



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
ELECTRONICS AND COMMUNICATION ENGINEERING
W.E.F 2015

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Scheme of Teaching and Examinations
B. Tech. (Electronics and Communication Engineering)
W.E.F. 2015



DELHI TECHNOLOGICAL UNIVERSITY
(Formerly Delhi College of Engineering)

CONTENTS

Delhi Technological University	EC-4
• Vision	EC-4
• Mission	EC-4
Department of Electronics and Communication Engineering	EC-5
• Vision	EC-5
• Mission	EC-5
Program Educational Objectives	EC-6
Scheme of Teaching and Examination	EC-7
List of Departmental Electives	EC-12
List of Open Electives	EC-14
Syllabus	EC-16
Syllabus of Core Courses	EC-40
Departmental Electives	EC-82
Syllabus of Departmental Electives of V Semester	EC-83
Syllabus of Departmental Electives of VI Semester	EC-100
Syllabus of Departmental Electives of VII Semester	EC-122
Syllabus of Departmental Electives of VIII Semester	EC-139
Syllabus of Open Electives	EC-169



Delhi Technological University

(Formerly Delhi College of Engineering)

Shahbad Daultapur, 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 ELECTRONICS & COMMUNICATION ENGINEERING

VISION

To foster education, innovation and research in the internationally-relevant and socially viable areas of electronic design and communication technologies

MISSION

1. Creation of comprehensive, intellectual and socially responsible world-class engineers with a scientific and design-oriented attitude to problem-solving.
2. Encouraging a 'networked academic and research atmosphere' by incubating the talents of the student community by their association with the various academic and research labs of repute.
3. Establishment of centres of excellence in the areas of electronics and communication technologies.
4. Conduction of training programmes for adaptation to the ever-evolving design problems and cutting edge technologies of the globally integrated world of tomorrow.

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

- PEO1:** Incultation of an ability to understand and apply the subject-specific knowledge to the practical problems in the areas of electronics and communication engineering.
- PEO2:** Encouragement of a team-led effort to investigate and provide ecologically sustainable, cost-effective solutions to the problems in the subject area.
- PEO3:** Enhancement of competence in engineering modeling and experimental capabilities to pursue research oriented higher education.
- PEO4:** Creation of all-round, well conversant, socially and ethically responsible individuals with excellent communication skills.

**DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
BACHELOR OF TECHNOLOGY (ELECTRONICS & COMMUNICATION ENGINEERING)**

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	Programing 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.	EE251	Electronic Instrumentation and Measurements	AEC	4	3	0	2	3	0	15	25	20	40	-
2.	EC201	Analog Electronics-I	DCC	4	3	0	2	3	0	15	25	20	40	-
3.	EC203	Digital Design-I	DCC	4	3	0	2	3	0	15	25	20	40	-
4.	EC205	Signals & Systems	DCC	4	3	0	2	3	0	15	25	20	40	-
5.	EC207	Engineering Analysis & Design (Network Analysis and Synthesis)	DCC	4	3	1	0	3	0	15	25	20	40	-
6.	HU201	Engineering Economics	HMC	3	3	0	0	3	0	25	-	25	50	-
		Total		23										

II Year:Even Semester

S.No.	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	EE262	Electromagnetics	AEC	4	3	1	0	3	0	25	-	25	50	-
2.	EC 202	Analog Electronics – II	DCC	4	3	0	2	3	0	15	25	20	40	-
3.	EC204	Digital Design – II	DCC	4	3	0	2	3	0	15	25	20	40	-
4.	EC206	Communication Systems	DCC	4	3	0	2	3	0	15	25	20	40	-
5.	EC208	Computer Architecture	DCC	4	3	0	2	3	0	15	25	20	40	-
6.	MG201	Fundamentals of Management	HMC	3	3	0	0	3	0	25	-	25	50	-
		Total		23										

