rules in Large Databases:** Association Rule Mining, Mining Single Dimensional Boolean Association Rules from Transactional Databases, Mining Multilevel Association Rules from Transaction Databases, Mining Multidimensional Association Rules from Relational Databases and Data Warehouses, From Association Mining to Correlation Analysis, Constraint Based Association Mining.	8
4.	**Classification and Prediction:** Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Classification by Back propagation, Classification Based on Concepts from Association Rule Mining, Other Classification Methods, Prediction, Classifier Accuracy.	8
5.	**Cluster Analysis in Data Mining:** Types of Data in Cluster Analysis. A Categorization of Major Clustering Methods, Partitioning Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Outlier Analysis.	6
6.	**Mining Complex Types of Data:** Multidimensional Analysis and Descriptive Mining of Complex Data Objects, Mining Spatial Databases, Mining Multimedia Databases, Mining Time Series and Sequence Data, Mining Text Databases. Applications and trends in Data Mining: - Applications, Systems products and research prototypes, Additional themes in data mining, Trends in Data mining, spatial mining, and Web Mining.	6

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
Text Books:		
1.	Data Warehousing Fundamentals, P. Ponnian, John Weliey.	2001
2.	Data Mining Introductory & Advanced Topics, M.H. Dunham, Pearson Education.	2002
3.	Data Mining Concepts & Techniques, Han, Kamber, M. Kaufman.	2006
Reference Books:		
1.	The Data Warehouse Lifecycle Tool Kit, Ralph Kimball, John Wiley	1998
2.	Master in Data Mining, M.Berry , G.Linoff, John Wiley	2004
3.	Building the Data Ware houses, W.H.Inmon, WielyDreamtech	1996

1. Subject Code: **MC-413**   Course Title: **Compiler Design**

2. Contact Hours   : L-3   T-1   P-0

3. Examination Duration (Hrs.) : Theory : 3   Practical : 0

4. Relative Weightage   : CWS: 25 PRS: 0   MTE: 25 ETE: 50   PRE: -0

5. Credits   : 4

6. Semester   : VII

7. Subject Area   : DEC

8. Pre-requisite   : Theory of Automata

9. Objective   : To study the design of all the phases of compiler in detail.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction:** Definition , Phases and Passes, FSM & RE's and their application to Lexical Analysis, Implementation of Lexical Analyzers, Lexical- Analyzer Generator, Lex – Compiler.	6
2.	**Syntax Analysis:**Formal Grammar and their application to Syntax Analysis, BNF Notation,.The Syntactic specification of Languages: CFG, Derivation and Parse Trees, Shift Reduce Parsing, Operator precedence parsing, top down Parsing, Predictive Parsers.	6
3.	LR Parsers, the canonical collection of LR(0)items, constructing SLR Parsing Tables, Constructing canonical LR Parsing tables and LALR parsing tables , An Automatic Parser Generator, YACC.	6
4.	**Syntax Directed Translation:** Syntax directed Translation Schemes, Implementation of Syntax directed translators, Intermediate Code, Postfix notation, Parse Trees and Syntax Trees, Three address Code, Quadruple & Triples, Translation of Assignment Statements, Boolean expressions, Control Statements, Array Reference Books in Arithmetic expressions , Procedure Calls , Declarations and Case statements Translations.	10
5.	**Symbol Tables:** Data Structure for Symbol Tables, representing scope information.Run Time Administration: Implementation of simple Stack allocation scheme, storage allocation in block structured language.	4
6.	**Error detection and Recovery:** Lexical phase errors,syntax phase errors,semantic errors.And Error recovery techniques, Code Optimization: Loop optimization, the DAG representation of basic blocks, value numbers and Algebraic Laws, Global Data – Flow Analysis and Code generation.	10

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	Aho,Ullman &Sethi, "Compiler Design", Addison Wesley.	2006
2.	D.M.Dhamdhere, "Compiler Construction – Principles & Practice", Macmillan India	1988

1. Subject Code: **MC – 415**   Course Title: **WIRELESS AND MOBILE COMPUTING**

2. Contact Hours   : L-3   T-1   P-0

3. Examination Duration (Hrs.)   : Theory : 3   Practical : Nil

4. Relative Weightage   : CWS: 25 PRS: 0   MTE: 25 ETE: 50   PRE: 0

5. Credits   : 4

6. Semester   : VII

7. Subject Area   : DEC

8. Pre-requisite   : NIL

9. Objective   : To understand the concept of wireless communication, mobile computing paradigm, its novel applications and limitations

10. Details of Course

S. No.	Contents	Contact Hours
1.	Introduction, issues in mobile computing, overview of wireless telephony: cellular concept, GSM: air-interface, channel structure, location management: HLR, VLR, hierarchical, handoffs, channel allocation in cellular systems, Cellular telephone, Digital Cellular Standards, Call Routing in GSM , Satellite Technology, FDMA, TDMA, CDMA and GPRS.	5

2.	Wireless Networking, Wireless LAN Overview: MAC issues, PCF, DCF, Frame types, addressing, IEEE 802.11 standards, Blue Tooth: Architecture , Layers and protocols, Wireless multiple access protocols, TCP over wireless, Wireless applications, data broadcasting, Mobile IP, WAP: Architecture, protocol stack, application environment, applications, WAP application environment(WAE), WML, WSP, WTP and WTLS.	9
3.	Data management issues, data replication for mobile computers, Replication through data allocation, User profile replication scheme, optimistic replication and active replication, adaptive clustering for mobile wireless networks, File system, Disconnected operations.	6
4.	Mobile Agents computing: Introduction, Advantages, Application Domains; security and fault tolerance: Protecting server, code signaling, Firewall approach; security techniques and algorithms: DES, 3DES, AES, Diffie Hellman, RSA and Elliptic curve; transaction processing in mobile computing environment: Structure, properties, Data consistency, Transaction relation, Recovery and wireless data Dissemination.	9
5.	Ad Hoc networks, localization, Routing protocols: Global state routing (GSR), Destination sequenced distance vector routing (DSDV), Fisheye state routing(FSR), Dynamic source routing (DSR), ABR, Route Discovery, Route Repair/Reconstruction, Establishment, Maintenance; Ad Hoc on demand distance vector routing (AODV).	9
6.	Temporary ordered routing algorithm (TORA), Quality of Service in Ad Hoc Networks, and applications.	3

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
Text Books:		
1.	J. Schiller, Mobile Communications, Addison Wesley.	2000
2.	A.K. Talukder and R.R. Yavagal, Mobile Computing, TMH	2006
3.	M. V. D. Heijden, M. Taylor, Understanding WAP, Artech House.	1997
Reference Books:		
1.	Charles Perkins, Mobile IP, Addison Wesley.	1997

2.	Charles Perkins, Ad hoc Networks, Addison Wesley	2001

1. Subject Code: **MC-417**   Course Title: **Multimedia System**

2. Contact Hours   L-3   T-1   P-0

3. Examination Duration (Hrs.)   : Theory : 3   Practical : Nil

4. Relative Weightage   : CWS: 25 PRS: 0   MTE: 25 ETE: 50 PRE: 0

5. Credits   : 4

6. Semester   : VII

7. Subject Area   : DEC

8. Pre-requisite   : NIL

9. Objective   : To study the concepts of multimedia data, algorithms and compression.

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Introduction** to Multimedia, Multimedia Information, Multimedia Objects, Multimedia in business and work. Convergence of Computer, Communication and Entertainment Products ,Stages of Multimedia Projects: Multimedia hardware, Memory & storage devices, Communication devices, Multimedia software's, presentation tools, tools for object generations, video, sound, image capturing, authoring tools, card and page based authoring tools.	9
2.	**Multimedia Building Blocks**: Text, Sound MIDI, Digital Audio, audio file formats, MIDI under windows environment Audio & Video Capture.	6
3.	**Data Compression:** Huffman Coding, Shannon Fano Algorithm, Huffman Algorithms, Adaptive Coding, Arithmetic Coding Higher Order Modeling. Finite Context Modeling, Dictionary based Compression, Sliding Window Compression, LZ77, LZW compression, Compression, Compression ratio loss less &lossy compression.	9

4.	**Speech Compression &Synthesis**: Digital Audio concepts, Sampling Variables, Loss less compression of sound, loss compression & silence compression.	6
5.	**Images**: Multiple monitors, bitmaps, Vector drawing, lossy graphic compression, image file formatic animations Images standards, JPEG Compression, Zigzag Coding,	**5**
6.	**Multimedia Database.** Content based retrieval for text and images, Video**:** Video representation, Colors, Video Compression, MPEG standards, MHEG Standard Video Streaming on net, Video Conferencing, Multimedia Broadcast Services, Indexing and retrieval of Video Database, recent development in Multimedia.	**7**

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
	Text Books:	
1.	Tay Vaughan "Multimedia, Making IT Work" Osborne McGraw Hill.	1998
2.	Buford "Multimedia Systems" Addison Wesley.	1994
3.	Agrawal & Tiwari "Multimedia Systems" Excel.	2000
	Reference Books:	
1.	Mark Nelson "Data Compression Book" BPB.	1995
2.	David Hillman "Multimedia technology and Applications" Galgotia Publications.	1998
3.	Rosch "Multimedia Bible" Sams Publishing.	1995
4.	Sleinreitz "Multimedia System" Addison Wesley.	2001
5.	James E Skuman "Multimedia in Action" Vikas.	1993

1. Subject Code: **MC-404**   Course Title: **Matrix Computation**

2. Contact Hours   : L-3   T-1   P-0

3. Examination Duration (Hrs.)   : Practical: 3   Practical : Nil

4. Relative Weightage : CWS: 25   PRS: MTE: 25   ETE: 50   PRE:

5. Credits : 4

6. Semester : VIII

7. Subject Area : DEC

8. Pre-requisite : Linear algebra, scientific computing

9. Objective : 1) Use computational techniques and algebraic skills essential for the study of systems of linear equations, matrix algebra, vector spaces, eigenvalues and eigenvectors, orthogonality and diagonalization. (Computational and Algebraic Skills).

2) Use visualization, spatial reasoning, as well as geometric properties.

10. Details of Course

S. No.	Contents	Contact Hours
1.	Floating point computations, IEEE floating point arithmetic, analysis of round off errors, Sensitivity analysis and condition numbers, Linear systems, Jacobi, Gauss-Seidel and successive over relaxation methods, LU decompositions, Gaussian elimination with partial pivoting, Banded systems, positive definite systems, Cholesky decomposition - sensitivity analysis, Gram-Schmidt orthonormal process, Householder transformation, QR factorization, stability of QR factorization.	14
2.	Solution of linear least squares problems, normal equations, singular value decomposition (SVD), Moore-Penrose inverse, Rank deficient least squares problems, Sensitivity analysis of least-squares problems, Sensitivity of eigenvalues and eigenvectors.	14
3.	Reduction to Hessenberg and tridiagonal forms; Power, inverse power and Rayleigh quotient iterations, Explicit and implicit QR algorithms for symmetric and non-symmetric matrices, Reduction to bi diagonal form,Sensitivity analysis of singular values and singular vectors,Krylov subspace methods, conjugate gradient method.	14

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/Reprint
1.	B.N. Datta, Numerical Linear Algebra and applications.	1995, 2nd edition, SIAM
2.	G. H. Golub and C. F. Van Loan, Matrix Computations.	3rd edition, John Hopkins University Press
3.	L. N. Trefethen, Numerical Linear Algebra.	SIAM 1997

1. Subject Code: **MC-406**   Course Title: **Partial Differential Equations**

2. Contact Hours   : L-3   T-1   P-0

3. Examination Duration (HRS)   : Theory: 3   Practical : Nil

4. Relative Weightage   : CWS: 25 PRS: 0   MTE: 25 ETE: 50 PRE: 0

5. Credits   : 4

6. Semester   : VIII

7. Subject Area   : DEC

8. Pre –requisite   : Ordinary differential equations, Multivariable calculus, Fourier series and Fourier Transform.

9. Objective   : The aim of this course to teach the students how to solve partial differential equations and interpret the resulting solutions. More emphasis will be placed on solution techniques rather than theorems and proofs which is appropriate for engineering students.

10. Details of Course

S. No.	Contents	Contact Hours
1.	**First order partial differential equation (PDEs):** Formation of PDEs, linear and quasi-linear first order PDEs, Lagrange, method, integral surface passing through a given curve, non-linear first order PDEs, Charpit's method, Jacobi's method for non-linear PDEs.	8
2.	**Second order PDEs:** Classification of second order PDEs, reduction to canonical or normal forms and characteristics equation, Monge's method, method of separation of variables, Initial and boundary value problems.	7
3.	**The wave equation:** Fourier series solution of wave equation, Numerical solution of wave equation, The infinite and semi infinite string problems, the d'Alembert solution.	9
4.	**The Heat equation:** Fourier series solution of heat equation, Heat conduction in infinite media, The maximum and minimum principles, Duhamel's principle.	9
5.	**The Laplace equation:** Boundary value problems for Laplace and Poisson equations, Maximum and minimum principles, Green's identity and fundamental solution, Poisson integral formula, Dirichlet's problem for upper half plane and cube, Nuemann problem for a rectangle and upper half plane.	9
	Total	**42**

11. Suggested Books

S. No.	Name of books / Authors Publishers	Year of Publication
1.	E. Kreyszig: Advanced Engineering Mathematics, Wiley	2011
2.	Peter V. O' Neil: Advanced Engineering Mathematics, Cengage Learning.	2007
3.	I.N. Sneddon: elements of Partial differential equations, Dover publications.	2006
4.	Dennis G. Zill: Differential Equation with Boundary value Problem, 8th edition, Brooks Cole	2012

1. Subject Code: **MC-408**   Course Title: **Quality Control & Decision Making**

2. Contact Hours   : L-3   T-1   P-0

3. Examination Duration (Hrs)   : Theory: 3   Practical: Nil

4. Relative weightage   : CWS: 25 PRS:0   MTE: 25 ETE: 50   PRE:0

5. Credits   : 4

6. Semester   : VIII

7. Subject Area   : DEC

8. Pre-requisite   : Basic knowledge of probability & statistics.

9. Objective   : This course introduces basic quality management concepts and definitions and builds on that knowledge to explore Statistical Process Control (SPC) based quality improvement techniques as a means to diagnose, reduce and eliminate causes of variation and to assist in process improvement, production control, production planning and decision-making. A brief review of the fundamentals of statistics and probability and their applications in quality management is provided, and various measurement and control techniques, for example charts for variables and attributes are presented.

10. Details of Courses:

S.No	Contents	Contact Hours
1	Introduction to Statistical Quality Control, Process control and product control. Tools for SQC. Control charts for variables. Control charts for attributes. Natural tolerance limits and specification limits.	10
2	Acceptance sampling inspection plans. Single Sampling plan. Double sampling plan and their comparison. Sequential sampling plan.	10

3	Components and analysis of time series. Measurement of trend, seasonal variations and cyclic variations. Auto-regression series. Auto-correlation and correlogram. Choosing an appropriate forecasting model. Time series forecasting of seasonal data.	15
4	Decision making. Pay off tables. Decision trees. Maximax payoff, Maxmin payoff. Expected monetary value. Expected opportunity loss. Return-to-risk ratio. Decision making with sample information. Utility.	05

11. Suggested Books

S No	Name of Books /Authors Publishers	Year of Publication
1	Statistics for Managers (7th Edition) by David M.Levine, David F. Stephan, and Kathryn A. Szabat. PHI Learning Delhi.	2013
2	Probability and Statistics for Engineers & Scientists by Walpole, Myers, Myers, and Ye. Prentice Hall, NJ.	2011
3	Introduction to Statistical Quality Control by Montgomery, D.C. John Wiley and Sons.	2008

1. Subject Code: **MC-410**   Course Title: **Topology**

2. Contact Hours   : L-3   T-1   P-0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: NIL

4. Relative Weightage   : CWS: 25 PRS: 0   MTE: 25 ETE: 50 PRE: 0

5. Credits   : 4

6. Semester   : VIII

7. Subject Area   : DEC

8. Pre-requisite   : NIL

9. Objective   : To impart knowledge of Topological Spaces, Connectedness, Compact Spaces, Countability axioms, etc

10. Details of Course

S. No.	Contents	Contact Hours
1.	Topological spaces, Basis for a topology, The order topology, The product topology on X✕Y, The subspace topology, Closed sets and limit points, Continuous function, The product topology.	9
2.	The metric topology, Connected spaces, Connected subspaces of the real line, Components and Local connectedness.	9
3.	Compact spaces, Compact subspaces of the real line, Limit point compactness, Local compactness.	9
4.	Countability axioms, The separation axioms, Normal spaces, Urysohn Lemma, Urysohnmetrization theorem, The Tietze extension theorem.	9
5	The Tychonoff Theorem, Stone-Cech compactification, Complete metric spaces, Compactness in metric spaces.	6
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	"Topology" by James R. Munkres, Prentice Hall of India, (Second edition), New Delhi.	2000
2.	Elements of General topology, S.T. Hu, Holden-Day Inc, San Francisco.	1964
3.	Topology, J.G. Hocking and G.S. Young, Addison-Wesley Pub. Com.	1961
4.	Introduction to Topology and Modern analysis, G.F. Simmons, McGraw Hill International Edition (1963) Singapore.	1963

1. Subject Code: **MC-412**   Course Title: **Functional Analysis**

2. Contact Hours   : L-3   T-1   P-0

3. Examination Duration (Hrs.)   : Theory: 3 Practical: NIL

4. Relative Weightage   : CWS: 25 PRS: 0   MTE: 25 ETE: 50 PRE: 0

5. Credits   : 4

6. Semester   : VIII

7. Subject Area   : DEC

8. Pre-requisite   : NIL

9. Objective   : To impart knowledge of Hilber spaces, Banach
                                      spaces, Spectral theory and etc

10. Details of Course

S. No.	Contents	Contact Hours
1.	Linear transformations, Banach spaces, continuous linear transformations, the Hahn-Banach theorem.	7
2.	The natural embedding of *N* into *N***, The open mapping theorem, the conjugate of an operator.	8
3.	Hilbert space, Orthogonal complements, Orthonormal sets, The Conjugate space of H, the adjoint of an operator, Self adjoint operators, Normal and unitary operators.	11
4.	Finite dimensional Spectral theory, Matrices, Determinants and spectrum of an operator, The spectral theorem.	8
5	Banach algebras - Definition and some examples, Regular and singular elements, Topological divisors of zero, The spectrum, The formula for the spectral radius.	8
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	"Introduction to Topology and Modern Analysis" by G.F. Simmons, McGraw Hill Book Company.	1963
2.	Functional Analysis by B.V. Limaye, Prentice - Hall of India, New Delhi.	1981
3.	A.E. Taylor, Introductin to Functional Analysis, John Wiley and Sons, New York.	1958
4.	Walter Rudin, Functional Analysis, Tata McGraw Hill Publishing Company Ltd., New Delhi.	1973

1. Subject Code: **MC-418**   Course Title: **Optimization Techniques**

2. Contact Hours   : L-3   T-0   P-2

3. Examination Duration (Hrs.) : Theory: 3   Practical: Nil

4. Relative Weightage   : CWS: 15 PRS: 15 MTE: 30 ETE: 40   PRE: 0

5. Credits   : 4

6. Semester   : VIII

7. Subject Area   : DEC

8. Pre-requisite   : Real Analysis, Linear Algebra

9. Objective   : The general objectives of the course is to introduce the fundamental concepts of Optimization Techniques that make the learners aware of the importance of optimizations in real scenarios and provide the concepts of various classical and modern methods of for constrained and unconstrained problems in both single and multivariable.

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Convex Optimization and Quadratic Programming:** Convex functions and their properties, Convex optimization problems, Convex programming problems, Quadratic programming problems, wolf method for quadratic programming.	10
2.	**Some Generalized Convex Functions and Fractional Programming:** Quasiconvex and Quasiconcave functions, Pseudoconvex and Pseudoconcave functions, Linear fractional programming problems.	10
3.	**Optimality Conditions and Duality in Nonlinear Programming:** Introduction, feasible directions and linearizing cone, Basic constraint qualification, lagrangian and lagrange multipliers, karush kuhn tucker necessary/sufficient optimality conditions, duality in nonlinear programming, wolf dual, mixed dual and Lagrange dual.	10
4.	**Algorithm in Nonlinear Programming:** Franck and wolf's method, Gradient projection method, Penalty function method, barrier function method, multistage decision problems.	10
	Total	40

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	C.R.Bector, S.Chandra, J. Dutta, Principles of Optimization Theory, Narosa Publications.	2016
2.	M.S. Bazaraa, H.D.Sherali, & C.M. Shetty, Nonlinear Programming Theory & Algorithms, John Willey & Sons.	2006
3.	Suresh Chandra, Jayadeva, Aparna Mehra, Numerical optimization with applications, Narosa Publications.	2009
4.	Singiresu S. Rao, Engineering Optimization: Theory and Practice, John Wiley &Sons.	2009

5.	N.S. Kambo, Mathematical Programming Techniques, East-West Press Pvt. Ltd.	2008

1. Subject Code: **MC –420**   Course Title: **Information Theory and Coding**

2. Contact Hours   : L-3   T-1   P-0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: Nil

4. Relative Weightage   : CWS: 25 PRS: 0   MTE: 25 ETE: 50 PRE: 0

5. Credits   : 4

6. Semester   : VIII

7. Subject Area   : DEC

8. Pre-requisite   : NIL

9. Objective   : This Course provide Design the channel performance using Information theory, comprehend various error control code properties, apply linear block codes for error detection and correction, apply convolution codes for performance analysis & cyclic codes for error detection and correction, design BCH & RS codes for Channel performance improvement against burst errors.

