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

ENGINEERING PHYSICS

W.E.F 2015

DEPARTMENT OF APPLIED PHYSICS

Scheme of Teaching and Examinations

B. Tech. (Engineering Physics)

Majors in Electronics and Minors in any one of the following
(Nanoscience and Technology/Photonics/Space and Atmospheric Sciences/Plasma Science and Technology/Nuclear Engineering/Robotics and Intelligent Systems)

W.E.F. 2015

DELHI TECHNOLOGICAL UNIVERSITY

(Formerly Delhi College of Engineering)

CONTENTS

Delhi Technological University

(Formerly Delhi College of Engineering)

Shahbad Daulatpur, Bawana Road, Delhi – 110 042

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 PHYSICS

VISION

Consolidating teaching and learning process covering all aspects of pure and applied physics that promotes research and development leading to creation of new knowledge, inventions and discoveries fostering institute-industry linkages and entrepreneurial culture for betterment of all its stake holders and society at large..."

MISSION

1. To establish global and industry standards of excellence by generating new knowledge in all the endeavors concerned to teaching, learning, research and consultancy.

2. To develop close linkages with industry to undertake collaborative projects so as to enable young engineers to be a part of fast changing technological scenario.

3. To help our students in developing human potentials, intellectual interests, creative abilities and be lifelong learners to meet the challenges of the national and global environment and be true professional leaders.

4. To stand up to the needs and expectations of our society by equipping and training our students to be good citizens, aware of their commitments and responsibilities, to make this world a better place to live.

5. To be a world class centre for education, research and innovation in the various upcoming fields of Applied Physics.

6. To focus on the development of cutting-edge technologies and to foster an environment of seamlessness between academia and industry.

PROGRAM EDUCATIONAL OBJECTIVES(PEOs)

PEO 1: To educate professionals in the current and vibrant emerging areas of Applied Physics.

PEO 2: To develop the professionals to understand and enrich with fundamental knowledge of Applied Physics to use as platform for various core engineering subjects.

PEO 3: To provide an environment for students to be interested, motivated to tackle the complex problems and capable of self-learning.

PEO 4: To equip students with integrity and ethical values so that they become responsible Engineers

DEPARTMENT OF APPLIED PHYSICS
BACHELOR OF TECHNOLOGY (ENGINEERING PHYSICS)

I Year: Odd Semester

Teaching Scheme					Contact Hours/Week			Exam Duration (h)		Relative Weights (%)				
S. No.	Subject Code	Course Title	Subject Area	Credit	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
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

Teaching Scheme					Contact Hours/Week			Exam Duration		Relative Weights (%)				
S. No.	Subject Code	Course Title	Subject Area	Credit	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
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.	ME251	Engineering Mechanics	AEC	4	3	1	0	3	0	25	0	25	50	-
2.	EP201	Introduction to Computing	DCC	4	3	0	2	3	0	15	15	30	40	-
3.	EP203	Mathematical Physics	DCC	4	3	1	0	3	0	25	0	25	50	-
4.	EP205	Classical and Quantum Mechanics	DCC	4	3	1	0	3	0	25	0	25	50	-
5.	EP207	Digital Electronics (Engineering Analysis and Design)	DCC	4	3	0	2	3	0	15	15	30	40	-
6.	MG201	Fundamentals of Management	HMC	3	3	0	0	3	0	25	0	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.	EC262	Communication System	AEC	4	3	0	2	3	0	15	15	30	40	-
2.	EP202	Condensed Matter Physics	DCC	4	3	0	2	3	0	15	15	30	40	-
3.	EP204	Optics	DCC	4	3	0	2	3	0	15	15	30	40	-
4.	EP206	Microprocessor and Interfacing	DCC	4	3	0	2	3	0	15	15	30	40	-
5.	EP208	Computational Methods	DCC	4	3	1	0	3	0	25	0	25	50	-
6.	HU202	Engineering Economics	HMC	3	3	0	0			25	0	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.	EP301	Semiconductor Devices	DCC	4	3	1	-	3	0	25	0	25	50	-
2.	EP303	Electromagnetic Theory, antennas and Propagation	DCC	4	3	0	2	3	0	15	15	30	40	-
3.	EP3xx	Departmental Elective Course- 1	DEC/ GEC	4	3	0/1	2/0	3	0	15/ 25	15/-	30 /25	40/ 50	-
4.	EP3xx	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	01	0	3	0	25	-	25	50	-
6.	HU301	Technical Communication	HMC	2	0	0	0	3	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.	EP302	Fiber Optics and Optical Communication	DCC	4	3	0	2	3	0	15	15	30	40	-
2.	EP304	Fabrication and Characterization of Nanostructures	DCC	4	3	1	0	3	0	15	15	30	40	-
3.	EP306	Microwave Engineering	DCC	4	3	0	2	3	0	25	-	25	50	-
4.	EP3xx	Departmental Elective Course- 3	DEC/ GEC	4	3	0/1	2/0	3	0	15/25	15/-	30 /25	40/ 50	-
5.	EP3xx	Departmental Elective Course- 4	DEC/ GEC	4	3	0/1	2/0	3	0	15/25	15/-	30 /25	40/ 50	-
6.	HU304	Profession Ethics & Human Values	HMC	2	2	0	0	3	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.	EP401	B.Tech. Project-I	DCC	4										
2.	EP403	Training Seminar	DCC	2										
3.	EP405	VLSI and FPGA design	DCC	4	3	0	2	3	0	15	15	30	40	-
4.	EP407	Mobile and Satellite communication	DCC	4	3	0	2	3	0	15	15	30	40	-
5.	EP4xx	Departmental Elective Course -5	DEC/ GEC	4	3	0/1	2/0	3	0	15/ 25	15/-	30/ 25	40/ 50	-
6.	EP4xx	Departmental Elective Course-6 (Minor)	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.	EP402	B.Tech. Project-II	DCC	8										
2.	EP404	Alternate Energy Storage and Conversion Devices	DCC	4	3	0	2	3	0	15	15	30	40	-
3.	EP4xx	Departmental Elective Course-7 (Minor)	DEC/ GEC	4	3	0/1	0	3	0	25	0	25	50	-
4.	EP4xx	Departmental Elective Course -8	DEC/ GEC	4	3	0/1	0	3	0	25	0	25	50	-
		Total		**20**										

List of Departmental Elective Courses

S. No.	Elective Code	Title of Elective	Elective no.
1.	EP-305	Atomic and Molecular Physics	DEC-1, 2
2.	EP-307	Biophysics	
3	EP-309	Quantum Information and Computing	
4.	EP-311	Computer Networking	
5.	EP-308	Laser and Instrumentation	DEC-3, 4
6.	EP-310	Medical Physics and Physiological measurements	
7.	EP-312	Fourier optics and holography	
8.	EP-314	Instrumentation and Control	
9.	EP-316	Cosmology and Astrophysics	
10.	EP-409	Information theory and coding	DEC-5, 6
11.	EP-411	Advanced Simulation Techniques in Physics	
12.	EP-413	Continuum Mechanics	
13.	EP-415	Nano Science and Technology	
14.	EP- 417	Photonics	
15.	EP-419	Introduction to Automation and Motion Control	
16	EP-421	Principles of Nuclear Engineering	
17.	EP-423	Space and Atmospheric Science-I	
18.	EP-425	Plasma Science and Technology-I	
19.	EP-406	Introduction to Spintronics	DEC-7, 8

20.	EP-408	Integrated Optics	
21.	EP-410	Robotic Engineering	
22.	EP-412	Nuclear Materials for Engineering Applications	
23.	EP-414	Space and Atmospheric Science-II	
24.	EP-416	Plasma Science and Technology-II	
25.	EP-418	Digital Signal Processing	
26.	EP-420	Fuzzy Logic and Neural Networks	
27.	EP-422	Embedded Systems Design	

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

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: **ME- 251** Course Title: **Engineering Mechanics**

2. Contact Hours : L : 3 T : 1 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 : 4

6. Semester : III

7. Subject Area : AEC

8. Pre-requisite : Nil

9. Objective : To impart knowledge to the students about the distribution and balancing of forces acting on various objects, either in rest or in motions , and the methods of analyzing their effects.…

S. No.	Contents	Contact Hours
1.	**UNIT-I:** Rigid body static: Equivalent force system, Equation of equilibrium, Freebody diagram, Reaction, Static indeterminacy and partial constraints, Two and three forces systems	04
2.	**UNIT-1I:** Structures: 2D truss, Method of joints, Method of section, Frame, Beam, Types of loading and supports, Shear force and bending moment diagrams, Relation among load-shear for5ce-bending moment.	08
3.	**UNIT-III:** Friction: Dry friction(static and kinematics) , wedge friction, disc friction (thrust bearings) , belt friction, square threaded screws, journal bearings, (Axle friction) , Wheel friction, Rolling resistance	08

4.	**UNIT-IV:** Centre of gravity and Moment of Inertia : First and Second Moment of Area and Mass, radius of gyration, Parallel axis theorem, product of inertia, rotation of axes, and principal M.I. Thin plate, M.I. by direct method (by integration) , Composite bodies, Virtual work and energy method , Virtual displacement, principle of virtual work, Mechanical efficiency, Work of a force/ couple (springs etc) , Potential energy and equilibrium, stability	08
5.	**UNIT-V:** Kinematics of Particles: Rectilinear motion, curvilinear motion, rectangular , normal, tangential , polar, cylindrical , spherical (co ordinates) , relative and constrained motion, space curvilinear motion	08
6.	**UNIT-VI:** Motion of rigid bodies: Translation, fixed axis rotation , general planner motion, work-energy, power, potential energy, impulse-momentum and associated conservation principles, Euler equation s of motion and its application	06
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors	Year of Publication/ Reprint
1.	Engineering Mechanics by Dr. A.K.Tayal	2011
2.	Engineering Mechanics Statics and Dynamics By Dr. R.S. Khurmi	2012
3.	Engineering Mechanics By Dr. D.S.Kumar	2012
4.	Engineering Mechanics by Dr. S.S. Bhavikatti	1995

1. Subject Code: **EP-201** Course Title: **Introduction to Computing**
2. Contact Hours : L : 3 T : 0 P : 2
3. Examination Duration (Hrs.) : Theory : 3 Practical : 0
4. Relative Weight : CWS : 15 PRS : 15 MTE : 30 ETE : 40 PRE : 0

5. Credits : 4

6. Semester : ODD

7. Subject Area : III

8. Pre-requisite : Nil

9. Objective : To familiarize the students with the widely used software Matlab so that they can develop to skill to solve the problem related to applied physics and engineering using Matlab

10. Details of Curse :

S. No.	Contents	Contact Hours
1.	**UNIT-I:** Introduction to Matlab: Advantages and disadvantages, Matlab environment: Command window, Figure window, Edit window, Variables and Arrays: Initializing variables in Matlab, Multidimensional arrays, Subarrays.	04
2.	**UNIT-1I:** Special values, Displaying output data, Data file, Scalar and array operations, Hierarchy of operations, Built-in-Matlab functions, Introduction to plotting: 2D and 3D plotting. Branching Statement and Program design: Introduction to top-Down design Technique, Use of pseudo code, Relational and logical operators, Branches, additional plotting features of Matlab	08
3.	**UNIT-III:** Loops: The while loop, for loop, details of loops operations, break and continue statement, nesting loops, Logical arrays and vectorization, User Defined Functions: Introduction to Matlab functions	08
4.	**UNIT-IV:** Variable passing in Matlab, Optional arguments, Sharing data using global memory, preserving data between calls to a function, function functions, Subfunction and private function.	08

5.	**UNIT-V:** Complex Data and Character Data: Complex data, String functions, Multidimensional arrays, Additional 2D plots, three dimensional plots, Input/Output Function: Text read function, load and save commands.	08
6.	**UNIT-VI:** An introduction to Matlab file processing, file opening and closing, Binary I/O functions, Formatted I/O functions, comparing binary and formatted functions, file positioning and Status functions, Numerical methods and developing the skills of writing the program	06
Total		**42**

11. Suggested Books

S. No	Name of Books/Authors	Year of Publication/ Reprint
1	MATLAB Programming for Engineers by Steven C. Chapra/ Cengage	2012
2	Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers/ Oxford	2010
3	Mastering MATLAB by Duane C. Hanselman/Pearson	2008
4	Computational Photonics: An Introduction with Matlab by M. S. Wartak Cambridge University Press	2013
5	Matlab: An Introduction with Applications by Amos Gilat/ Wiley India Private Limited	2007
6	A Concise Introduction to Matlab by W. J. Palm III McGraw Hill	2012

1. Subject Code: **EP-203** Course Title: **Mathematical Physics**
2. Contact Hours : L : 3 T : 1 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 : 4

6. Semester : III

7. Subject Area : DCC

8. Pre-requisite : Basic knowledge of Vector analysis, Differentiation, Integration and ordinary differential equations (linear algebra)

9. Objective : to develop student's facility with certain mathematical techniques and to highlight applications of mathematical methods to physical systems.

10. Details of Course :

S.No.	Contents	Contact Hours
1.	**Review of Vector Analysis:** Scalar and vector fields, Triple Products, Vector Differentiations, divergence and curl, Vector and Volume Integrations, Applications of Greens, Gauss's and stokes theorem, Equation of continuity and its applications	8
2.	**Tensors:** Definition, Rank of a Tensor, Einstein's summation convention, Dummy and real index, Contravariant, Covariant and Mixed tensors, Addition, substraction, Contraction, Multiplication of tensors: inner and outer product, Quotient law, symmetric and anti-symmetric tensors-application of tensor theory to strain, thermal expansion, piezo-electricity and converse piezo-electric effect	10
3.	**Complex Variables:** Introduction, Functions of complex variables, limit, continuity, Analytic function, Cauchy-Reimann equations, Harmonic function, Singular points and classification, Cauchy theorem, Cauchy's integral formula, Taylor's and Laurent's series, Residues, Calculations of residues, Residue theorem-evaluation of definite integrals.	12
4.	**Partial Differentiatial Equations:** Introduction, Method of separation of variables- Solution of Laplace Equation in two dimensions- D'alemberts solution of the wave equation, Application of Laplace equation to two dimensional steady state of heat flow in a thin rectangular plate - application to the vibration of a rectangular membrane.	06

5.	**Numerical analysis:** Introduction to Numerical analysis, Forward and backward differences, Relation between the operators, Concept of Interpolation and Extrapolation, Newton-Gregory formula for forward and backward interpolation, Solution of ordinary differential equations of first order using Runge-Kutta Method.	06
Total		**42**

11. Suggested Books

S.No.	Name of Books/ Authors	Year of Publication/ Reprint
1.	Vector Analysis by M. R. Spiegel/Schaum's outline series, Tata McGraw Hill	1959
2.	Vector and Tensor analysis by Harry Lass, International Student edition/McGraw-Hill	1950
3.	Tensor Analysis-theory and applications by I.S. Sokolnikof/John Wiley & Sons, Inc	1951.
4.	Physical properties of crystals – their representation by Tensors and Matrices by J.F. Nye/Oxford Science Publications, Oxford University Press	1957
5.	Complex variables by M. J. Ablowitz, A.S. Fokas/2nd Edition/ Cambridge University Press	2003
6.	Complex variable and applications by J.W. Brown and R.V. Churchill/6th ed., McGraw-Hill Higher Education	2009
7.	Advanced Engineering Mathematics by Erwin Kreyszig/10th Edition/John Wiley & Sons, INC.	2011
8.	Higher Engineering Mathematics by H.K. Dass, Er. R. Verma/ S. Chand & Company Ltd.	2012

1. Subject Code: **EP-205** Course Title: **Classical and Quantum Mechanics**

2. Contact Hours : L : 3 T : 1 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 : 4

6. Semester : III

7. Subject Area : DCC

8. Pre-requisite : Basic knowledge of Modern Physics, Differentiation, Integration and Partial and Ordinary differential equations

9. Objective : * To develop familiarity with the physical concepts and facility with the mathematical methods of classical mechanics.