III Year: Odd Semester

S.No.	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	EC301	Digital Communication	DCC	4	3	0	2	3	0	15	25	20	40	
2.	EC303	Linear Integrated Circuits	DCC	4	3	0	2	3	0	15	25	20	40	-
3.	ECxxx	Departmental Elective Course -1	DEC/ GEC	4	3	0/1	2/0	3	0	15/ 25	25/-	20/ 25	40/ 50	
4.	ECxxx	Departmental Elective Course-2	DEC/ GEC	4	3	0/1	2/0	3	0	15/ 25	25/-	20 /25	40/ 50	
5.	UExxx	Open Elective Course	OEC	3	3	0	0	3	0	25		25	50	-
6.	HU303	Professional Ethics & Human Values	HMC	2	2	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.	EC 302	VLSI Design	DCC	4	3	0	2	3	0	15	25	20	40	
2.	EC 304	Digital Signal Processing	DCC	4	3	0	2	3	0	15	25	20	40	-
3.	EC306	Embedded Systems	DCC	4	3	0	2	3	0	15	25	20	40	-
4.	ECxxx	Departmental Elective Course -3	DEC/ GEC	4	3	0/1	2/0	3	0	15/ 25	25/-	20/ 25	40/ 50	
5.	ECxxx	Departmental Elective Course- 4	DEC/ GEC	4	3	0/1	2/0	3	0	15/ 25	25/-	20/ 25	40/ 50	
6.	HU302	Technical Communication	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.	EC 401	B. Tech Project-I	DCC	4										
2.	EC403	Training Seminar	DCC	2										
3.	EC405	Microwave Engineering	DCC	4	3	0	2	3	0	15	25	20	40	-
4.	EC407	Optical Communication	DCC	4	3	0	2	3	0	15	25	20	40	-
5.	EC 4xx	Departmental Elective Course- 5	DEC/ GEC	4	3	0/1	2/0	3	0	15/25	25/-	20/25	40/50	
6.	EC 4xx	Departmental Elective Course- 6	DEC/ GEC	4	3	0/1	2/0	3	0	15/25	25/-	20/25	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.	EC402	B. Tech Project-II (Contd. From VII Sem.)	DCC	8										
2.	EC 404	Wireless Communication	DCC	4	3	0	2	4	-	15	25	20	40	-
3.	EC 406	Departmental Elective Course- 7	DEC/ GEC	4	3	0/1	2/0	3	0	15/25	25/-	20/25	40/50	-
4.	EC 4xx	Departmental Elective Course- 8	DEC/ GEC	4	3	0/1	2/0	3	0	15/25	25/-	20/25	40/50	
		Total		20										

List of Departmental Elective Courses

S.NO.	SUBJECT CODE	SUBJECTS	Elective No.
1.	EC- 305	Semiconductor Device Electronics	DEC -1, DEC-2
2.	EC – 307	Antenna Design	
3.	EC - 309	Bio – Medical Electronics & Instrumentation	
4.	EC - 311	Algorithms Design And Analysis	
5.	EC – 313	Microprocessors And Interfacing	
6.	EC – 315	Computer Communication Networks	
7.	EC - 317	Operating Systems	
8.	EC – 319	CMOS Analog Integrated Circuits	
9.	EC – 321	IC Technology	
10.	EC - 323	Control Systems	
11.	EC - 308	Analog Filter Design	DEC-3, DEC-4
12.	EC – 310	Testing And Diagnosis Of Digital System Design	
13.	EC – 312	Software Defined Radio And Cognitive Radio	
14.	EC - 314	RF Design	
15.	EC – 316	Wireless Sensor Networks	
16.	EC – 318	RF Circuits in CMOS Technology	
17.	EC – 320	Soft Computing	
18.	EC – 322	Green Sensors	
19.	EC - 324	Nano Electronics	
20.	EC – 326	Data Converters	
21.	EC – 328	Speech Recognition	
22.	EC – 330	Digital Image Processing	
23.	EC - 332	Information Theory and Coding	