10. Details of Course

S. No.	Contents	Contact Hours
1.	Discrete information sources, entropy, joint and conditional entropy, chain rule. Source coding, mapping functions and efficiency, mutual information, prefix codes, instantaneous decoding, construction of Huffman codes. Lempel-Ziv coding.	10
2.	Discrete memoryless channel model, transition probability matrix, channel capacity, symmetric channels. Block coding, equivocation. Entropy rate, channel-coding theorem. Markov chains and data processing.	8

3.	Data translation coding, prefix codes and block codes, fixed and variable length block codes, the Kraft inequality. Channel coding for error correction. Error rates and error distribution for the binary symmetric channel, Error detection and correction, maximum likelihood decoding principle, Hamming distance code capability. Linear block codes, Hamming weight, Hamming distance, and the Hamming cube. Syndrome decoders and the parity-check theorem.	12
4.	Cyclic codes, polynomial representation of cyclic codes, polynomial modulo arithmetic. Generator, parity-check, and syndrome polynomials. Systematic cyclic codes, the Hamming codes. BCH codes, Burst-correcting codes.	10

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	G.A. Jones and J.M. Jones, Information and Coding Theory, Springer Undergraduate Mathematics Series.	2000
2.	W.C. Huffman and V. Pless, Fundamental of Error Correcting Codes, Cambridge University Press.	2010
3.	R.B. Wells, Applied Coding and Information Theory for Engineers, Pearson Education.	1999
4.	T.M. Cover and J.M. Thomas, Elements of Information Theory, Wiley Student Edition.	2006
5.	Robert B. Ash, Information Theory, Dover Publications	1990

1. Subject Code: **MC-422**   Course Title: **Finite element methods**

2. Contact Hours   : L-3   T-1   P-0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: Nil

4. Relative Weightage   : CWS: 25 PRS:-   MTE: 25 ETE: 50 PRE:

5. Credits   : 4

6. Semester   : VIII

7.	Subject Area	: DEC
8.	Pre-requisite	: Knowledge of linear algebra, differ. eqs. & scientific computing
9.	Objective	: This course provide the fundamental concepts of the theory of the finite element method to give understanding of the fundamental theory of the FEA method to develop the ability to generate the governing FE equations for systems governed by partial differential equations and enhance the ability use of the basic finite elements for structural applications using truss, beam, frame, and plane elements and understand the application and use of the FE method for heat transfer problems.

10. Details of Course

S. No.	Contents	Contact Hours
1.	Variational Principles and Methods, Variational Formulations, Need for Weighted-Integral Statements, Boundary Value, Initial Value, and Eigenvalue Problems, Integral Identities, Linear and Bilinear Functionals. Elements of Calculus of Variations: Variational Operator and First Variation, Fundamental Lemma of Variational Calculus, Variational methods (Ritz method, The method of weighted residuals). weak formulation.	20
2.	Applications of finite element method to differential equations: two point boundary value problems, initial value problems in one dimension, eigenvalue and time dependent problems, heat and wave equations	20
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	An Introduction to the Finite Element Method by J. N. Reddy	3rd ed. Publisher: Mcgraw Hill
2.	The finite element method by O.C. Zienkiewicz	5th ed., Butterworth
3.	Introduction to the finite element method: theory, prog. and application By E.G. Thompson	2009, Wiley student edition.

1. Subject Code: **MC424**   Course Title: **Game Theory**

2. Contact Hours   : L-3   T-1   P-0

3. Examination Duration (Hrs)   : Theory: 3   Practical: Nil

4. Relative weightage   : CWS: 25 PRS: -   MTE: 25 ETE: 50 PRE: -

5. Credits   : 4

6. Semester   : VIII

7. Subject Area   : DEC

8. Pre-requisite   : NIL

9. Objective   : This course is intended to provide students with a comprehensive treatment of game theory with specific emphasis on applications in Economics and Engineering. The aim of this course is to introduce students to the novel concepts of Game Theory with special emphasis on its applications in diverse fields and current research.

10. Details of Courses:

S.No	Contents	Contact Hours
1	**Two-Person Zero Sum Games** Maximin and minimax criterion of optimality, Saddle point, Pure and mixed strategies, Dominance property.	9
2	**Solution Methods for Matrix Games** Algebraic method, Graphical method for solving $2 \times n$ and $n \times 2$ games, Invertible matrix games, Symmetric games, Matrix Games and Linear Programming	9
3	**Two-Person Non-zero sum Games** 2×2 Bimatrix Games, Interior Mixed Nash Points by Calculus, Nonlinear Programming Method for Nonzero Sum Two-Person Games	10
4	**N-Person Non-zero sum Games with a Continuum of Strategies** Economic Applications of Nash Equilibrium, Duels, Auctions – Complete Information	12

11. Suggested Books

S No	Name of Books /Authors Publishers	Year of Publication
1	E.N. Barron, Game Theory: An Introduction, John Wiley & Sons	2008
2	Osborne M.J., An Introduction to Game Theory, Oxford University Press	2004
3	A. Mas-Colell, M.D. Whinston and J.R. Green, Microeconomic Theory, Oxford University Press	1995
4	R.A. Gibbons, Primer in Game Theory, Pearson Education	1992

1. Subject Code: **MC-426**   Course Title: **Differential Geometry**

2. Contact Hours   : L-3   T-1   P-0

3. Examination Duration (HRS)   : Theory: 3   Practical : Nil

4. Relative Weightage   : CWS: 25 PRS: 0   MTE: 25 ETE: 50   PRE: 0

5.	Credits	:	4
6.	Semester	:	VIII
7.	Subject Area	:	DEC
8.	Pre –requisite	:	NIL
9.	Objective	:	The course will serve as an introduction to modern differential geometry. We will focus on local and global theory of curves and surfaces. The aim of this module is to describe how techniques from advanced calculus and linear algebra may be used to give meaning to the concept of shape for curves and surfaces in space.

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Geometry of Curves**: Parametric representation of curves, arc length, tangent vectors and vector fields in space, tangent line, osculating plane, inflextion point, normal plane, principal, normal, binormal, curvature and torsion, fundamental theorem for space curves, Frenet –Serret formulae, osculating circle, osculating sphere, spherical indicatrix, Frenet approximation.	12
2.	**Geometry of surfaces:** Parameterization, arc length, tangent plane, differentials, first and second fundamental forms, curves in surfaces, normal and geodesic curvature, ruled surface , developable surface, edge of regression,.	9
3.	**Intrinsic and extrinsic geometry of surfaces:** Gauss curvature, Gauss characteristic equations, Gauss and Weingarten formula, equations of Mainardi-Codazzi.	7
4.	**Geometry of geodesics:** Geodesic property, equation of geodesic, Geodesic polar co-ordinates,	7
5.	**Global result about surfaces:** The gauss-Bonnet theorem, Theorem of parallels, Fundamental existence theorem for surfaces.	7
Total		**42**

11. Suggested Books

S. No.	Name of books / Authors Publishers	Year of Publication
1.	Nirmala Prakash: Differential Geometry; an integrated approach, Mc Graw-Hill, 2nd edition	1982
2.	B.O' Neill: Elementary Differential Geometry, Elsevier	2006
3.	J.A. Thorpe: Elementary Topics in Differential Geometry, Springer	1979
4.	Christian Bar: Elementary Differential Geometry, CUP	2010
5.	M.P. do Carmo: Differential Geometry of curves and surfaces, Prentice Hall	1979

1. Subject Code: **MC-432**   Course Title: **Fuzzy Sets and Fuzzy Logic**

2. Contact Hours   : L-3   T-1   P-0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: Nil

4. Relative Weightage   : CWS: 25 PRS: 0   MTE: 25 ETE: 50   PRE: 0

5. Credits   : 4

6. Semester   : VIII

7. Subject Area   : DEC

8. Pre-requisite   : NIL

9. Objective   : Humans have a remarkable capability to reason and make decisions in an environment of uncertainty, imprecision, incompleteness of information, and partiality of knowledge, truth and class membership. The principal objective of **fuzzy logic** is formalization/mechanization of this capability by providing an understanding of the basic mathematical elements of the theory of fuzzy sets, fuzzy logic inference with emphasis on

their use in the design of intelligent or humanistic systems. Provide an insight into fuzzy inference applications.

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Fuzzy Sets:** Basic concepts, fuzzy sets versus crisp sets, fuzzy sets versus rough sets, operations on fuzzy sets, complements, intersections, unions and their combinations, fuzzy numbers, fuzzy equations.	8
2.	**Fuzzy Relation:** Crisp versus fuzzy relations, binary fuzzy relations, equivalence relations, compatibility relations, ordering relations, fuzzy morphisms.	8
3.	**Fuzzy Logic:** Classical logic, multivalued logics, fuzzy propositions, fuzzy quantifiers, Linguistic Hedges, influence from conditional fuzzy propositions, conditional and qualified propositions, quantified propositions.	8
4.	**Fuzzy expert systems:** Fuzzy implications, Multiconditional approximate reasoning, interval-valued approximate reasoning.	8
5.	**Fuzzy controllers:** Fuzzy systems and neural networks, fuzzy automata, applications in economics, computer engineering and reliability theory.	8
Total		**40**

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	George J. Klir, Bo Yuan, Fuzzy Sets and Fuzzy Logic Theory and Applications, Prentice Hall of India Pvt. Ltd.	1995
2.	H. J. Zimmerman, Fuzzy Set Theory and its Applications, Fourth edition, Springer.	2012
3.	Timothy J. Ross, Fuzzy Logic with Engineering applications, Third edition, Wiley.	2013

1. Subject Code: **MC - 434**   Course Title: **Numerical methods for PDE**

2. Contact Hours   : L-3   T-0   P-2

3. Examination Duration (Hrs.)   : Theory : 3   Practical: Nil

4. Relative Weightage   : CWS: 15 PRS: 15 MTE: 30 ETE: 40   PRE:

5. Credits   : 4

6. Semester   : VIII

7. Subject Area   : DEC

8. Pre-requisite   : Some knowledge of numerical methods, PDEs. And MATLAB

9. Objective   : To learn computational solution of PDEs

10. Details of Course

S. No.	Contents	Contact Hours
1.	Overview of PDEs: Classification of multidimensional PDEs: Elliptic, Hyperbolic, Parabolic, Implicit Vs Explicit Methods to Solve PDEs, Well-posed and ill-posed PDEs.	10
2.	Numerical solution of parabolic equations: Explicit methods for 1-D heat or diffusion equation, Difference Approximations for Derivative Terms in PDEs, Numerical solution of 1-D heat equation using the finite difference method, Explicit Forward Euler method, Stability analysis for forward Euler method, Method of lines, Implicit methods for 1-D heat equation, Finite Difference for 2D Heat (or Diffusion) Problems, Alternating Direct Implicit method, Crank Nicolson implicit method.	16
3.	Numerical Solution of Elliptic and hyperbolic equations: The 5-points and nine points stencil for the Laplacian, Some finite difference methods for 1-D hyperbolic equations and their convergence and stabilities.	16
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	Finite difference methods for ordinary and partial diff. equations, Randall Leveque.	SIAM, 2007
2.	A first course in the Numerical analysis of differential equations, A. Iserles.	Cambridge, 2008
3.	Numerical partial differential equations: finite difference methods by J.W. Thomas.	Springer 2006.

1. Subject Code: **MC – 436**   Course Title: **Petrinet Theory and Applications**

2. Contact Hours   : L-3   T-1   P-0

3. Examination Duration (Hrs.) : Theory: 3   Practical: Nil

4. Relative Weightage   : CWS: 25 PRS: 0   MTE: 25 ETE: 50 PRE: 0

5. Credits   : 4

6. Semester   : VIII

7. Subject Area   : DEC

8. Pre-requisite   : NIL

9. Objective   : In this course the students will learn Basic concepts of Petri nets, typical analysis problems, analysis methods, Petri net languages, restrictions and extensions of basic class of Petri nets, Colored Petri nets, Hierarchical and Object oriented Petri nets, Petri nets tools, applications.

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Basics of Petri nets:** Petri nets, Petri net structure, dual of a Petri net, inverse Petri net, markings, dynamics, state space, alternate formulations of Petri nets.	9
2.	**Modelling with Petri nets:** Events and conditions, concurrency, conflicts, finite state machine using Petri net, modelling of producer/consumer problem, modelling of dining philosophers problem, modelling of readers/writers problem and modelling of chemical process.	9
3.	**Analysis of Petri nets:** Safeness, boundedness, conservation, liveness, coverability, firing sequences and reachability.	9
4.	**Classes of Petri nets:** S-graphs, S-systems, T-graphs, T-systems, free choice systems, deadlocks and traps.	6
5.	**Matrix Approach:** Incidence matrix of a Petri net, state equations, adjacency matrix, transitive matrix, place transitive matrix, transition transitive matrix, characteristic equation, characteristic polynomial and characterization of sub-classes of Petri nets by matrices.	9

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	Petri net theory and modelling of systems by J. L. Peterson, Englewood cliffs, Nj: Prentice-Hall Inc., 1981.	1981
2.	Petri nets by W. Reisig, Springer-Verlag, 1985.	1985
3.	Free choice Petri nets by J. Desel and J. Esparza, Cambridge University Press, 1995, Online ISBN-9780511526558.	1995

1. Subject Code: **MC-438**   Course Title: **Tensor Calculus**

2. Contact Hours: L-3   T-1   P-0

3. Examination Duration (Hrs)   : Theory: 3   Practical : Nil

4.	Relative Weightage	:	CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5.	Credits	:	4
6.	Semester	:	VIII
7.	Subject Area	:	DEC
8.	Pre –requisite	:	Knowledge of elementary calculus, differential equations, vector calculus.
9.	Objective	:	The principal aim of tensor calculus is to investigate the relations which remain valid when we change from one coordinate system to any other. It has applications in most branches of theoretical physics and engineering, such as mechanics, fluid mechanics, elasticity, plasticity and electromagnetism, general theory of relativity.

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Tensors and their algebra:** Transformation of coordinates, contra variant and covariant tensors, mixed tensors, addition and subtraction of tensors, contraction, product of tensors (Inner and outer), symmetric and skew-symmetric tensors, quotient's law, conjugate symmetric tensor.	8
2.	**Metric tensor:** Metric tensor, length of a curve and null curve, associated tensors, raising and lowering of indices, vector magnitude, Levi-Civita tensor, relative and absolute tensor, hypersurfaces and congruence of curves.	9
3.	**Christoffel symbols and covariant differentiation:** Christofell three index symbols, transformation laws for Christoffel symbols, covariant derivatives, gradient, divergence and curl in tensor form, equation of geodesics, geodesics coordinate system. Null geodesics.	9
4.	**Riemann curvature tensor:** Riemann Christoffel tensor or curvature tensor and properties, Riemannian symbols of second kind, covariant form, Ricci tensor, scalar curvature, The Einstein tensor, Bianchi identity.	9

5.	**Some advanced topics in tensor:** Lie derivative, Killing vectors and equations, Applications to general relativity.	7
	Total	**42**

11. Suggested Books

S. No.	Name of books / Authors Publishers	Year of Publication
1.	Mc Connel, A.J.: Application of Tensor Analysis, Dover publications	2011
2.	Dalarsson, M and Dalarsson, N.:Tensor Calculus, Relativity and Cosmology, Elsevier Publication	2005
3.	Synge, J.L. and A. schild: Tensor Calculus, Dover Publication	1978
4.	D.F. Lowden: Introduction to Tensor Calculus, Relativity and Cosmology, Dover Publication, 3rd edition	2003

1. Subject Code: **MC – 440**   Course Title: **STATISTICAL INFERENCE**

2. Contact Hours   : L-3   T-1   P-0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: Nil

4. Relative Weightage   : CWS: 0   PRS: 0   MTE: 0   ETE: 0   PRE: 0

5. Credits   : 4

6. Semester   : VIII

7. Subject Area   : DEC

8. Pre-requisite   :

9. Objective   : In this course we introduce desirable properties that good estimators and hypothesis tests should enjoy and use them as criteria in the development of optimal estimators and test procedures.

10. Details of Course

S. No.	Contents	Contact Hours
1.	**UNIT 1:** Point and Interval Estimation, Characteristics of Estimators, Unbiasedness, Consistency, Efficiency, Sufficiency, Maximum Likelihood Estimation, Confidence Interval and Confidence Limits.	8
2.	**UNIT 2:** Statistical Hypotheses, Critical Region, Two Types of Errors, Level of Significance, Power of the Test, Optimum Test Under Different Situation, Inference Concerning One Mean, Operating Characteristic Curves, Inference Concerning Two Means.	9
3.	**UNIT 3:** Estimation of Variance, Hypothesis Concerning One and Two Variances. Estimation of Proportions, Hypothesis Concerning One and Several Proportions, Analysis of r×c Tables, Goodness of Fit.	9
4.	**UNIT 4:** Least Square Estimator of the Regression Parameters, Statistical Inferences about the Regression Parameters, Curvilinear Regression, Multiple Regression, Coefficients of Determination and Correlation, Adequacy of the Model, Logistic Regression Models.	9
5.	**UNIT 5:** Non Parametric Methods, Wald-Wolfowitz Run Test, Test for Randomness, Median Test, Sign Test.	7
	TOTAL	**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	Miller & Freund: Probability and Statistics For Engineers, Pearson Education.	2017
2.	Sheldon M. Ross: Introduction to Probability and Statistics For Engineers and Scientists, Academic Press.	2009
3.	Levine, Stephan & Szabat: Statistics for Managers, PHI Learning.	2014

OPEN ELECTIVE COURSES

CO351 ENTERPRISE & JAVA PROGRAMMING

1. Subject Code: **CO351**   Course Title: **Enterprise & Java programming**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs   Practical 0

4. Relative Weightage   : CWS 25   PRS 0   MTE 25   ETE 50   PRE 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : Nil

9. Objective   : To introduce fundamentals of Enterprise Java Programming, concepts of program development using beans.

10. Details of Course :

Unit No.	Contents	Contact Hours
1.	**Collections :** Collection Interfaces, Concrete Collections, Collections Framework. **Multithreading :** Creating and running thread, Multiple thread synchronization, Thread communication, Thread group, Thread priorities, Daemon Thread, Life Cycle of Thread.	5

2.	Fundamentals in Networking: Sockets in Java - Internet Addressing - DNS – Ipv4,IPv6- URL class - TCP/IP and Datagram. The interfaces and classes for networking :Interfaces and classes of java.net package; InetAddress class : IP address scope - Host name resolution - Methods of InetAddress class; Program to look up the IP addresses for a hostname - Factory methods - Creating and using Sockets : Socket class - constructors and methods of Socket class. Creating TCP servers &clients : TCP/IP server sockets - Constructors and methods of ServerSocket class - Program to create a TCP/IP server and client. Handling URL: URL class - constructors and methods of URL class -URLConnection class - fields of URLConnection class - methods of URLConnection class. Working with Datagrams: DatagramPacket - Constructors for DatagramPacket class - Methods of DatagramPacket class - creating Datagram server and client.	6
3.	JDBC Package :JDBC – JDBC versus ODBC – Types of JDBC drivers – Connection – Statement – PreparedStatement.ResultSet :Fields of ResultSet – Methods of ResultSet – Executing a query - ResultSetMetaData – DatabaseMetaData. Datatypes in JDBC : Basic datatypes in JDBC – Advanced datatypes in JDBC – fields of Statement – methods of Statement – CallableStatement Interface – BatchUpdates	6
4.	Servlets : Using Servlets - Servlet Package - Servlet lifecycle - init() method - service() method , doGet() method, doPost() method and destroy() method . Classes and interfaces of Servlet: Servlet - GenericServlet - ServletConfig - ServletContext - ServletException - ServletInputStream - ServletOutputStream - ServletRequest – ServletResponse. Classes and interfaces of HttpServlet: HttpServlet - HttpServletRequest - HttpServletResponse - Reading HTML form data from Servlets - Response Headers - Response Redirection. Handling Servlets : Servlet Chaining - HttpUtils - Database access with JDBC inside servlet. State and Session management : Cookies - HttpSession - Server Side includes - Request forwarding – RequestDispatcher.	7

5.	Concepts of Java Beans: Java Beans - Advantage of Java Beans - Reflection and Introspection - Customizers – Persistence. Developing Java Beans : Bean Developer Kit (BDK) - Creating a Java Bean - Creating a Bean Manifest file - Creating a Bean JAR file. Controls and Properties of a Bean : Adding controls to Beans - Giving Bean Properties - BeanInfo interface - SimpleBeanInfo class. Types of Properties: Design pattern for Properties: Simple properties - Indexed Properties; Descriptor Classes - Giving Bean methods - Bound and Constrained Properties - Property Editors.	9
6.	Components of EntrepriseBeans : Distributed Multitiered Applications -J2EE components: J2EE clients, Web components, J2EE containers. Developing an Enterprise Bean : Packaging - Enterprise JavaBeans Technology - Enterprise Bean - Contents of an Enterprise Bean. Session Bean : Stateful session bean – life cycle of stateful session bean - Stateless session bean – life cycle of stateless session – ejbCreate methods – Business methods – Home interface – Remote interface – Running the session bean. Entity Bean :Persistence - Bean managed Persistence - Container Managed Persistance - Shared Access - Primary key – Relationships. Message Driven Bean :life cycle of message driven bean – onMessage method.	9
Total		**42**

11. Suggested Books

S. No.	Name of Books / Authors/ Publishers
Text Books	
1.	Java 2 Programming Black Book - Steven Holzner dreamTech Press(ISBN-9788177226553), 2005
2.	JavaBeans Programming from the GroundUp - Joseph O'Neil, TMGH, New Delhi(ISBN- 007463786X), 2001
Reference Books	

3	Head first EJB-O'Reilly (ISBN: 8173665265), 2003
4.	"Beginning Java™ EE 6 Platform with GlassFish 3 From Novice to Professional" by Antonio Goncalves– Apress publication(ISBN: 9781430219545), 2009

CO353 E-COMMERCE AND ERP

1. Subject Code: **CO353**   Course Title: **E-Commerce and ERP**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs   Practical 0

4. Relative Weightage   : CWS 25 PRS 0   MTE 25   ETE 50   PRE 0

5. Credits   :   3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : Nil

9. Objective   : To introduce E-Commerce and ERP

10. Details of Course

Unit No.	Contents	Contact Hours
1.	Introduction: Definition of Electronic Commerce, E-Commerce: technology and prospects, incentives for engaging in electronic commerce, needs of E-Commerce, advantages and disadvantages, framework, Impact of E-commerce on business, E-Commerce Models.	7
2.	Network Infrastructure for E- Commerce: Internet and Intranet based E-commerce- Issues, problems and prospects, Network Infrastructure, Network Access Equipments, Broadband telecommunication (ATM, ISDN, FRAME RELAY). Mobile Commerce: Introduction, Wireless ApplicationProtocol, WAP technology, Mobile Information device.	7

3.	Web Security: Security Issues on web, Importance ofFirewall, components of Firewall, Transaction security, Emerging client server, Security Threats, Network Security, Factors to consider in Firewall design, Limitation of Firewalls.	6
4.	Electronic Payments: Overview, The SET protocol, Payment Gateway, certificate, digital Tokens, Smart card, credit card, magnetic strip card, E-Checks, Credit/Debit card based EPS, online Banking. EDI Application in business, E- Commerce Law, Formsof Agreement, Govt. policies and Agenda.	6
5.	ERP Introduction, Benefits, Origin, Evolution and Structure:Conceptual Model of ERP, The Evolution of ERP, The Structure of ERP. Business Process Reengineering, Data ware Housing, Data Mining, Online Analytic Processing(OLAP), Product Life Cycle Management(PLM),LAP, Supply chain Management.	8
6.	ERP Marketplace and Marketplace Dynamics:Market Overview, Marketplace Dynamics, The Changing ERP Market. ERP- Functional Modules: Introduction, Functional Modules of ERP Software, Integration of ERP, Supply chain and Customer Relationship Applications. ERP Implementation Basics, ERP Implementation Life Cycle, Role of SDLC/SSAD, Object Oriented Architecture, Consultants, Vendors and Employees, ERP & E-Commerce, Future Directives- in ERP, ERP and Internet.	8
Total		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers
1.	Goel, Ritendra "E-commerce", New Age International,2007
2.	Ravi Kalakota, Andrew Winston, "Frontiers of Electronic Commerce", Addison-Wesley. 1996
3.	Vinod Kumar Garg and Venkitakrishnan N K, "Enterprise Resource Planning – Concepts and Practice", PHI 2004
4.	Rahul V. Altekar "Enterprise Resource Planning", Tata McGraw Hill, 2004
5.	Alexis Leon, "ERP Demystified", Tata McGraw Hill, 2014

CO355 CRYPTOGRAPHY AND INFORMATION SECURITY

1. Subject Code: **CO355**   Course Title: **Cryptography and Information Security**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs   Practical 0

4. Relative Weightage   : CWS 25 PRS 0   MTE 25   ETE 50   PRE 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : NIL

9. Objective   : To study various cryptographic techniques, mathematics related to cryptography and some network security protocols.