* The student will be able to formulate and explain fundamental concepts of quantum mechanics, will learn to Solve Schrodinger equation to obtain eigenvectors and energies and describe the propagation of a particle in various potentials

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Basic Principles of classical dynamics: Constraints of motion , generalised coordinates , D'Almbert Principle , The Lagrangian function, Lagrange's equations of motion: derivation and applications , Conservation theorems, Central forces: Definition and properties, The equations of motion, the equivalent one dimensional problem and classification of orbits.	8
2.	Hamilton's variational principle, The Hamiltonian (H), Hamilton's Canonical equations of motion, Physical Significance of H, Cyclic coordinates Derivation of Hamilton's equations from a variational principle, Applications of Hamilton's equations of motion	8
3.	Review of Schrödinger equation. Simple potential problems- penetration of a potential barrier, Dirac's Bra and ket notations, Operator Algebra : Hermitian, orthonormality, Superposition, Commutation Algebra, Ehrenfest Theorem, Angular momentum Operators and their algebra	8

4.	Approximation techniques in quantum mechanics : Stationery Perturbation Theory, Variational Method, Applications of variation method – (i) Ground state of hydrogen atom and (ii) helium atom.	8
5.	Wentzel Kramers Brillouin (WKB) approximation, Principle of WKB approximation, connection formulae for penetration of a barrier. Application of WKB Approximation method – (i) Transmission through a barrier (ii) Theory of alpha decay. Time dependent perturbation theory, perturbation theory for non degenerate case, a charged particle in an electromagnetic field	10
Total		**42**

11. Suggested Books

S.No.	Name of Books/ Authors	Year of Publication/ Reprint
1.	Classical Mechanics by H. Goldstein/Addison Wesley	2011
2.	Quantum Physics by S. Gasiorowicz/John Wiley , Asia	2003
3.	A textbook of Quantum Mechanics by P.W. Mathews and K. Venkatesan/Tata McGraw Hill	2nd Edition
4.	Quantum Mechanics by Schwabl/Narosa	2005
5.	Quantum Mechanics by L.I. Schiff/McGraw Hill	3rd Edition
6.	Quantum Mechanics by Merzbacher/John Wiley , Asia	3rd Edition
7.	Introduction to Quantum Mechanics by B.H. Bransden and C. J. Joachain/Longman	2nd Edition

1. Subject Code: **EP 207** Course Title: **Digital Electronics (Engineering Analysis and Design)**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : 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 familiarize the student with the concept of Boolean algebra, logic gates, sequential and combinational circuits, counters and RAMs.

10. Details of Course :

S. No.	Contents	Contact Hours
1.	Minimization Techniques: Boolean postulates and laws – De-Morgan's Theorem-Principle of Duality	3
2.	Boolean expression - Minimization of Boolean expressions — Minterm – Maxterm	1
3.	Sum of Products (SOP) – Product of Sums (POS) – Karnaugh map Minimization, Don't care conditions	3
4.	Implementation of Logic Functions using gates, NAND–NAND and NOR-NOR implementations.	2
5.	BCD and XS3 Addition, Gray Codes	1
6.	1's complement and 2's complement subtraction.	3
7.	Introduction to the circuits for Arithmetic UNIT: Design procedure – Half adder – Full Adder – Half subtractor – Full subtractor	1
8.	Parallel binary Adder/Subtractor –Serial Adder/Subtractor - BCD adder – 2's complement adder/subtractor	3
9.	Multiplexer, Demultiplexer, Decoder, Encoder,	2
10.	Latches, Flip-flops - SR, JK, D, T, and Master-Slave – Characteristic table and equation — Edge triggering – Level Triggering	2
11.	Realization of one flip flop using other flip flops.	2
12.	Registers – shift registers - Bidirectional shift registers, serial and parallel configurations.	1

13.	Shift register counters – Ring counter, Johnson counter, Asynchronous Ripple or serial counter	3
14.	Asynchronous Up/Down counter - Synchronous counters – Synchronous Up/Down counters – Programmable counters	1
15.	Design of Synchronous counters: state diagram- State table – State minimization –State assignment - Excitation table and Circuit implementation	2
16.	Modulo–n counter,– Non-Sequential Counter Design using JK, D and T-design.	2
17.	Introduction to VHDL-Behavioural Modeling, Dataflow Modeling, Structural Modeling, Application in Digital System Designs.	2
18.	Digital to analog converter: Binary Weighted Resistors, Analog to digital converter-Successive Approximation Method,	1
19.	Logic gates, DTL, TTL, ECL, I^2L, CMOS Gates and their parameters and comparisons.	2
20.	Classification of memories – ROM - ROM organization - PROM – EPROM – EEPROM – EAPROM	2
21.	RAM – RAM organization – Write operation – Read operation, memory expansion	2
22.	Static RAM Cell-Bipolar RAM cell – MOSFET RAM cell – Dynamic RAM cell	1
Total		**42**

11. Suggested Books

S.No	Name of Books/ Authors	Year of Publication/ Reprint
1.	Thomas L. Floyd , Digital Fundamentals, Pearson Education Asia	1994
2.	Digital Integrated Electronics by H.Taub & D. Schilling(TMH).	1997
3.	Digital Principles and Application by Malvino & Leach (TMH).	1986

4.	Digital Electronics And Logic Design by M.Mano (EPI)	2004
5.	Switching And Finite Automata Theory by Z. Kohavi (TMH).	2009
6.	Modern Digital Electronics by R. P. Jain (TMH).	2009

1. Subject Code: **MG201** Course Title: **Fundamentals of 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 : III
7. Subject Area : HMC
8. Pre-requisite : NIL
9. Objective : The basic objective of this paper is to acquaint the students with the basic concepts of management necessary to deal with emerging business environment besides sensitizing them about societal challenges.
10. Details of Course :

S.No.	Detail Contents	Contact Hrs.
1	Definition of management, importance of management, management principals, managerial roles, managerial ethos, management vs administration, managerial functions, task and responsibilities, organizational structure, motivation: meaning, theories and techniques.	8
2	Concept of business environment, corporate social responsibility and corporate governance, managerial values and ethics.	8

3	Objectives and importance of financial management, basics of capital budgeting, cost of capital, emerging sources of funds for new projects, introduction to stock market.	9
4	Functions of marketing, marketing Vs sales, interface of marketing with other departments, customer life time value, new product development, unethical issues in marketing.	8
5	Introduction to knowledge management, knowledge society, knowledge economy, building knowledge assets, sources of knowledge, technology innovation process, E-governance: definition, objectives and significance; challenges in Indian context, Digital India programme.	9
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:9780273755869)
2	Financial Accounting, 4 ed, S.N. Maheshwari and S.K. Maheshwari, Vikas Pulication,2005 (ISBN: 8125918523)
3.	Management, James A F Stonner, Pearson Education,2010 (ISBN: 9788131707043)
4.	Marketing Management, 14th ed., Philip Kotler , Kevin Lane Keller, Abraham Koshy and MithileswarJha, Pearson Education, 2013 (ISBN: 9788131767160)
5	Knowledge Management in Organizations: A Critical Introduction, Donald Hislop, Oxford University Press,2013 ISBN: 9780199691937.

1. Subject Code: **EC-262** Course Title: **Communication system**
2. Contact Hours : L : 3 T : 0 P : 2
3. Examination Duration (Hrs.) : Theory : 3 Practical :
4. Relative Weight : CWS : 15 PRS : 15 MTE : 30 ETE : 40 PRE : 0
5. Credits : 4
6. Semester : IV

7. Subject Area : AEC

8. Pre-requisite : Nil

9. Objective : To provide the in depth analysis of the concepts of the communication and modulation demodulation technique.

S. No.	Contents	Contact Hours
1.	**Introduction:** Block diagram of an electronic communication system, electromagnetic spectrum-band designations and applications, need for modulation. **Concept of Noise:** External noise, internal noise, signal to noise ratio, noise factor, noise temperature, Friss formula.	08
2.	**Amplitude modulation:** modulation index, frequency spectrum, generation of AM (balanced modulator), Amplitude Demodulation (diode detector), Other forms of AM: Double side band suppressed carrier, DSBSC generation (balanced modulator), Single side band suppressed carrier, SSBSC generation (filter method), SSB detection, Introduction to other forms of AM (Pilot Carrier Modulation, Vestigial Side Band modulation). **Angle modulation:** Frequency and Phase modulation, modulation index and frequency spectrum, equivalence between FM and PM, Generation of FM (direct methods), FM detector (slope detector, PLL).	12
3.	**Pulse Analog Modulation:** Sampling theorem, Errors in Sampling. Pulse Amplitude Modulation (PAM), Time Division Multiplexing (TDM). Pulse Width Modulation (PWM) and Pulse Position Modulation (PPM). Generation and detection of PAM, PWM, PPM. **Pulse Code Modulation:** Need for digital transmission, Quantizing, Uniform and Non-uniform Quantization, Quantization Noise, Companding, Coding, Decoding, Regeneration, Transmission noise and Bit Error Rate. Differential Pulse Code Modulation, Delta Modulation, Adaptive Delta Modulation.	12

4.	**Digital Carrier Modulation Techniques:** Information capacity, Bit Rate, Baud Rate and M-ary coding. Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), Binary Phase Shift Keying (BPSK) and Quadrature Phase Shift Keying (QPSK). QPSK, Amplitude modulation, bandwidth efficiency, carrier recovery – squaring loop, Costas loop, DPSK.	10
Total		**42**

11. Suggested Books

S.No.	Name of Books/ Authors	Year of publication/ reprint
1.	Electronic Communications: Modulation and Transmission, by Robert J. Schoenbeck,	1991
2.	Electronic Communications by D.Roddy and J.Coolen	2008
3.	Electronic Communications by Kennedy	2011
4.	Digital and Analog Communication Systems by L.W.Couch	2001
5.	Communication Systems by Haykins	2006

1. Subject code: **EP- 202** Course title: **Condensed Matter Physics**
2. Contact Hours : L:3 T:0 P:2
3. Examination Duration (Hrs) : Theory: 3 Practical: 0
4. Relative Weight : 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 provides a valuable theoretical introduction, principles, techniques and an overview

of the fundamental applications of the physics of solids.

10. Detail of Course :

S. No.	Contents	Contact Hours
1.	**Crystal Structure and bonding:**Introduction to crystal physics,Bravais lattices, Symmetry operations, Miller indices, Interplanar spacing, X-ray diffraction, Reciprocal lattice, Brillouin zones, Ionic bonding, Bond dissociation energy, Madelung constant of ionic crystals, Covalent, Metallic and Intermolecular bonds, Defects in crystals, Point and line defects.	08
2.	**Lattice Vibrations:** Lattice vibration and thermal properties: Einstein and Debye models; continuous solid; linear lattice; acoustic and optical modes; dispersion relation; attenuation; density of states; phonons and quantization; thermal conductivity of metals and insulators.	05
3.	**Free Electron Theory:** Free electron theory of metals; Electronic motion in a one and three dimensional potential well; Fermi energy, total energy, Density of states, Fermi-Dirac Distribution function, Wave equation in a periodic potential and Bloch theorem; Kronig-Penny model; band theory; Distinction between metal, semiconductor and insulators; band gap.	05
4.	**Dielectrics:** Polarization mechanism and types, dielectric constant, polarizabilities, Electronic, Ionic, Orientation/ dipolar polarizations under DC / AC field, Local Field, ClausiusMossoti equation, Behaviour of polarization under impulse, Dielectric loss, ferroelectric, piezoelectric and pyroelectric materials, application of dielectric materials.	08
5.	**Magnetism:** Magnetism: concept of magnetism, permeability and susceptibility. classification of dia-, para-, ferro-, antiferro and ferrimagnetism (Ferrites), Langevin theory of diamagnetism&paramagnetism, Weiss theory of paramagnetism, Ferromagnetic materials, Origin of internal field and exchange interaction, Domain theory, Bloch wall, Hysteresis, magnetic storage and surfaces, Application of magnetic materials, GMR.	08

6.	**Superconductivity:** Introduction and historical developments; Meissner effect and its contradiction to the Maxwell's equation; Effect of magnetic field, Type-I and Type-II superconductors, Critical parameters, Thermal properties, energy gap, Isotope effect, London equations, Penetration depth, Coherence length, BCS theory, Cooper pair, ground state, Josephson effect and tunnelling, Applications of superconductors.	08
Total		**42**

11. Suggested Books

S. No.	Name of Books/ Authors	Year of publication/ Reprint
1.	Elementary Solid State Physics, by M. A. Omar/ Addison-Wesley	1975
2.	Introduction to Solid State Physics, by C. Kittel/ John Wiley	1996
3.	Solid State Physics, by A. J. Dekker/ Macmillan	1986
4.	Solid State Physics, N. W. Ashcroft and N. D. Mermin/ HBC Publication	1976
5.	Solid State Physics, by S. O. Pillai/ New Age International publication	2002
6.	Material Science and engineering: An Introduction By W. D. Callister Junior/ John Wiley & Sons, Inc	2003

1. Subject Code: **EP-204** Course Title: **Optics**
2. Contact Hours : L : 3 T : 0 P : 2
3. Examination Duration (Hrs.) : Theory : 3 Practical : 0
4. Relative Weight : CWS : 15 PRS : 15 MTE : 30 ETE : 40 PRE : 0
5. Credits : 4
6. Semester : IV
7. Subject Area : DCC

8. Pre-requisite : Knowledge of the concepts of trigonometric operations and differential and integral calculus

9. Objective : To provide the in depth analysis of the concepts of the interference, diffraction and polarization and the applications related to them

10. Details of Course :

S. No.	Contents	Contact Hours
1.	Wave nature of light, Coherence: Spatial and temporal coherence, spectral resolution of a finite wave train, Optical Beats, Coherence time and line width via fourier analysis, Fourier transform spectroscopy.	08
2.	Theory of interference and interferometers: Interference of two monochromatic waves, two beam interference, multiple beam interference, Michelson interferometer, Fabry Perot interferometer	08
3.	Theory of diffraction, Fraunhofer diffraction, Single slit diffraction, two slit diffraction, N slit diffraction, diffraction by a circular aperture, diffraction by rectangular aperture, Resolving power of grating.	06
4.	Fresnel Diffraction , Fresnel Half period zones , zone plate, Gaussian beam propagation, Fresnel diffraction A Rigorous approach, Diffraction by straight edge, diffraction of a plane wave by along narrow slit and transition to the fraunhofer region	10
5.	Polarization , Production of Polarized light by different mechanisms	05
6.	Introduction to Lasers , Different types of lasers, Einstein Coefficients and Optical Amplification	05
Total		**42**

11. Suggested Books

S.No.	Name of Books/ Authors	Yearof Publication/ Reprint
1.	Optics by Hecht and Ganeshan/Pearson	2012

2.	Introduction to Optics by A.Ghatak/Tata McGraw Hill.	2012
3.	Principles of Optics by M. Born and E. Wolf, McMillan	
4.	Optical Physics by S. C. Lipson and H. Lipson/ Cambridge University Press	2010
5.	Introduction to optics by Pedrotti and Pedrotti/ Pearson Prentice Hall	2014
6.	Optoelectronics and Photonics by S.O. Kasap/Pearson	2010

1. Subject Code: **EP 206** Course Title: **Microprocessor and Interfacing**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : 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 : To familiarize the student with the concept of Microprocessors, memory organization, addressing modes and programing.
10. Details of Course :

S. No.	Contents	Contact Hours
1.	Basic Concepts of Microprocessors, Introduction to 8086 Microprocessor	2
2.	Internal architecture, Concept of address, data and control buses	2
3.	8086 hardware specifications: pin-outs and the pin-functions	2

4.	Real Mode Memory Addressing, Introduction to protected mode memory addressing	2
5.	Memory Address Space Organization.	2
6.	Programming model of 8086-general purpose registers, special purpose registers and segment registers	2
7.	Physical address generation, data addressing modes, program memory addressing modes, stack memory addressing modes	3
8.	data transfer instructions, arithmetic and logic instructions, flag control instructions, program control instructions	2
9.	Input/Output instructions	3
10.	Types of Interrupts, interrupt instructions, hardware interrupt interface, software interrupts, NMI interrupt	2
11.	Bus Cycle Timing Diagrams.	3
12.	Minimum and Maximum mode	1
13.	Subroutines: Call and Return Functions.	1
14.	Programmable Interrupt Controller – 8259	2
15.	Programmable Peripheral Interface (PPI) 8255	2
16.	Programmable Direct Memory Access (DMA) Controller - 8237/8257,	2
17.	Programmable Interval Timer - 8253.	2
18.	Introduction to PIC Microcontrollers, PIC microcontroller overview and features, PIC 16F877: ALU, CPU registers, pin diagram	2
19.	PIC reset actions, PIC oscillator connections, PIC memory organization,	2
20.	PIC 16F877 instructions, Addressing modes, I/O ports.	1
21.	Interfacing applications of Microcontroller-interfacing of 7 segment display, LCD interfacing, ADC and DAC interfacing.	2
Total		**42**

11. Suggested Books

S.No.	Name of Books/ Authors	Year of Publication/ Reprint
1.	Y. Liu and G. A. Gibson, Microcomputer Systems: The 8086/8088 Family., Prentice Hall of India.	2nd Ed
2.	Douglas Hall, Microprocessors Interfacing, Tata McGraw Hill.	
3.	Barry B. Brey, The Intel Microprocessors., Prentice Hall of India.	7th Ed
4.	Walter A. Treibel and Avtar Singh, The 8088 and 8086 Microprocessors, Prentice Hall of India.	
5.	Rafiquzzaman, Microprocessors, Prentice Hall of India.	
6.	A.K.Ray, K.M.Bhurchandi, Advanced Microprocessors and Peripherals, TMH.	Second edition
7.	Microcontroller and Embedded systems- M.A.Mazadi, J.G.Mazadi & R.D.McKinlay - Pearson PHI.	
8.	Embedded Design with Microcontrollers by Martin Bates.	