24.	EC - 409	Computer Vision	DEC-5, DEC-6	
25.	EC –411	Bio – Medical Signal And Image Processing		
26.	EC – 413	Power Electronics		
27.	EC – 415	System On Chip Design		
28.	EC – 417	CAD For VLSI Design		
29.	EC – 419	Memory Design		
30.	EC – 421	Computer And Numerical Techniques In Electromagnetics		
31.	EC – 423	Internet and Web Technologies		
32.	EC – 425	Mixed Signal Design		
33.	EC – 427	Information Theory and Coding		
34.	EC – 408	Low Power VLSI Design		DCE-7, DEC-8
35.	EC – 410	Advanced Coding Theory		
36.	EC- 412	Machine Learning		
37.	EC- 414	EMC / EMI		
38.	EC- 416	Pattern Recognition		
39.	EC- 418	Estimation And Detection Theory		
40.	EC – 420	Cloud Computing		
41.	EC – 422	Robotics & Machine Vision		
42.	EC – 424	Fault Tolerant Computing		
43.	EC – 426	Distributed Computing		
44.	EC – 428	Neuroelectronics		
45.	EC – 430	Advanced Computer Architecture		
46.	EC – 432	Bio – Impedance Based Measurements		
47.	EC – 434	Fundamentals of MIMO		
48.	EC – 436	Advance Microwave & Antenna Design		
49.	EC- 438	Radar and Satellite Communication		

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 Electronics 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 assemblies – 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, Fraunhofer 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, Core-cladding 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, zener 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, Tellegen'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 Gabel, Tata McGraw-Hill Publishing Company; 5 th Edition.	2009
2	Electrical and Electronic Technology, Edward Hughes, Ian Mckenzie Smith, John Hiley, Pearson Education, 10 th edition.	2010
3	Linear Circuit Analysis: Time, Domain, Phasor and Laplace Transform Approaches Raymond A. De Carlo, Pen-Min Lin, Oxford University Press, 2 nd 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, 2 nd 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.	<p>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.</p>	06
2.	<p>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.</p>	09
3.	<p>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-spots of biodiversity; Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity.</p>	09
4.	<p>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.</p>	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. 9 th Edition ISBN : 978-81-265-3135-6	2011
2.	Advanced engineering mathematics: Jain/Iyenger; Narosa. 2 nd 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, Frobenius 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
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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. <i>3 Sections</i> (2014) or <i>Gestures: Poetry from SAARC Countries</i> Ed. K. Satchidanandan. Sahitya Akademi: New Delhi ISBN- 81-260-0019-8 Ursula K. Leguin. <i>The Telling</i> , Harcourt Inc. 2000 or <i>Animal Farm</i> by George Orwell (1945) ISBN: 9781502492791 or <i>Frankenstein</i> 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.	<i>Improve your Writing</i> by V.N.Arora and Lakshmi Chandra OUP: Delhi ISBN 13: 978-0-19-809608-5	1981, 2013 (Revised Edition)
2.	<i>Technical Communication: Principles and Practice</i> by Meenakshi Raman and Sangeeta Sharma OUP: Delhi. ISBN-13: 9780-19-806529-6	2011, Reprinted in 2014
3.	<i>English Phonetics and Phonology: A Practical Course.</i> By Peter Roach. Cambridge: Cambridge University Press. (Fourth Edition) ISBN: 978-0-521-14921-1	2009, 2014 (Reprinted)
4.	Vijay Seshadri. <i>3 Sections</i> , Harper Collins India Ltd.: India. ISBN: 9789351367734. or <i>Gestures: Poetry from SAARC Countries</i> Ed. K. Satchidanandan. Sahitya Akademi: New Delhi ISBN- 81-260-0019-8	2014 1996, Reprint 2007

5.	Ursula K. Leguin. <i>The Telling</i> , Harcourt Inc. 2000 or <i>Animal Farm</i> by George Orwell (1945) ISBN: 9781502492791 or <i>Frankenstein</i> by Mary Shelley (1818) Harper Collins India Ltd.: Noida ISBN: 9780007350964	2000 1945/ 2014 Reprint 1818/ Latest Reprint 2012
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11. Suggested Books :