10. Details of Course

Unit No.	Contents	Contact Hours
1.	**Introduction:** Need for security, Introduction to security attacks, services and mechanism, introduction to cryptography, Conventional Encryption: Conventional encryption model, classical encryption techniques- substitution ciphers and transposition ciphers, cryptanalysis, stereography, stream and block ciphers, Intruders, Viruses and related threads.	6
2.	**Modern Block Ciphers:** Block ciphers principals, Shannon's theory of confusion and diffusion, Fiestal structure, data encryption standard(DES), strength of DES, crypt analysis of DES, block cipher modes of operations, triple DES, IDEA encryption and decryption, strength of IDEA, key distribution.	6

3.	Introduction to graph, ring and field, prime and relative prime numbers, modular arithmetic, Fermat's and Euler's theorem, primarily testing, Euclid's Algorithm, Chinese Remainder theorem, discrete logarithms, Principals of public key crypto systems, RSA algorithm, security of RSA, key management, Diffle-Hellman key exchange algorithm, introductory idea of Elliptic curve cryptography, Elganel encryption	8
4.	**Message Authentication and Hash Function:** Authentication requirements, authentication functions, message authentication code (MAC), hash functions, security of hash functions and MACS, MD5 message digest algorithm, Secure hash algorithm(SHA), Public Key Infrastructure(PKI): Digital Certificate, private key management, Digital Signatures: Digital Signatures, authentication protocols, digital signature standards (DSS), proof of digital signature algorithm.	6
5.	**Authentication Applications:** Kerberos and X.509, directory authentication service, password, challenge-response, biometric authentication, electronic mail security-pretty good privacy (PGP), S/MIME.	8
6.	**IP Security:** Architecture, Authentication header, Encapsulating security payloads, combining security associations, key management. **Web Security:** Secure Socket Layer(SSL) and transport layer security, TSP, Secure Electronic Transaction (SET), Electronic money, WAP security, firewall design principals, Virtual Private Network (VPN) security.	8
Total		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers
1.	William Stallings, "Cryptography and Network Security: Principals and Practice", Prentice Hall, New Jersy. 2016
2.	Atul Kahate, "Cryptography and Network Security", TMH. 2009
3.	Behrouz A. Forouzan, "Cryptography and Network Security", TMH.2007
4.	Johannes A. Buchmann, "Introduction to Cryptography", Springer-Verlag. 2004
5.	Bruce Schiener, "Applied Cryptography". 2015

CO357 OPERATING SYSTEM

1. Subject Code: **CO357**   Course Title: **Operating System**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs   Practical 0

4. Relative Weightage   : CWS 25   PRS 0   MTE 25   ETE 50   PRE 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : NIL

9. Objective   : To familiar with the fundamental principles of the operating system, its services and functionalities, the concepts of processes, synchronization and scheduling, memory management and need for protection in computer systems

10. Details of Course

Unit No.	Contents	Contact Hours
1.	**Introduction:** Operating system and function, Evolution of operating system, Batch, Interactive, Time Sharing and Real Time System, System protection. **Operating System Structure:** System Components, System structure, Operating System Services.	4
2.	**Concurrent Processes:** Process concept, Principle of Concurrency, Producer Consumer Problem, Critical Section problem, Semaphores, Classical problems in Concurrency, Inter Process Communication, Process Generation, Process Scheduling. **CPU Scheduling:** Scheduling Concept, Performance Criteria of Scheduling Algorithm, Evolution, Multiprocessor Scheduling.	9

3.	**Deadlock:** System Model, Deadlock Characterization, Prevention, Avoidance and Detection, Recovery from deadlock combined approach.	8
4.	**Memory Management:** Base machine, Resident monitor, Multiprogramming with fixed partition, Multiprogramming with variable partition, Multiple base register, Paging, Segmentation, Virtual memory concept, Demand paging, Performance, Paged replacement algorithms, Allocation of frames, Thrashing, Cache memory organization, Impact on performance.	9
5.	**I/O Management & Disk Scheduling:** I/O devices and organization of I/O function, I/O Buffering, DISK I/O, Operating System Design Issues. **File System:** File Concept, File Organization and Access Mechanism, File Directories, File Sharing, Implementation Issues	9
6.	**Case Studies:** Windows, Linux and Unix	3
Total		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers
Text Books	
1.	Silbersachatz and Galvin, "Operating System Concepts", Pearson, 5th Ed, 2001
2.	Tannenbaum, "Operating Systems", PHI, 4th Edition, 2000
Reference Books	
3.	Milenekovic, "Operating System Concepts", McGraw Hill 2001
4.	Dietel, "An introduction to operating system", Addison Wesley 1983

CO359 INTELLECTUAL PROPERTY RIGHTS

1. Subject Code : **CO359**   Course Title: **Intellectual Property Rights**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (ETE)(Hrs.) : Theory 3Hrs   Practical 0

4. Relative Weightage   : CWS 25 PRS 0   MTE 25 ETE 50   PRE 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : Nil

9. Objective   : To familiarize the students with basic concepts in each type of IPR together with historical developments in the subject & its importance in modern times.

10. Details of Course

Unit No.	Contents	Contact Hours
1.	Introduction: Concept of IPR, Historical development , kinds of IPR,brief description of patent, trademark, copyright ,industrial design, importance of IPR, IPR authorities.	5
2.	PATENTS :Introduction, Indian Patent Act 1970 &2002, Protectable subject matter--patentable invention, Procedure for obtaining patent, Provisional and complete specification Rights conferred on a patentee, transfer of patent, Revocation and surrender of patents, Infringement of patents, Action for infringement, Patent agents, Patent in computer programs.	8
3.	Trademark: Introduction, Statutory authorities, principles of registration of trademarks, rights conferred by registration of trademarks, Infringement of trademarks and action against infringement, procedure of registration and duration,licensing in trademark	7
4.	Copyright: Introduction, Author and ownership of copyright, rights conferred by copyright,term of copyright, assignment/licence of copyright, Infringement of copyright ,remedies against infringement of copyright, registration of copyright, copyright enforcement and societies	7

5.	Industrial design: The design act-2000, registerability of a design, procedure of registration of a design, piracy of a registered design, Case law on designs	6
6.	International IPR & case laws: World intellectual property organization, WCT, WPPT, TRIPS, Copyright societies, international IPR dispute resolution mechanism. Case laws.	9
Total		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers
Textbooks:	
1.	Law Relating to Intellectual property, fourth edition by B.L.Wadehra .Universal law publishing co. pvt. Ltd , 2007. ISBN 978-81-7534-588-1
Reference books:	
2.	Intellectual property: Patents, copyright ,trademarks and allied rights. Fifth edition by W.R. Cornish. Sweet & Maxwell publisher, 2003. ISSN 9780421781207
3	Law and practice of intellectual property in India by VikasVashishth, 2006 **ISBN:** 81-7737-119-3
4	Patents ,copyrights, trade marks and design by B L Wadhera, 2014
5	Dr. B. L. Wadhera, "Intellectual Property Law Handbook". Universal Law Publishing, 2002.

CO361 DATABASE MANAGEMENT SYSTEM

1. Subject Code: **CO361**   Course Title: **Database Management System**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs   Practical 0

4. Relative Weightage   : CWS 25 PRS 0   MTE 25   ETE 50   PRE 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : NIL

9. Objective   : To provide knowledge about the principles, concepts and applications of Database Management System.

10. Details of Course

Unit No.	Contents	Contact Hours
1.	**Introduction:** Data base system concepts and its architecture, Data models schema and instances, Data independence and data base language and interface, Data definition languages, DML. Overall data base structure. **Data modeling using Entity Relationship Model:** E.R. model concept, notation for ER diagrams mapping constraints, Keys, Concept of super key, candidate key, primary key generalizations, Aggregation, reducing ER diagrams to tables, extended ER model.	7
2.	**Relational Data Model and Language:** Relational data model concepts, integrity constraints, Keys domain constraints, referential integrity, assertions, triggers, foreign key relational algebra, relational calculus, domain and tuple calculus, SQL data definition queries and updates in SQL.	7
3.	**Data Base Design:** Functional dependencies, normal forms, 1NF, 2NF, 3NF and BCNF, multi-valued dependencies fourth normal forms, join dependencies and fifth normal forms. Inclusion dependencies, loss less join decompositions, normalization using FD, MVD and JDs, alternatives approaches to database design.	6
4.	**File Organization, Indexing and Hashing** Overview of file organization techniques, Indexing and Hashing-Basic concepts, Static Hashing, Dynamic Hashing, Ordered indices, Multi-level indexes, B-Tree index files, B+- Tree index files, Buffer management **Transaction processing concepts:** Transaction processing system, schedule and recoverability, Testing of serializability, Serializability of schedules, conflict & view serializable schedule, recovery from transaction failures, deadlock handling.	8

5.	**Concurrency Control Techniques:** Locking Techniques for concurrency control, time stamping protocols for concurrency control, concurrency control in distributed systems. multiple granularities and multi-version schemes.	8
6	**Case Studies:** Commercial databases, Oracle, Postgress, MySQL	6
	Total	**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers
	Text Books
1	Elmasri, Navathe,"Fundamentals of Database systems", Addision Wesley, 2016
2	Korth, Silberchatz, Sudarshan,"Data base concepts", McGraw-Hill. 2010
	Reference Books
1	Ramakrishna, Gehkre, "Database Management System", McGraw-Hill 2014
2	Date C.J.,"An Introduction to Database systems" 2006

EC351 MECHATRONICS

1. Subject Code: **EC351**   Course Title: **Mechatronics**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs   Practical 0

4. Relative Weightage   : CWS 25 PRS 0   MTE 25   ETE 50   PRE 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : Nil

9. Objective   : To introduce fundamentals of Mechatronics

10. Details of Course

Unit No.	Contents	Contact Hours
1.	Introduction : Basic Definitions and key elements of Mechatronics, Mechatronic Design Approach: Functions of Mechatronic Systems, Ways of Integration, Information Processing Systems (BasicArchitecture and hardware and Software trade-offs, Concurrent Design Procedure for Mechatronic Systems	6
2.	System Interfacing, Instrumentation,and Control Systems: Input and output Signals of a Mechatronic System, Signal Conditioning and microprocessor control, Microprocessor-Based Controllers and Microelectronics, Programmable Logic Controllers	6
3.	Introduction to Micro- and Nanotechnology, Micro-actuators, Micro-sensors, Nanomachines. Modeling Electromechanical Systems: Models for Electromechanical Systems, Rigid Body Models, Basic Equations of Dynamics of Rigid Bodies, Simple Dynamic Models, Elastic System Modeling, Dynamic Principles for Electric and Magnetic Circuits, Earnshaw's Theorem and Electromechanical Stability	10
4.	The Physical Basis of Analogies in Physical System Models: The Force-Current Analogy: Across and Through Variables, Maxwell's Force-Voltage Analogy:Effort and Flow Variables, A Thermodynamic Basis for Analogies	6
5.	Introduction to Sensors and Actuators: Characteristics of Sensor and Actuator Time and Frequency Measurement, The Role of Controls an modelling in Mechatronics: Integrated Modeling, Design, and Control Implementation, Special Requirements of Mechatronics that Differentiate from Classic Systems and Control Design, Modeling as Part of the Design Process, Modeling of Systems and Signals	6
6.	Design Optimizationof Mechatronic Systems: Optimization Methods, Principles of Optimization : ParametricOptimization, General Aspects of the OptimizationProcess, Types of Optimization Methods, Selection of aSuitable Optimization Method, Optimum Design of Induction Motor (IM), IM Design Introduction : Classical IM Design, Use of a Neuron Network for the Identification ofthe Parameters of a Mechanical dynamic system, Mechatronics and Computer Modelingand Simulation, Mechatronics and the Real-Time useof Computers, Communications andComputer Networks,Control withEmbedded Computersand ProgrammableLogic Controllers	8
Total		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers
1.	Mechatronics : an introduction by Robert H Bishop, Taylor & Francis, 2005
2	Introduction to Mechatronics by KK AppuKuttan Oxford University Press, 2007

EC353 COMPUTER VISION

1. Subject Code : **EC-353**   Course Title: **Computer Vision**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs   Practical 0

4. Relative Weightage   : CWS 25 PRS -   MTE 25 ETE 50   PRE 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : Nil

9. Objective   : To introduce fundamentals of Computer Vision and algorithms for object detection, recognition and tracking.

10. Details of Course

Unit No.	Contents	Contact Hours
1.	Introduction to computer vision: Role of Artificial intelligence and image processing in Computer Vision, Industrial Machine Vision applications, System architecture. Visual Sensors: Camera sensors: RGB, IR, Kinect sensor, Camera interfaces and video standards, Characteristics of camera sensors commercially available cameras. Camera Calibration: Interior, exterior calibration and rectification using Tsai's Calibration method.	5

2.	Basics of image processing – Pixel representations histograms ,transforms, colour filters, noise removal, Geometry: Math methods -linear algebra, vectors, rotations, Stereo – Epi-polar geometry, correspondence, triangulation ,Disparity maps . Basics of video processing – Background subtraction techniques – frame differencing, Gaussian Mixture Modelling (GMM), Object localization and processing:- Contours, edges, lines, skeletons.	7
3.	Image representation: Local Wavelet basis (multiscale), Global Fourier basis(Frequency), Adaptive basis (PCA and ICA) , Adaptive basis(discriminants) Basics of Object detection – Template matching, Cascade classifiers.	8
4.	Object Recognition : Object Modeling, Bayesian Classification, Feature Selection and Boosting, Scene and Object Discrimination.	6
5.	Motion and Tracking: Motion detection and tracking of point features, optical flow, SURF, SIFT. Tracking- Kalman filter, Particle Filter, Comparison of deterministic and probabilistic methods condensation, tracking humans, multi-frame reconstruction under affine and perspective projection geometry.	8
6.	Introduction to Computer Vision programming libraries: MATLAB/ OpenCV. advantages and disadvantages of each .	8
Total		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers
1.	Computer Vision: A Modern Approach (2nd Edition) 2nd Edition by David A. Forsyth (Author), Jean Ponce (Author), 2002
2.	Learning OpenCV: Computer Vision with the OpenCVLibrary Gary Bradski, Adrian Kaehler, 2008

EC355 EMBEDDED SYSTEM

1. Subject Code: **EC- 355**　　　　　Course Title: **Embedded Systems**

2. Contact Hours　　　　　　　　: L: 3　　　T: 0　　　P: 0

3. Examination Duration (ETE)(Hrs.)　: Theory 3 Hrs　　　Practical　0

4. Relative Weightage　　　　　　: CWS 25　PRS 0　　MTE 25　ETE 50　PRE 0

5. Credits　　　　　　　　　　　: 3

6. Semester　　　　　　　　　　: V

7. Subject Area　　　　　　　　: OEC

8. Pre-requisite　　　　　　　　: Knowledge of Computer Architecture and Microprocessors

9. Objective　　　　　　　　　　: To introduce fundamentals of 16 and 32 bit Microcontrollers, assembly language programming. The course also focuses on interfacing of different interrupt driven peripherals. It also covers in detail Real Time Operating Systems, Bus architecture, Digital Signal Processors and System On-Chip.

10. Details of Course

Unit No.	Contents	Contact Hours
1.	Overview of Embedded Systems: Characteristics of Embedded Systems. Comparison of Embedded Systems with general purpose processors. General architecture and functioning of micro controllers. PIC and 8051 micro controllers : Architecture, memory interfacing , interrupts, instructions, programming and peripherals .	8
2.	ARM : Architecture, memory interfacing , interrupts, instructions and Assembly Language programming. Exception processing and pipeline architecture and applications.	12

3.	Digital Signal Processors: DSP Architecture, DSP applications, algorithms, data path, memory, addressing modes, peripherals. TI and Sharc family of DSP processors.	4
4.	System On Chip : Evolution, features, IP based design, TI OMAP architecture and peripherals. Digital Multimedia processor: Architecture and peripherals.	4
5.	SRAM, DRAM working and organization. Interfacing memory with ARM 7. Elements of Network Embedded Systems	4
6.	RTOS : RT-Linux introduction, RTOS kernel, Real-Time Scheduling Bus structure: Time multiplexing, serial, parallel communication bus structure. Bus arbitration, DMA, PCI, AMBA, I2C and SPI Buses.	10
Total		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers
1.	Computers as components: Principles of Embedded Computing System Design, Wayne Wolf, Morgan Kaufman Publication, 2000
2.	ARM System Developer's Guide: Designing and Optimizing System Software, Andrew N. Sloss, Dominic Symes, Chris Wright, , Morgan Kaufman Publication, 2004
3.	Design with PIC Microcontrollers, John B. Peatman, Pearson Education Asia, 2002
4.	The Design of Small-Scale embedded systems, Tim Wilmshurst, Palgrav, 2003
5.	Embedded System Design, Marwedel, Peter, Kluwer Publishers, 2004

EC357 DIGITAL IMAGE PROCESSING

1. Subject Code: **EC 357**   Course Title: **Digital Image Processing**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (ETE) (Hrs.) : Theory 3Hrs   Practical 0

4. Relative Weightage   : CWS 25 PRS 0   MTE 25   ETE 50   PRE 0

5. Credits   : 3

6.	Semester	: V
7.	Subject Area	: OEC
8.	Pre-requisite	: Signals and Systems
9.	Objective	: To introduce the fundamentals of visual information, representation of 2-D and 3-D information, enhancement of information, retrieval of information, and various colour models.

10. Details of Course

Unit No.	Contents	Contact Hours
1.	Introduction to Image processing, fundamental steps in DIP, concept of visual information, image formation model, image sampling and quantization, digital image representation, spatial and gray level resolution, relationship between pixels, application of image processing system.	6
2.	Introduction to Multidimensional signals and systems, 2D-Signals, 2D systems, classification of 2D system, 2D convolution, 2D Z-transform, Image Transform: 2D-DFT, discrete cosine, discrete sine, Haar, Walsh, Hadamard, Slant, KL, SVD, Hough, Radon, Ridgelet.	8
3.	Image enhancement; Spatial domain: linear transformation, image negative, grey level shifting, non-linear transformation, logarithmic transformation, exponential transformation, grey level slicing, bit plane slicing, image averaging, mask processing, histogram manipulations, histogram thresholding, histogram stretching, histogram equalization, noise removing filters, smoothing filters, sharpening filters. Enhancement in Frequency Domain; ideal low pas filter, Butterworth low pass filter, ideal high pass filters, Butterworth high pass filter, band pass filter, Gaussian filters, Homomorphic filtering.	10
4.	Image restoration: degradation model, noise models, restoration in presence of noise, periodic noise removal in frequency domain, notch filters, inverse filtering, Wiener filtering.	6

5.	Introduction to Morphological Image Processing operations, dilation and erosion, opening and closing, hit-or-miss transformation, boundary extraction, region filling, extraction connected components, convex hull, thinning, thickening, skeletons, pruning.	6
6.	Introduction to various colour models: RGB, CMY, CMYK, HSI, HSV, and YCbCr. Concept of image compression, Image Segmentation: detection of discontinuities, edge linking and boundary detection, thresholding, region based segmentation, use of motion in segmentation.	6
Total		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers
1.	Digital Image Processing/ Gonzalez and Woods/ Pearson Education, 2008/Third Edition
2.	Fundamentals of Digital Image Processing/ A.K. Jain/ PHI, Indian Edition
3.	Digital Image Processing using MATLAB/ Gonzalez, Woods, and Eddins/ McGraw Hill, Second/ 2013
4.	Digital Image Processing/ K.R. Castleman/ Pearson, 2014
5.	Digital Image Processing Algorithms and Applications/I. Pitas/John Wiley, 2002
6.	Image Processing, Analysis, and Machine Vision/Milan Sonka, Vaclav Hlavac, Roger Boyale/ Cengage Learning, 4th Edition

EC359 VLSI DESIGN

1. Subject Code: **EC -359**   Course Title: **VLSI Design**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs   Practical 0

4. Relative Weightage   : CWS 25 PRS 0   MTE 25   ETE 50   PRE 0

5. Credits   : 3

6. Semester   : V

7.	Subject Area	:	OEC
8.	Pre-requisite	:	Nil
9.	Objective	:	To give the student an understanding of the different design steps required to carry out a complete digital VLSI (Very-Large-Scale Integration) design in silicon.