1. Subject Code: **EP-208** Course Title: **Computational Methods**
2. Contact Hours : L : 3 T : 1 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 : 4
6. Semester : IV
7. Subject Area : DCC
8. Pre-requisite : Nil
9. Objective : To familiarize the students with the numerical techniques to solve the problem related to science and engineering.

10. Details of Course : ……**……s of Course**

S. No.	Contents	Contact Hours
1.	**UNIT I** Errors in numerical calculations: Introduction, Number and their accuracy, Errors and their analysis, Absolute, Relative, Percentage and Maximum probable error, Physical significance of errors, General error formula, Error in series approximation	04
2.	**UNIT II** Solution of numerical algebraic and transcendental equation: Roots of equations, Direct method and iteration method, Bisection method, Regula Falsi Method or Method of False position, Secant or Chord method, Newton-Raphson method, Solution of simultaneous linear algebraic equation: Gauss-elimination method, Gauss-Jordon elimination method, Power method, Jacobi method for finding eigen values, Rotation Matrix, Method of triangularization, Relaxation Method	08
3.	**UNIT III** Interpolation: Introduction, Errors in polynomial Interpolation, Finite differences, Detection of errors by use of difference tables, Differences of a polynomial, Interpolation with equally spaced data points: Newton's forward and backward formulae for interpolation, Central difference: Gauss forward, Gauss Backward, Stirling, Bessels, Everett's formula for interpolation, Interpolation with unequally data points: Lagrange's interpolation formula, Divided differences and their property, Newton Divided differences formula, Curve fitting: Introduction, Least square curve fitting procedures, fitting a straight line, nonlinear curve fitting, curve fitting by a sum of exponentials, Data fitting with cubic splines	10
4.	**UNIT IV** Numerical Differentiation and Integration: Cubic Spline method, maximum and minimum values of a tabulated data, Numerical integration, Newton-cotes integration formulae, trapezoidal method, Simpson's 1/3-rule, Simpson's 3/8-rule, Boole's and Weddle's Rule, Romberg integration, , Euler-Maclaurin formula, Gaussian integration, Numerical double integration	08
5.	UNIT V Numerical solution of ordinary differential equations: Introduction, solution by Taylor's series, Picard's method of successive approximation methods, Euler's method, modified Euler's method, Runge-Kutta method, predictor-corrector method, solution of second order and simultaneous differential equations	06

6.	**UNIT VI** Numerical solution of partial differential equation: Introduction, Finite difference approximations to derivatives, Laplace's equation, Jacobi's method, Iterative method for solution of equation	06
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors	Year of Publication/ Reprint
1	Numerical Methods for Engineers by Steven C. Chapra and Raymond P Canale/ McGraw-Hill International Editions	1998
2	An Introduction to Computational Physics by Tao Pang Cambridge University Press	2010
3	Numerical Methods for Engineers and Scientists by Amos Gilat/ John Wiley & Sons	2008
4	Applied Numerical Analysis by Gerald and Wheatley	2003/ Pearson
5	Numerical methods for Scientific and Engineering Computation by Jain Iyengar and Jain	2009/New Age

1. Subject Code: **HU202** Course Title: **Engineering Economics**
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 : IV
7. Subject Area : DCC
8. Pre-requisite : NIL
9. Objective : To enable the students to understand the economic

theories which may be applied to maximize return and economic environment in which they have to operate.

10. Details of Course :

S.No.	Contents	Contact Hours
1.	**Introduction:** Nature and significance of economics, Goods and Utility, Basic Concept of Demand and Supply, Elasticity of Demand- Price elasticity of Demand, Cross elasticity of Demand, Production - Production Function, Production Process and Factors of Production, Market – Introduction to Monopoly, Perfect Competition, Oligopoly and Monopolistic Competition, Cost Concepts- Opportunity Cost, Total Cost, Average Cost; Marginal Cost; Life Cycle cost, Sunk Cost; Preparation of Cost Sheet Profit Maximisation- numerical problem.	10
2.	**Money- its evaluation and function, Bank- Commercial Bank and Central Bank and brief idea about function of banking system:**. Tax and Subsidy, Type of Tax- Direct and Indirect, Monetary and fiscal policy, Inflation and Business cycle, International trade, terms of Trade, Gain from International Trade, Free Trade vs. Protection, Dumping, Balance of Payment.	10
3.	**Role of Science, Engineering and Technology in Economic Development:** Seven salient Feature of the Indian Economy; Inclusive Growth; relevance for the Indian Economy; Globalisation & opening up of the Indian Economy; GDP- definition and Its measurement; How knowledge of engineering and technology may be used to improve life at slum; Green Revolution and White revolution. Reasons for their success and can we replicate them. Appropriate Technology & Sustainable Development. Entrepreneurship: Macro environment for promotion of entrepreneurship: How environment has changed after advent of IT and Globalisation.	12
4.	**Elementary Economic Analysis:** Interest formulas and their Applications; Calculations of economic equivalence, Bases for Comparison of Alternatives: Present Worth Method, Future worth method, Annual equivalent, Internal Rate of Return; Business Risk; Factors which should be taken care while deciding price of the product in the market.	10
TOTAL		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers
1.	G.J. Thuesen, & W.J. Fabrycky, Engineering Economy, Pearson Education, 2007, ISBN 013028128X
2.	William G. Sullivan, Elin M. Wicks, C. Patrick Koelling, Engineering Economy, Prentice Hall,(First Indian reprint). 2009, ISBN 0131486497
3.	Donald G. Newman, Jerome P. Lavelle & Ted G. Eschenbach, Engineering Economic Analysis, Oxford University Press, USA , 2004, ISBN 0195168070
4.	Seema Singh, Economics for Engineering Students, IK International Publishing House Pvt. Ltd, 2014, ISBN 8190777041

1. Subject Code: **EP-301** Course Title:**Semiconductor Devices**
2. Contact Hours : L : 3 T : 1 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 : 4
6. Semester : V
7. Subject Area : DCC
8. Pre-requisite : Basic knowledge of physics, bonding, matter waves and schrodingers concept with mathematical physics back ground is pre-required for this course.
9. Objective : To impart the fundamental knowledge pertaining to semiconductor materials, various devices that can be fabricated using semiconductor devices along with their construction and working condiction. Applications various semiconductor devices in science and technology will be discussed.

10. Details of Course :

S.No.	Contents	Contact Hours
1.	**Introduction to the Quantum theory of solids:** Allowed and forbidden Energy bands, Electrical conduction in solids, density of state function, Semiconductor in Equilibrium: Equilibrium carrier concentration, Intrinsic semiconductor, Extrinsic semiconductor, Position of Fermi energy level.	10
2.	**Carrier transport phenomenon:** Random motion, Drift and diffusion, Graded Impurity distribution, Excess carriers: Injection level, Lifetime, Direct and indirect semiconductors, P-N Junction: Device structure and fabrication, Equilibrium picture, DC forward and reverse characteristics, Small-signal equivalent circuit, Generation – Recombination currents, Junction Breakdown, Tunnel diode.	12
3.	**Bipolar Junction Transistor:** History, Device structures and fabrication, Transistor action and amplification, low frequency, common- base current gain, Small-signal Equivalent circuit, Ebers-Moll model MOS Junction: C-V characteristics, threshold voltage, body effect Metal Oxide Field Effect Transistor: History, Device structures and fabrication, Common source DC characteristics.	10
4.	Small-signal equivalent circuit, Differences between a MOSFET and a BJT Junction FET and MESFET: Basic pn JEFT & MESFET operation, Device characteristics, Recent Developments: Hetero-junction FET, Hetro-junction bipolar transistor Optical Devices: Solar Cells, Photodectectors, LEDs.	10
	Total	**42**

11. Suggested Books

S.No.	Name of Books/ Authors	Year of Publication/ Reprint
1.	Solid State Electronic Devices by Ben G. Streetman , Wiley Eastern	1970
2.	Physics of Semiconductor Devices by Michael Shur, Prentice Hall	1980
3.	Introduction to Solid State Physics by Kittel, Wiley	1986

4.	Integrated Electronics by Millman and Halkias, Wiley	1987
5.	Semiconductor Physics and Devices by Donald A.Neamen, Mc Graw Hill	1985

1. Subject Code: **EP 303** Course Title: **Electromagnetic Theory, antennas and Propagation**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : 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 : To familiarize the student with the concept of propagation electromagnetic wave in a transmission line, Maxwell's equations, Antennas and wave propagation.
10. Details of Course : 5th Semester

Sl. No.	Contents	Contact Hours
1.	Maxwell's equations, constitutive relations, wave equation, plane wave functions	04
2.	Rectangular waveguide, circular waveguide, dielectric slab waveguide	03
3.	Surface guided waves, characteristics of TM and TE modes, Impossibility of TEM waves in waveguides, wave impedances	04
4.	Characteristic impedance, excitation of modes, cutoff wavelength and phase velocity	02
5.	Cavities and power losses	02

6.	Transmission lines: transmission line equation in time and frequency domain, losses and dispersion, reflection from an unknown load; quarter wavelength, single stub and double stub matching; Smith Chart and its applications.	04
7.	distortion – distortion less transmission line – The telephone cable – Inductance loading of telephone cables. Input impedance of lossless lines – reflection on a line not terminated by Zo - Transfer impedance – reflection factor and reflection loss.	02
8.	Introduction to Antennas, Antenna parameters: Radiation intensity. Directive gain. Directivity. Power gain. Beam Width. Band Width. Gain and .radiation from simple dipole and aperture, horn antenna, microstrip antenna, parabolic disc antenna.	04
9..	Concept of antenna arrays, end fire and broadside arrays, Expression for electric field from two and three element arrays. Uniform linear array. Method of pattern multiplication. Binomial array.	03
10.	Use of method of images for antennas above ground.	02
11.	Basic types of propagation; ground wave, space wave and sky wave propagation. Sky wave propagation: Structure of the ionosphere	02
12.	Effective dielectric constant of ionized region. Mechanism of refraction. Refractive index. Critical frequency. Skip distance. Maximum usable frequency. Fading and Diversity reception.	03
13.	Space wave propagation: Reflection from ground for vertically and horizontally polarized waves. Reflection characteristics of earth. Resultant of direct and reflected ray at the receiver.	04
14.	Duct propagation. Ground wave propagation: Attenuation characteristics for ground wave propagation. Calculation of field strength at a distance.	03
Total		**42**

11. Suggested Books:

S.No.	Name of Books/ Authors	Year of Publication/ Reprint
1.	Advanced Engineering and Electromagnetics By C.A.Balanis.	2012

2.	Antennas and Wave Propagation by J.D.Kraus, R.J.Marhefka and A.S.Khan	2014
3.	Electromagnetics for Engineers by S.E.Schwarz	1990
4.	Introduction to Electrodynamics by David J.Griffiths	2012
5.	Electromagnetic Waves and Radiating Systems by E.C. Jordan & K.G. Balmain	1964

1. Subject Code: **HU 301** Course Title: **Technical Communication**

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

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

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

5. Credits : 2

6. Semester : V/ VI

7. Subject Area : HMC

8. Pre-requisite : Nil

9. Objectives : To train students for business communication to enhance employability skills with special emphasis on placement interviews and public speaking.

10. Details of Course :

Sl. No.	Contents	Contact Hours
1.	English for Professional Purposes: Technical Communication- Methods, Strategies and Skills Communication in Global Contexts- Social, Cultural, Political and Technical, especially in formal set up	1 2

2.	Communication at the Workplace: Oral and Written: **Written Communication**- Letters, Orders (Sale/Purchase) Report Writing, Technical proposals Resume, SOP, Memo, Notice, Agenda, Minutes, Note Taking/Making, **Oral Communication**: Seminars, Conferences, Meetings, Office Etiquettes/ Netiquettes, Presenting Written Material Negotiation, Demonstration, Group Discussion, Interview	6 6
3.	**Group Discussion** and **Report Writing:** Group Discussion (Continous assessment through the semester) Minor Report Writing(to be submitted before Mid- Semester Examination) Major Report writing (To be submitted before End Semester Examination)	13
Total		**28**

11. Suggested Books:

Sl.No.	Name of Books, Authors, Publishers	Year of Publication/ Reprint
1	Technical Communication: Principles and Practice Raman, Meenakshi and Sangeeta Sharma, Oxford University Press, ISBN-13: 978-0-19-806529-6	2011, Reprinted 2014
2	Writing to Get Results, (3rd Ed) Blicq, Ron S., Lisa A. Moretto, John Wiley and Sons, Inc. ISBN 0-7803-6020-6	2001
3	Effective Technical Communication: A Guide for Scientists and Engineers , Mitra, Barun K. OUP: Delhi ISBN-13: 978-0-19-568291-5	2006
4	Personality Development and Soft Skills, Mitra, Barun K. New Delhi: Oxford University Press. ISBN-9780198060017	2014
5	The Essence of Effective Communication**,** Ludlow, Ron and Fergus Panton. Prentice Hall: PHI. ISBN-81-203-0909-X	1996
6	Advanced Technical Communication, Gupta, Ruby. Foundation Books, CUP. ISBN 978-81-7596-733-5	2011
8	Soft Skills: Enhancing Employability, Rao, M.S. Connecting Campus with Corporate ISBN: 978-93-80578-38-5	2011

9	Developing Communication Skills (2nd Ed), Mohan, Krishna and Meera Banerji, Macmillan Publishers India Ltd. ISBN 13: 978=0230-63843-3	2009

1. Subject Code: **EP-302** Course Title: Fiber **Optics and Optical Communication**
2. Contact Hours : L : 3 T : 0 P : 2
3. Examination Duration (Hrs.) : Theory : 3 Practical : 0
4. Relative Weight : CWS : 15 PRS : 15 MTE : 30 ETE : 40 PRE : 0
5. Credits : 4
6. Semester : VI
7. Subject Area : DCC
8. Pre-requisite : Knowledge of the basic concepts of optics . Knowledge of the partial differential equations, their solutions & special functions
9. Objective : To provide the in concepts fiber optics and optical communication systems
10. Details of Course :

S.No.	Name of Books/ Authors	Year of Publication/ Reprint
1.	Fibre Optic communication by Keiser	2009 / McGraw Hill.
2.	Optical communication systems by J.Gowar	Prentice Hall India
3.	Integrated optics by T. Tamir	Springer-Verlag

4.	Optical fibres telecommunication by S.E. Miller & A.G. Chynoweth	2010/ Academic Press
5.	Nonlinear Fiber Optics by Govind Aggarwal	2013/ Elsevier
6.	Optoelectronics and Photonics by S.O. Kasap	2010/ Pearson
7.	Fiber Optics Handbook for engineers and scientists by F.C. Allard	2009/ McGraw Hill

11. Suggested Books:

S. No.	Contents	Contact Hours
1.	Introduction and importance of Fiber Optics Technology. Ray analysis of optical fiber: Propagation mechanism of rays in an optical fiber, Meridional rays, Skew rays, Fiber numerical aperture	04
2.	Electromagnetic mode theory for optical propagation, Modal analysis of planar step index waveguide	08
3.	Mode theory for circular waveguides: step index fibers Propagation characteristics of step index fibers, graded index fibers Fabrication of optical fibers	10
4.	Signal degradation on optical fiber due to dispersion and attenuation, Pulse dispersion in graded index optical fibers, Material dispersion, Waveguide dispersion and design considerations	08
5.	Optical Sources : LEDs and Laser diodes Detectors for optical fiber communication	06
6.	Optical fiber amplifiers – EDFA: Gain spectrum and gain band width, EDFAs for WDM transmission.	06
Total		**42**