Sl.No.	Name of Books, Authors, Publishers	Year of Publication / Reprint
1.	Maison, Margaret M. <i>Examine Your English</i> . Orient Blackswan: Delhi,	2009
2.	Sharma, Sangeeta & Binod Sharma. <i>Communication Skills for Engineers & Scientists</i> , PHI.	2012
3.	Swan, Michael, Catherine Walter. <i>Oxford English Grammar Course</i> . OUP: Delhi,	2011
4.	Kumar, E Suresh & P Sreehari <i>A Handbook for English Language Laboratories</i> , 2 nd Edition, Cambridge University Press, Foundation Books,	2014
5.	Dutt, P Kiranmai, Geetha Rajeevan & CLN Prakash <i>A Course in Communication Skills</i> . Cambridge University Press (Foundation Books).	2013
6.	Mitra, Barun K. <i>Personality Development and Soft Skills</i> .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, 13 th 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

4.	Sensors and Their Applications: Classification of sensors, sensor modeling and characteristics, different types of sensors, Potentiometer, LDR ,Photo cell ,Photo diode, Phototransistors, IR emitter/detector, Thermal detector ,Optical encoder ,Magnetic sensors, Hall Effect sensors, Piezoelectric crystal, Capacitive sensors, inductive sensors Ultrasonic sensors, Pyroelectric sensors, Tachometer ,Resolver, Strain gauge , Load Cell, Smart Sensors. Measurement of physical parameters like pressure, temperature , level, flow, thickness, acceleration, speed, displacement, humidity etc.	10
5.	Electronics Instruments: Digital storage Oscilloscope(DSO), Current and Voltage Probes, Function Generators, Spectrum analyzers.	4
6.	Digital Interfaces in Measurement Systems: IEEE-488 instrumentation bus(GPIB), GPIB bus structure and operation, Serial Data Communication links like RS-232 C and D interface, RS-422, RS-423, and RS 485 Interface ,Universal Serial bus(USB), data Transmission on fiber optic cables, virtual instruments..	4
TOTAL		42

11. Suggested Books :

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Introduction to Instrumentation and Measurements by R. B. Northrop, CRC, 2 nd Edition Prenticehall International	2005
2	Students Reference Manual For Electronic Instrumentation Laboratories by S. Wolf and R. F.M. Smith, PHI, 2nd Edition(ISBN: 0130421820)	2004
3.	Modern Electronic Instrumentation and Measurement Techniques , A. D. Helfrick and W. D. Cooper, PHI	1990
4.	Mechatronics , A. Smaili and F. Mrad Oxford University Press	2009

1. Subject Code: **EC 201** Course Title: **Analog Electronics – I**

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

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

4. Relative Weightage : CWS: 15 PRS: 25 MTE: 20 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : III
7. Subject Area : DCC
8. Pre-requisite : Nil
9. Objective : To introduce p-n junction theory, operation of the semiconductor devices and their use in basic electronic circuits.

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Review of semiconductor physics, p-n Junction diode: Physical operation, I-V characteristic and diode equation, Large-signal model, Concept of load line, p-n junction capacitances (depletion and diffusion), small signal (low and high frequency) model, Breakdown in p-n diodes, Zener diode.	8
2.	Diode Applications: Rectifier circuits, Zener diode based voltage regulators, limiting and clamping circuits, voltage multipliers, switching behaviour of p-n diode, SPICE model of p-n diode, an example of p-n diode data sheet.	6
3.	Bipolar Junction Transistor(BJT): Physical structure and modes of operation, BJT current components, The Ebers-Moll model, BJT characteristics, and large-signal equivalent circuit, BJT Biasing for Discrete-Circuit Design, BJT small-signal equivalent, Basic single-stage BJT amplifier configurations, BJT as a switch, SPICE BJT model and simulation examples.	10
4.	Metal oxide semiconductor Field Effect Transistors MOSFET: Physical structure and V-I characteristics of Enhancement/Depletion- type MOSFETs (n/p-channel), Biasing in MOS amplifier circuits, Small signal equivalent circuit of MOSFET, Basic configurations of single-stage MOS amplifier circuits, MOSFET as an analog switch, SPICE MOSFET models and simulation examples. The Junction Field Effect Transistor (JFET): Physical structure, drain and transfer characteristics, SPICE JFET model and simulation examples.	10