10. Details of Course

Unit No.	Contents	Contact Hours
1.	Introduction to VLSI, Manufacturing process of CMOS integrated circuits, CMOS n-well process design rules, packaging integrated circuits, trends in process technology. MOS transistor, Energy band diagram of MOS system,MOS under external bias, derivation of threshold voltage equation, secondary effects in MOSFETS	6
2.	MOSFET scaling and small geometry effects, MOScapacitances, Modeling of MOS transistors using SPICE, level I II and equations, capacitance models. The Wire: Interconnect parameters: capacitance, resistanceand inductance. Electrical wire models: The ideal wire, the lumpedmodel, the lumped RC model, the distributed RC model, the transmission line model, SPICE wire models.	6
3.	MOS inverters: Resistive load inverter, inverter with n-type MOSFET load, CMOS inverter: Switching Threshold, Noise Margin, Dynamic behavior of CMOS inverter, computing capacitances, propagation delay, Dynamic power consumption, static power consumption, energy, and energy delay product calculations, stick diagram, IC layout design and tools.	8

4.	Designing Combinational Logic Gates in MOS and CMOS: MOS logic circuits with depletion MOS load. Static CMOS Design: Complementary CMOS, Ratioedlogic, Pass transistor logic, BiCMOS logic, pseudo nMOS logic, Dynamic CMOS logic, clocked CMOS logic CMOS domino logic, NP domino logic, speed and power dissipation of Dynamic logic, cascading dynamic gates.	8
5.	Designing sequential logic circuits: Timing matrices for sequential circuits, classification of memory elements, static latches and registers, the bistability principle, multiplexer based latches , Master slave Edge triggered register , static SR flip flops, dynamic latches and registers, dynamic transmission gate edge triggered register, the C2MOS register	8
6.	Pulse registers, sense amplifier based registers, Pipelining, Latch verses Register based pipelines, NORA-CMOS. Two-phase logic structure; VLSI designing methodology –Introduction, VLSI designs flow, Computer aided design technology: Design capture and verification tools, Design Hierarchy Concept of regularity, Modularity & Locality, VLSI design style, Design quality.	6
Total		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers
1.	Digital integrated circuits a design perspective byJan M Rabaey, Anantha Chadrakasan Borivoje Nikolic, Pearson education, 2011.
2.	CMOS digital integrated circuits by Sung MO KangYusuf Leblebici, Tata McGraw Hill Publication, 2002
3.	Principle of CMOS VLSI Design by Neil E Weste and Kamran Eshraghian, Pearson education, 2000.

EE351 POWER ELECTRONIC SYSTEMS

1. Subject Code: **EE-351**　　　　　　Course Title: **Power Electronic Systems**

2. Contact Hours　　　　　　　　　: L: 3　　T: 0　　P: 0

3. Examination Duration (Hrs.)　　: Theory: 3　　　Practical: 0

4.	Relative Weight	:	CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5.	Credits	:	3
6.	Semester	:	V
7.	Subject Area	:	OEC
8.	Pre-requisite	:	NIL
9.	Objective	:	To familiarize the students with power electronics and its applications.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	Solid State Power Devices: Principle of operation of SCR, dynamic characteristic of SCR during turn ON and turn OFF, parameters of SCR, dv/dt and di/dt protection, snubber circuit, commutation circuits; Principle of operation ofMOSFET, IGBT, GTO, MCT, SIT, SITH, IGCT, their operating characteristics.	8
2.	Single-phase Converter: Half wave converter, 2-pulse midpoint converter, half controlled and fully controlled bridge converters, input current and output voltage waveforms, effect of load and source impedance, expressions for input power factor, displacement factor, harmonic factor and output voltage, effect of free-wheeling diode, triggering circuits. Three-phase Converter: Half wave, full wave, half controlled and fully controlled bridge converters, effect of load and source impedance, expressions for input power factor, displacement factor, harmonic factor and output voltage,	8
3.	AC-AC Converters: Principle of operation of cycloconverter, waveforms, control technique; Introduction of matrix converter.	4
4.	DC-DC Converters: Principle of operation of single quadrant chopper, continuous and discontinuous modes of operation; Voltage and current commutation, design of commutating components; Introduction to SMPS.	4

5.	Inverters: Voltage source and current source inverters, Principle of operation of single-phase half bridge and full bridge voltage source inverters, voltage and current waveforms; Three-phase bridge inverter, 120^0 and 180^0 modes of operation, voltage and current waveforms with star and delta connected RL load; Voltage and frequency control of inverters; PWM techniques-single pulse, multiple pulse, selective harmonic elimination, sinusoidal PWM.	8
6.	Applications: FACTS Technology: Reactive power control in power systems, transmission system compensation, static series and shunt compensation, static shunt and series compensators- SVC, STATCOM, TCSC, SSSC and their working principles and characteristics. Combined series-shunt compensators –UPFC and its applications and characteristic. VSC-HVDC Systems: Principles and applications	10
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1.	Mohan N., Undeland T. M. and Robbins W. P., "Power Electronics-Converters, Applications and Design", 3rd Ed., Wiley India, 2002.
2.	Rashid M. H., "Power Electronics Circuits Devices and Applications", 3rd Ed., Pearson Education, 2004.
3.	N.G. Hingorani and L. Gyugyi, "Understanding FACTS", IEEE Press, 2000
4.	K.R. Padiyar, "Facts Controllers In Power Transmission and Distribution", New Age publishers, 2013
5.	HVDC power transmission system, K.R.Padiyar, NewAge Publishers,2011

EE353 ELECTRICAL MACHINES AND POWER SYSTEMS

1. Subject Code: **EE-353**   Course Title: **Electrical Machines and Power Systems**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: 0

4. Relative Weight   : CWS: 25 PRS: 0   MTE: 25 ETE: 50   PRE: 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : NIL

9. Objective   : To familiarize the students with electrical machines and power systems.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	Transformers : constructional features, types, Special constructional features – cruciform and multiple stepped cores, cooling methodology, conservators, breather, Buchholz relay, voltage, current and impedance relationships, equivalent circuits andphasor diagrams at no load and full load conditions,voltage regulation, losses and efficiency, all day efficiency, auto transformer and equivalent circuit, parallel operation and load sharing.	8
2	Asynchronous machines: General constructional features of poly phase asynchronous motors, concept of rotating magnetic field, principle of operation, phasor diagram, Equivalent circuit, torque and power equations, torque-slip characteristics, losses and efficiency.	8
3	Synchronous machines : General constructional features, armature winding, emf equation, effect of distribution and pitch factor,flux and mmf relationship, phasor diagram, non-salient pole machine, equivalent circuit, determination of equivalent circuit parameters by open and short circuit tests, voltage regulation using synchronous impedance method, power angle characteristics	9
4	Single line diagram of power system, brief description of power system elements, synchronous machine, transformer, transmission line, bus bar, circuit breaker and isolator. Supply System:different kinds of supply system and their comparison, choice of transmission voltage. Transmission Lines:configurations, types of conductors, resistance of line, skin effect	9

5	Transmission lines: Calculation of inductance and capacitance of single phase, three phase, single circuit and double circuit ,transmission lines, representation and performance of short, medium and long transmission lines, Ferranti effect,surge impedance loading.	8
Total		**42**

11. Suggested Books

S. No.	Name of Authors /Books / Publishers
1	Fitzgerald. A.E., Charles KingselyJr, Stephen D.Umans, 'Electric Machinery', Tata McGraw Hill, 2006.
2	M.G. Say, 'Performance and Design of Alternating Current Machines', CBS Publishers, New Delhi, 2008
3	Nagrath I. J and Kothari D.P. 'Electric Machines', Tata McGraw Hill Publishing Company Ltd, 2010.
4	Power System Analysis, J. Grainger and W.D. Stevenson, TMH, 2006.
5	Electrical Power Systems,C. L.Wadhwa, New age international Ltd. Third Edition, 2010
6	Electric Power Generation, Transmission&Distribution,S.N.Singh, PHI Learning, 2008.

EE-355 INSTRUMENTATION SYSTEMS

1. Subject Code: **EE-355**   Course Title: **Instrumentation Systems**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: 0

4. Relative Weight   : CWS: 25 PRS: 0   MTE: 25 ETE: 50 PRE: 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite : NIL

9. Objective : To familiarize the students with instrumentation systems.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	Transducers-I:Definition, advantages of electrical transducers, classification, characteristics, factors affecting the choice of transducers, strain gauges, resistance thermometer, thermistors, thermocouples, LVDT, RVDT	8
2	Transducers-II:Capacitive, piezoelectric, Hall effect and opto electronic transducers. measurement of motion, force, pressure, temperature flow and liquid level.	8
3	Telemetry:General telemetry system, land line & radio frequency telemetering system, transmission channels and media, receiver & transmitter. Data Acquisition System:A/D and D/A converters, analog data acquisition system, digital data acquisition system, modern digital data acquisition system and signal conditioning.	8
4	Display Devices and RecordersDisplay devices, storage oscilloscope, DSO, spectrum analyzer, digital recorders. RecentDevelopments:Introduction to virtual and intelligent instrumentation, fibre optic transducers, smart sensors, smart transmitters, process instrumentation diagrams.	8
5	Programmable Logic Controllers :Evolution of PLC-sequential and programmable controllers, architecture and programming of PLC, relay logic and ladder logic, functional blocks, communication networks for PLC, field bus, profi-bus, mod-bus	10
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Electronic Instrumentation and Measurement Techniques, W.D. Cooper and A.D. Helfrick, Prentice Hall International, 2009.
2	Measurement Systems Application and Design Ernest Doebelin, McGraw- Hill Higher Education, 5th edition , 2003
3	Instrumentation, Measurement and Analysis, B.C. Nakra& K. Chaudhry, Tata McGraw Hill, 2nd Edition, 2001.
4	Advanced Measurements and Instrumentation, A.K. Sawhney, DhanpatRai& Sons, 2010
5	Process Control Instrumentation Technology, Curtis D. Johnson, Pearson, 6th edition, 1999
6	Programmable Logic Controllers, Frank D. Petruzella McGraw-Hill Higher Education, 4th edition, 2010

EE357 UTILIZATION OF ELECTRICAL ENERGY

1. Subject Code: **EE-357**   Course Title: **Utilization of Electrical Energy**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: 0

4. Relative Weight   : CWS: 25 PRS: 0   MTE: 25 ETE: 50   PRE: 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : NIL

9. Objective   : To familiarize the students with the concept of electrical power, energy and its utilization.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	Illumination: Definition:- Luminous flux, solid angle, luminous intensity, illumination, luminous efficiency, depreciation factor, coefficient of utilization, space to height ratio, reflection factor, glare, shadow, lux. Nature of light, visibility spectrum curve of relative sensitivity of human eye and wave length of light, Review of laws of illumination, Different types of lighting sources and their use in domestic, street and industrial lighting, Energy considerations. LED's and their driving circuits.	10
2	Electric Heating : Advantages of electrical heating, Heating methods: Resistance heating – direct and indirect resistance heating, properties of resistance heating elements, Induction heating; principle of core type and coreless induction furnace, Electric arc heating; direct and indirect arc heating, construction, working and applications of arc furnace, Dielectric heating, applications in various industrial fields, Infra-red heating and its applications, Microwave heating	08
3.	Electric Welding: Introduction to electric welding, Welding methods, Principles of resistance welding, types – spot, projection seam and butt welding and welding equipment used, Principle of arc production, electric arc welding, characteristics of arc, Design of Power supply and welding control circuit, comparison between AC and DC arc welding, welding control.	08
4.	Electrolytic Processes: Need of electro-deposition laws of electrolysis, process of electro-deposition - clearing, operation, deposition of metals, polishing, buffing equipment and accessories for electroplating factors affecting electro-deposition , principle of galvanizing and its applications, anodising and its applications, electroplating on non-conducting materials, manufacture of chemicals by electrolytic process, electrolysis for water purification	08
5.	Refrigeration and Air Conditioning and Water Coolers: Principle of air conditioning, vapour pressure, refrigeration cycle, eco-friendly refrigerants, description of electrical circuit used in a) refrigerator, b) air-conditioner, and c) water cooler, variable speed drive for compressors, high speed compressors, insta-chill, Peltier effect, thermoelectric cooling, sterling engines, solar concentrator heating and cooling,	08
	Total	**42**

11. Suggested books:

S. No.	Name of Authors /Books / Publishers
1.	Dubey G. K., "Fundamentals of Electric Drives", 2nd Ed., Narosa Publishing House,2007.
2.	Taylor E. O., "Utilization of Electric Energy (in SI units)", Orient Longman, Revised in S.I. units by Rao, V.V.L,1999
3.	Hancock N. N., "Electric Power Utilisation", Wheelers,1979.

EE-359 NON-CONVENTIONAL ENERGY SYSTEMS

1. Subject Code: **EE-359**   Course Title: **Non-conventional Energy Systems**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: 0

4. Relative Weight   : CWS: 25 PRS: 0   MTE: 25 ETE: 50 PRE: 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : NIL

9. Objective   : To familiarize the students with the non-conventional sources of energy and their integration to the grid.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	**Introduction to Non Conventional Energy Systems** Various non-conventional energy resources Introduction, availability, classification, relative merits and demerits. Solar Cells: theory of solar cells, solar cell materials, solar cell array, solar cell power plant, limitations. Solar Thermal Energy: solar radiation, flat plate collectors and their materials, applications and performance, focusing of collectors and their materials, applications and performance, solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.	10
2	**Geothermal Energy** Resources of geothermal energy, thermodynamics of geo-thermal energy conversion, electrical conversion, non-electrical conversion,environmental considerations. Magneto-hydrodynamics (MHD):principle of working of MHD power plant, performance and limitations.	8
3	**Fuel Cells:** Basic principle of working, various types of fuel cells, performance and limitations.	8
4	**Thermo-electrical and thermionic conversions** Principle of working of thermo-electrical and thermionic conversions, performance and limitations. Wind energy: wind power and its sources, site selection criteria, momentum theory, classification of rotors, concentrations and augments, wind characteristics, performance and limitations of wind energy conversion systems.	8
5	**Energy from Bio-mass, Ocean Thermal, Wave and bio-waste** Availability of bio-mass and its conversion principles, ocean thermal energy conversion principles, performance and limitations, wave and tidal energy conversion principles, performance and limitations, bio-waste recycling power plants.	8
Total		**42**

11. Suggested books:

S. No.	Name of Authors /Books / Publishers
1	Renewable Energy Resources, John Twidell, Tony Weir, Taylor and Francis, 2nd edition,2005.

2	Solar Engineering of Thermal Processes,John A. Duffie, William A. Beckman, John Wiley & Sons, 4th edition,2013.
3	Biofuels, Solar and Wind as Renewable Energy Systems: Benefits and Risks,D. Pimentel, Springer,1st edition,2010.
4	Solar Photovoltaic Technology and Systems: A Manual for Technicians, Trainers and Engineers,Chetan Singh Solanki, PHI Learning,2013.
5	Non Conventional Energy Resources, D.S. Chauhan, New Age International Pvt Ltd.,2006

EE-361 EMBEDDED SYSTEMS

1. Subject Code: **EE-361**   Course Title: **Embedded Systems**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: 0

4. Relative Weight   : CWS: 25 PRS: 0   MTE: 25 ETE: 50 PRE: 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : NIL

9. Objective   : To familiarize the students with the concepts of embedded systems.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	Embedded Processing – Evolution, Issues and Challenges;	1
2	System and Processor Architecture : von Neumann, Harvard and their variants	2

3	Memory Architecture and Devices; Input-Output Devices and Mechanisms	5
4	Instruction Set and Addressing Modes, Interfacing of Memory and Peripheral Devices – Functional and Timing Issues	6
5	Application Specific Logic Design using Field Programmable Devices and ASICs	2
6	Analog to Digital and Digital to Analog Converters	2
7	Bus I/O and Networking Considerations, Bus and Wireless Protocols	4
8	Embedded Systems Software : Constraints and Performance Targets	2
9	Real-time Operating Systems : Introduction, Scheduling in Real-time Operating Systems	4
10	Memory and I/O Management : Device Drivers	2
11	Embedded Software Development : Flow, Environments and Tools	2
12	System Specification and Modelling	2
13	Programming Paradigms	2
14	System Verification	2
15	Performance Analysis and Optimisation : Speed, Power and Area Optimisation, Testing of Embedded Systems	4
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1.	S. Heath, "Embedded Systems Design", Elsevier India,2005
2.	M. Ben-Ari, "Principles of Concurrent and Distributed Programming", Pearson,2005
3.	Jane Liu, "Real Time Systems", Pearson,2002

EN-351 ENVIRONMENTAL POLLUTION AND E –WASTE MANAGEMENT

1. Subject Code: **EN-351**   Course Title: **Environmental Pollution & E- Waste Management**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (ETE) (Hrs.) : Theory: 3 Hrs.   Practical: 0

4. Relative Weightage   : CWS 25 PRS 0   MTE 25   ETE 50   PRE 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : Nil

9. Objective   : The overall aims of the course are for students to acquire understanding of the new and emerging contaminants from various industrial processes and their transformation products. Studying emerging environmental issues related to newer methods of manufacture of industrial products.

10. Details of Course

Unit No.	Contents	Contact Hours
1	UNIT-I New and emerging pollutants and related transformation products, Effects & risks of emerging contaminants on ecosystems and humans, Persistent pollutants. Analytical methods for identifying emerging pollutants and the products of their transformation	9
2	UNIT-II Micro pollutants- Pesticides, Pharmaceutical - Veterinary and human drugs, personal care products, Surfactants and surfactant metabolites, Flame retardants, Industrial additives and agents.Emerging pollutants' toxicity, and their water-related characteristics (degradability, solubility, sorption…)	9

3	UNIT-III Emerging Issues - E-waste, Hazardous Waste, Nuclear Waste, Nano pollution, Thermal Pollution, pollutant emission and treatment	8
4	UNIT-IV Emerging pollutants' emergence and fate in surface and ground water, as well as mathematical modelling, Sustainable Development, Risk mitigation	8
5	UNIT-V Transformation Products of Emerging Contaminants in the Environment, Removal of emerging contaminants from water, soil and air, methods and preventive measures.	8
Total		**42**

Course Outcome:
1. Introduction to new and emerging contaminants and their transformation products.
2. Study of pollutants from manufacturing of goods.
3. Emerging area in environmental pollution.
4. Study of life cycle of a contaminant, modeling and mitigation.

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1.	G. Buttiglieri, T.P. Knepper, (2008), Removal of emerging contaminants in Wastewater Treatment: Conventional Activated sludge Treatment, Springer-Verlag Berlin Heidelberg, HdbEnvChem, vol. 5, Part S/2:1-35, DOI: 10.1007/698_5_098
2.	Alok Bhandari; Rao Y. Surampalli; Craig D. Adams; Pascale Champagne; Say Kee Ong; R. D. Tyagi; and Tian Zhang, Eds., (2009) Contaminants of Emerging Environmental Concern, American Society of Civil Engineers, ISBN (print): 978-0-7844-1014-1, ISBN (PDF): 978-0-7844-7266-8
3.	Dimitra A. Lambropoulou, Leo M. L. Nollet Eds. () Transformation Products of Emerging Contaminants in the Environment: Analysis, Processes, Occurrence, Effects and Risks, 1st Edition, Wiley, ISBN-13: 978-1118339596, ISBN-10: 1118339592

EN353 OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT

1. Subject Code: **EN- 353**   Course Title: **Occupational Health and Safety Management**

2. Contact Hours   :   L: 3   T: 0   P: 0

3. Examination Duration (ETE) (Hrs.)   :   Theory 3 Hrs

4. Relative Weightage   :   CWS 25   PRS 0   MTE 25   ETE 50   PRE 0

5. Credits   :   3

6. Semester   :   V

7. Subject Area   :   OEC

8. Prerequisite   :   Nil

9. Course Objectives   :
    1. Introduction about occupational health and related issues.
    2. To give a basic idea about environmental safety management, industrial hygiene.
    3. To introduce about training cycle, chemical hazards and control measures.
    4. To aware and provide knowledge about ergonomics and different disorders.
    5. To provide knowledge about different standards related to safety and health.

10. Detail of Course:

Unit no.	Contents	Contact Hours
1	UNIT –I Definition of Occupational Health as per WHO/ILO. Occupational Health and Environmental Safety Management – Principles practices. Common Occupational diseases: Occupational Health Management Services at the work place. Pre-employment, periodic medical examination of workers, medical surveillance for control of occupational diseases and health records.	8

2	UNIT –II Occupational Health and Environment Safety Management System, ILO and EPA Standards. Industrial Hygiene: Definition of Industrial Hygiene, Industrial Hygiene: Control Methods, Substitution, Changing the process, Local Exhaust Ventilation, Isolation, Wet method, Personal hygiene, housekeeping and maintenance, waste disposal, special control measures.	8
3	UNIT –III Element of training cycle, Assessment of needs. Techniques of training, design and development of training programs. Training methods and strategies types of training. Evaluation and review of training programs. Chemical Hazard: Introduction to chemical hazards, dangerous properties of chemical, dust, gases, fumes, mist, Vapours, Smoke and aerosols. Evaluation and control of basic hazards, concepts of dose response relationship, bio-chemical action of toxic substances. Concept of threshold, limit values.	9
4	UNIT –IV Occupational Health Hazards, Promoting Safety, Safety and Health training, Stress and Safety, Exposure Limit. Ergonomics-Introduction, Definition, Objectives, Advantages. Ergonomics Hazards. Musculoskeletal Disorders and Cumulative Trauma Disorders. Physiology of respiration, cardiac cycle, muscle contraction, nerve conduction system etc. Assessment of Workload based on Human physiological reactions. Permissible limits of load for manual lifting and carrying. Criteria or fixation limits.	9
5	UNIT –V Bureau of Indian standards on safety and health 14489 - 1998 and 15001 – 2000, OSHA, Process Safety Management (PSM) as per OSHA, PSM principles, OHSAS – 18001, EPA Standards, Performance measurements to determine effectiveness of PSM. Importance of Industrial safety, role of safety department, Safety committee and Function.	8
Total		**42**

Course Outcomes:
1. The student will be able to understand the basics of occupational health and related issues.
2. Understanding of the fundamental aspects of safety, industrial hygiene along with learning theory to safety training methodology.
3. Considerate about hazardous materials, emergency management, ergonomics and human factors

4. Able to understand the adverse effects of hazards and develop control strategies for hazardous conditions and work practices
5. Learn about Indian standards of health and safety and able to apply applicable standards, regulations and codes.

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1.	Handbook of Occupational Health and Safety, NIC, Chicago, 1982.
2.	Encyclopedia of Occupational Health and Safety, Vol. I and II. International Labour Organisation, Geneva, 1985.
3.	Accident Preventional Manual, NSC Chicago, 1982.
4.	Henrich, H.W., Industrial Accident Prevention, McGraw Hill, 1980.