1. Subject code: **EP- 304** Course title: **Fabrication and Characterization of Nanostructures**

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

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

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

5. Credits : 4

6. Semester : VI

7. Subject area : DCC

8. Pre-requisite : Basic knowledge of crystal structure and physics of solids

9. Objective : The main goal of this subject is to provide basic understanding of Fabrication and Characterization of nanostructures in the fascinating world of "Nanotechnology" and implementing it for various applications

10. Detail of Course :

S. No.	Contents	Contact Hours
1.	X-ray Diffraction (XRD), Bragg's law, Application in crystallography, Diffractogram, Paricle size determination using XRD, **Probe Techniques:** Atomic Force Microscopy (AFM), Scanning Electron Microscopy (SEM), Scanning Tunneling Microscopy (STM), Transmission Electron Microscopy (TEM), High Resolution Transmission Electron Microscopy (HRTEM)	08
2.	Infrared Spectroscopy, Raman Spectroscopy, Electronic spectroscopy for atoms and molecules, Spin Resonance Spectroscopy, Nuclear Magnetic Resonance spectroscopy (NMR), Deep level transient spectroscopy (DLTS), Kelvin-probe measurements, Nanoscale current-voltage (I-V) investigations, Capacitance-Voltage (C-V) Relationships	08

3.	Fundamental concepts of Bottom-Up and Top-Down approaches, Self assembly and Self organization, Lithographic Process and its Limitations, Nonlithographic Techniques	04
4.	Growth Techniques of Nanomaterials: Plasma Arc discharge, Sputtering, Evaporation: Thermal, E-beam evaporation, Laser ablation, Chemical Vapor Deposition (CVD), Plasma enhanced CVD, Thermal CVD, Vapor phase growth, Laser assisted Thermal CVD, Pulsed Laser Deposition, Molecular Beam Epitaxy (MBE), Sol-Gel Technique, Electrodeposition, Other Processes: Ball Milling, Chemical Bath Deposition (CBD), Ion Beam Deposition (IBD), Ion Implantation	12
5.	Fabrication of nanoparticles, Synthesis of mposites and nanostructures, Fabrication of quantum dots, Nanowires, Nanorods, Nanointermetallics, Controlled colloidal synthesis, Synthesis of polymer supported clusters and polymeric nanofibers, Nanolithography, Electron beam and focused ion beam lithographies, Carbon Nanotubes (CNT's): Single Walled, Multi-walled	10
Total		**42**

11.Suggested Books:

S. No.	Name of Books/ Authors	Year of Publication/ Reprint
1.	Nanotechnology by Gregory Timp	1999/ Springer
2.	Introduction to Nanoscience & Technology by K.K. Chattopadhyay, A.N. Banerjee	2012/PHI Learning Pvt. Ltd.
3.	Nanolithography: A borderland between STM, EB, IB and X-ray lithographies- M. Gentili et al	1994/ Springer
4.	Nanostructures & Nano Materials by Guozhong Cao, Ying Wang	2011/World Scientific
5.	Infrared Spectroscopy: Fundamentals and applications by Barbara Stuart	2004/Wiley

1. Subject Code: **EP 306** Course Title: **Microwave Engineering**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS:15 MTE: 30 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VI
7. Subject Area : DCC
8. Pre-requisite : NIL
9. Objective : To familiarize the student with the concept of transmission line, microwave tubes and devices.
10. Details of Course :

S. No.	Contents	Contact Hours
1.	Introduction and review of transmission lines.	2
2.	Applications of Microwaves. Waveguide components and applications- Coupling Mechanisms – Probe, Loop, Aperture types.	2
3.	Waveguide Discontinuities – Waveguide irises, Tuning Screws and Posts, Matched Loads	2
4.	Waveguide Attenuators –Resistive Card, Rotary Vane types; Waveguide Phase Shifters– Dielectric, Rotary Vane types.	2
5.	Waveguide Multiport Junctions – E plane and H plane Tees, Magic Tee, Hybrid Ring	2
6.	Directional Couplers – 2 Hole, Bethe Hole types	2
7.	Ferrites– Composition and Characteristics, Faraday Rotation; Ferrite Components – Gyrator, Isolator, Circulator.	2
8.	Scattering Matrix– Significance, Formulation and Properties. S Matrix Calculations for – 2 port Junction, E plane and H plane Tees, Magic Tee, Directional Coupler, Circulator and Isolator.	2

9.	MICROWAVE SOLID STATE DEVICES: Introduction, Classification, Applications. TEDs – Introduction, Gunn Diode – Principle, RWH Theory, Characteristics, Basic Modes of Operation, Oscillation Modes	4
10.	Avalanche Transit Time Devices – Introduction, IMPATT and TRAPATT Diodes.	2
11.	Limitations and Losses of conventional tubes at microwave frequencies	2
12.	Microwave tubes – O type and M type classifications. O-type tubes	2
13.	2 Cavity Klystrons – Structure, Reentrant Cavities, Velocity Modulation Process and Applegate Diagram, Bunching Process and Small Signal Theory – Expressions for o/p Power and Efficiency.	4
14.	Reflex Klystrons – Structure, Applegate Diagram and Principle of working, Mathematical Theory of Bunching.	2
15.	Significance, Types and Characteristics of SlowWave Structures; Structure of TWT and Amplification Process (qualitative treatment), Suppression of Oscillations, Nature of the four Propagation Constants, Gain Considerations.	3
16.	M-type Tubes- Introduction, Cross-field effects, Magnetrons	2
17.	Different Types, 8-Cavity Cylindrical Travelling Wave Magnetron	2
18.	Hull Cut-off and Hartree Conditions, Modes of Resonance and PI-Mode Operation.	3
Total		**42**

11. Suggested Books:

S.No.	Name of Books/ Authors	Year of Publication/ Reprint
1.	Microwave Devices and Circuits – Samuel Y. Liao, PHI, 3rd Edition,	1994.
2.	2. Microwave Principles – Herbert J. Reich, J.G. Skalnik, P.F. Ordung and H.L. Krauss, CBS Publishers and Distributors, New Delhi,	2004.
3.	3. Foundations for Microwave Engineering – R.E. Collin, IEEE Press, John Wiley,	2nd Edition, 2002.

4.	4. Microwave Circuits and Passive Devices – M.L. Sisodia and G.S.Raghuvanshi, Wiley Eastern Ltd., New Age International Publishers Ltd.,	1995.
5.	5. Microwave Engineering Passive Circuits – Peter A. Rizzi, PHI,	1999.
6.	6. Electronic and Radio Engineering – F.E. Terman, McGraw- Hill, 4th ed.,	1955.

1. Subject Code: **HU 304** Course Title: **Professional Ethics and Human Values**

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

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

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

5. Credits : 2

6. Semester : V/ VI

7. Subject Area : HMC

8. Pre-requisite : Nil

9. Objective Processes : To make students aware of the ethics and codes of conduct required by Engineers and Professionals.

10. Details of Course :

Sl No.	Name of Books, Authors, Publishers	Contact Hours
1	**Human Values and Ethics:** Morals, Values, Ethics and Integrity, Need for Value Education for Engineers, Happiness, Prosperity, Harmony.	6
2	**Code of Ethics and Professionalism:** Professionalism and the Code of Ethics, Technical Education, Human Values and Coexistence, Universal Human Order, Natural acceptance.	6

3	**Professional Ethics and Technology :**Science, Technology and Professional EthicsEngineering Ethics, Environmental Ethics, Safety, Responsibility and Rights	8
4	**Case Studies:** Holistic Technologies, Eco-friendly production systems, The role of responsible engineers and technologists, Global Issues concerning Engineers	8
Total		**28**

11. Suggested Books:

Sl.No.	Name of Books, Authors, Publishers	Year of Publication/ Reprint
1	Professional Ethics, Subramanian, R, Oxford University Press, ISBN13: 978-0-19-808634-5	2011
2	Professional Ethics and Human Values,Govindarajan, M. S. Natarajan, V.S. Senthilkumar PHI, **ISBN: 978-81-203-4816-5**	2013
3	Constitution of India and Professional Ethics, Reddy, G.B. and Mohd. Suhaib, IK International Publishing House. ISBN: 81-89866-01-X	2006
4	Introduction to Engineering Ethics (2nd Ed.) Martin, Mike W. and Roland Schingzinger McGraw-Hill ISBN 978-0-07-248311-6	2010
5	Gopi, S., “Global Positioning System: Principles and Applications”, Tata McGraw Hill. (ISBN 0-07-7691528-1)	2005

1. Subject Code: **EP401** Course Title: **B.Tech Project-I**
2. Contact Hours : L:0 T:0 P:0
3. Examination Duration (Hrs.) : Theory: 0 Practical: 0
4. Relative Weight **:** CWS: 0 PRS: 0 MTE: 0 ETE: 0 PRE: 0
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: **EP403** Course Title: **Training Seminar**

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

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

4. Relative Weight **:** CWS: 0 PRS: 0 MTE: 0 ETE: 0 PRE: 0

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**: EP 405** Course Title: **VLSI and FPGA Design**

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

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

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

5. Credits : 4

6. Semester : VII

7. Subject Area : DCC

8. Pre-requisite : NIL

9. Objective : To familiarize the student with the concept of MOSFET, VLSI circuits, RAM, ROM and implementation of FPGA.

10. Details of Course :

S. No	Contents	Contact Hours
1.	Enhancement mode & Depletion mode MOSFETs	2
2.	Basic MOS inverter design, transfer characteristics, logic threshold	1
3.	NAND \ NOR logic	1
4.	Transit time and inverter time delay, CMOS inverter	2
5.	Inverting and non-inverting type super buffers, noise margins.	2
6.	MOS design rules: Lamda based design rules and MOS layers.	2
7.	Stick diagrams, NMOS design layout diagrams	1
8.	Scaling of MOS Circuits. Functional limitations to scaling	2
9.	Failure mechanism in VLSI, Fault finding in VLSI chips.	2
10.	Packaging of VLSI devices, packaging types. Packaging design consideration	2
11.	VLSI assembly technology and fabrication technologies.	2
12.	Static Random Access Memories (SRAMs), SRAM Cell Structures, MOS SRAM Architecture	3
13.	MOS SRAM Cell and Peripheral Circuit, Bipolar SRAM, SOI	2
14.	Application Specific SRAMs; DRAMs, MOS DRAM Cell	2
15.	Failures in DRAM, Advanced DRAM Design and Architecture	2
16.	Bipolar & CMOS PROM, EEPROMs, Floating Gate EPROM Cell	2
17.	Nonvolatile SRAM, Flash Memories	2

18.	Introduction to ASICs and FPGAs, Fundamentals in digital IC design	2
19.	FPGA & CPLD Architectures, FPGA Programming Technologies	2
20.	FPGA Logic Cell Structures	2
21.	FPGA Implementation of Combinational Circuits	2
22.	FPGA Sequential Circuits	2
Total		**42**

11. Suggested Books

S.No	Name of Books/Authors	Yearof publication/ reprint
1	Dougles A. Pucknell and kamran Eshraghian, “Basic VLSI Systems and Circuits Prentice Hall of India Pvt. Ltd.	1995
2	Wayne Wolf, “Modern VLSI Design, 2nd Edition Prentice Hall of India Pvt. Ltd.	2002
3	Ashok K.Sharma, “ Semiconductor Memories Technology	2002
4	Testing and Reliability Prentice Hall of India Pvt. Ltd.	2008
5	Wen C. Lin, “Handbook of Digital System Design	1990

1. Subject Code: **EP 407** Course Title: **Mobile and Satellite Communication**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS:15 MTE: 30 ETE: 40 PRE: 0
5. Credits 4
6. Semester : VII
7. Subject Area : DCC
8. Pre-requisite : NIL

9. Objective : To familiarize the student with the concept of Modulation techniques and satellite system.

10. Details of Course :

S. No.	Contents	Contact Hours
1.	Introduction to wireless communication: Evolution of mobile communications, mobile radio systems- Examples, trends in cellular radio and personal communications. Cellular Concept: Frequency reuse, channel assignment, hand off, Interference and system capacity, tracking and grade of service, Improving Coverage and capacity in Cellular systems, Free space propagation model, reflection,diffraction, scattering.	10
2.	Modulation Techniques: Minimum Shift Keying, Gauss ion MSK, M-ary QAM, M-ary FSK, Orthogonal Frequency Division Multiplexing, Performance of Digital Modulation in Slow-Flat Fading Channels and Frequency Selective Mobile Channels.Coding: Vocoders, Linear Predictive Coders, Selection of Speech Coders for Mobile Communication, GSM Codec, RS codes for CDPD.	10
3.	Multiple Access Techniques: FDMA, TDMA, CDMA, SDMA, Synchronous & Statistical TDM, North American digital multiplexing hierarchy, European TDM, Spread spectrum: Frequency Hopping & Direct Sequence spread spectrum. Terminal handling & polling. Switched Communication Networks: Circuit, Message, Packet & Hybrid Switching, Softswitch Architecture with their comparative study, X.25, ISDN. Capacity of Cellular CDMA and SDMA.Second Generation and Third Generation Wireless Networks and Standards, WLL, Blue tooth. AMPS, GSM, IS-95 and DECT	10
4.	Introduction to satellite communication, Satellite Systems, Orbits and constellations: GEO, MEO and LEO, Satellite space segment, Propagation and satellite links, Free-space loss, Attenuation, polarization, fading and scintillation, Link budget analysis, Satellite Communication Techniques, FEC and ARQ, Satellite Communications Systems andApplications- INTELSAT systems, VSAT networks, GPS, GEO, MEO and LEO mobile communications, INMARSAT systems,Iridium, Globalstar, Odyssey	12
Total		**42**

11. Suggested Books

S.No.	Name of Books/ Authors	Year of Publication/ Reprint
1.	T.S.Rappaport, Wireless Communications: Principles and Practice, Second Edition Pearson Education/ Prentice Hall of India,	Third Indian Reprint 2003
2.	R. Blake, Wireless Communication Technology Thomson Delmar,	2003
3.	W.C.Y.Lee, Mobile Communications Engineering: Theory and applications, Second Edition McGraw-Hill International	1998

1. Subject Code: **EP-402** Course Title: **B.Tech Project-II**
2. Contact Hours : L:0 T:0 P:0
3. Examination Duration (Hrs.) : Theory:0 Practical: 0
4. Relative Weight **:** CWS: 0 PRS: 0 MTE: 0 ETE:0 PRE: 0
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.

1. Subject code: **EP- 404** Course title: **Alternative Energy Storage and Conversion Devices**
2. Contact Hours : L:3 T:0 P:2
3. Examination Duration (Hrs) : Theory: 3 Practical: 0

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

5. Credits : 4

6. Semester : VIII

7. Subject area : Renewable energy

8. Pre-requisite : NIL

9. Objective : The student will be able to understand about the various renewable energy resources their primary requirement and importance in various applications.