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Introduction to Number Systems and Codes : Switching properties of Diodes, BJT and FET, Logic gates, DTL, TTL, ECL, I ² L, CMOS Gates and their parameters and comparisons, Applications of switching transistors in bistable, monostable, astable and Schmitt trigger circuits.	8
2.	Boolean algebra, Switching Function, minimization of switching function: Karnaugh map method and Tabulation Method don't care terms and applications with respect to code converters and Digital Comparators, etc.	6
3.	Gated Flip Flops, Master Slave Flip Flop, Ripple and Parallel Counter, Up-Down Counter, Shift Registers and Ring Counter, designing the combinational circuits of the counters through Excitation Table.	6
4.	Introduction to the circuits for Arithmetic Unit: Serial and parallel Binary Adders, 2's compliment and principle of subtraction, Carry-Look Ahead Adder, and BCD adder: Principles of multiplication, division in ALU.	6
5.	Semiconductor memories: ROM, PROM, EPROM, EEPROM, Bipolar RAM, static and dynamic RAM. Encoder and Decoder, Demultiplexer, multiplexer, Designing combinational circuits with multiplexer, ROM ,PAL and PLA	8
6.	Analog-to-Digital conversion:., dual slope integration method and voltage to frequency conversion, principal of DVM. , counter type, successive approximation type, Flash ADC , D-A converter: weighted resistors type, R2R ladder type.	8
TOTAL		42

11. Suggested Books :

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Modern Digital Electronics by R. P. Jain (TMH)	2003
2.	Digital Principles and Application by Malvino & Leach (TMH).	2014
3.	Digital Electronics And Logic Design by M. Mano (PHI)	2008

3.	The Laplace Transform. The Region of Convergence for Laplace Transforms. The Inverse Laplace Transform. Geometric Evaluation of the Fourier Transform from the Pole-Zero Plot. Properties of the Laplace Transform. Some Laplace Transform Pairs. Analysis and Characterization of LTI Systems Using the Laplace Transform. System Function Algebra and Block Diagram Representations. The Unilateral Laplace Transform.	8
4.	Z-Transform: Basic principles of z-transform, z-transform definition, Relationship between z-transform and Fourier transform, Region of Convergence, Properties of ROC, Properties of z-transform, Poles and Zeros, Inverse z-transform using Contour integration, Residue Theorem, Power Series expansion and Partial fraction expansion.	8
5.	Sampling: Representation of continuous time signals by its sample – Types of sampling, sampling theorem, aliasing, decimation, interpolation. Reconstruction of a Signal from its samples. Mathematical Background: Representation of signals using ortho-normal basis functions. Power and Energy spectral density. Correlation functions. Hilbert Transform and its properties. Pre-envelope and Complex Envelope. Band pass signals and Band pass systems.	8
TOTAL		42

11. Suggested Books :

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Signals & Systems by Alan V. Oppenheim, Alan S. Willsky and S. Hamid Nawab, Pearson, Second Edition, Pearson Education, ISBN:81-7808-688-3	2013
2.	Signal & Systems by Simon Haykin and Barry Van Veen; Second Edition, John Wiley & Sons, ISBN : 0471- 16474-7	2003
3.	Linear systems and signals by B.P.Lathi, Oxford Publication	2004
4.	Fundamentals of Signal & Systems using the Web and MATLAB, By Kamen : Pearson	2007
5.	Fundamentals of Signals and Systems, Third Edition, Edward W Kamen& Bonnie's Heck, Prentice Hall.	2006

5. Credits : 3
6. Semester : III
7. Subject Area : HMC
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 ology 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