EN-355 GIS & REMOTE SENSING

1. Subject Code: **EN-355**   Course Title: **GIS & Remote Sensing**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs

4. Relative Weightage   : CWS 25 PRS 0   MTE 25 ETE 50   PRE 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Prerequisite   : Nil

9. Course Objectives   :
1. Introduce GIS and its significance in engineering and science.
2. To familiarize students with GIS data and its applications.
3. To familiarize students about the basics of remote sensing and its multi concepts.
4. To disseminate knowledge about sensors and different kind of resolution in the area of remote sensing.
5. To familiarize students about the diverse applications of remote sensing.

10. Detail of Course:

Unit no.	Contents	Contact Hours
1	Unit-1: Geographic Information System Introduction, Definition of GIS, Components of GIS, Input data for GIS, Geographical concepts	7
2	Unit-2:GIS Data GIS data types, Data representation, Data sources, Geo-referencing of GIS data, GIS database, Database Management System, Data analysis terminology, GIS software packages, GIS application	9
3	Unit-3:Remote Sensing Introduction to Remote Sensing and Remote Sensing System, Multi concept of remote sensing, Advantages and disadvantages of remote sensing, Electromagnetic radiation, Polarisation, Thermal radiation	8
4	Unit-4:Remote Sensing Platforms Important remote sensing satellites, Classifications of sensors and platforms, Passive and Active sensors, Major remote sensing sensors, Spatial resolution, Spectral resolution, Radiometric resolution, Temporal resolution, Glopal Positioning System	9
5	Unit-5:Application of Remote Sensing Digital Image Processing, Application of Remote Sensing in Land use and Land cover mapping, Ground water mapping, Urban growth studies, Wasteland mapping, Disaster management, Agriculture, Forestry application	9
	Total	**42**

Course Outcomes:
1. The Student will learn about basics of GIS and its significance.
2. The Student will be able to understand the utility of GIS data as well as Data Management System.
3. The Student will learn the fundamentals of remote sensing.
4. The unit of Remote Sensing Platform will generate a clear cut understanding among students about the satellites, their functioning and Global Positioning System. Geographical information system, its components, DMS and its various applications in real life.
5. The Student will be able to attain thorough knowledge about the application of remote sensing in different areas.

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1.	Fundamentals of Remote Sensing – George Joseph, University Press, Hyderabad, India.
2.	Remote Sensing and Geographical Information System – AM Chandra & SK Ghosh Narosa Publishing House, New Delhi.
3.	Concepts and Techniques of Geographic Information Systems – C. P. Lo & Albert K.W. Yeung, PHI Learning Private Limited, New Delhi.
4.	Geographic Information System – Kang Tsung Chang, Tata Mc Graw hill, Publication Edition, 2002.

EP351 PHYSICS OF ENGINEERING MATERIALS

1. Subject code: **EP351**   Course title: **Physics of Engineering Materials**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (Hrs)   : Theory: 3   Practical: 0

4. Relative Weight   : CWS: 25 PRS: 0   MTE: 25 ETE: 50 PRE: 0

5. Credits   : 3

6. Semester   : V

7. Subject area   : OEC

8. Pre-requisite   : NIL

9. Objective   : To familiarize the fundamentals /basic concepts and advances of the different materials keeping in view of the engineering applications. There is ample opportunity to become involved in cutting edge Materials Science and Engineering Research

10. Detail of Course:

Unit No.	Contents	Contact Hours
1.	**Crystallography:** Introduction to crystal physics,Space lattice, Basis and the Crystal structure, Bravais lattices; Miller indices, simple crystal structures,Interplanar spacing, Intra and Intermolecular bonds (Ionic, Covalent, Metallic, Van der Waals and Hydrogen Bond), Defects in crystals, Basics of X- ray diffraction and its applications	10
2.	**Semiconductors:** Band theory of solids, Intrinsic and Extrinsic semiconductors, Statistics of electrons and holes in intrinsic semiconductor, Hall effect, Effect of temperature on conductivity, Generation and recombination, drift and diffusion current, Einstein relation, Applications of Semiconducting Materials.	10
3.	**Dielectric and Magnetic Materials** *Dielectric Materials:* Dielectric polarization and dielectric constant, Various polarization processes, Applications of Dielectric Materials *Magnetic Materials:* Concept of Magnetism, Classification of dia-para, Ferro, Antiferro and Ferrimagnetism, ferrites, soft and hard magnetic materials, Applications of Magnetic Materials	07
4.	**Superconductivity:** Introduction and historical developments; General properties of super conductors, Meissner effect and its contradiction to the Maxwell's equation; Types of Superconductors, London equations, Penetration depth, High Temperature Superconductors, Applications of superconductors.	07
5.	**Advanced Engineering Materials:** Introduction, Synthesis, characterization and applications of Photonic glasses, Phosphors and Nanophosphors, other selective topics in advanced materials.	08
Total		**42**

11. Suggested Books:

S. No.	Name of Books/ Authors
1.	Introduction to Solid State Physics, by C. Kittel, 1996/ John Wiley & sons
2.	Solid State Physics, by S. O. Pillai, 2010/ New Age International (P) Ltd.
3.	Materials Science and Engineering by V. Raghavan, 2009/PHI Learning Pvt. Ltd.
4.	Solid State Physics, N. W. Ashcroft and N. D. Mermin, 1976/ HBC Publication
5.	Engineering Materials Science by Milton Ohring, 1995/Academic Press
6.	Material Science and engineering: An Introduction By W. D. Callister Junior, 2007/ John Wiley & Sons, Inc
7.	Handbook of Electronic and Photonic Materials by SafaKasap, Peter Capper (Eds.), 2006/Springer

EP353 NUCLEAR SECURITY

1. Subject code: **EP353**   Course title: **Nuclear Security**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (Hrs)   : Theory: 3   Practical: 0

4. Relative Weight   : CWS: 25 PRS:--   MTE: 25 ETE: 50 PRE: --

5. Credits   : 3

6. Semester   : V

7. Subject area   : OEC

8. Pre-requisite   : Basic knowledge of Nuclear Physics

9. Objective   : This course will provide basic understanding of Nuclear Security which is essential for establishing nuclear culture in the society

10. Detail of Course:5th/6th Semester

S. No.	Contents	Contact Hours
1.	Introduction to nuclear security: Basics of nuclear security, Practice and culture, Background, Objective, Scope, Structure, Nuclear security and safety culture: Characteristics of nuclear security culture	08
2.	Nuclear security regime, Importance of human factor and management leadership in nuclear security, Nuclear security threats: Threat informed security, The design basis threat	07
3.	System characterization, PPS requirements and objectives: Facility characterization, Target identification, Consequence analysis, PPS performance objectives	06
4.	Physical protection system technologies: Intrusion detection, Exterior and Interior Sensors, Access control, Contraband detection, Field detection sensors at borders/major public Events, Alarm assessment, Communication and display, Access delay, Response and neutralization, Response strategies and impact of On and Off site response, Cyber security.	09
5.	Security system design and evaluation: Adversary path analysis and Multi path optimization, Scenario development, Insider analysis, Transportation, Design approaches and vulnerability assessments, System design at major public events, Design of security systems to interrupt illicit trafficking, Analysis of quantitative risk assessment methods.	08
6.	Consequence mitigation and event response: Consequence management following nuclear events, Analysis of deterrence value of security measures, Roles and responsibilities of institutions and individuals	04
Total		**42**

11. Suggested Books

S. No.	Name of Books/ Authors
1.	Nuclear security briefing book, by Wyn Bowen, Matthew Cottee, Chris Hobbs, Luca Lentini and Matthew Moran, 2014/King's College, London, UK
2.	IAEA Nuclear Security Series No. 13, Nuclear Security recommendations on physical protection of nuclear material and nuclear facilities by IAEA, 2011/ International Atomic Energy Agency (IAEA)
3.	The International Legal Framework of Nuclear Security: IAEA International law series No. 4 by IAEA, 2011/International Atomic Energy Agency (IAEA)
4.	Seeking Nuclear Security Through Greater International Cooperation by Jack Boureston and Tanya Ogilvie-White, 2010/Council on Foreign Relations (CFR's) International Institutions
5.	Book Review: South Asia's Nuclear Security by Bhumitra Chakma , 2015/Oxon, UK, Routledge

HU351

1. Subject Code: **HU351**   Course Title: **Econometrics**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (ETE)   : Theory 3 Hrs   Practical 0

4. Relative Weightage   : CWS 25 PRS 0   MTE 25   ETE 50   PRE 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : Nil

9. Objective:

10. Details of Course

Unit	Contents	Contact Hrs
1.	Introduction Concept of Econometrics, methodology of Econometrics, types of Econometrics, Difference between Econometrics and Mathematical Economics, Type of Data, Sources of data, Estimating Economic Relationship	8
2.	Mathematics and Economic Application Differential Calculus and its application in Economics- Price and Cros Elasticity of demand, Profit maximization under Perfect Competition, Monopoly, Oligopoly and Monopolistic Competition Integral Calculus and its application in Economics - Capital Formation, Compound Interest; Capital value and Flow Value; Consumer surplus under pure competition and monopoly; Producers Surplus Differential Equation and its application in Economics – Market Price Function; Dynamic Multiplier;	12
3.	Regression Statistical verses Deterministic Relationships, Regression verses Causation; Two variable Regression Analysis; Population Regression Function (PRG), Stochastic specification of PRF; The Significance of the Stochastic Term; stochastic disturbance Term; the sample regression Function (SRF); Method of Ordinary Least Squares; Properties of Least Square Estimators: The Gauss-Markov Theorem, Coefficient of determination r^2: A Measure of "goodness of fit"; Monto Carlo Experiments	8
4.	Classical Normal Linear Regression Mode (CNLRM) The Probability distribution of Disturbances (meu); Normality Assumption, Method of Maximum Likelihood Multiple regression Analysis: The Problem of estimation; The problem of Inference Cobb-Douglas Production function; Polynomial Regression Model; Testing for structural or Parametric stability of regression Models; the Chow test	6
5.	Dummy Variable (DV) Regression Models Nature; ANOVA models; Regression with a mixture of Quantitative and Qualitative regressors: The ANCOVA Models; DV alternative to the Chow Test; Interaction effects using Dummy Variable; Use of DV in seasonal Analysis	6
Total		**40**

11. Suggested books

S.No.	Name of Books, Authors, Publishers
1.	Wooldridge Jeffrey , Introductory Econometrics, Cencage Learning- ISBN-13-978-81-315-1673-7; ISBN-1081-315-1673-3,2014
2.	Damodar N. Gujrati, Basic Econometrics, Mcgraw Hill Education (India) Limited, Fifth Edition,2013 ISBN-978-0-07-133345-0; ISBN; 0-07-133345-2
3.	Ramu Ramanathan, Introductory Econometrics with Applications, Harcourt Brace Jovanovich Publishers, Latest USA ISBN-

MA351 HISTORY CULTURE & EXCITEMENT OF MATHEMATICS

1. 1 Subject code: **MA351**   Course title: **History Culture and Excitement of Mathematics**

2. Contact Hours   : L-3   T-0   P-0

3. Examination Duration (Hrs)   : Theory: 3   Practical : Nil

4. Relative weightage   : CWS: 25 PRS: -   MTE: 25 ETE: 50   PRE: 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre requisite   : --

9. Objective: To be capable in learning the history and culture on the Mathematics subjects

Unit No.	Contents	Contact Hours
1.	Ancient, Medieval and Modern Indian Mathematics: Aryabhata, Brahmagupta, Bhaskar, Lilavati, Ramanujan	7
2	Introduction to Ancient books of Indian Mathematicians: Sidhantas, Sulvasutras, Vedic Mathematics	7

3	Contribution of Indian Mathematicians in the field of Mathematics: Value of Pi, The symbol zero, Number theory, Trigonometry, and Mensuration, Hindu Multiplication, Long Division, Indeterminate equation	7
4	Mathematicians Around the world: Newton, Leibnitz, Cauchy, Lagrange in the field of Geometry, Calculus, Algebra, Probability	7
5	Algebra in the Renaissance: Solution of cubic equation, Ferrari's Solution in the quartic equation, Irreducible Cubics and complex numbers	7
6	Paradoxes, Fallacies and Pitfalls of Mathematics	7
Total		**42**

11. Suggested books

S.No.	Name of Books, Authors, Publishers
1.	History of Mathematics, by carl B Boyer, Wiley International edition, 1968.
2.	Mathematics of Music, Susan Kelly, UW-L Journal of under graduate research, Vol-XIV, 2011.

ME 351 POWER PLANT ENGINEERING

1. Subject Code: **ME 351**   Course Title: **Power Plant Engineering**

2. Contact Hours: 42   : L: 3   T: 0   P: 0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: 0

4. Relative Weight   : CWS: 25 PRS: 0   MTE: 25 ETE: 50 PRE: 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : NIL

9. Objective   : To familiarize the students with thermodynamic cycles and various components of power plants.

10. Details of Course:

S. No.	Contents	Contact Hours
1	Indian energy scenario, Indian coals: formation, properties, analysis, benefication and heating value calculation of coals; coking and non-coking coals, fuel handling systems; coal gasification. Classification of power plants, base load and Peak load power stations, co-generated power plant, captive power plant, and their fields of application & selection criteria,.	7
2	**Steam Generators:** High pressure utility boiler, natural and forced circulation, coking and non-coking coal, coal benefication, coal pulverization, pulverized fuel firing system, combustion process, need of excess air, cyclone furnace, fluidized bed boiler, electrostatic precipitators and wet scrubbers, boiler efficiency calculations, water treatment.	7
3	**Combined Cycle Power Plants:** Binary vapour cycles, coupled cycles, gas turbine- steam turbine power plant, gas pipe line control, MHD-Steam power plant.	7
4	**Other power plants:** Nuclear power plants - working and types of nuclear reactors, boiling water reactor, pressurized water reactor, fast breeder reactor, controls in nuclear power plants, hydro power plant -classification and working of hydroelectric power plants, tidal power plants, diesel and gas power plants.	7
5	**Instrumentation and Controls in power plants:** Important instruments used for temperature, flow, pressure, water/steam conductivity measurement; flue gas analysis, drum level control, combustion control, super heater and re-heater temperature control, furnace safeguard and supervisory system (FSSS), auto turbine run-up system(ATRS).	7
6	**Environment Pollution and Energy conservation:** Economics of power generation: load duration curves, power plant economics, pollution from power plants, disposal/management of nuclear power plant waste, concept of energy conservation and energy auditing.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	**Power Plant Engineering** by M.M. Elwakil, Tata McGraw Hill, ISBN- 0070662746.
2	**Power Plant Engineering** by P.K Nag, Tata McGraw Hill, ISBN- 0070435993.
3	**Steam and Gas turbines** by A Kostyuk and V Frolov, MIR Publishers, ISBN- 9785030000329.
4.	**Modern Power Plant Engineering** by J Wiesman and R Eckart, Prentice hall India Ltd, ISBN- 97801359725.
5.	**Planning Fundamentals of thermal Power Plants** by F.S Aschner, John Wiley, ISBN- 07065159X.
6.	**Applied Thermodynamics** by T.D Eastop and McConkey, Longman Scientific and Technical, ISBN- 0582305351.
7.	**CEGB volumes on power plant, Cwntral Electricity Generation Board, ISBN- 0080155680.**
8.	**NTPC/NPTI publications on Power plants**, ISBN- 9788132227205.

ME353 RENEWABLE SOURCES OF ENERGY

1. Subject Code: **ME 353**   Course Title: **Renewable Sources of Energy**

2. Contact Hours: 42   : L: 3   T: 0   P: 0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: 0

4. Relative Weight   : CWS: 25 PRS: 0   MTE: 25 ETE: 50   PRE: 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : NIL

9. Objective   : To familiarize the students with renewable energy sources like solar, geothermal, wind and tidal.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	Man and Energy, world production and reserve of conventional energy sources, Indian production and reserves, Energy alternatives	7
2	Solar radiation: Origin, nature and availability of solar radiation, estimation of solar radiation. Photovoltaic cells. Design consideration and performance of different types of solar cells. Flat plate, focusing collectors. Effects of receiving surface location and orientation.	7
3	Devices for solar thermal collection and storage. Energy storage devices such as water storage systems, packed Bed storage systems, phase change storage systems. Heat transfer considerations relevant to solar energy. Characteristics of materials and surfaces used in solar energy absorption.	7
4	Application systems for space heating, solar water pumps, solar thermal pond, Solar Thermal Power plants, solar distillation, Solar Refrigeration and solar air conditioning, other solar energy utilization.	7
5	Solar PV systems. Fuel Cell Technologies. Generation and utilization of biogas, design of biogas plants, Wind energy systems.	7
6	Geothermal Energy Systems. Tidal energy systems. Oceanic power generation. Design considerations, Installation and Performance Evaluation. MHD power generations. Role of the nonconventional energy sources in power planning.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	G. D. Rai, "Energy Technolgy", Khanna Publishers, ISBN- 97881740907438.
2	S.P. Sukhatme, " Solar Energy", Tata-Mcgraw hill, New Delhi, ISBN- 0074624531.
3	"Solar Energy thermal process" JADuffie and W.A. Beckman, John Wiley& sons, New York, ISBN- 1118418123.

4	Solar energy, Frank Kaieth& Yogi Goswami, Taylor and Francis, ISBN- 1560327146.
5	Treatise of Solar Energy, H.P. Garg, John Willey & sons, ISBN- 9027719306.

ME355 COMBUSTION GENERATED POLLUTION

1. Subject Code: **ME 355**   Course Title: **Combustion Generated Pollution**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: 0

4. Relative Weight   : CWS: 25 PRS: 0   MTE: 25 ETE: 50 PRE: 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : NIL

9. Objective   : To introduce the students to different types of fuels, emissions from various engines, exhaust treatment of various engines and instruments used for measuring emissions.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	Engine fundamentals: Fuels, alternative fuels for IC engines, Type of hydro carbons. Gasoline specifications. Effect of Engine parameters on performance, fuel injection for SI engines, Engine vehicle road performance, road performance and fuel economy.	7
2	Emissions and air pollution: Automotive Emissions and their role in air pollution. Photo-chemical smog. Chemistry of smog formation. Combustion in Homogeneous mixtures, emission formation. Incomplete combustion, formation of hydro-carbons, Carbon monoxide and oxides of nitrogen, Aldehyde emissions.	7

3	Influence of design and operating variables on gasoline engine exhaust emissions. Hydrocarbon Evaporative Emissions: Various sources and methods of their control. Canisters for controlling evaporative emissions. Emission control systems for gasoline engines: Blow by control closed PCV system design.	7
4	Exhaust treatment devices: Air injection into exhaust system.	7
5	Thermal reactors, Catalytic convertor. Stratified charge engines. Honda CVCC engine. Diesel engine combustion Emissions: Sources of emissions during combustion. Effect of air fuel ratio, speed, injection timing on performance and emission formation. D.I and I.D.I engine emissions.	7
6	Methods of reducing emissions, exhaust gas recirculation, smoke emission from diesel engines. Emission Instruments: Non- dispersive Infrared analyzer, Gas chromatograph, flame ionization detector, chemiluminescent analyzer	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Combustion generated air pollution, Earnest S Starkman, Springer, ISBN-9780306305302.
2	Fundamentals of Air pollution engineering, Richard C. Hagan, Prentice Hall, ISBN-0133325371.
3	Air pollution threat & response, David Alym, Addison-Wesley Publication, ISBN-0201043556.

ME357 THERMAL SYSTEM

1. Subject Code: **ME 357**   Course Title: **Thermal System**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: 0

| 4. | Relative Weight | : | CWS: 25 PRS: 0   MTE: 25 ETE: 50   PRE: 0 |

4. Relative Weight   : CWS: 25 PRS: 0   MTE: 25 ETE: 50   PRE: 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : NIL

9. Objective   : To familiarise the students with the process of thermodynamic analysis of engineering systems and to enhance critical thinking and provide them with a wider view to handle engineering problems.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Fundamentals**: properties of pure substance in Solid, Liquid and Vapour Phases, PVT Behavior of simple compressible system, T-S and H-S diagram, Steam Tables, determination of quality of steam, Throttling Calorimeter, Combined Separating & Throttling Calorimeter, Maxwell and other thermodynamics relations, mixture of non reactive ideal gases, Real gases, Compressibility chart, Law of corresponding state, Air water vapor mixture, calculation of properties of air water vapour mixture.	7
2	**Rankine Cycle And Analysis**: Rankine cycle and its representation on T-S and H-S diagrams; Effect of low backpressure and high entry pressure and temperature and its limitations; necessity of re-heating, ideal and actual regenerative feed water heating cycle and its limitations. Typical feed water heating arrangements for various capacity power plants.	7
3	**Introduction To Boilers**: Classification of Boilers, Boiler mountings and accessories; draft systems, circulation system; Combustion and its calculations, and Boiler performance.	7
4	**Steam Nozzles**: Types of Nozzles, Flow of steam through nozzles; Condition for maximum discharge through nozzle; Nozzle efficiency. Effect of friction and Supersaturated flow through nozzle.	7

5	**Steam Turbines** : Working principle and types of steam turbines; Velocity diagrams for impulse and reaction turbines, compounding of impulse turbines; Optimum velocity ratio and maximum efficiency. Comparison of impulse and reaction turbines. Condition line and reheat-factor, losses in steam turbines; governing of steam turbines.	7
6	**Condensers and Cooling towers**: Types and working of condensers, types and performance of cooling towers.	7
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	**Engineering Thermodynamics** by P.K.Nag, Tata McGraw Hill Publishing Company Limited, ISBN – 1259062562, 2013.
2	**Engineering Thermodynamics**byRogers, Pearson Education, ISBN- 631197036.
3	**Thermodynamics** by Kenneth Wark, Mcgraw-hill Book Company, 5th edition, ISBN- 0070682860, 1988.
4.	**Engineering Thermodynamics: work and heat transfer** by Gordon Rogers and Yon Mayhew, Longman, 4th edition, ISBN – 0471861731, 1992.
5.	**Fundamentals of Classical Thermodynamics** by Van Wylen and Sonntag, John Wiley & Sons Inc., 3rd edition, ISBN – 0471861731, 1986.
6.	**Fundamentals of Engineering Thermodynamics** by Moran and Shaprio, **John Wiley & Sons, Inc., 7th edition, ISBN – 0470917687, 2010.**
7.	**Thermodynamics: An Engineering Approach** by Cengel and Boles, The McGraw-Hill Companies, 8th edition, ISBN: 0073398179, 2014.
8.	**Applied Thermodynamics for Engineering Technologists**byT.D. Eastop, Prentice Hall, 5th edition, ISBN- 05820919344, 1993.
9.	**Treatise on Heat Engineering** by V. P.Vasandani and D.S. Kumar, Metropolitan Book Co. (p) Ltd., ISBN- 810003500.