10. Detail of Course :

S. No.	Contents	Contact Hours
1.	**Introduction to Renewable energy resources:** Introduction to world energy scenario, solar radiation, Solar Geometry, radiation models; Solar Thermal, thermal efficiency, concentrators, evacuators, introduction to thermal systems (flat plate collector), solar architecture.	7
2.	**Photo voltaic (PV) technology:** Present status, solar cells technologies, Introduction to semiconductor physics, doping, P-N junction, Solar cell and its I-V characteristics, PV systems components, applications.	5
3.	**Wind Energy:** Wind speed and power relation, power extracted from wind, wind distribution and wind speed measurement by anemometer, Wind power systems: system components, Types of wind turbines, wind turbine efficiencies, Betz limit.	7
4.	**Bio-Energy:** Biomass and its uses, Classification of biomass, wood composition, Characteristics of biomass, Biomass conversion processes, Gasification and combustion of biomass, Gasifiers, pyrolysis,biogas, bio-fuel, bio-diesel, ethanol production.	8
5.	**Energy storage & Conversion systems:** introduction to battery systems, rechargeable batteries: lithium - ion, Pb-acid, Ni-Metal hydride batteries, fuel cells; classification of fuel cells, AFC, SOFC, PAFC etc. their construction and working, Efficiency of fuel cells, super capacitors.	8

6.	**Hydel&Tidel Energy:** Types of Hydro Power Plants, Hydro Power Estimates – Hydrological analysis, Effect of storage, power canal, Hydraulic Turbines – Types of turbines, their parts and working, Governing and controls of turbines, tidal energy and ocean energy.	7
Total		**42**

11. Suggested Books

S. No.	Name of Books/ Authors	Year of publication/ Reprint
1.	Solar Cells by M. A. Green. / Prentice Hall	1981
2.	Principles of Solar Engineering by D. Y. Goswami, F. Kreith and J. F. Kreid/ Taylor & Francis	2000
3.	Fundamentals of renewable energy processes by Aldo Vieira da Rosa. / Academic pressElsevier) USA	2005
4.	Hand book of Energy Audits by Albert Thuman, P.E.,C.E.M. Fairmont Press Inc.	2003/
5.	Bio fuels by David M. Mousdale/ CRC Press Taylor & Francis	2008
6.	Bio fuel Engineering by caye M. Drapchoetal. / McGraw Hill	2008
7	Solar Engineering of Thermal Processes by J. A. Duffie and W. A. Beckman John Wiley & Sons	2006
8.	Solar Energy - Principles of thermal collection and storage by S. P. Sukhat	1996

DEPARTMENT ELECTIVE

1. Subject code: **EP- 305** Course title: **Atomic and Molecular Physics**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25, PRS:--, MTE: 25, ETE: 50, PRE: --
5. Credits : 4
6. Semester : V
7. Subject area : DEC-1
8. Pre-requisite : Basic knowledge of Atoms and Molecules
9. Objective : The course provides basic understanding of the Nature, essential principles, fundamental techniques and their prospective applications
10. Detail of Course :

S. No.	Contents	Contact Hours
1.	Bohr-Sommerfeld theory of Hydrogen Atom, Quantum mechanics of Hydrogen atom: Angular momentum & Parity, Magnetic dipole moments, Electron spin and Vector atom model, Spin orbit Interaction: Hydrogen fine structure, Identical particles & Pauli's principle	08
2.	Helium Atom & its spectrum, Multielectron atoms: Hartree's field: Atomic ground states & periodic table, Spectroscopic terms: L-S & j-j couplings, Spectra of alkali elements, Spectra of alkaline earth elements	07
3.	The Zeeman effect, Paschen-Back effect, The stark effect, Hyperfine structure of spectral lines, The Breadth of Spectral lines, X-ray spectra, Fine structure in X-ray Emission Spectra, X-ray Spectra and Optical spectra	06
4.	Rotational spectroscopy: Rigid rotor, Rotational spectra of diatomic molecules, Intensities of spectral lines, Isotope effects, Non-Rigid Rotator, Rotation levels of polyatomic molecules: spherical, symmetric, and Asymmetric top molecules	07

5.	Vibrational spectroscopy: Vibration of diatomic molecules, Harmonic oscillator and Anharmonic oscillator, Vibrational-rotational couplings, Vibration of polyatomic molecules	06
6.	Electronic spectroscopy: Electronic spectra of diatomic molecules, vibrational coarse structure, Franck-Condon Principle, Dissociation energy and dissociation products, Rotational fine structure of Electronic-Vibration transition, Production of excited state, Radiative processes, Kasha's Rule, Jablonbski diagram, Luminescence, Photoluminescence, kinetics, Quantum yield and Lifetime	08
Total		**42**

11. Suggested Books:

S. No.	Name of Books/ Authors	Year of publication/ Reprint
1.	Introduction to Atomic Spectra, by Harvey Elliott White /McGraw Hill	1934
2.	Principles of Modern Physics, by Robert B. Leighton McGraw Hill	1959/
3.	Molecular spectra and molecular structure I, II and III. Spectra of diatomic molecules by G. Herzberg/Prentice-Hall	1939
4.	Fundamentals of molecular spectroscopy by C. N. Banwell and E.M. McCash4/McGraw Hill	1994
5.	Principles of fluorescence spectroscopy by J.R. Lakowicz. Springer	1983

1. Subject Code: **EP-307** Course Title: **Biophysics**
2. Contact Hours : L : 3 T : 1 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 : 4
6. Semester : V

7. Subject Area : DEC-1

8. Pre-requisite : Nil

9. Objective : The student will be able to enhance the basic understanding of Bio-Physics

10. Details of Course :

S. No.	Contents	Contact Hours
1.	Background of membrane biophysics, Basic structure and composition of membrane, Donnan equilibrium, GHK, Ion transport system overview, Whole cell behavior: cardiac, Integration: from channels to whole cell, Whole cell behavior: currents, gating, kinetics, control, Measurement approaches, Automaticity and pacemakers, Excitation contraction coupling (cardiac and neuro), Cardiac EC coupling, structure and function, NMJ	10
2.	Ion channel structure and gating function, Common elements organized to make specific function, Protein structure, pore formation, charge field, Control of channel function, voltage activation, ligand activation, signaling, gating kinetics, Ion selectivity, Ion channel types and characterization, Channel types, structure, function, Same channels in different cell types, Molecular biology in ion channels, Sample channelopathies	10
3.	Modeling and simulation of channels, Stochastic processes, State transition mechanics and modeling, Examples of disease modeling, Whole cell behavior: neuron, Integration, Propagation, saltatory conduction, Neuron synapse, synaptic plasticity, Structure of the synapse, Electrochemical transduction, Postsynaptic integration and information processing.	10
4.	Modeling and simulation of whole cell EP, Review of HH formalism; modern extensions, Mathematical formulation, numerical implementation, examples of software, Strengths and limitations of simulation, Cardiac cell-to-cell communication, Gap junction structure, function	12
Total		**42**

11. Suggested Books:

S.No	Name of Books	Year of publication/ Reprint
1	Biophysics: An Introduction Roland Glaser	2000
2	Molecular and Cellular Biophysics Meyer B. Jackson	2006
3	Introductory Biophysics: Perspectives on the Living State J.R. Claycomb and Jonathan Quoc P. Tran	2010
4	Quantitative Understanding of Biosystems: An Introduction to Biophysics Thomas M. Nordlund	2011

1. Subject Code: **EP-309** Course Title: **Quantum Information and Computing**

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

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

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

4. Credits : 4

5. Semester : V

6. Subject Area : DEC-2

7. Pre-requisite : Nil

8. Objective : The student will be able to formulate and explain about research based emerging field quantum computing with the help of fundamental concepts of quantum mechanics, and will learn to formulate the Schrodinger equation to obtain eigenvectors and energies and describe the propagation of quantum information using logic gates in various fields.

10. Details of Course :

S.No.	Contents	Contact Hours
1.	**UNIT I:** Introduction to Turing machines-classical probabilistic and deterministic Turing machines, Quantum Turing machines; introduction to computability, complexity, classical complexity and quantum complexity classes-Quantum Physics and Computers.	10
2.	**UNIT II:** Review of Quantum Mechanics- state vectors, superpositions, UNITary operators, hermitian operators, Schrödinger equation, Hamiltonian evolution, the concept of quantum measurement, the concept of qubits, quantum registers and quantum gates Quantum Algorithms. Introduction to quantum algorithms, Deutsch's algorithm, Shor's algorithm and Grover's search Algorithm, Physical implementation of simple quantum gates.	12
3.	**UNIT III:** Quantum Cryptography and Quantum Teleportation, real physical systems and technological feasibility Heisenberg uncertainty principle, polarization states of photons, quantum cryptography using polarized photons, entanglements.	10
4.	**UNIT IV:** Introduction to the EPR paradox, BELL's theorem, Bell basis, teleportation of a single qubit, review of some current experiments and candidate physical systems, technological feasibility of a quantum computer and the limitations imposed by noise.	10
Total		**42**

11. Suggested Books

S.No.	Name of Books/ Authors	Year of Publication/ Reprint
1.	Introduction to Quantum Computation and Information By Hoi-Kwong Lo, Tim Spiller, and SanduPopescu/World Scientific.	1998
2.	The Quantum Computer by Jacob West (, 2000). Web Page	April 28, 2000

3.	Quantum Computation and Quantum Information by Michael A. Nielsen & Isaac L. Chuang Cambridge University Press	2010 (10th ed.)

1. Subject Code: **EP-311** Course Title: **Computer Networking**
2. Contact Hours : L : 3 T : 1 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 : 4
6. Semester : V
7. Subject Area : DEC-2
8. Pre-requisite : Nil
9. Objective : The student will be able to understand about the computer networking and architectures
10. Details of Course :

S. No.	Contents	Contact Hours
1.	**OSI Reference Model and Network Architecture:** Introduction to Computer Networks, Example networks ARPANET, Internet, Private Networks, Network Topologies: Bus-, Star-, Ring-, Hybrid -, Tree -,Complete -, Irregular –Topology; Types of Networks : Local Area Networks, Metropolitan Area Networks, Wide Area Networks; Layering architecture of networks, OSI model, Functions of each layer, Services and Protocols of each layer	12
2.	**TCP/IP:** Introduction, History of TCP/IP, Layers of TCP/IP, Protocols, Internet Protocol, Transmission Control Protocol , User Datagram Protocol, IP Addressing, IP address classes, Subnet Addressing, Internet Control Protocols, ARP, RARP, ICMP, Application Layer, Domain Name System, Email – SMTP, POP,IMAP; FTP, NNTP, HTTP, Overview of IP version 6.	10

3.	**Local Area Networks:** Introduction to LANs, Features of LANs, Components of LANs, Usage of LANs, LAN Standards, IEEE 802 standards, Channel Access Methods, Aloha, CSMA, CSMA/CD, Token Passing, Ethernet, Layer 2 & 3 switching, Fast Ethernet and Gigabit Ethernet, Token Ring, LAN interconnecting devices: Hubs, Switches, Bridges, Routers, Gateways.	10
4.	Wide Area Networks: Introduction of WANs, Routing, Congestion Control, WAN Technologies, Distributed ueue Dual Bus (DQDB), Synchronous Digital Hierarchy (SDH)/ Synchronous Optical Network (SONET), Asynchronous Transfer Mode (ATM), Frame Relay, Wireless Links. Introduction to Network Management: Remote Monitoring Techniques: Polling, Traps, Security management, Firewalls,VLANs, Proxy Servers	10
Total		**42**

11. Suggested Books

S.No.	Name of Books/ Authors	Year of Publication/ Reprint
1.	Computer Networks (3rd edition), Tanenbaum Andrew S International edition	, 1996.
2.	Data Communications, Computer Networks and Open Systems (4th edition), Halsall Fred, Addison Wesley, Low Price Edition.	2000,
3.	Computer Networks – A System Approach, Larry L. Peterson & Bruce S. Davie,	2nd Edition
4.	Computer Networking – ED Tittel, , T.M.H.	2002

1. Subject Code: **EP-308** Course Title: **Laser and Instrumentation**
2. Contact Hours : L : 3 T : 1 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 : 4

6. Semester : VI

7. Subject Area : DEC-3

8. Pre-requisite : Basic knowledge LASER Physics, Quantum Mechanis & Optics

9. Objective : *1. Acquire fundamental understanding of the basic Physics behind optoelectronic devices.

2. Develop basic understanding of light emitting diodes.

3. Develop detailed knowledge of laser operating principles and structures.

4. Acquire in depth understanding of photo detectors

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Laser Physics: Various common laser systems and applications, fabrication of lasers, optical amplifications, laser rate equations, gain coefficient, line broadening, optical resonators, Q-switchings, mode locking and pulse compression.	10
2.	Nonliear Optics: Nonlinear optical susceptibilities, harmonic generation, frequency conversion, phase matching	8
3.	Photonic Devices: Optical detectors, photomultiplier tubes, monochormator, CCD.	8
4.	Analytical Instruments: Spectrophotomers, FTIR, fluorescence and Raman Spectromenter, X-ray diffractometer, scanning electron microscopy, atomic force microscopy. Low Temperature: Gas liquefiers, Cryo-fluid path, liquid He cryostat design, low temperature measurement.	8

5.	Laboratory Component: Physical parameter measurement using different sensor; low pressure generation and measurement	8
Total		**42**

11. Suggested Books

S.No.	Name of Books/ Authors	Year of Publication/ Reprint
1.	Principles of Lasers by O. Svelto/Plenum Press	1998
2.	Non Linear Optics by R. W. Boyd Academic Press	2003/
3.	Modern Electronic Instrumentation and Measurement Techniques by A. D. Helfrick and W. D. Cooper/Prentice-Hall of India	1996
4.	Principles of Measurement Systems by J. P. Bentley/Longman	2000
5.	Experimental Techniques in Low Temperature Physics by G. K. White/Clarendon	1993
6.	Vacuum Technology by A. Roth	1990/ Elsevier
7.	Principles of Instrumental Analysis by D. A. Skoog, F. J. Holler and T. A. Nieman/Saunders Coll. Publ.	1998

1. Subject Code: **EP-310** Course Title: **MEDICAL PHYSICS AND PHYSIOLOGICAL MEASUREMENTS**
2. Contact Hours : L : 3 T : 1 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 : 4
6. Semester : VI
7. Subject Area : DEC-3
8. Pre-requisite : Nil

9. Objective : Acquire fundamental understanding of the applications of Physics in medical

10. Details of Course :

S. No.	Contents	Contact Hours
1.	Overview of Human body - Origin of bio-potentials -ENG, EMG,ECG and EEG	12
2.	Heart and ECG Waveform - standard lead system and functional blocks - Biofluid mechanics	12
3.	Blood pressure measurement - Different blood flow meters	10
4.	Electric impedance plethysmography - photo plethysmography - pulse oximetry.	8
Total		**42**

11. Suggested Books

S.No.	Name of Books/ Authors	Year of Publication/ Reprint
1.	Medical Physics and Biomedical Engineering, Brown, B.H. Institute of Physics Publishing, 2. John. G. Webster,	1999
2.	Medical Instrumentation : Application and Design	2nd Edition, John Wiley

1. Subject Code: **EP-312** Course Title: **FOURIER OPTICS AND HOLOGRAPHY**

2. Contact Hours : L : 3 T : 1 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 : 4

6. Semester : VI

7. Subject Area : DEC- 3

8. Pre-requisite : Basic knowledge of Modern Physics, Optics & Quantum Physics

9. Objective : * Information processing using optical techniques such as holography and Fourier transform is an important area of Modern Optics. In this course the fundamentals, techniques and applications of holography and Fourier optics will be provided.