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Vector Analysis: Review of Coordinate systems and Transformations– Cartesian, Circular and Spherical coordinates and Transformations. Vector Calculus – Differential length, Area and Volume; Line, Surface and Volume Integrals; Del Operator, Gradient of a Scalar, Divergence of a vector and Divergence theorem, Curl of a vector and Stokes theorem.	4
2.	Electrostatics and Magneto statics : Electric field due to various distributed charge distributions, Gauss's law and its applications, Electric energy and Capacitance, Electric Boundary conditions; Poisson's and Laplace equations, Method of images. Biot Savart's law, Ampere's circuit law and its applications, Magnetic boundary conditions, Magnetic energy and Inductance.	10
3.	Maxwell's Equation: Continuity equation and Relaxation Time, Faraday's law, Displacement current, Maxwell equations in their general time varying forms, Special cases of Maxwell's equations for Good dielectrics, Good conductors and for Time-Harmonically varying Fields, Significance of loss tangent.	10
4.	Electromagnetic Wave Propagation: Electromagnetic Wave Equation in a general medium and its solution, Wave propagation in lossless and lossy dielectrics, Plane waves in free space, Plane waves in good conductors, Power and Poynting's vector, Reflection and refraction of plane waves at normal and oblique incidence.	10
5.	Transmission Lines: Transmission line parameters and equations; Input impedance, VSWR, and Power; Complex reflection coefficient, Short and Open Circuit Stubs, Smith Chart, Some applications of Transmission lines, Transients on transmission lines, Microstrip transmission lines.	4
6.	Waveguides: Rectangular waveguides, Field equations for Transverse Electric and Magnetic modes, Wave propagation in the guide and its propagational characteristics, Power transmission and attenuation, Waveguide current and mode excitation, Waveguide resonators. Application in Non Destructive Testing.	4
TOTAL		42

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Frequency Response: s-Domain analysis: Poles, Zeros, and Bode plots, the amplifier transfer function, Low-frequency/ high-frequency response of common-source/common emitter amplifiers, common-base/ common-gate amplifier, frequency-response of emitter and source follower.	8
2.	Frequency response of cascaded stages: Cascode configurations, the common-collector and common emitter cascade, frequency response of the differential amplifier. SPICE simulation example.	8
3.	Feedback: Properties of feedback amplifiers, basic feedback topologies, analysis and characteristics of various feedback amplifier circuits. Loop gain, stability problem, effect of feedback on the amplifier poles, stability study using bode plots, frequency compensation.	10
4.	Principles of oscillations, Barkhausen criterion, Frequency stability, Various types of oscillators: RC Phase shift, Wein bridge, Hartley, Colpitt, Crystal oscillators. Amplitude limiter circuits. Output stage and Power Amplifiers: Classification of output stages, class A, B and AB output stages, Biasing the class AB circuit, variations on the class AB configuration, Power BJTs, MOS power transistors, IC power amplifiers.	10
5.	Microelectronic Technology, Planar process, Fabrication: Bipolar Transistor, FET, CMOS; Monolithic diodes, Metal semiconductor contact, Integrated circuit resistors and capacitors, Integrated circuit packaging, Characteristics of integrated circuit components, Microelectronic circuit layout .	6
TOTAL		42

11. Suggested Books :

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Microelectronics circuits by Sedra and Smith; Oxford university press	1982

3.	Reduction of flow tables of completely and incompletely specified sequential machines, concept of secondary state assignment and realization of circuits of FSM,	6
4.	Decomposition of FSM & composite machine equivalence between Mealy and Moore model machine. Race and Hazard problems with asynchronous sequential machine stuck-at and bridging faults	8
5.	Introduction to design with the programmable modules: ROM, PAL, PLA, FPGA , ASIC	6
6.	Algorithmic state machine: ASM Chart, data and control subsystem and implementation of ASM. Introduction to ASM designing with microprogramming.	6
TOTAL		42