ME359 REFRIGERATION & AIR CONDITIONING

1. Subject Code: **ME 359**   Course Title: **Refrigeration and Air Conditioning**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (Hrs.) : Theory: 3   Practical: 0

4. Relative Weight   : CWS: 25 PRS: 0   MTE: 25 ETE: 50   PRE: 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : NIL

9. Objective   : To learn properties of different refrigerants, and thermodynamic cycles of refrigeration. To understand comfort parameters and air conditioning.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	**Introduction to Refrigeration**: Necessity and applications, unit of refrigeration and C.O.P., types of Ideal cycles of refrigeration, air-refrigeration, bell coleman cycle, open and dense air systems, actual air-refrigeration system problems, refrigeration needs of aircrafts, actual refrigeration system	7
2	**Vapour Compression Refrigeration**: Working principle and essential components of the plant, simple vapour compression refrigeration cycle - COP, Representation of cycle on T-S and p-h charts - effects of sub cooling and super heating - cycle analysis - Actual cycle, Influence of various parameters on system performance – necessity of multistaging, multistage compression system, and their analysis, necessity and working of cascading system	10

3	**Refrigerants and Absorption Refrigeration:** Desirable properties of refrigerants, classification of refrigerants used, nomenclature, ozone depletion, global warming, vapor absorption system, calculation of max COP.	4
4	**Air Conditioning**: Psychometric properties & processes, comfort air-conditioning, summer and winter air-conditioning, cooling & dehumidification systems, load calculation and applied psychrometry.	7
5	**Human Comfort:** Requirements of human comfort and concept of effective temperature, comfort chart, comfort air-conditioning, requirements of industrial air-conditioning, air-conditioning load calculations.	7
6	**Control:** Refrigeration and air-conditioning control, air handling, air distribution and duct design	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	**Refrigeration and Air Conditioning** by C. P. Arora, Tata McGraw Hill, ISBN-9788120339156.
2	**Refrigeration and Air Conditioning** by A. R .Trott and T. C. Welch, Butterworth-Heinemann, ISBN- 9780080540436.
3	**Refrigeration and Air ConditioningTechnology** by Whitman, Jhonson and Tomczyk, Thomson Delmer Learning, ISBN- 1111644470.
4	**Refrigeration and Air Conditioning** by Abdul Ameen, Prentice Hall of India Ltd, ISBN- 9789303206560..
5	**Basic Refrigeration and Air Conditioning** by P. N. Ananthanarayan, Tata McGraw Hill, ISBN- 9789383286560.
6	**Refrigeration and Air Conditioning** by Wilbert F. Stoecker and Jerold W. Jones, Tata McGraw Hill, ISBN- 007061623X.
7.	**Refrigeration and Air Conditioning by** Richard Charles Jordan, Gayle B. Priester, Prentice hall of India Ltd, ISBN-9780406269313.

8	**ASHRAE Handbook – Refrigeration 2010,** ISBN- 9781933742922.

ME361 INDUSTRIAL ENGINEERING

1. Subject Code: **ME361**   Course Title: **Industrial Engineering**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: 0

4. Relative Weight   : CWS: 25 PRS: 0   MTE: 25 ETE: 50   PRE: 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : NIL

9. Objective   : To make students aware of industrial engineering concepts of work study and measurement, quality control and reliability etc.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	**Introduction** Introduction, Definition and objectives of Industrial Engineering, Scope of Industrial Engineering, Production systems and their classifications; Productivity-Total and partial productivity, Reasons and remedy for poor productivity	7
2	**Job analysis and Work Measurement Systems** Work System Design: Taylor's scientific management, Gilbreth's contributions; method study, micro-motion study, principles of motion economy; work measurement - stop watch time study, micro motion and memo motion, work sampling, standard data, PMTS; ergonomics; job evaluation, merit rating, incentive schemes, and wage administration; business process reengineering	7

3	**Production Planning and Control** Types and characteristics of production systems Objective and functions of Production, Planning & Control, Routing, Scheduling and Operations scheduling, production scheduling, job shop scheduling problems, sequencing problems, scheduling tools and techniques, Loading, Dispatching and its sheets & Gantt charts	7
4	**Quality Engineering** Quality concept and costs; statistical quality control, Concept of specification limits, statistical control limits, process capability, Process control and control charts for both attributes and variable data. Acceptance Sampling- Single and double sampling	7
5	**Reliability and Maintenance** Reliability, availability and maintainability; distribution of failure and repair times; determination of MTBF and MTTR, reliability models; system reliability determination; Maintenance management and its objectives, Various types of Maintenance Planning, House Keeping, 5S concepts	7
6	**Material Handling** Principles, functions, and objectives of Material Handling; Selection and classification of Material Handling Equipments; Relation of material handling with plant layout	7
Total		**42**

11. Suggested Books

S. No.	Name of Authors /Books / Publishers
1	Industrial Engineering and Management; B. Kumar, Khanna Publication, ISBN- 8174091963, 2011.
2	Introduction to work Study, International Labour Office, Geneva, 3rd edition, Oxford and IBH publishing Co. Pvt. Ltd, New Delhi, ISBN- 8120406028, 2008.
3	Industrial Engineering and Management, Pravin Kumar, Pearson Education, 1st edition, ISBN- 9789332543560, 2015.

ME363 PRODUCT DESIGN & SIMULATION

1. Subject Code: **ME363**   Course Title: **Product Design & Simulation**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: 0

4. Relative Weight   : CWS: 25 PRS: 0   MTE: 25 ETE: 50 PRE: 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : NIL

9. Objective   : To familiarize the students with the process of product design and development.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	**Stages in design process:** Introduction to various stages of the design process: Formulation of problem, Generate alternatives, Evaluation, Guided Redesign. Case study.	5
2	**Product life cycle:** New product introduction: early introduction, increased product life. Life cycle management tool, System integration, QFD, House of quality, Pugh's method, Pahl and Beitz method. Case studies	5
3	**Value engineering:** Introduction, nature and measurement of value. Value analysis job plan. Creativity. Value analysis test. Case studies	5
4	**Concurrent/ reverse engineering:** Introduction, basic principles, components, benefits of concurrent engineering. Concept of reengineering	5

5	**Material selection:** Materials in design. The evolution of engineering materials. Design tools and material data. Material selection strategy, attribute limits, selection process, material selection. Case studies	5
6	**Process selection:** Introduction. Process classification: shaping, joining and finishing. Systematic process selection, process cost. Computer – aided process selection	5
7	**Design for manufacture and assembly:** Design for Manufacture and Assembly (DFMA). Reasons for not implementing DFMA. Advantages of DFMA with case studies. Design features and requirements with regard to assembly, Design for Manufacture in relation to any two manufacturing processes: machining and injection molding. Need, objectives	4
8	**System Simulation**: Techniques of simulation, Monte Carlo method, Experimental nature of simulation, Numerical computation techniques, Continuous system models, Analog and Hybrid simulation, Feedback systems, Computers in simulation studies, Simulation software packages	4
9	**Simulation of Mechanical Systems**: Building of Simulation models, Simulation of translational and rotational mechanical systems, Simulation of hydraulic systems	4
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
TEXT BOOKS:	
1	David G Ullman, "The Mechanical Design Process." Publisher-McGrawhillIncSingapore, ISBN-13: 9780072975741, 1992.
2	Kevin Otto & Kristin Wood Product Design: "Techniques in Reverse Engineering and new Product Development." 1 / e 2004 , Publisher- Pearson Education New Delhi , ISBN-13: 9780130212719,
3	L D Miles "Value Engineering."Publisher- McGraw-Hill, 1972
4	Karl T Ulrich, Steven D Eppinger , " Product Design &Development."Publisher-Tata McGrawhill New Delhi, ISBN-13: 9780078029066, 2003

5	Hollins B & Pugh S "Successful Product Design." Publisher- Butter worths London, ISBN 9780408038614.
6	N J M Roozenberg , J Ekels , N F M Roozenberg " Product Design Fundamentals and Methods ."Publisher- John Willey & Sons, ISBN-13: 9780471954651, 1995.

ME365 COMPUTATIONAL FLUID DYNAMICS

1. Subject Code: **ME 365**   Course Title: **Computational Fluid Dynamics**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: 0

4. Relative Weight   : CWS: 25 PRS: 0   MTE: 25 ETE: 50   PRE: 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : NIL

9. Objective   : To provide basic concepts of CFD in terms of comprehensive theoretical study and its computational aspects.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	Introduction to CFD, Historical background, Impact of CFD	3
2	The Governing Equations of Fluid Dynamics Derivation, Discussion of physical meanings and Presentation of forms particularly suitable to CFD.	7
3	Mathematical Behavior of Partial Differential Equations: Impact on CFD	6

4	Basic Aspects of Discretization: Introduction to Finite Difference, Finite Elements and Finite Volume Methods. Detailed treatment of Finite Difference method, explicit and implicit methods, errors and stability analysis.	12
5	Grids with Appropriate Transformations Adaptive grids and unstructured meshes. Lift reduction, down force generation and drag reduction. An introduction to the aerodynamics of airflows for cooling.	7
6	Commercial codes (e.g. FLUENT etc.). Grid generation, techniques and application. Basic principles and concepts and the characteristics of wings and diffusers	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Computational Fluid Dynamics",John Anderson," McGraw- Hill Ltd.
2	Computational Fluid Dynamics",Tu, Elsevier.
3	Introduction to Computational Fluid Dynamics,Niyogi, Pearson Education, Delhi

ME367 FINITE ELEMENT METHODS

1. Subject Code: **ME 367**   Course Title: **Finite Element Methods**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: 0

4. Relative Weight   : CWS: 25 PRS: 0   MTE: 25 ETE: 50   PRE: 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite : NIL

9. Objective : To enable students to apply Galerkin method and virtual work principle to problems in solid mechanics. To teach them numerical solution of differential equations with finite element method.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	Fundamental concepts of the Finite Element Method. One Dimensional Problem(Bar of uniform and variable cross sections), The Galerkin Approach, The potential –Energy Approach, shape Functions, Derivation of stiffness matrix and load vector for the element and for the entire domain. Evaluation of displacement, stresses and reaction forces.	12
2	**Trusses**:-. Introduction, Plane Trusses, Local and Global coordinate Systems, Element Stiffness Matrix and Stress calculations	3
3	Two –Dimensional problem using Constant strain triangles(CST), Two-dimensional isoparametric elements and numerical integration ,element stiffness matrix, Force vector.	6
4	Applications of finite element method to heat transfer.	4
5	Application of finite element method to electrical systems.	10
6	**Dynamic analysis**:- Element mass matrices,Evaluation of Eigenvalues and Eigenvectors. Use of Softwares such as MAT LAB/ABAQUS/ANSYS/ NASTRAN/ IDEAS. Basic feature of these softwares.	7
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Finite Element Procedures, K.J. Bathe, Prentice Hall of India.
2	Finite Elements in Engineering by Chandrupatla and Belegundu.
3	Finite element Method by J.N.Reddy.
4.	Finite element Method,O.C. Zienkiewicz& R.A. Taylor
5.	Finite element Analysis,C.S. Krishnamurthy
6.	Finite element Method, Kenneth H. Hubener
7.	Finite Element Method, Desai & Abel

ME369 TOTAL LIFECYCLE MANAGEMENT

1. Subject Code: **ME 369**   Course Title: **Total Lifecycle Management**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: 0

4. Relative Weight   : CWS: 25 PRS: 0   MTE: 25 ETE: 50   PRE: 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : NIL

9. Objective   : To familiarize the students with the concept of Total Life Cycle, and applying life cycle thinking to define tradeoffs. This course also introduces to sustainability and use of renewable resources.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	**Introduction:** Extensive definition of Concurrent Engineering (CE), CE design methodologies, Review of CE techniques like DFM (Design for manufacture), DFA (Design for assembly), QFD (Quality function deployment), RP (Rapid prototyping), TD (Total design), for integrating these technologies, Organizing for CE, CE tool box, Collaborative product development	8
2	**Use of Information Technology:** IT support, Solid modeling, Product data management, Collaborative product Commerce, Artificial Intelligence, expert systems, Software hardware component design.	8
3	**Design Stage:** Lifecycle design of products, Opportunities for manufacturing enterprises, Modality of concurrent engineering design, automated analysis, Idealization control, CE in optimal structural design, Real time constraints	8
4	**Need for PLM:** Importance of PLM, Implementing PLM, Responsibility for PLM, Benefits to different managers ,Components of PLM, Emergence of PLM, Lifecycle problems to resolve, Opportunities to seize	9
5	**Components of PLM:** Components of PLM, Product lifecycle activities, Product organizational structure, Human resources in product lifecycle, Methods, techniques, Practices, Methodologies, Processes, System components in lifecycle, slicing and dicing the systems, Interfaces, Information, Standards	9
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Integrated Product Development M.M. Anderson and L Hein IFS Publications
2	Design for Concurrent Engineering J. Cleetus CE Research Centre, Morgantown
3	Concurrent Engineering Fundamentals: Integrated Product Development Prasad Prentice hall India

4	Concurrent Engineering in Product Design and Development I Moustapha New Age International
5	Product Lifecycle Management John Stark Springer-Verlag, UK
6	Product Lifecycle Management Michael Grieves McGraw Hill
7	Concurrent Engineering: Automation tools and Technology Andrew Kusiak Wiley Eastern

ME371 VALUE ENGINEERING

1. Subject Code: **ME 371**   Course Title: **Value Engineering**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: 0

4. Relative Weight   : CWS: 25 PRS: 0   MTE: 25 ETE: 50 PRE: 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : NIL

9. Objective   : To understand the concept and approaches of value analysis and engineering with an emphasis on case studies.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	An Overview Of Value Engineering-Concepts and approaches of value analysis and engineering - importance of value, Function - identity, clarify – analysis	8

2	Evaluation of VE-Evaluation of function, Problem setting system, problem solving system, setting and solving management - decision - type and services problem, evaluation of value	8
3	Results accelerators, Basic steps in using the systems	8
4	Understanding the decision environment, Effect of value analysis on other work in the business- Life Cycle Cost (LCC), Case studies	9
5	VE Level Of Effort-VE Team, coordinator, designer, different services, definitions, construction management contracts, value engineering case studies, Effective organization for value work, function analysis system techniques- FAST diagram, Case studies	9
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Parker, D.E., "Value Engineering Theory", Sundaram publishers, 1990
2	Miles, L.D., "Techniques of Value Engineering and Analysis", McGraw Hill Book Co., 2nd End., 1972
3	Khanna, O.P., "Industrial Engineering and Management", Dhanpat Rai and Sons, 1999.

MG351 FUNDAMENTALS OF FINANCIAL ACCOUNTING AND ANALYSIS

1. Subject Code : **MG351**   Course Title: **Fundamentals of Financial Accounting and Analysis**

2. Content Hours   : L: 3   T: 0   P: 0

3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs   Practical 0

4. Relative Weightage   : CWS: 25 PRS   MTE: 25 ETE : 50 PRE

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8.	Pre-requisite	:	Nil
9.	Objective	:	Familiarizing the students with the financial environment of business, especially the financial markets and acquaint them with accounting mechanics, process and system.

10. Details of Course:

Unit No.	Detail Contents	Contact Hours
1	**Introduction to Management** :Basic concepts of management, management process, principles of management, functions, levels, managerial roles and skills, managerial ethics and corporate social responsibility	8
2	**Introduction to Financial Environment and accounting:** Financial Markets - Capital Markets, Basics of capital market mechanism, instruments, financing and rating institutions. Importance, Objectives and Principles of Accounting, Accounting Concepts and conventions, and the Generally Accepted Accounting Principles (GAAP) Overview of the Accounting Process. Accounting standards as Issued by Institute of Chartered Accountants of India (ICAI).	10
3	**Overview of Business Activities and Principal Financial Statements:** Observe the types of information provided by the three principal financial statements and how firms might use this information in managing and evaluating a business. Understand the rationale and the information value of the statements of Balance Sheet, Profit and Loss statement, cash flows.	8
4	**Financial Analysis-I:** Distinction between cash profits and book profits. Understanding the cash flow statement and the funds flow statement.	8
5	**Financial Analysis –II**: Importance, objectives and concept of Ratio Analysis- Liquidity, leverage, solvency and profitability ratios.	8
Total		**42**

11. Suggested Books

S. No.	Name of Books / Authors/ Publishers
1	Fundamental of Management, Stephen P. Robbins, David A. De Cenzo and Mary Coulter, Pearson Education,2011, ISBN- 978-0273755869
2	Introduction to Accountancy, 10 ed., T.S. Grewal, S. Chand and Company (P) Ltd., New Delhi,2009, ISBN- 9788121905695
3	Advance Accounts by M.C Shukla and T.S Grewal and SC Gupta, S. Chand and Company (P) Ltd., New Delhi,1997, ISBN- 9788121902786
4	Financial Accounting, 4 ed, S.N. Maheshwari and S.K. Maheshwari, Vikas Pulication,2005, ISBN- 8125918523
5	Financial Accounting Reporting & Analysis, Cengage, 7/e, W Albrecht Stice & James Stice, Cengage Learning,2010, ISBN- 0538746955

MG353 FUNDAMENTALS OF MARKETING

1. Subject Code : **MG353**   Course Title : **Fundamentals of Marketing**

2. Content Hours   : L: 3   T: 0   P: 0

3. Examination Duration (ETE)(Hrs.) : Theory: 3 Hrs   Practical 0

4. Relative Weightage   : CWS:25 PRS   MTE:25 ETE:50   PRE

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : Nil

9. Objective   : The basic objective of this paper is to make students aware of fundamental concepts of marketing necessary for making decisions in complex business situations by managers and start up entrepreneurs.

10. Details of Course:

Unit No.	Detail Contents	Contact hours
1	**Basic concepts of management**: management process, principles of management, functions, levels, managerial roles and skills, managerial ethics and corporate social responsibility	8
2	**Introduction to marketing**: nature and scope of marketing, marketing mix, marketing vs. sales, role of marketing in society, interface of marketing with other departments in organization, Customer Life Time Value, ethical issues in marketing Concept of market segmentation: consumer and industrial, targeting and positioning, sales forecasting	9
3	**Product mix decisions:** new product development process, test marketing, concept of Product Life Cycle, product packaging decisions	8
4	**Pricing decisions** : consideration in setting price, major pricing strategies, promotional mix decisions: advertising, sales promotion, personal selling, publicity, opportunities and avenues of online promotion	9
5	**Promotion and distribution decisions** :design and management of distribution channel for physical products and services, reasons of channel conflict, handling strategies, basic challenges in supply chain management of e-commerce firms	9
Total		**42**

11. Suggested Books

Unit No.	Name of Books / Authors/ Publishers
1	Fundamental of Management, Stephen P. Robbins, David A. De Cenzo and Mary Coulter, Pearson Education, 2011, ISBN-978-0273755869
2	Marketing Management, 14th ed., Philip Kotler , Kevin Lane Keller, Abraham Koshy and MithileswarJha, Pearson Education, New Delhi, 2013,(**ISBN-10:** 9788131767160)

3	Marketing, 14th ed., Etzel, Bruce J Walker, William J Stanton and Ajay Pandit, Mc Graw Hill Education, 2009, ISBN -9780070151567
4.	MKTG, Charles W Lamb, Joe F Hair, Carl NcDaniel and Dheeraj Sharma, Cengage Learning,2012, ISBN- 9788131517086
5.	Marketing Management, RajanSaxena, Tata Mc Graw Hill Education, 2005, ISBN-9780070599536

MG355 HUMAN RESOURCE MANAGEMENT

1. Subject Code : **MG355**   Course Title : **Human Resource Management**

2. Content Hours   : L: 3   T: 0   P: 0

3. Examination Duration (ETE)(Hrs.) : Theory: 3 Hrs   Practical 0

4. Relative Weightage   : CWS:25 PRS   MTE:25 ETE:50   PRE

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : Nil

9. Objective   : To develop necessary understanding in design and execution of human resource strategies for the achievement of organization goals.

10. Details of Course**:**

Unit No.	Content	Contact hours
1.	**Basic concepts of management:** management process, principles of management, functions, levels, managerial roles and skills, managerial ethics and corporate social responsibility	8

2.	**Introduction:** Concept, nature, scope, objectives and importance of HRM; Evolution of HRM; Environment of HRM; Personnel Management vs HRM. Acquisition of Human Resources: HR Planning; Job analysis – job description and job specification; recruitment – sources and process; selection process – tests and interviews; placement and induction. Job changes – transfers, promotions/ demotions, separations.	9
3.	**Training and Development:** Concept and importance of training; types of training; methods of training; design of training programme; evaluation of training effectiveness; executive development – process and techniques; career planning and development.	8
4.	**Performance Appraisal:** Performance appraisal – concept and objectives; traditional and modern methods, limitations of performance appraisal methods.	8
5.	**Compensation and Maintenance:** Compensation: job evaluation – concept, process and significance; components of employee remuneration – base and supplementary; maintenance: overview of employee welfare, health and safety, social security.	9
	Total	**42**

11. Suggested Books

S. No	Name of the book /Authors /Publishers
1	Fundamental of Management, Stephen P. Robbins, David A. De Cenzo and Mary Coulter, Pearson Education, 2011, ISBN-978-0273755869
2	Human Resource Management, G. Dessler, B. Varkkey, Pearson prentice Hall, 2011, (ISBN – 978-81-317-5426-9)
3	International HRM a cross cultural approach, T. Jackson, Sage publications, London, 2002, (ISBN – 0-7619-7404-0)
4	HRM and Performance: Achievements and Challenges, D. E. Guest, J .Paauwe, P. Wright, John Wiley and sons, UK, 2013, (ISBN – 978-1-118-48261-2)
5	A Handbook of Human Resource Management Practice, M. Armstrong, Kogan Page Limited, UK, 2007 ,(ISBN – 978–0–7494–4631-4)

MG357 KNOWLEDGE AND TECHNOLOGY MANAGEMENT

1. Subject Code : **MG 357**   Course Title : **Knowledge and Technology Management**

2. Content Hours   : L: 3   T: 0   P: 0

3. Examination Duration (ETE)(Hrs.) : Theory: 3 Hrs   Practical 0

4. Relative Weightage   : CWS:25 PRS   MTE:25 ETE:50   PRE

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : Nil

9. Objective   : Preparing the students to understand how the new age organizations are leveraging on the power of knowledge and technology. Acquiring the knowledge to address the issues faced by the corporate world for a deeper understanding.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Basic concepts of management**, management process, principles of management, functions, levels, managerial roles and skills, managerial ethics and corporate social responsibility	8
2.	Introduction to Knowledge Management: Data, Information, Knowledge Management (KM), Knowledge Society, Knowledge Economy, Types of Knowledge, Tacit knowledge and explicit knowledge, Essential components of KM model Building Knowledge Assets: Various knowledge assets, Tools of Knowledge, Knowledge Audit, AAR (After Action Review), Analyzing current knowledge state.	9

3.	Creating Strategies for Success: KM strategy, Codification, Personalization, Knowledge Management Implementation, Generating a KM-specific vision, Integrating organizational and business goals with KM, Choosing the right KM techniques, Relevant case studies in this area.	9
4.	Understanding Technology: Definition, Key concepts, Need for technology, History of technological developments, Role and importance of technology in 21st century, Recent developments in the field of technology.	8
5.	Technology-Management integration: Management as a concept, Technology management, Life cycle approach to technology management, Innovation, Creativity, Technology innovation process.	8
Total		**42**

11. Suggested Books

S. No.	Name of Books /Authors/Publishers
1.	Fundamental of Management, Stephen P. Robbins, David A. De Cenzo and Mary Coulter, Pearson Education,2011, ISBN-978-0273755869
2	Knowledge Management in Organizations: A Critical Introduction, Donald Hislop, Oxford University Press,2013, ISBN: 9780199691937.
3	The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation, IkujiroNonaka and Hirotaka Takeuchi, Oxford University Press,1995, ISBN: 0195092694.
4	Hitotsubashi on Knowledge Management (Hardcover), Hirotaka Takeuchi and IkujiroNonaka, John Wiley and Sons, 2004, ISBN: 0470820748.
5	Management of Technology: The Key to Competitiveness and Wealth Creation, Tarek Khalil and Ravi Shankar, McGraw Hill Education (India) Private Limited, 2nd Edition, 2012, ISBN: 9780070677371.