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Signals and systems, Fourier Transform(FT), Sampling theorem, Diffraction theory; Fresnel-Kirchhoff formulation and angular spectrum method	9
2.	brief discussion of Fresnel and Fraunhofer diffraction, FT properties of lenses and image formation by a lens; Frequency response of a diffraction-limited system under coherent and incoherent illumination	11
3.	OTF-effects of aberration and apodization, comparison of coherent and incoherent imaging, super-resolution; Techniques for measurement of OTF; Analog optical information processing: Abbe-Porter experiement, phase contrast microscopy and other simple applications; Coherent image processing:	9
4.	VanderLugt filter; joint-transform correlator; pattern recognition, Synthetic Aperture Radar.	8
5.	Basics of holography, in-line and off-axis holography; 3 12 Transmission and reflection holograms, Amplitude and phase holograms, Recording materials. Thick and thin holograms	5
Total		**42**

11. Suggested Books

S.No.	Name of Books/ Authors	Year of Publication/ Reprint
1.	Introduction to Fourier Optics by J.W.Goodman/Mc Graw Hill	1996
2.	Optical Holography, Principles, Techniques and Applications by Hariharan/ Cambridge Univ.Press	1996
3.	The Fourier Transforms and its applications by R.N.Bracewell/Mc Graw Hill	1965
4.	Linear systems, Fourier Transforms and optics by Gaskill.J/ Wiley	1978
5.	Fundamentals of Holography by Denisyuk, Y/ MIR Publisher	1984
6.	An Optical holography by R.J.Collier / Academic Press	1971

1. Subject Code: **EP-314** Course Title: **Instrumentation and Control**
2. Contact Hours : L : 3 T : 1 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 : 4
6. Semester : VI
7. Subject Area : DEC-4
8. Pre-requisite : Nil
9. Objective : Develop detailed knowledge of instruments and Control
10. Details of Course :

S. No.	Contents	Contact Hours
1.	**Instrumentation:** Transducers, classification & selection of transducers, strain gauges, inductive & capacitive transducers, piezoelectric and Hall-effect transducers, thermisters, thermocouples, photo-diodes & phototransistors, encoder type digital transducers, signal conditioning and telemetry, basic concepts of smart sensors and application	12
2.	Control System:Linear, Non Linear, Time Varying and Linear Time Invariant System, Servomechanism, Historical Development of Automatic Control and Introduction to Digital Computer Control, Mathematical Models of Physical Systems, Differential Equations of Physical Systems, Transfer Functions, Block Diagram Algebra and Signal Flow Graphs. Feedback and Non-feedback Systems Reduction of Parameter Variations By Use of Feedback Control Over System Dynamics By Use of Feedback Control of Effects of Disturbance Single By Use of Feedback and Regenerative Feedback.	12
3.	**Time and frequency response Analysis:** Standard test signals, Time responseofFirst order Systems, Time Response of Second-Order Systems, Steady-State Error and Error Constants, Effect of Adding a Zero to a System, P, PI and PID Control Action and Their Effect, Design Specifications of Second-Order Systems and Performance Indices. Correlation Between Time and Frequency Response, Polar Plots, Bode Plots, and All Pass and Minimum-Phase Systems.	10
4.	The Concept of Stability, Necessary Conditions for Stability, Hurwitz Stability Criterion, Routh Stability Criterion and relative Stability Analysis. The Root Locus Concept, Construction of Root Loci, Root Contours, Systems with Transportation Lag, Sensitivity of the Roots of the Characteristic equation, Mathematical Preliminaries, Nyquist Stability Criterion, Definition of Gain Margin and Phase Margin, Assessment of Relative Stability Using Nyquist Criterion and Closed-Loop Frequency Response.	8
Total		**42**

11. Suggested Books

S. No.	Name of Books/ Authors	Year of Publication/ Reprint
1.	Modern Electronic Instrumentation and Measurement Techniques by Helfrick and Cooper Prentice- Hall of India, Reprint	1988.
2.	Electrical Measurement and Measuring Instruments by Golding, E.W. 3rd Edition; Sir Issac Pitman and Sons,	1960.
3.	Control Systems Engineering by Nagrath& Gopal New Age International. Publishers	6th Edition
4.	Instrumentation Measurement and Feedback" by Jones,	1986

1. Subject Code: **EP-316** Course Title: **Cosmology and Astrophysics**
2. Contact Hours : L : 3 T : 1 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 : 4
6. Semester : VI
7. Subject Area : DEC-4
8. Pre-requisite : Nil
9. Objective : Acquire in depth understanding of Astronomy and cosmology

10. Details of Course :

S. No.	Contents	Contact Hours
1.	Our place in the Universe: A tour of the Universe, its scale and contents (e.g. planets, stars, galaxies and the interstellar medium). Observational astronomy: the electromagnetic spectrum; geometrical optics (ray diagrams, focal length, magnification etc); diffraction (resolving power, Airy disc, diffraction limit etc); telescopes (reflecting, refracting, multi-wavelength).	12
2.	Properties of stars: brightnesses (luminosities, fluxes and magnitudes); colours (blackbody radiation, the Planck, Stefan-Boltzmann and Wien laws, effective temperature, interstellar reddening); spectral types; spectral lines (Bohr model, Lyman &Balmer series etc, Doppler effect); Hertzprung-Russell diagram; the main sequence (stellar masses, binary systems, Kepler's laws, mass-luminosity relations); distances to stars (parallax, standard candles, P-L relationships, m-s fitting etc); positions of stars (celestial sphere, coordinate systems, proper motions, sidereal and universal time).	12
3.	The life and death of stars: energy source (nuclear fusion, p-p chain, triple-alpha, CNO cycle, lifetime of the Sun); solar neutrinos; basic stellar structure (hydrostatic equilibrium, equation of state); evolution beyond the main sequence; formation of the heavy elements; supernovae; stellar remnants (white dwarfs, neutron stars, black holes, degeneracy pressure, Swarszchild radius, escape velocities). Planets & life in the Universe: formation of the stars and protoplanetary discs (molecular clouds, Jeans mass); contents of the solar system; planetary and cometary orbits; equilibrium temperatures; extrasolar planets (Doppler wobble, transits, microlensing; prospects); search for life elsewhere; SETI. Galaxies: Constituents of galaxies; stellar populations; the interstellar medium; HII regions; 21cm line; spirals and ellipticals; galactic dynamics; galaxy rotation curves and dark matter; active galaxies and quasars.	10
4.	Cosmology: Galaxies and the expanding Universe; Hubble's Law; the age of the Universe; the Big Bang; cosmic microwave background (blackbody radiation); big bang nucleosynthesis (cosmic abundances, binding energies, matter & radiation); introductory cosmology (the cosmological principle, homogeneity and isotropy, Olber's paradox); cosmological models (critical density, geometry of space, the fate of the Universe); dark energy and the accelerating Universe.	8
Total		**42**

11. Suggested Books

S. No	Name of Books, Authors	Year of publication/ reprint
1	Zeilik& Gregory, Introductory Astronomy & Astrophysics,(Saunders College Publishing	4th ed
2	Morison, I., Introduction to Astronomy and Cosmology	Wiley
3	Kutner, M.L., Astronomy: A Physical Perspective	Cambridge University Press
4	Green, S.F. & Jones, M.H., An Introduction to the Sun and Stars	Cambridge University Press
5	Jones, M.H. &Lambourne, R.J.A., An Introduction to Galaxies & Cosmology	Cambridge University Press
6	Carroll, B.W. &Ostlie, D.A., An Introduction to Modern Astrophysics	Pearson

1. Subject Code: **EP-409** Course Title: **Information Theory and Coding**
2. Contact Hours : L : 3 T : 1 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 : 4
6. Semester : VII
7. Subject Area : DEC-5
8. Pre-requisite : Nil
9. Objective : To introduce information theory, the fundamentals of error control coding techniques and their applicationstechniques and their applications

10. Details of Course :

S. No.	Contents	Contact Hours
1.	**UNIT-I:** Review of probability theory, Definition of Information Measure and Entropy: Measure of information, Average information content of symbols in long independent sequences, Average information content of symbols in long dependent sequences. Mark-off statistical model for information source, Entropy and information rate of mark off source, Mutual information. Asymptotic Properties of Entropy and Problem Solving in Entropy	08
2.	**UNIT-II:** Block Code and its Properties, Data compression, Kraft-Mcmillan Equality and Compact Codes, Encoding of the source output, Shannon's encoding algorithm, Coding Strategies, Huffman Coding, Shannon-Fano-EliasCoding and Introduction to Arithmetic Coding.	08
3.	**UNIT-III:** Introduction to Information Channels, Communication Channels, Discrete communication channels, Continuous channels. Discrete memory less Channels, Mutual information, Channel Capacity, Channel coding theorem, Differential entropy and mutual information for continuous ensembles, Channel capacity Theorem.	08
4.	**UNIT-IV:** Introduction to Error Control Coding: Introduction, Types of errors, examples, Types of codes Linear Block Codes: Matrix description, Error detection and correction, Standard arrays and table look up for decoding	09
5.	**UNIT-V:** Binary Cycle Codes, Algebraic structures of cyclic codes, Encoding using an (n-k) bit shift register, Syndrome calculation. BCH codes. RS codes, Golay codes, Shortened cyclic codes, Burst error correcting codes. Burst and Random Error correcting codes. Convolution Codes, Time domain approach. Transform domain approach	09
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors	Year of Publication/ Reprint
1	Digital and Analog Communication Systems by K. Sam Shanmugam / Wiley India Private Limited	2012
2	Digital Communications by Simon Haykin/ Wiley	2006
3	Information Theory, Coding and Cryptography by Ranjan Bose McGraw Hill Education	2008
4	Elements of Information Theory by Thomas M. Cover and Joy A. Thomas / Wiley	2013
5	Fundamentals of Information Theory and Coding Design by Roberto Togneri and Christopher J.S deSilva/ Chapman and Hall	2003
6	Introduction to Coding and Information Theory by Steven Roman / Springer	1997

1. Subject Code: **EP-411** Course Title: **Advanced Simulation Techniques in Physics**

2. Contact Hours : L : 3 T : 1 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 : 4

6. Semester : VII

7. Subject Area : DEC-5

8. Pre-requisite : Nil

9. Objective : To develop the numerical skill of advanced level for solving the problem related to theoretical physics.

10. Details of Course :

S. No.	Contents	Contact Hours
1.	**UNIT-I:** Basic Numerical Methods and Classical Simulations: Review of differentiation, integration (quadrature), and finding roots. Integration of ordinary differential equations. Monte Carlo simulations, applications to classical spin systems. Classical Molecular Dynamics.	08
2.	**UNIT-1I:** Quantum Simulations: Time-independent Schrodinger equation in one dimension (radial or linear equations). Scattering from a spherical potential; Born Approximation; Bound State solutions. Single particle time-dependent Schrodinger equations.	08
3.	**UNIT-III:** Hartree-FockTheory: restricted and unrestricted theory applied to atoms. Schrodinger equation in a basis: Matrix operations, variational properties; applications of basis functions for atomic, molecular, solid-state and nuclear calculations.	08
4.	**UNIT-IV:** Mini-projects on different fields of physics, e.g., Thermal simulations of matter using Car-Parrinello molecular dynamics; Many-Interacting-Particle Problems on Hubbard and Anderson model for electrons using Lanczos method (exact diagonalisation) for the lowest states	09
5.	**UNIT-V:** Quantum Monte Carlo methods; Computational methods for Lattice field theories; Microscopic mean-field theories (Hartree-Fock, Bogoliubov and relativistic mean-field); methods in nuclear many-body problems.	09
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors	Year of Publication/ Reprint
1	Introduction to Fortran 90 and 95 by S. J. Chapman/ McGraw Hill, Int. Ed.	1998

2	Computational Physics by S. E. Koonin and D. C. Meredith, 1990. / Addison-Wesley	1990
3	An Introduction to Computational Physics by Tao Pang/Cambridge University Press	2010
4	Computational Physics by R. H. Landau and M. J. P. Mejia 1997. /John Wiley	1997
5	Computational Physics by J. M. Thijssen, / Cambridge Univ Press	1999
6	Computational Physics by K. H. Hoffmann and M. Schreiber / Springer	1996

1. Subject Code: **EP-413** Course Title: **Continuum Mechanics**
2. Contact Hours : L : 3 T : 1 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 : 4
6. Semester : VII
7. Subject Area : DEC- 5
8. Pre-requisite : Vector calculus , Elementary differential equations and elementary symbolic computing
9. Objective : * The continuum mechanics clearly brings out the general principles that are common to both solid and fluid mechanics. This subject also discusses necessity for assumption of solid and fluid i.e., in the form of constitutive equations. Further, the frame work of continuum mechanics is useful for understanding elasticity, plasticity, viscoelastcity and viscoplasticity.

10. Details of Course :

S. No.	Contents	Contact Hours
1.	Vector space, Cauchy-Schwartz inequality, and Triangle inequality, Dot product, Cross product, Outer product, Kronecker delta, Permutation symbol, Definition of tensor, Summation convention, Free index, Dummy index, Examples to understand notations, Operations on second-order tensors (SOT), Cofactor tensor, Invariants of SOT, Inverse of SOT, Eigenvalues and Eigenvectors, Geometric interpretation of eigenvectors, Cayley-Hamilton theorem	8
2.	Skew-symmetric, Orthogonal, and Symmetric tensors, Additive decomposition, Polar decomposition, Square root tensor, Calculus of Tensors	9
3.	Kinematics : Mapping function, Deformation gradient, Length, Area, and Volume, Material and spatial description, Rate of deformation, Spin tensors, Strain tensors, Rigid transformation, Leibniz rule of integration, Transport theorems	8
4.	Cauchy hypothesis and Cauchy theorem, Equation of motion, Angular momentum balance, Equation of motion in material coordinates, Piola Kirchhoff stress tensor, Energy balance, Second law of thermodynamics, Principle of material frame-indifference, Constitutive equations	8
5.	Linear elasticity: Applied Linear Elasticity: Mathematical solutions for plane stress, plane strain and axisymmetric boundary value problems, energy methods. Linear Viscoelasticity: Discrete models (Maxwell, Kelvin, Voigt), hereditary integrals, creep, stress relaxation, dynamic loading, hysteresis, Fluid mechanics: Introduction to Poroelasticity: Two-phase (fluid-solid) mixture models, balance laws for mass/momentum/energy, applications to biological tissues	9
Total		**42**

11. Suggested Books

S.No.	Name of Books/ Authors	Year of Publication/ Reprint
1.	Foundations and applications of mechanics:Volume I: Continuum mechanics by Jog, C.S/ Narosa Publishing House	2007
2.	Introduction to the mechanics of continuous medium by Malvern, L.E/ Prentice-Hall	1969
3.	introduction to continuum mechanics by Gurtin, M.E., / Academic press, Inc.	1981

1. Subject Code: **EP-415** Course Title: **Nanoscience & Technology**
2. Contact Hours : L : 3 T : 0 P : 2
3. Examination Duration (Hrs.) : Theory : 3 Practical : 2
4. Relative Weight : CWS : 15 PRS : 15 MTE : 30 ETE : 40 PRE : 0
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC-5
8. Pre-requisite : Basic knowledge of quantum mechanics, and Semiconductor
9. Objective : Objective of this course is to study the properties of material at nanoscale, and to highlight applications of nanomaterial

10. Details of Course :

S. No.	Contents	Contact Hours
1.	Concept of dimensionality of solids, 3D to 0D; Energy band structure in low dimensions, motion of electron in bands, Density of states, Density of Modes, Density of Phonons and Photons,	06
2.	Population of conduction band, Valance band and Fermi levels for 3D, 2D, 1D and 0D system, Quasi Fermi level, Joint Density of States,	08
3.	Quantum dot (QD), Coulomb Blockade Effect in QD, Conductance formula for nanostructures, quantized conductance, Tunel Resistance for single electron charging, Charging energy model, Ballistic transport, manifestation of electron and photon confinement and its application in the design and development of nanoscale electronic and optical devices.	06
4.	Behavior of low dimension solids under electric and magnetic fields, Symmetric and Landau Guage, Proof of total energy and wavefunction of electrons in 2D or 1D system in perpendicular magnetic Field. Landu Levels, Landau Orbits, Degeneracy of Landau Levels, Landau level filling, Shubnikov-deHass Oscillation, Integer Quantum Hall Effect, Fractional Hall Effect	10
5.	Quantum mechanical treatment of low dimensional solids, Photon and phonon transport, optical absorption, interband absorption, optical properties, inter sub-band transitions, Two dimensional electron gas.	04
6	Applications of nanomaterial, theory of oxygen sensing by ZnO nanostructures, Carbon nanotubes for gas and vapor sensing (NH_3, NO_2, H_2, CH_4, SO_2, H_2S , Carbon nanotube based Biosensor, Field emission properties from nanostructures	08
Total		**42**

11. Suggested Books

S.No.	Name of Books/ Authors	Year of Publication/ Reprint
1.	Introduction to Nanoscale Science & Technology by M. Di Ventra et al Springer	2004
2.	Introduction to Nanotechnology by C P Poole Jr and Franks J Owens Willey	2003
3.	Quantum Electronics by A. Yariv Willey	1989
4.	Nanophotonics by Paras N Prasad Willey	2004
5.	Carbon Nanotube Electronics, edited by Ali Javey, Jing Kong, Springer	2009
6.	Physics of Nanostructured Solid State Devices, Supriyo Bandyopadhyay, Published by Springer	2012

1. Subject Code: **EP-417** Course Title: **Photonics**
2. Contact Hours : L : 3 T : 1 P : 0
3. Examination Duration (Hrs.) : Theory : 3 Practical : 0
4. Relative Weight : CWS : 25 PRS : MTE : 25 ETE : 50 PRE : 0
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC-5
8. Pre-requisite : Knowledge of the basic concepts of optics Knowledge of the partial differential equations, their solutions & special functions
9. Objective : To provide the in concepts in the area of photonics

10. Details of course :

S. No.	Contents	Contact Hours
1.	Propagation of EM waves in anisotropic Materials, Uniaxialand biaxial materials, Polarization Devices. Electro opticeffects – Kerr and Pockels effects, Amplitude and PhaseModulators, Beam deflection and scanning devices. Magneto-optic effects – Faraday, Cotton-Mouton andinverse Faraday effects, Optical diode and isolator.	12
2.	Interaction of light with acoustic waves, Acousto-opticmodulators and beam deflectors and their application tolaser, display and printing technologies. Nonlinear interactionof light with Matter, Origin of optical nonlinearities, Secondorder optical processes (SFG, DFG, SHG and OPA), Frequencyconverters and their applications, Third order nonlinearoptical processes (self action, self focusing, self phasemodulation, optical bistability, degenerate four-wave-mixingand phase conjugation)	12
3.	Electric and magnetic dipole transitions, Einstein's transition probabilities, Lifetime and collision broadening of atomic transitions, Doppler broadening, Master amplification, Rate equation for atomic transitions. Microwave solid state measures.	12
4.	Optical resonators and lens waveguides, Lasers and their general characteristics, Resonant cavities and laser modes, Different types of lasers, Sample applications (scientific and technological)	06
Total		**42**