PE351 ADVANCED MACHINING PROCESS

1. Subject Code: **PE-351**   Course Title: **Advanced Machining Process**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: 0

4. Relative Weight   : CWS: 25 PRS: 0   MTE: 25   ETE: 50   PRE: 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : NIL

9. Objective   : To understand basic principles of various processes and their applications. State various parameters influencing the machining process.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	Introduction, need of advanced machining processes, hybrid processes, microelectro mechanical system, (MEMS), nano electromechanical systems(NEMS),Ultrasonic micro machining - mechanics of cutting, parametric analysis, process capabilities, applications.	7
2	Abrasive jet machining: Introduction, set ups, gas propulsion system, abrasivefeeder, machining chamber, AJM nozzle, abrasive parametric analysis, processscapabilities, applications, abrasive micro machining, Water jet machining:Introduction, process characteristics, process performance, applications, Abrasive Water jet machining: Abrasive finishing process: Working principle, parametric analysis, process variables, process performance and applications,	8

3	Abrasive flow machining- Working principle, parametric analysis, process variables, process performance and applications, Magnetorheological abrasive flow finishing- Working principle, parametric analysis, process variables, process performance and applications, Magnetic float polishing, Magnetic abrasive finishing- Working principle, parametric analysis, process variables, process performance and applications	10
4	Electro discharge machining (EDM): Introduction, Working principle, parametric analysis, process variables, process characteristics, applications, hybrid processes such as electro discharge grinding, diamond grinding, wire EDM, Electro discharge micro grinding,	7
5	Laser beam machining- production of laser, working principle, types of laser, process characteristics and applications. Electron beam machining: Working principle, process parameter, process characteristics, and applications. Ion beam machining: Working principle, process parameter, process characteristics, and applications.	8
6	Plasma arc machining: Working principle, Plasma arc cutting system, applications.	2
Total		**42**

11. Suggested Books:

S. No.	Title, Author, Publisher and ISBN No.
1	Advanced machining process, Dr.V.K.Jain, Allied publisher, **ISBN**:978-81-7319-915-8.
2	Non traditional methods of manufacturing, Shan&Pandey, **ISBN**, 0070965536

PE353 SUPPLY CHAIN MANAGEMENT

1. Subject Code: **PE-353**   Course Title: **Supply Chain Management**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: 0

4. Relative Weight   : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0

5. Credits   : 3

6.   Semester   :   V

7.   Subject Area   :   OEC

8.   Pre-requisite   :   NIL

9.   Objective   :   To understand the key considerations at the various stages involved in the supply of product in order to maintain the smooth flow from source to the point of consumption so that overall organizational performance may improve.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	**Introduction:** Perspective of Supply Chain Management, Managing uncertainty, Key issue in supply chain management.	6
2	**Inventory Management and Risk Pooling:** Inventory management, Classification of inventory, Centralized versus Decentralized Warehousing and Risk pooling, Value of Information, Quantification of Bullwhip effect, Causes and remedies of Bullwhip effect.	8
3	**Resource planning:** Aggregate Production Planning- Chase and leveling strategies, MRP, MRP-II, Agile manufacturing Systems	6
4	**Procurement and Outsourcing strategies:** Introduction, outsourcing benefits and risks, Make/Buy decision, e-procurement, Vendor selection and quota allocation.	7
5	**Strategic Alliances:** Introduction, Third party logistics, Demand driven strategies, Distribution strategies- direct shipment, cross docking, transshipment, Supplier relationships management, Customer relationship management.	8
6	**International Issues in Supply Chain Management:** Concepts in Globalization, Globalization forces, Risks and Advantages of International supply chains, Issues in International supply chain management, Regional differences in logistics.	7
Total		**42**

11. Suggested Books:

S. No.	Title, Author, Publisher and ISBN No.
1.	Simchi-Levi, Kaminsky, Philip K. and 'Designing and Managing the Supply Chain: Concepts, Strategic and Case Studies', McGraw-Hill/Irwin, (ISBN, 10: 0072357568, 13: 978-0072357561).
2	Supply Chain Management by Chopra and Mendle, **ISBN**: 9780132743952
3	Supply Chain Management: Text and Cases by JannatSah.,**ISBN**-10: 8131715175.

PE355 WORK STUDY DESIGN

1. Subject Code: **PE-355**   Course Title: **Work Study Design**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: 0

4. Relative Weight   : CWS: 25 PRS: 0   MTE: 25 ETE: 50   PRE: 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : NIL

9. Objective   : To provide basic understanding to the students about the concept and significance of work study and ergonomics. To impart thorough knowledge to the students about various techniques of work-study for improving the productivity of an organization.

10. Details of Course:

Unit No.	Contents	Contact Hrs
1	Productivity: Definition, reasons for low productivity, methods to improve productivity, Work-study and productivity	4

2	Human factor in work-study: Relationship of work-study man with management, supervisor & workers, qualities of a work-study man.	5
3	Method-study: Definition, objectives, step-by-step procedure, questioning techniques, charts and diagrams for recording data. Like outline process charts, flow process charts, multiple activity charts, two handed process chart, string diagram, travel chart, cycle graph, Chrono-cycle graph, therbligs, micro motion study and film analysis, Simo chart, principles of motion economy. Development and installation of new method..	9
4	Work-Measurement: Definition, various techniques of work-measurement work-sampling, stopwatch time study & its procedure, Job selection, Equipment and forms used for time study, rating, methods of rating, allowances and their types, standard time, numerical problems, predetermined - time standards and standard data techniques. Incentive: Meaning, objectives of an incentive plan, various types of incentive plans	9
5	Ergonomics: Introduction, history of development, man-machine system and its components. Introduction to structure of the body- features of the human body, stress and strain, metabolism, measure of physiological functions- workload and energy consumption, biomechanics, types of movements of body members, strength and endurance, speed of movements. NIOSH lifting equation, Lifting Index, Maximum acceptable Weights and Forces, Distal upper extremities risk factors, Strain Index, RULA, REBA.	8
6	Applied anthropometry - types, use, principles in application, design of work surfaces and seat design. Visual displays for static information, visual displays of dynamic information, auditory, tactual and olfactory displays and controls. Assessment of occupational exposure to noise, heat stress and dust .Effect of vibration/ noise, temperature, illumination and dust on human health and performance	7
Total		**42**

11. Suggested Books:

S. No.	Title, Author, Publisher and ISBN No.
1.	Barnes Ralph M., "Motion & Time study: Design and Measurement of Work", Wiley Text Books, **ISBN-10:** 8126522178, 2009.

2	Marvin E, Mundel& David L, "Motion & Time Study: Improving Productivity", Pearson Education,**ISBN-10:** 0136030440, 2000.
3	Benjamin E Niebel and FreivaldsAndris, "Methods Standards & Work Design", McGraw Hill,**ISBN-10**1259064840, 1997.
4	International Labour organization, "Work-study", Oxford and IBH publishing company Pvt. Ltd., N.Delhi, **ISBN-10** 8120406028, 2001

PE357 PRODUCT DESIGN & SIMULATION

1. Subject Code: **PE-357**   Course Title: **Product Design & Simulation**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: 0

4. Relative Weight   **:** CWS: 25 PRS: 0   MTE: 25 ETE: 50 PRE: 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : NIL

9. Objective   : To allow students to develop the technical, analytical, and managerial skills necessary to perform the tasks successfully.

10. Details of Course:

Unit No.	Content	Contact Hours
1	**Stages in design process:** Introduction to various stages of the design process: Formulation of problem, Generate alternatives, Evaluation, Guided Redesign. Case study.	6

2	**Product life cycle:** New product introduction: early introduction, increased product life. Life cycle management tool, System integration, QFD, House of quality, Pugh's method, Pahl and Beitz method. Case studies.	6
3	**Value engineering:** Introduction, nature and measurement of value. Value analysis, job plan. Creativity and techniques of creativity. Value analysis test. Case studies. **Material selection:** Materials in design. The evolution of engineering materials. Design tools and material data. Functional material, shape and process. Material selection strategy, attribute limits, selection process, common methods of material selection. Case studies.	6
4	**Concurrent/ reverse engineering:** Introduction, basic principles, components, benefits of concurrent engineering. Concept of reengineering. **Process selection:** Introduction. Process classification: shaping, joining and finishing. Systematic process selection, Ranking, process cost. Computer – aided process selection.	6
5	**Design for manufacture and assembly:** Design for Manufacture and Assembly (DFMA). Reasons for not implementing DFMA. Advantages of DFMA with case studies. Design features and requirements with regard to assembly, product Design for Manufacture in relation to any two manufacturing processes: machining and injection molding. Need, objectives.	8
6	**System Simulation**: Techniques of simulation, Monte Carlo method, Experimental nature ofsimulation, Numerical computation techniques, Continuous system models, Analog andHybrid simulation, Feedback systems, Computers in simulation studies, Simulation softwarepackages. **Simulation of Mechanical Systems**: Building of Simulation models, Simulation oftranslational and rotational mechanical systems, Simulation of hydraulic systems.	10
Total		**42**

11. Suggested Books:

S. No.	Title, Author, Publisher and ISBN No.
1	**Product Design and Development**, "Karl T. Ulrich, Steven D. Eppinger"Mc GrawHill.**ISBN:**9780072296471
2	**Integrated Product and Process Development**, "John M. Usher, Utpal Roy and H. R. Parasaei.ISBN: 978-0-471-15597-3
3	**Product Design for Manufacture and Assembly**, "G. Boothroyd, P. Dewhurst and W. Knight" MarceDaker.ISBN:978-1420089271
4.	**Engineering Design and Design for Manufacturing**: A structured approach, "John R. Dixon and CPoli" Field Stone Publishers, USA. ISBN: 9780964527201
5.	**Material Selection in Mechanical Design**, "M. F. Ashby"Elsevier. ISBN: 9780080419077

PE359 TOTAL LIFE CYCLE MANAGEMENT

1. Subject Code: **PE359 Course**   Title: **Total Life Cycle Management**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: 0

4. Relative Weight   **:** CWS: 25 PRS: 0   MTE:25   ETE:50   PRE: 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : NIL

9. Objective   : To familiarize the students with the concept of Total Life Cycle, management of old vehicles, applying life cycle thinking to define tradeoffs. This course also introduces to sustainability, use of renewable resources.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Introduction :** Definition of Total Life Cycle (TLC) – Conceptof TLC - Life Cycle Impacts - Integrating Life Cycle Technologies- Products and Processes Within TLC - TLC Methodology- TLC AccessementData to Complex Products – ResultantImprovement for Product	8
2	**Vehicles End of Life** : Design for End of Old VehicleManagement - Problems of Old Vehicles in EmergingMarkets - Recovery and Economic Feasibility of MaterialsSuch As Plastic, Rubber, Aluminium, Steel, etc.	8
3	**Trade-offs :** Applying Life Cycle Thinking to Define TradeoffsAlong the Supply, Manufacture - Use and End of Life Chain- Effects on the Customer - Expectation of the Customer -Evaluate Product Cost on Fuel Consumption, Emission,Durability, Environment and Health	10
4	**Sustainability:**What Is Sustainability - Use of RenewableResources - View to Design Horizon.	8
5	**Harmonization of Environmental Goals:** TLC for Emerging Vs Developed Markets - Rules and Regulations to Guide Designers - International Common Practices for End of LifeVehicles.	8
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Life Cycle Management Case Study of an Instrument Panel /SAE, 1997/
2	Accident Reconstruction: Automobiles, Tractor-semitrailers, Motorcycles, and Pedestrians /Society of Automotive Engineers, 1987 /0898834546, 9780898834543.

PE361 TOTAL QUALITY MANAGEMENT

1. Subject Code: **PE-361**   Course Title: **Total Quality Management**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (Hrs.)   : Theory: 3   Practical: 0

4.	Relative Weight	: CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5.	Credits	: 3
6.	Semester	: V
7.	Subject Area	: OEC
8.	Pre-requisite	: NIL
9.	Objective	: To understand the philosophy and core values of Total Quality Management (TQM); determine the voice of the customer and the impact of quality on economic performance and long-term business success of an organization;

10. Details of Course:

Unit No.	Content	Contact Hours
1	**Introduction to Quality-** Definition of Quality- product, user, value, and manufacturing based perspectives, Dimensions of Quality, Quality Planning, Quality costs- optimization of quality costs, seven tools of quality control;Philosophies of Quality Gurus- Deming, Juran, Crosby, Feigenbaum, Ishikawa, Taguchi. Comparison of Quality Philosophies.	9
2	**Statistical Process Control-**Introduction to Quality characteristics- variables and attributes, Types and causes of variations, Control Charts for variables and attributes, Process capability.	8
3	**Acceptance Sampling-**Sampling process and lots formation; Advantages and applications of acceptance sampling; characteristics of O.C. Curve; Single, double, multiple, sequential sampling; ASN, ATI, AOQL, AOQ, AQL, LQL, Producer's and Consumer's risks.	7
4	**Six Sigma and ISO 9000:2000-** Principles of Six Sigma, Statistical basis, Tools and techniques, DMAIC principle, application of six sigma in manufacturing and service organizations, structure of ISO standards, Factors leading to ISO, Implementation and registration, Benefits of ISO.	6

5	**Life Testing-Reliability-**Life testing: objective, failure data analysis, MTTF, MTBF, hazard rate, exponential and Weibull models, system reliability-series, parallel and mixed configurations, Markov model.	6
6	**Reliability Design and Allocation-** Design for reliability, reliability improvement techniques, active redundancy and standby redundancy, K-out-of-N redundancy and maintenance policies.	6
Total		**42**

11. Suggested Books:

S. No.	Title, Author, Publisher and ISBN No.
1.	Evans JR,Lindsay WM, "The Management and Control of Quality", Cengage learning, India, **ISBN-10:** 8131501361, 2011
2	BediKanishka,"Quality Management",Oxford University Press India, **ISBN-10:** 0195677951, 2006
3	Besterfield,"Total Quality Management", Pearson Education, **ISBN-10:** 9332534454, 2015
4	Gryna FM, Chua RCH, Defeo JA, "Juran"s Quality Planning and Analysis for Enterprise Quality", McGraw Hill Education (India) Private Limited, **ISBN-10:** 0070618488, 2006

PT361 HIGH PERFORMANCE POLYMERS

1. Subject Code: **PT361**   Course Title: **High Performance Polymers**

2. Contact Hours   : L: 03   T: 00   P: 00

3. Examination Duration (Hrs.)   : Theory: 03   Practical: 00

4. Relative Weight   : CWS: 25 PRS: 00 MTE: 25 ETE: 50   PRE: 00

5. Credits   : 03

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : NIL

9.	Objective	:	To impart knowledge about heat resistant polymers, liquid crystalline polymers, conducting and other special polymers.

10. Details of Course

S. No.	Contents	Contact Hours
1	Heat resistant polymers: Requirements for heat resistance, Determination of heat resistance, Synthesis, Structure-property relationships, Applications of heat resistant polymers like polyamides, polyimides and its derivatives, polyquinolines, polyquinoxalines, PBT, PBO, PBI, PPS, PPO, PEEK, engineering plastic blends.	9
2	Liquid crystalline polymers, Concept of liquid crystalline phase, Theories of liquid crystallinity, Characteristics of LC state and LCPs, Rheology of liquid crystalline polymers, Blends of LCPs, Self reinforced composites, Applications.	9
3	Conducting polymers, Conduction mechanism, semi-conductors and conducting polymers, Band theory, Doping of polymeric systems, Processing and testing of conducting polymers, Applications and recent advances in conducting polymers.	9
4	Synthesis and applications of photosensitive polymers, Curing reactions.	6
5	Polymers in specialty applications: Polymers in agricultural applications, Green houses, Mulches, Control release of agricultural chemicals, Seed coatings, Polymers in construction and building applications.	9
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publisher
1	Encyclopedia of Polymer science and Engineering Vol.1-17/ J.I. Kroschwitz, 2007
2	Additive for coatings/ John Bieleman/ Wiley-VCH, 2000.
3	Fire Properties of Polymeric Composites Materials/ A.P. Mouritz, A G. Gibson/ Springer, 2006.

4	Modern Biopolymers science: Bridging the divide between fundamentals treatise and industrial application/S. Kasapis, I.T. Nortan, J.B. Ubbink/ Elsevier 2009

PT363 SEPARATION TECHNOLOGY

1. Subject Code: **PT363** Course Title: **Separation Technology**

2. Contact Hours : L: 03 T: 00 P: 00

3. Examination Duration (Hrs.) : Theory: 03 Practical: 00

4. Relative Weight : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00

5. Credits : 03

6. Semester : V

7. Subject Area : OEC

8. Pre-requisite : NIL

9. Objective : To familiarize students with various separation techniques.

10. Details of Course

Unit No.	Contents	Contact Hours
1	Separation factors and its dependence on process variables, classification and characterization, thermodynamic analysis and energy utilization, kinetics and mass transport, Theory of cascades and its applications.	7
2	Membrane Separations, Merits and demerits, Commercial, pilot plant polarization of membrane processes and laboratory membrane permeators, Dialysis, Reverse osmosis, Ultrafiltration, Membrane operations, Design controlling factors.	7
3	Separation by Sorption Techniques, Types and choice of adsorbents, chromatographic techniques, Retention theory mechanism, Design controlling factors, ion exchange chromatography equipment and commercial processes, recent advances in sorption technology.	7

4	Ionic Separations: Theory, mechanism and equipments for electrophoresis, dielectrophoresis and electro dialysis, Controlling factors, Applications, Design considerations.	7
5	Thermal Separation: Thermal diffusion, Rate law, Theories of thermal diffusion for gas and liquid mixtures, Equipments design and applications, Zone melting, Equilibrium diagrams, Controlling factors, Apparatus and applications.	7
6	Other Techniques: Adductive crystallization, Molecular addition compounds, Clathrate compounds and adducts, Equipments, Applications, Economics and commercial processes. Foam Separation: Surface adsorption, Nature of foams, Apparatus, Applications and Controlling factors.	7
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publisher
1	New Chemical Engineering Separation Techniques/ Schoen/ Wiley Interscience, New York, 1972.
2	Separation Processes/ C.J. King/ Tata McGraw Hill, New Delhi,1982.
3	Bioseparations – Principles and Techniques/ B. Sivasankar/ Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4	Separation process Principles/ Seader, Henley and Roper/ John Wiley & Sons 2010
5	Membrane Separation processes/ Kaushik Nath/ PHI , 2008.

PT365 NON-CONVENTIONAL ENERGY

1. Subject Code: **PT365**　　　　　　Course Title: **Non-Conventional Energy**

2. Contact Hours　　　　　　　　: L: 03　　T: 00　　P: 00

3. Examination Duration (Hrs.)　: Theory: 03　　　Practical: 00

4. Relative Weight　　　　　　　: CWS: 25　PRS: 00　MTE: 25　ETE: 50　PRE: 00

5.	Credits	: 03
6.	Semester	: V
7.	Subject Area	: OEC
8.	Pre-requisite	: NIL
9.	Objective	: To make student aware about the fundamentals and applications of non-conventional energy.