11. Suggested Books

S.No.	Name of Books/ Authors	Year of Publication/ Reprint
1.	Fundamental of Photonics by Baha E.A., Saleh and M.C. Teich/ John Wiley and Sons	2010
2.	Photonics by Ralf Menzel Springer Verilog	2001
3.	Integrated optics by T. Tamir Springer-Verilog	1975

4.	Nonlinear Optics by Boyd/ Academic Press.	2010
5.	Nonlinear Fiber Optics by Govind Aggarwal/ Elsevier	2013
6.	Optoelectronics and Photonics by S.O. Kasap/Pearson	2010
7.	Optical Electronics by A. Yariv/ Holt Rinehart and Winston	2012

1. Subject Code: **EP-419** Course Title: **Introduction to Automation and Motion Control**

2. Contact Hours : L : 3 T : 1 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 : 4

6. Semester : VII

7. Subject Area : DEC-6

8. Pre-requisite : Nill

9. Objective : To introduce recent advancement in Automation technology and the robots

10. Details of Course :

S. No.	Contents	Contact Hours
1.	Introduction: Automation and Robotics, Definition, Basic Structure of Robots, Classification of Robots based on co-ordinate system, Present trends and future trends in robotics, Overview of robot subsystems, Components of Robot system-Manipulator, Controller, Power conversion UNIT etc, Specifications of robot.	10
2.	End Effectors and Actuators: Different types of grippers, vacuum & other methods of gripping, overview of actuators, Internal & External sensors, position, relocking and acceleration sensors, proximity sensors, force sensors, touch slip laser range tinder, camera.	08

3.	Motion Planning and Controllers: On-off trajectory, relocking and acceleration profile, Cartesian motion of manipulator, joint interpolated control, Jacobian in terms of D-H matrix, Obstacle avoidance, Basic control system, control loops of robotic system, Fuzzy controllers**.**	08
4.	Robot Vision: Machine Vision system, description, sensing, Digitizing, Image Processing and Analysis and Application of Machine Vision System, Robotic assembly sensors & Intelligent Sensors. Object recognition.	08
5.	Robots for Industrial Automation: Need for Automation, Robotics for automation. Robot Intelligence and Task Planning, MEMS (Micro Electro Mechanical Systems) – Introduction and working principle, Nano-robots	08
Total		**42**

11. Suggested Books

S.No.	Name of Books/ Authors	Year of Publication/ Reprint
1.	Fundamentals of Robotics: Analysis and Control by *Robert J Schilling* PHI	1990
2.	Robotic Engineering by *Klafter, Thomas Negin*	1993
3.	Robotics for Engineers by *Yoram Koren* McGraw Hill	1987
4.	Fundamentals of Robotics by T.C. Manjunath Nandu Publishers	2014
5.	Robotics and Control by R. K. Mittal, I. J. Nagrath Tata McGraw Hill	2003

1. Subject Code: **EP-421** Course Title:**Principles of Nuclear Engineering**
2. Contact Hours : L : 3 T : 1 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 : 4

6. Semester : VII

7. Subject Area : DEC-6

8. Pre-requisite : NIL

9. Objective : To impart the knowledge on Nuclear Physics, Nuclear Reactions,Nuclear Reactors and safety.

10. Details of Course :

S.No.	Contents	Contact Hours
1.	**Nuclear Physics-** Nuclear model of the atom - Equivalence of mass and energy - Binding - Radio activity - Half life - Neutron interactions - Cross sections. **Nuclear Reactions and Reactor Materials-** Mechanism of nuclear fission and fusion - Radio activity - Chain reactions - Critical mass and composition - Nuclear fuel cycles and its characteristics - Uranium production and purification - Zirconium, thorium, beryllium.	15
2.	**Reprocessing-** Nuclear fuel cycles - spent fuel characteristics - Role of solvent extraction in reprocessing - Solvent extraction equipment. **Nuclear Reactors-** Reactors - Types of fast breeding reactors - Design and construction of fast breeding reactors - heat transfer techniques in nuclear reactors - reactor shielding.	15
3.	**Safety, Disposal and Proliferation-** Nuclear plant safety- Safety systems - Changes and consequences of an accident - Criteria for safety - Nuclear waste - Type of waste and its disposal - Radiation hazards and their prevention - Weapons proliferation.	12
Total		**42**

11. Suggested Books

S.No.	Name of Books/ Authors	Year of Publication/ Reprint
1.	Fundamentals of Nuclear Engineering by Thomas J.Cannoly/John Wiley	1978

2.	Introduction to Nuclear Power by Collier J.G., and G.F.Hewitt/ Hemisphere Publishing, New York	1987
3.	Introduction to Nuclear Engineering by Lamarsh U.R/Second Edition, Addison Wesley M.A	1983
4.	Radioactive Waste - Politics, Technology and Risk by Lipschutz R.D. Ballingor, Cambridge. M.A.	1980

1. Subject Code: **EP-423** Course Title: **Space and Atmospheric Science-I**
2. Contact Hours : L : 3 T : 0 P : 2
3. Examination Duration (Hrs.) ` : Theory : 3 Practical : 2
4. Relative Weight : CWS : 15PRS : 15 MTE : 30 ETE : 40 PRE : 0
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC-6
8. Pre-requisite : Basic knowledge of Space and Atmosphere.
9. Objective : To impart the fundamental knowledge pertaining to space and atmosphere. Measurement of meteorological parameters using various techniques.Global warming its consequences. Effect of trace gases, aerosols on climatic conditions will be discussed.

10. Details of Course :

S.No.	Contents	Contact Hours
1.	**Earth's Atmosphere:** Definition of Climate**,** Physical factorsof climate, earth sun relationship, ecliptic and equatorial plane, rotation of earth, seasons, climatic controls. Climatic classification: methods of Koppen and Thornthwaite, Microclimate-basic concepts. Layers of atmosphere, variation of temperature, pressure with height in the atmosphere. Composition of the atmosphere. Maxwell's equation & Electromagnetic wave; black body radiation law-Plank's law and Stefan-Boltzmann law and Wien's displacement law.	10
2.	Spectral Characteristic of solar and thermal infrared radiation, Geographical and seasonal distribution of incoming solar radiation, outgoing radiation, net radiation, Energy balance of earth and atmosphere; Greenhouse effect and atmospheric scattering, clouds and aerosols. Indian Climatology: Climate zones of India, Pressure, wind temperature and rainfall distribution during the four seasons. Western disturbances, fog, thunderstorm, hail, cold waves, subtropical jet stream, south-west and north-east monsoon.	12
3.	**Atmospheric thermodynamics:** Ideal gas equation of state; Dry air as a mixture of ideal gases; First Law: work, heat, specific heat and energy conservation; Second Law: entropy, adiabatic processes, potential temperature, Thermodynamic potentials; Thermodynamic cycles. Hydrostatic equation, scale height, geopotential, Dry adiabatic lapse rate and static stability.	10
4.	**Meteorological Instrumentation:**Ground based climatic station and automatic weather station for the measurement of air temperature, humidity, atmospheric pressure; wind speed, velocity and rain fall. Air borne systems for upper air observations-Rawinsonde, Radiosonde, GPS sonde-estimation of convective boundary layer height, thermos dynamical parameters and construction of T-phigram; Introduction to Space borne systems for the measurement of meteorological parameters.	10
Total		**42**

11. Suggested Books

S.No.	Name of Books/ Authors	Year of Publication/ Reprint
1.	Hand book of the Atmospheric Science-Principles and Applications by C.N.Hewitt and Andrea V.Jackson Black, Wiley	1970
2.	Atmospheric Chemistry and Physics by John H.Seinfield and Spyros N. Pandias., Prentice Hall	1990
3.	An Introduction to dynamics Meteorology by James R. Hotton, Wiley	1986
4.	A first course in Atmospheric Thermodynamics by Petty G.W. , Cambridge University press.	1998

1. Subject Code: **EP-425** Course Title: **Plasma Science and Technology-I**
2. Contact Hours : L : 3 T : 1 P : 0
3. Examination Duration (Hrs.) : Theory : 3 Practical : 0
4. Relative Weight : CWS : 25 PRS : 15 MTE : 25 ETE : 50 PRE : 0
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC-6
8. Pre-requisite : Understanding of Classical physics, electromagnetic theory including Maxwell's equations, and mathematical familiarity with partial differential equations and complex analysis
9. Objective : *Acquiring basic knowledge concerning: 1) plasma parameters in technological devices, laboratory and nature; 2) motion of charged particles in magnetic fields, plasma confinement schemes, MHD models, simple equilibrium and stability analysis, 3) two-fluid hydrodynamic plasma models, and wave propagation in a magnetic field.

10. Details of Course :

S.No.	Contents	Contact Hours
1.	**Introduction to Plasmas** Plasma as a fourth state of matter, an ionized gas, particle interactions and collective effects, occurrence of plasma in nature, Applications of plasma. Characteristics of plasmas/ criteria for definition of plasma: quasi-neutrality, Debye shielding, plasma parameter, Plasma oscillations and plasma frequency. Fluid and Kinetic approaches to the study of plasma (basic concepts) Boltzmann and Fokker Planck Equations: Transport Phenomena.	8
2.	**Methods of Plasma Production and Plasma Diagnostics** DC discharge, RF discharge, photo-ionization, microwave plasma production, tunnel ionization, laser avalanche breakdown of gases, laser ablation, plasma measurements (density, temperature), Langmuir probes, neutral and ion beam probes, particle defects and velocity analyzer, Microwave diagnostics.	8
3.	**Motion of charged particle in Uniform and Non uniform E and B Fields** Single particle motion in uniform E and B Fields: uniform **B** field, **E** = 0, uniform **B** and non zero **E**, guiding centre drift, $\mathbf{E}\times\mathbf{B}$ drift, drift due to gravity or other forces. Single particle motion in non-uniform B field: grad **B drift,** curvature **B** drift, adiabatic invariant.	8
4.	**Fluid description of Plasmas** Maxwell's equations, pressure gradient force, rate of collisional loss of momentum and energy, fluid equations: equation of continuity, equation of motion, equation of energy balance, electron and ion response to dc and ac electric fields: DC conductivity, AC conductivity and MHD power generation.	8
5.	**Computational Methods in Plasma Physics** Analysis of methods for the numerical solution of the partial differential equations of plasma physics, including those of elliptic, parabolic, hyperbolic, and eigen value type. Topics include finite difference, finite element, spectral, particle-in-cell(PIC), Monte Carlo, moving grid, and multiple-time-scale techniques, applied to the problems of plasma equilibrium, transport, and stability.	10
	Total	**42**

11. Suggested Books

S.No.	Name of Books/ Authors	Year of Publication/ Reprint
1.	Introduction to plasma physics and controlled fusion, F.F. Chen / Springer science	1983
2.	Principles of plasma physics, N. Krall and A.W. Trivelpiece /San Francisco Press	1986
3.	Classical Electrodynamics, J.D. Jackson NewYork	3rd Edition
4.	Interaction of electromagnetic waves with electron beams and plasmas, C.S. Liu and V.K. Tripathi/World Scientific	1994
5.	Computational plasma physics: With Applications to fusion and Astrophysics, Toshiki Tajima/Westview Press	2004
6.	Plasma Physics via Computer Simulation, C.K. Birdsall, A. B. Langdon/IOP Publishing Ltd	1991

1. Subject Code: **EP-406** Course Title: **Introduction to Spintronics**

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

2. Examination Duration (Hrs.) : Theory : 3 T:1 Practical : 0

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

4. Credits : 4

5. Semester : VIII

6. Subject Area : DEC-7

7. Pre-requisite : Basic knowledge of quantum mechanics, and semiconductor, magnetic material

8. Objective : Objective of this course is to study the properties of material at nanoscale, and to highlight applications of nanomaterial in spintronics. Fundamental of spintronics

9. Details of Course :

S. No.	Contents	Contact Hours
1.	**UNIT-I:** Stern-Gerlach experiments with electron spins, Zeeman Effect, Pauli spin Matrices, Pauli equation and spinors	04
2.	**UNIT-II:** Spin-Orbit Interaction and coupling, Zeeman splitting, Dresselhaus and Rashba spin splitting, Magnetization, Bloch states with SO coupling, Electronic structure of GaAs, orientation and spin pumping, GMR, CMR, TMR, , Spin injection, Spin detection	08
3.	**UNIT-1II:** Stoner-Wohlafarth Model, Two resister model, Density of states of minority and majority spin tunneling magnetosresistance (TMR), JMR, MR1, MR2, MR3, spin valve Hysteresis in spin valve magnetoresistance, Spin accumulation,	08
4.	**UNIT-1V:** Bloch equations, T1 and T2 times, Elliot-Yafet mechanism with phonons, Dyakonov-Perel, Bir-Aronov-Pikus, hyperfine coupling mechanisms, density matrix, pure and mixed states, spin kinetic equation, motional narrowing.	08
5.	**UNIT-V:** Spin-polarized transport, Intrinsic spin Hall effect Electrochemical potential, Spin diffusion, FN junction, Rashba formalism of linear spin injection, Equivalent circuit model, Silsbee-Johnson spin-charge coupling.	08
6	**UNIT-VI:** Datta-Das spin-FET, P-N junctions, Magnetic bipolar diode, Magnetic bipolar transistor, Magnetic tunneling devices	06
Total		**42**

11. Suggested Books

S.No.	Name of Books/ Authors	Year of Publication/ Reprint
1.	Igor Zutic, J. Fabian, and S. Das Sarma, *Spintronics: Fundamentals and Applications*, Rev. Mod. Phys. **76**, 323 (2004).	2004
2.	D.D. Awschalom, N. Samarath, and D. Loss, *Semiconductor Spintronics and Quantum Computation* (Springer, Berlin, 2004). Springer	2004

3.	S. Datta, *Electronic Transport in Mesoscopic Systems* (Cambridge University Press, Cambridge, 1995).	1995
4.	I. Zutic, J. Fabian, and S. Das Sarma, Spintronics: Fundamentals and applications, Rev. Mod. Phys. 76, 323 (2004)	2004
5.	Introduction to spintronics, Book by S. Bandyopadhyay Springer	2008

1. Subject Code: **EP-408** Course Title: **Integrated Optics**
2. Contact Hours : L : 3 T : 1 P : 0
3. Examination Duration (Hrs.) : Theory : 3 Practical : 0
4. Relative Weight : CWS : 25 PRS : MTE : 25 ETE : 50 PRE : 0
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC-7
8. Pre-requisite : Knowledge of the basic concepts of optics . Knowledge of the partial differential equations, their solutions & special functions
9. Objective : To provide the in concepts in the area of integrated optics
10. Details of course :

S. No.	Contents	Contact Hours
1.	Principles of optical Integrated circuits; Theory of optical waveguides, PlanAr, Rectangular core and Rib waveguide, homogeneous and inhomogeneous waveguide	12
2.	Coupled mode theory, optical waveguide couplers, tapers, bends; Passive and active waveguides polarizer, printe	10

3.	Optical amplifier, modulators and switches; Opto-electronic integrated circuits-Simulation Tools and CAD packages for optical integrated circuits; Technology: Materials and Device process, patterning and Lithography, Deposition and Diffusion techniques	10
4.	Lithium Niobate based integrated optics technology- Process and Characterization; Application: Integrated optic devices and circuits for High speed long distance telecommunication, Optical processing and Optical computing.	10
Total		**42**

11. Suggested Books

S.No.	Name of Books/ Authors	Year of Publication/ Reprint
1.	Integrated optics by Reinhard Marz/ Artech House publisher	2009
2.	Integrated optics by Robert G. Hunsperger Springer-Verlag	1995
3.	Integrated optics by T. Tamir Springer-Verlag	2012
4.	Optical integrated circuits by Hiroshi Nishihara Mcgraw Hill professional	2010/
5.	Nonlinear Fiber Optics by Govind Aggarwal/ Elsevier	2013
6.	Optoelectronics and Photonics by S.O. Kasap/Pearson	2010
7.	Glass integrated optics and optical fiber devices by S. Iraj Najafi SPIE Publishing	1994

1. Subject code: **EP- 410** Course title: **Robotic Engineering**
2. Contact Hours : L:3 T:1 P:0
3. Examination Duration (Hrs) : Theory: 3 Practical: 0
4. Relative Weight : CWS:25, PRS:--, MTE:25, ETE:50, PRE:--
5. Credits : 4
6. Semester : VIII

7. Subject area : DEC-7

8. Pre-requisite : Basic knowledge of Automation

9. Objective : The course provides basic understanding of the Automation and Robotics

10. Detail of Course :

S. No.	Contents	Contact Hours
1.	Robotic manipulation – Automation and Robots – Robot Classification – Applications – Robot Specifications – Notation. Direct Kinematics: The ARM Equation – Dot and Cross products – Coordinate frames – Rotations – Homogeneous coordinates – Link coordinates – The arm equation – A five-axis articulated robot (Rhino XR-3) – A four-axis SCARA Robot (Adept One) – A six-axis articulated Robot (Intelledex 660). Inverse Kinematics: Solving the arm equation – The inverse kinematics problem – General properties of solutions – Tool configuration – Inverse kinematics of a five-axis articulated robot (Rhino XR-3) – Inverse kinematics of a four-axis SCARA robot (Adept one) - Inverse kinematics of a six-axis articulated robot (Intelledex 660) - Inverse kinematics of a three-axis articulated robot – A robotic work cell.	14
2.	Workspace analysis and trajectory planning: Workspace analysis – Work envelop of a five-axis articulated robot – Work envelope of a four-axis SCARA robot – Workspace fixtures – The pick-and-place operation – Continuous-path motion – Interpolated motion – Straight-line motion. Differential motion and statics: The tool-configuration Jacobian matrix – Joint-space singularities – Generalized Inverses – Resolved-Motion rate control:n<=6 – Rate control of redundant robots:n>6 – rate control using {1}-inverses – The manipulator Jacobian – Induced joint torques and forces. Manipulator Dynamics: Lagrange's equation – Kinetic and Potential energy – Generalized force – Lagrange -Euler dynamic model – Dynamic model of a two-axis planar articulated robot - Dynamic model of a three-axis SCARA robot – Direct and Inverse dynamics – Recursive Newton-Euler formulation – Dyamic model of a one-axis robot.	14

3.	Robot control: The control problem – State equation – Constant solutions – Linear feedback systems - Single-axis PID control – PD-Gravity control – Computed-Torque control – Variable-Structure control – Impedance control, Robot vision – Image representation – Template matching – Polyhedral objects – Shape analysis – Segmentation – Iterative processing – Perspective Transformations – Structured illumination –Camera calibration. Task planning: Task-level programming – Uncertainty – Configuration space – Gross-Motion planning – Grasp planning – Fine-Motion planning – Simulation of planar motion – A task-planning problem	14
Total		**42**

11. Suggested Books

S. No.	Name of Books/ Authors	Year of publication/ Reprint
1.	Robert J.Schilling, Fundamentals of Robotics – Analysis & Control (Chapters 1 to 9 – UNIT I, II, III, V) Prentice Hall of India Pvt. Ltd.	2002
2.	Saeed B.Niku, Introduction to Robotics – Analysis, Systems, Applications (Chapters 6 & 7 – UNIT IV) /Prentice Hall of India Pvt. Ltd.	2003

1. Subject Code: **EP-412** Course Title:**Nuclear Materials for Engineering Applications**
2. Contact Hours : L : 3 T : 1 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 : 4
6. Semester : VIII
7. Subject Area : DEC-7
8. Pre-requisite : Fundamentals of Nuclear Physics

9. Objective : To impart the knowledge on Nuclear materials, Mechanical properties, Dislocations and radiation effects.

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Overview of Nuclear Systems- Various types [LWR, PHWR, GCR, FBR, Fusion], Materials – Selection, Nature of Materials, Crystal Structure, Imperfections, Diffusion in Solids, Radiation Damage, Binary Elastic Collisions, Displacements due to PKA.	13
2.	Properties of Materials, Mechanical Properties, Fracture, Fatigue and Creep, SCC (& corrosion), Dislocation Theory, Types, Stress Fields and Strain Energy, Forces on Dislocations, Dislocation Interactions, Dislocation Sources and Pile-ups, Hardening: Dislocation, Precipitation, Grain-boundary, Solution, Strain.	15
3.	Radiation Effects, Microstructural Changes, Friction and Source Hardening, Fracture and DBTT, Embrittlement and Fracture, Reactor Materials, LWR Core Materials Radiation Growth – Zircaloys, Void Swelling (Stainless Steels), Radiation Induced vs Radiation Enhanced Creep, Pressure Boundary Materials, Fusion Materials	14
Total		**42**

11. Suggested Books

S.No.	Name of Books/ Authors	Year of Publication/ Reprint
1.	Fundamental Aspects of Nuclear Reactor Elements by D.R. Olander NTIS, ERDA	1975
2.	Introduction to Dislocations by D.Hull and D.J. Bacon Pergamon Press	1965
3.	Nuclear Reactor Materials by C.O. Smith/Addison-Wesley	1967
4.	Materials Science and Engineering by W.D. Callister/Wiley	1991

5.	Fundamentals of Radiation Materials Science by G.S. Was/ Springer	2007

1. Subject Code: **EP-414** Course Title:**Space and Atmospheric Science-II**
2. Contact Hours : L : 3 T : 1 P : 0
3. Examination Duration (Hrs.) : Theory : 3 Practical : 0
4. Relative Weight : CWS : 25 PRS : MTE : 25 ETE : 50 PRE : 0
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC-7
8. Pre-requisite : Basic knowledge of Space and Atmosphere-I
9. Objective : To impart the fundamental knowledge pertaining to space and atmosphere. Measurement of meteorological parameters using various techniques.Global warming its consequences.The electric Structure of thunderstroms precipitation and related topics will be discussed.
10. Details of Course :

S.No.	Contents	Contact Hours
1.	**Radar Principles and Meteorology:** Introduction to RADAR, types of Radars- Mono-static, pulsed radar, FM-CW radar; Basic principles of pulsed (Wind Profiler) radar- Antenna Basics-radar signal processing; Types of Radar Scattering theory-Wind vector calculations; Wind Profiler Applications-Aviation, Tropical Cyclone, Thunderstorm, Meteorological (Synoptic and Mesoscale) and Environmental.	10

2.	**Air pollution and its measurement techniques:** Primary gaseous pollutants (CO_2, CH4, CO and Nox)-sources and their effects on climate/human health. Secondary gaseous pollutants (Ozone and PAN)-Formation and their effect on human health. Gaseous pollutants measurement techniques-principles, block diagrams and working. Description of aerosols, sources of aerosols, aerosol production mechanisims, effects of aerosols on climate and human health. Measurement techniques-Direct measurements by sampling and remote sensing measurements by Multi wavelength solar radiometer and Lidar.	12
3.	**Atmospheric aerosols:** Continental and Marine (Origin, Physical and Chemical characteristics), Cloud Morphology, Warm Cloud Microphysics (Nucleation and Condensation), Growth of cloud droplets by collision and coalescence, Cold Cloud Microphysics (Nucleation and growth of ice), Ice in the atmosphere.	10
4.	The electrical structure of thunderstorms, Cloud electrification mechanisms, Physics of lightning, lightning and nitrogen fixation. Atmospheric electricity in fair weather (Ions and Atmospheric conductivity, Space charges), Electric field, Air-Earth currents, Precipitation currents and Point discharge currents. Global Electric Circuit (Classical concept, validity and limitations).	10
Total		**42**

11. Suggested Books

S.No.	Name of Books/ Authors	Year of Publication / Reprint
1.	Radar observations of atmosphere by L.J.Battan, Univ. Chicago Press,	1973
2.	Radio Meteorology by B.R.Bean and E.J.Dutton, U.S.Govt. Press	1980
3.	An Introduction to dynamics Meteorology by James R. Hotton, Wiley	1985
4.	A first course in Atmospheric Thermodynamics by Petty G.W. Cambridge University Press	1985

1. Subject Code: **EP-416** Course Title: **Plasma Science and Technology-II**

2. Contact Hours : L : 3 T : 1 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 : 4

6. Semester : VIII

7. Subject Area : DEC-8

8. Pre-requisite : EP-425 course in Plasma Science and Technology-I

9. Objective : * The course objective is to provide the students with Detailed knowledge about plasmas physics with main emphasis on plasma sources,

   * plasma diagnostics and applications for materials (thin film deposition, ion implantation and industrial use)

   * nano particle synthesis (as a tool for the tailoring of surfaces of materials to be used in advanced medical diagnostic and health care products)

10. Details of Course :

S. No.	Contents	Contact Hours
1.	**Plasma processing of materials** Synthesis of carbon nanotubes (CNTs) and Graphenes using plasma enhanced CVD and microwave plasma enhanced CVD, growth mechanism, surface plasmonics (sensors and devices)	8
2.	**Complex Plasmas** Dusty and strongly coupled plasmas, dust and colloidal crystals, phase transitions, Applications of dusty plasma crystals in environmental sciences, Kinetic theory of dusty plasmas. Plasma Electronics (Field Emission properties): CNTs and Graphenes, SWNT-FET, Mechanical Applications: NEMS and MEMS	10

3.	**Plasma Medicines and Bio-medical Applications** Non-thermal plasma sterilization of different surfaces: mechanisms of plasma sterilization, effects of atmospheric-pressure air plasma on bacteria and cells: direct versus indirect treatment, surface versus in-depth treatment, non-thermal plasma sterilization of air streams: kinetics of plasma inactivation of biological micro-organisms, plasma cleaning and sterilization of water: special discharges in liquid water applied for its cleaning and non-thermal plasma treatment of skin diseases, role of plasma in cancer treatment.	8
4.	**Applications to RF heating and current drive** Tokamak operation, electron cyclotron heating, ion-cyclotron heating, lower hybrid heating, lower hybrid heating and current drive, neutral beam heating.	8
5.	**Technical Applications** Plasma etching, plasma cutting and deposition in the microelectronics industry, ion implantation, electrostatic dust collectors, plasma waste treatment, plasma spray deposition, plasma rocket propulsion, plasma-chemical ozone production.	8
Total		**42**

11. Suggested Books

S.No.	Name of Books/ Authors	Yearof Publication/ Reprint
1.	Plasma Chemistry by Alexander Fridman Cambridge University Press	2008
2.	Kinetics of Complex plasmas by M.S. Sodha Springer 2014	2014
3.	Introduction to dusty plasma physics by P.K. Shukla and A A Mamun /IOP publishing Ltd.	2002
4.	Plasma Physics and Engineering by A. Fried and L.A. Kennedy Taylor and Francis Group	2011

1. Subject Code: **EP-418** Course Title: **Digital Signal Processing**

2. Contact Hours : L : 3 T : 1 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 : 4

6. Semester : VIII

7. Subject Area : DEC-8

8. Pre-requisite : Fundamentals of Nuclear Physics

9. Objective : To impart the knowledge on signal processing and DFT.

10. Details of Course :

S. No.	Contents	Contact Hours
1.	Introduction Limitations of analog signal processing, Advantage digital signal processing, discrete time characterization of signals & systems some elementary discrete time sequences and systems, concepts of stability, causality, linearity time invariance and memory, linear time invariant systems, and their properties, linear constant coefficient difference equations. Frequency domain representation of discrete time signal and systems complex exponentials as eigen function of LTI systems, Fourier transform of sequences.	8
2.	Processing of continuous time signals Discrete time processing of continuous time signals and vice – versa; decimation &interpolation ; changing the sampling rate by integer and non integer factors using discrete time processing .	8
3.	Discrete fourier transform DFT and its properties ; linear, periodic and circular convolution , linear filtering methods based on DFT, filtering of long data sequences; fast Fourier transform algorithm using using decimation in time and decimation in frequency techniques ; linear filtering approaches to computation of DFT.	8
4.	Transform analysis of LTI systems Frequency response of LTI systems, system function for system characterized by linear constant coefficient difference equations. Relationship between magnitude and phase; all pass systems, minimum phase systems. Structure for discrete time systems Signal flow graph representation, transposed forms, lattice structures	6

5	Design of digital filters Linear phase FIR filters; FIR differentiator and Hilbert transforms, FIR filter design by impulse invariance, bilinear transformation; Matched Z – transformation ; frequency transformation in the analog and digital domain.	6
6	Finite precision effects Fixed point and floating point representations, effect of coefficient quantization, effect of round off noise in digital filters, limit cycles. Digital signal processors Architecture and various features of TMS/ADSP, series of digital signal processors.	6
Total		**42**

11. Suggested Books

S.No	Name of Books/Authors	Yearof Publication/ Reprint
1	Oppenhiem, A.V &Sachsfer R.W, Discrete Time Signal Processing	1989
2	Proakis, J.G &Manolakis, D.G, Digital Signal Processing	1992
3	Rabiner, L.R. and Gold B. , Theory and applications of DSP Prentice Hall (India)	1975
4	Oppenheim, Alan V. &Willsky, Alan S. , Signals and Systems Prentice Hall (India)	1997
5	Johnson, J.R. / “Introduction to Digital Signal Processing Prentice Hall (India)	1989

1. Subject code: **EP- 420** Course title: **Fuzzy Logic and Neural Network**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25, PRS:--, MTE: 25, ETE: 50, PRE: --
5. Credits : 4
6. Semester : VIII
7. Subject area : DEC-8

8. Pre-requisite : Basic knowledge of networking

9. Objective : This course will provide understanding of the Neural networks and its applications

10. Detail of Course :

S. No.	Contents	Contact Hours
1.	Evolution of neural networks; Artificial Neural Network: Basic model, Classification, Feed forward and Recurrent topologies, Activation functions; Learning algorithms: Supervised, Un-supervised and Reinforcement; Fundamentals of connectionist modeling: McCulloach – Pits model, Perceptron, Adaline, Madaline	08
2.	Topology of Multi-layer perceptron, Back propagation learning algorithm, limitations of Multi-layer perceptron. Radial Basis Function networks: Topology, learning algorithm; Kohenen's self-organising network: Topology, learning algorithm; Bidirectional associative memory Topology, learning algorithm, Applications	08
3.	Recurrent neural networks: Basic concepts, Dynamics, Architecture and training algorithms, Applications; Hopfield network: Topology, learning algorithm, Applications; Industrial and commercial applications of Neural networks: Semiconductor manufacturing processes, Communication, Process monitoring and optimal control, Robotics, Decision fusion and pattern recognition	07
4.	Classical and fuzzy sets: Introduction, Operations and Properties, Fuzzy Relations: Cardinality, Operations and Properties, Equivalence and tolerance relation, Value assignment: cosine amplitude and max-min method; Fuzzification: Membership value assignment- Inference, rank ordering, angular fuzzy sets, Defuzzification methods, Fuzzy measures, Fuzzy integrals, Fuzziness and fuzzy resolution; possibility theory and Fuzzy arithmetic; composition and inference; Considerations of fuzzy decision-making	12
5.	Basic structure and operation of Fuzzy logic control systems; Design methodology and stability analysis of fuzzy control systems; Applications of Fuzzy controllers. Applications of fuzzy theory	07
Total		**42**

11. Suggested Books

S. No.	Name of Books/ Authors	Year of publication/ Reprint
1.	Neural Networks in Computer Intelligence by Limin Fu,/McGraw Hill	2003
2.	Soft Computing and Intelligent Systems Design, Theory, Tools and Applications by Fakhreddine O. Karray and Clarence De Silva./ Pearson Education, India	2009
3.	Fuzzy Logic with Engineering Applications by Timothy J. Ross/ McGraw Hill	1995
4.	Artificial Neural Networks by .B.Yegnanarayana, PHI, India	2006

1. Subject code: **EP- 422** Course title: **Embedded Systems**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15, PRS:-25-, MTE: 20, ETE: 40, PRE: 0
5. Credits : 4
6. Semester : VIII
7. Subject area : DEC
8. Pre-requisite : Knowledge of Computer Architecture and Microprocessors
9. Objective : This course will provide understanding of the Neural networks and its applications

10. Detail of Course :

S.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	Year of Publication/ Reprint
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

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 ofThread.	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: 3hrs
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

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, processcapabilities, 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, processvariables, process performance and applications	10
4	Electro discharge machining (EDM): Introduction, Working principle, parametricanalysis, process variables, process characteristics, applications, hybrid processessuch as electro discharge grinding, diamond grinding, wire EDM, Electrodischargemicro grinding,	7
5	Laser beam machining- production of laser, working principle, types of laser, processcharacteristics 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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