10. Details of Course

Unit No.	Contents	Contact Hours
1	Renewable and non-renewable energy sources, trends in energy consumption, Global and National scenarios, Prospects of renewable energy sources, Energy Management.	6
2	Solar Energy: Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, measurement of solar radiation, flat plate collectors, concentrating collectors, Solar air heaters-types, solar driers, Storage of solar energy-thermal storage, Photo voltaics - solar cells & its applications.	6
3	Wind Energy: Basic system principles, Assessment of wind available, Design principles, Manufactured designs, Sizing and storage of energy, System efficiency, Overview of wind industry.	4
4	Energy from Biomass: Calorific value of Biomass samples, Pyrolysis, 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.	6
5	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.	4

6	Ocean Energy: Ocean Thermal Electric Conversion systems like open cycle, closed cycle, Hybrid cycle. 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.	4
7	Magnetohydrdynamic Power Generation: Principle of MHD power generation, MHD system, Design problems and developments, gas conductivity, materials for MHD generators and future prospects.	4
8	Fuel Cells: Design principle and operation of fuel cell, Types of fuel cells, conversion efficiency of fuel cell, applications of fuel cells.	4
9	Hydrogen Energy: Hydrogen Production methods, Hydrogen storage, hydrogen transportation, utilization of hydrogen gas, hydrogen as alternative fuel for vehicles.	4
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publisher
1	Principles of Sustainable Energy Systems, Second Edition/ Frank Kreith, Susan Krumdieck/ CRC Press, 2013.
2	Non-conventional energy sources/ G.D. Rai/ Khanna Publishers, 2004.
3	Solar Energy: Fundamentals and Applications/ H.P. Garg & Jai Prakash/ Tata McGraw Hill, 2000
4	Solar Engineering of Thermal Processes/ Duffic and Beckman/ John Wiley, 2013
5	Non Conventional Energy Resources/ Saeed and Sharma/ S.K. Kataria& Sons ,2013

PT367 POLYMER WASTE MANAGEMENT

1. Subject Code: **PT367**   Course Title: **Polymer Waste Management**

2. Contact Hours   : L: 03   T: 00   P: 00

3. Examination Duration (Hrs.)   : Theory: 03   Practical: 00

4. Relative Weight   : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00

5. Credits   : 03

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : NIL

9. Objective   : To impart knowledge about polymer waste and their management.

10. Details of Course

Unit No.	Contents	Contact Hours
1	Polymer and Plastics Waste: Definition of plastics waste and the associated problems, Identification, collection methods and separation. Integrated waste management – source reduction, recycling, energy recovering process through thermal and biological destruction, Land filling and composting.	8
2	Plastics waste management: Source reduction, reuse, repair, recycling, and incineration with examples. Plastics recycling: Classification, Code of practice, Primary, secondary, territory and quaternary recycling with examples, Waste plastics as fillers.	8
3	Recycling and degradation of plastics: Recycling and sustainability correlation, Basic principles and recovery, recycling and resource conservation.	9
4	Recycling of plastics by surface refurbishing, Application of a coating, polishing, Plastics, Environmental and Thermal ageing, Chemical degradation, Wear and erosion, Biodegradable plastics – an overview.	9
5	Environmental issues, policies and legislation in India.	8
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publisher
1	Plastics Recycling – Products and Processes/ Ehrig (Ed.)/ Hanser Publication, 1993
2	Recycling and recovery of plastics/ Brandrup/ Hanser Publishers, New York, 1996
3	Handbook of Plastics Recycling/ By Francesco La Mantia/ Rapra Tech Ltd , 2002
4	Introduction to Plastics Recycling/ By VannessaGoodship/ Rapra Tech Ltd ,2007

PT369 NANOTECHNOLOGY IN POLYMERS

1. Subject Code: **PT369**   Course Title: **Nanotechnology in Polymers**

2. Contact Hours   : L: 03   T: 00   P: 00

3. Examination Duration (Hrs.)   : Theory: 03   Practical: 00

4. Relative Weight   : CWS: 25 PRS: 00 MTE: 25 ETE: 50   PRE: 00

5. Credits   : 03

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : NIL

9. Objective   : To make student aware about the applications of nanopolymers in various fields.

10. Details of Course

S. No.	Contents	Contact Hours
1	Concepts of nanotechnology, Time and length scale in structures, Nanosystems, Dimensionality and size dependent phenomena, Surface to volume ratio-Fraction of surface atoms, Surface energy and surface stress, surface defects, Properties at nanoscale (optical, mechanical, electronic, and magnetic).	8
2	Nano-materials, Classification based on dimensionality, Quantum Dots, Wells and Wires, Carbon-based nano-materials, Metal based nano-materials, Nanocomposites, Nanopolymers, Nanoglasses, Nanoceramics, Biological nanomaterials.	8
3	Synthesis of nanopolymers, Chemical Methods, Metal Nanocrystals by Reduction, Solvothermal Synthesis, Photochemical Synthesis, Sonochemical Routes, Chemical Vapor Deposition, Metal Oxide - Chemical Vapor Deposition, Physical Methods such as ball Milling, electrodeposition, spray pyrolysis, flame pyrolysis, DC/RF magnetron sputtering, Molecular beam epitaxy.	9
4	Nanofabrication, Photolithography and its limitations, Electron beam lithography, Nanoimprint, Soft lithography patterning, Characterization with Field Emission Scanning Electron Microscopy, Environmental Scanning Electron Microscopy, High Resolution Transmission Electron Microscope, Scanning Tunneling Microscope, Surface enhanced Raman spectroscopy, X-ray Photoelectron Spectroscopy, Auger electron spectroscopy, Rutherford back scattering spectroscopy.	9
5	Applications of nanomaterials, Solar energy conversion and catalysis, Molecular electronics and printed electronics, Nanoelectronics, Polymers with aspecial architecture, Applications in displays and other devices, Nanomaterials for data storage, Photonics, Plasmonics, Nanomedicine, Nanobiotechnology and Nanotoxicology.	8
	Total	**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publisher
1	Organic and Inorganic Nanostructures/ Nabok/ Artech House, 2005.
2	Nanoscience: Nanotechnologies and Nanophysics/ Dupas, Houdy, Lahmani/ Springer-Verlag Berlin Heidelberg ,2007

| 3 | Nanostructured Materials and Nanotechnology/ H.S. Nalwa/ Academic Press , 2002 |
| 4 | A Textbook of Nanoscience and Nanotechnology/ Pradeep/ Tata McGraw Hill Education Pvt. Ltd. , 2012 |

PT371 APPLICATIONS OF POLYMER BLENDS AND COMPOSITE

1. Subject Code: **PT371**   Course Title: **Applications of Polymer Blends and Composite**

2. Contact Hours   : L: 03   T: 00   P: 00

3. Examination Duration (Hrs.)   : Theory: 03   Practical: 00

4. Relative Weight   : CWS: 25 PRS: 00 MTE: 25 ETE: 50   PRE: 00

5. Credits   : 03

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : NIL

9. Objective   : To make student aware about the applications of polymers, blends and composites.

10. Details of Course

Unit No.	Contents	Contact Hours
1	Concepts of polymer blends, Advantages of blends over conventional polymers, Significance of polymer blend technology, Different steps involved in designing of a blend, Different methods of blending, Characterization of polymer blends.	8
2	Compatibilization and Phase Morphology, Role of compatibilizers in blend technology, techniques of compatibilization, Phase structure development in polymer blends, Factors affecting morphology of polymer blends, Properties of polymer blends.	8

3	Reinforcements, Properties and applications of Glass, Carbon, Kevlar, polyethylene, boron, ceramic and natural fibers. Concepts of matrix material, Thermoset matrix materials like - epoxy, polyester, vinyl esters, phenolic resin, polyimides, Thermoplastic matrix materials like - polyolefins, polyether ether ketones, polyphenylene sulfide, thermoplastic polyimides.	9
4	Concept of composites, particulate and fibrous composites, Properties of composites, Fabrication of continuous and short fiber composites and particulate composites, mechanical and physical properties	9
5	Applications of blends and composites for civil, aerospace, automobiles etc	8
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publisher
1	Fibre Reinforced composites/ P. K. Malik/ Marcel Deckar, 1988.
2	Composites Manufacturing: Materials, Product, and Process Engineering/ S.K. Mujumdar/ CRC press ,2002
3	Fibre-glass Reinforced Plastics/ N. P. Cheremisinoff (Ed)/ Noyce Pub, 1988.
4	Design Data for Reinforced Plastics/ N. L. Hancex, R. M. Mayer/ Chapman Hall, 1994.
5	Reinforced Plastics: Properties and Applications/ Raymond Seymour/ The Materials Information Society, 1991.

IT351 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

NAME OF DEPTT: **Information Technology**

1. Subject Code: **IT351**   Course Title: **Artificial Intelligence and Machine Learning**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs   Practical 0

4. Relative Weightage : CWS 25 PRS 0   MTE 25   ETE 50   PRE 0

5. Credits : 3

6. Semester : V

7. Subject Area : OEC

8. Pre-requisite : Knowledge of discrete mathematics

9. Objective : The student should be able to understand the different supervised, unsupervised and reinforcement learning algorithms and choose the appropriate machine learning tool for different real world examples.

10. Details of Course

S.No.	Contents	Contact Hours
1.	**Introduction** to Artificial Intelligence and Machine learning, State Space representation of problems, Concept of Search, overview of different tasks: classification, regression, clustering, control, Concept learning.	6
2.	**Heuristic Search Techniques:** Generate and Test, Hill Climbing, Best-first search, Branch and bound, A* algorithm, Game playing.	6
3.	**Knowledge Representation:**Propositional logic, Predicate Logic, semantic nets, frames	8
4.	**Supervised Learning:** Decision trees, nearest neighbors, linear classifiers and kernels, neural networks, linear regression; Support Vector Machines.	8
5.	**Unsupervised Learning:** Clustering, Expectation Maximization, Dimensionality Reduction, Feature Selection, PCA, factor analysis, manifold learning.	8
6.	**Applications &Research Topics**: Applications in the fields of web and data mining, text recognition, speech recognition	6
TOTAL		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
	Text Book	
1.	Artificial Intelligence by Elaine Rich, K. Knight, McGrawHill	2009
1.	Introduction to Machine Learning, Alpaydin, E., MIT Press, 2004	
2.	Machine Learning, Tom Mitchell, McGraw Hill, 1997.	1997
3.	Elements of Machine Learning, Pat Langley Morgan Kaufmann Publishers, Inc. 1995. ISBN 1-55860-301-8	1995
	Reference Book	
4.	The elements of statistical learning, Friedman, Jerome, Trevor Hastie, and Robert Tibshirani. Vol. 1. Springer, Berlin: Springer series in statistics, 2001.	2001
5.	Machine Learning: A probabilistic approach, by David Barber.	2006
6	Pattern recognition and machine learning by Christopher Bishop, Springer Verlag, 2006	2006

IT353 DATA STRUCTURES AND ALGORITHMS

NAME OF DEPTT: **Information Technology**

1. Subject Code: **IT353**   Course Title: **Data Structures and Algorithms**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs   Practical 0

4. Relative Weightage   : CWS 25 PRS 0   MTE 25   ETE 50   PRE 0

5. Credits   : 3

6. Semester   : ODD

7. Subject Area   : OEC

8. Pre-requisite : Nil

9. Objective : The objective of the course is to familiarize students with basic data structures and their use in fundamental algorithms.

10. Details of Course

S.No.	Contents	Contact Hours
1.	**Introduction:** Introduction to Algorithmic, Complexity- Time-Space Trade off. Introduction to C programming through Arrays, Stacks, Queues and Linked lists.	8
2.	**Trees:** Basic Terminology, Traversals, Binary search trees, optimal and average BST's. 2-4 trees, Applications of Binary search Trees, Complete Binary trees, Extended binary trees.	7
3.	**Introduction to algorithms:** Concept of algorithmic efficiency, run time analysis of algorithms, Asymptotic Notations. Growth of Functions, Master's Theorem, **Searching and Searching:** Linear Search, Binary search, Insertion Sort, Quick sort, Merge sort, Heap sort, Radix Sort.	9
4.	**Graphs:** Terminology and Representations, Graphs & Multi-graphs, Directed Graphs, Representation of graphs, Breadth first search and connected components. Depth first search in directed and undirected graphs and strongly connected components.	8
5.	**Spanning trees:** Prim's and Kruskal's algorithm, union-find data structure. Dijkstra's algorithm for shortest paths, shortest path tree. Directed acyclic graphs: topological sort and longest path. **Dynamic programming**: Principles of dynamic programming. Applications: Matrix multiplication, Travelling salesman Problem.	10
Total		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
Text Books:		
1.	Horowitz and Sahni, "Fundamentals of Data structures", Galgotia publications	1983
2.	Tannenbaum, "Data Structures", PHI	2007(Fifth Impression)
3.	T .H . Cormen, C . E . Leiserson, R .L . Rivest "Introduction to Algorithms", 3rd Ed., PHI.	2011 (reprint)
4.	E. Horowitz, S. Sahni, and S. Rajsekaran, "Fundamentals of Computer Algorithms," Galgotia Publication	
Reference Books		
1.	R.L. Kruse, B.P. Leary, C.L. Tondo, "Data structure and program design in C", PHI	2009(Fourth Impression)
2.	Aho ,Ullman "Principles of Algorithms "	

IT355 COMMUNICATION AND COMPUTING TECHNOLOGY

NAME OF DEPTT: **Information Technology**

1. Subject Code: **IT355**   Course Title: **Communication and Computing Technology**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs   Practical 0

4. Relative Weightage   : CWS 25 PRS 0   MTE 25 ETE 50   PRE 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite : Operating systems, Algorithm Design and Analysis and data structures

9. Objective : To introduce the concept of Communications in Computer networks

10. Details of Course

S.No.	Contents	Contact Hours
1.	**Introduction** to Goals and Applications of Networks, Network structure and architecture, The TCP/IP reference model, services, Network Topology.	6
2.	**Data Link Layer and Medium Access sub layer** - Channel Allocations, LAN protocols -ALOHA protocols - Overview of IEEE standards - FDDI. - Elementary Data Link Protocols, Sliding Window protocols.	6
3.	**Network Layer**: Routing, Congestion control, Internetworking -TCP / IP, IP packet, IP address, IPv6 and Mobile IP.	8
4.	**Transport Layer:** Design issues, TCP and UDP, connection management, Congestion control, Leaky bucket, Token bucket algorithm. QoS.	8
5.	**Application Layer:** File Transfer, Access and Management, Electronic mail, Virtual Terminals, Internet and Public Networks, Firewalls	6
6.	**Information and Web security**: IP Security, Architecture, Authentication header, Encapsulating security payloads, combining security associations, Secure Socket Layer(SSL) and transport layer security, TSP, Secure Electronic Transaction (SET), Electronic money.	8
	TOTAL	**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
	Text Book	
1.	S. Tananbaum, "Computer Networks", 3rd Ed, PHI	1999

2.	U. Black, "Computer Networks-Protocols, Standards and Interfaces", PHI	1996
3.	W. Stallings, "Computer Communication Networks", PHI	1999
3.	Data Communications and Networking, Behrouz A. Forouzan 5/e	2013
Reference Book		
4.	William Stallings, "Cryptography and Network Security: Principals and Practice", Prentice Hall, New Jersy.	2001
5.	Behrouz A. Forouzan, "Cryptography and Network Security", TMH.	2006

IT357 INTERNET AND WEB PROGRAMMING

NAME OF DEPTT: Information Technology

1. Subject Code : **IT357**   Course Title: **Internet and Web Programming**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs   Practical 0

4. Relative Weightage   : CWS 25 PRS 0   MTE 25 ETE 50   PRE 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : Nil

9. Objective   : To introduce the concept of internet and web programming

10. Details of Course

S.No.	Contents	Contact Hours
1.	**Internet and WWW:** Internet basic, Introduction to internet and its applications, E- mail, telnet, FTP, e-commerce, video conferencing, e-business. Internet service providers, domain name server, internet address World Wide Web (WWW): World Wide Web and its evolution, uniform resource locator (URL), browsers - internet explorer, netscape navigator, opera, firefox, chrome, mozilla. Search engine, web saver - apache, IIS, proxy server, HTTP protocol.	6
2.	**WEBSITES BASIC ANDWEB 2.0**: Web 2.0: Basics-RIA Rich Internet Applications - Collaborations tools - Understanding websites and web servers: Understanding Internet – Difference between websites and web server- Internet technologies Overview – Understanding the difference between internet and intranet; HTML and CSS: HTML 5.0 , XHTML, CSS 3.	6
3.	**E-MAIL SECURITY & FIREWALLS** : PGP - S/MIME - Internet Firewalls for Trusted System: Roles of Firewalls - Firewall related terminology- Types of Firewalls - Firewall designs - SET for E-Commerce Transactions, intellectual property: copyright, patents, trademarks, cyber laws	8
4.	**SERVELETS AND JSP**: JSP Technology Introduction-JSP and Servelets- Running JSP Applications Basic JSP- JavaBeans Classes and JSP-Tag Libraries and Files- Support for the Model- View- Controller Paradigm- Case Study- Related Technologies.	8
5.	**XML**: Introduction to XML, uses of XML, simple XML, XML key components, DTD and Schemas, Well formed, using XML with application.XML, XSL and XSLT. Introduction to XSL, XML transformed simple example, XSL elements, transforming with XSLT	6
6.	**PHP:** Starting to script on server side, Arrays, function and forms, advance PHP, Basic command with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, PHP my admin and database bugs.	8
	TOTAL	**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
	Text Books	
1.	Internet and Web Technologies by Raj Kamal, Tata McGraw Hill edition. (ISBN: 9780070472969)	2002
2.	An Introduction to Search Engines and Web Navigation, Mark Levene, Pearson Education. (ISBN: 978047052684)	2010
3.	Modeling the Internet and the Web,PierreBaldi,PaoloFrasconi, Padhraic Smyth, John Wiley and Sons Ltd. (ISBN: 978-0-470-84906-4)	2003
	Reference Books	
4.	HTML: A Beginner's Guide by Wendy Willard, Tata McGraw-Hill (ISBN: 9780070677234)	2009
5.	PHP and MySQL for Dynamic Web Sites, Ullman, Larry, Peachpit Press.1 (ISBN: 978-0-321-78407-0)	2012

IT359 JAVA PROGRAMMING

NAME OF DEPTT: Information Technology

1. Subject Code: **IT359**   Course Title: **Java Programming**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (ETE) (Hrs.) : Theory   3 Hrs   Practical 0

4. Relative Weightage   : CWS 25 PRS 0   MTE 25 ETE 50   PRE 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : Nil

9. Objective   : To introduce the concept of java programming

10. Details of Course

S.No.	Contents	Contact Hours
1.	**Introduction to Java**: Programming language Types and Paradigms, Computer Programming Hierarchy, How Computer Architecture Affects a Language? , Why Java?, Flavors of Java, Java Designing Goal, Role of Java Programmer in Industry, Features of Java Language, JVM –The heart of Java , Java's Magic Byte code.	6
2.	**The Java Environment:** Installing Java, Java Program Development, Java Source File Structure, Compilation, Executions. Lexical Tokens, Identifiers, Keywords, Literals, Comments, Primitive Datatypes, Operators Assignments.	6
3.	**Object Oriented Programming**: Class Fundamentals , Object & Object reference, Object Life time & Garbage Collection, Creating and Operating Objects , Constructor & initialization code block, Access Control, Modifiers, methods Nested , Inner Class &Anonymous Classes, Abstract Class & Interfaces Defining Methods, Argument Passing Mechanism, Method Overloading, Recursion, Dealing with Static Members, Finalize() Method, Native Method.	8
4.	**Extending Classes and Inheritance**: Use and Benefits of Inheritance in OOP, Types of Inheritance in Java, Inheriting Data members and Methods, Role of Constructors in inheritance, Overriding Super Class Methods, Use of "super", Polymorphism in inheritance, Type Compatibility and Conversion Implementing interfaces.	8
5.	**Package**: Organizing Classes and Interfaces in Packages, Package as Access Protection, Defining Package, CLASSPATH Setting for Packages, Making JAR Files for Library Packages Import and Static Import Naming Convention For Packages.	6
6.	**GUI Programming**: 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 Using Swing Components, Java Utilities (java.util Package) The Collection Framework: Collections of Objects, Collection Types, Sets , Sequence, Map, Understanding Hashing, Use of Array List & Vector.	8
TOTAL		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
	Text Books	
1.	The Complete Reference Java,, Herbert Schildt, ISBN: 978-0-07163177-8, Publisher: McGraw Hill	7th Edition
2.	Thinking in Java, Bruce Eckel, ISBN: 0-13-187248-6, Publisher: Prentice Hall	4th Edition
3.	The Java Programming Languages,, Ken Arnold, ISBN-13: 978-032134980, Publisher: Sun	4th Edition,
4.	Java in Nutshell,, Benjamin,ISBN: 9781449371296, Publisher: O'Reilly Media, Inc.	6th Edition

1. Subject Code: **CE351**   Course Title: **Geoinformatics and its Applications**

2. Contact Hours   : L: 3   T: 0   P: 0

3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs   Practical 0

4. Relative Weightage   : CWS 25 PRS 0   MTE 25 ETE 50   PRE 0

5. Credits   : 3

6. Semester   : V

7. Subject Area   : OEC

8. Pre-requisite   : Nil

9. Objective   : To familiarize the students with the concepts of the subject and its related applications in Civil Engineering and allied fields.

10. Details of Course

S. No.	Contents	Contact Hours
1	**Introduction to Geoinformatics, Remote Sensing, GIS and GPS:** Definitions of Geoinformatics, Remote Sensing, GIS and GPS, sources of energy, electromagnetic spectrum, electromagnetic radiation, reflection, transmission and absorption, Platforms and sensors, active and passive sensors, PAN, Multi and hyperspectral remote sensing data acquisition systems	8
2	**Maps, Datums, Projections Systems and spatial data analysis** - Plane and Geodetic surveying, Classification of surveys, Basic Principles of Surveying, Type of maps, scales and uses, plotting accuracy, map sheet numbering. Datums, coordinates and map projection systems. Data retrieval and querying, measurements in GIS, classification, accuracy.	8
3	**Optical, Thermal and Microwave Remote Sensing**. Brief review of Optical, thermal and microwave remote sensing, their utility, merit and demerits, Interaction of EMR with atmosphere, scattering, refraction, absorption, transmission, atmospheric windows, interaction of EMR with earth surface, spectral characteristics of remote sensing data,	8
4	**Basic Photogrammetry and Digital Image Processing:** Photogrammetry, aerial and terrestrial, applications of photogrammetry, types and geometry of aerial photograph, flying height and scale, relief (elevation) displacement. Digital image, digital image processing introduction to, preprocessing, enhancement, classification, visual image interpretation, Introduction to software - MATLAB, ENVI, ERDAS, AutoCAD etc	10
5	**Applications of Geoinformatics, Remote Sensing, GIS and GPS:** Land cover classification survey and Mapping, Digital elevation model (DEM), Introduction to SAR data, Applications in Disaster management, geology, forest security and military projects.	8
Total		**42**

11. Suggested Books:

S.N.	Name of Books/ Authors	
1	Agarwal, C.S. and Garg, P.K., "Remote Sensing in Natural Resources Monitoring and Management", Wheeler Publishing House(ISBN 6-74-268173-4)	2000
2	Bossler, J.D., "Manual of Geospatial Science and Technology", Taylor and Francis. (ISBN 0-74-68914355-7)	2002
3	Burrough, P.A. and McDonnell, R.A., "Principles of Geographic Information System", Oxford University Press. (ISBN 0-07-985256-4)	2000
4	Chandra, A.M. and Ghosh, S.K., "Remote Sensing and Geographical Information Systems", Alpha Science. (ISBN 0-07-8452567-1)	2005
5	Gopi, S., "Global Positioning System: Principles and Applications", Tata McGraw Hill. (ISBN 0-07-7691528-1)	2005

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