11. Suggested Books :

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	A Verilog HDL Primer by J. Bhaskar; BS Publication.	2001
2.	Switching And Finite Automata Theory by Z. Kohavi; TMH.	2009
3.	Verilog Digital Systems Design by Z. Navabi; Tata McGraw Hill.	2003
4.	Fundamental of Logic Design by Roth ; Cengage learning.	2013
5.	Advanced Digital design with Verilog HDL by Michael D Ciletti	2010
6.	Digital Logic State Machine Design” by D.J. Comer; Oxford University Press.	2012
7.	Contemporary Logic Design by R.H.Katz, G.Borriello; PHI.	2002
8.	Introduction To Digital Systems by M.Ercegovac, T. Lang and J.H.Morcno; Wiley Int.	2006
9.	Verilog HDL Palnitkar ; Pearson	2010

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Overview of Digital Fundamentals, Register Transfer and Micro operation: Register Transfer Language, Register Transfer, Bus and Memory Transfer, Arithmetic Micro operations, Logic Micro operations, Shift Micro operations, Design of ALU.	8
2.	Computer Organization and Design: Instruction Codes, Computer Registers, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, , Timing & Control, Instruction Cycle, Memory Reference Instructions, Input-Output and Interrupt related instruction cycle, Design of Hardwired and Microprogrammed Control Unit, Microprogramming .	8
3.	Input – Output Organization: Peripheral devices, Input – Output interface, Asynchronous Data Transfer, Modes of Data Transfer, Priority Interrupt, Direct Memory Access, Input – Output Processor.	4
4.	Memory: Memory hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware.	8
5.	Computer Arithmetic: Introduction, Addition and Subtraction, Multiplication Algorithms, Division Algorithms, Floating Point Arithmetic Operation, Decimal Arithmetic Unit, Decimal Arithmetic Operations. Hardware implementation of arithmetic algorithms.	8
6.	Introduction to RISC , Parallel Processing, Concept of Pipelining, Arithmetic Pipelining, Instruction Pipelining, Vector Processing, Array Processors.	6
TOTAL		42

11. Suggested Books :

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Computer System and Architecture by PHI, Mano M.	2006

10. Details of Course :

S.No.	Detail Contents	Contact Hours
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	Year of Publication/ Reprint
1.	Fundamental of Management, Stephen P. Robbins, David A. De Cenzo and Mary Coulter, Pearson Education,(ISBN:9780273755869)	2011
2.	Financial Accounting, 4 ed, S.N. Maheshwari and S.K. Maheshwari, Vikas Publication,(ISBN: 8125918523)	2005
3.	Management, James A F Stonner, Pearson Education, (ISBN: 9788131707043)	2010

2.	Baseband Shaping for Data Transmission: Discrete PAM Signals, Power Spectra of Discrete PAM Signals, Pulse Shaping, Inter Symbol Interference, Nyquist Criterion for Zero ISI & for Distortion-less Baseband Binary Transmission, Correlative Coding, Signaling with Duo-Binary Pulses, Eye Diagram, Equalization, Adaptive Equalization for Data Transmission, Scrambling and Descrambling.	06
3.	Signal space concepts: Analogy between Signals and Vectors, Geometric Structure of the Signal Space, L2 Space, Distance, Norm and Inner Product, Decomposition of a Signal and Signal Components, Complex Signal Space and Orthogonality, Orthogonal Signal Set, Base-Band Pulse Data Transmission, Gram-Schmidt Orthogonalization Procedure.	06
4.	Detection and Estimation: Review of Gaussian Random Process, Detection of Known Signals in Noise, Optimum Threshold Detection, Optimum Receiver for AWGN Channel, Matched Filter and Correlation Receivers, Decision Procedure: Maximum A- Posteriori Probability Detector- Maximum Likelihood Detector, Probability of Error, Bit Error Rate, Wiener Filter for Waveform Estimation, Linear Prediction.	06
5.	Digital modulation schemes: Coherent Binary Schemes: ASK, FSK, PSK, MSK, GMSK. Coherent M-ary Schemes, Non-Coherent Schemes, Calculation of Average Probability of Error for Different Modulation Schemes, Power Spectra of Digitally Modulated Signals, Performance Comparison of Different Digital Modulation Schemes. DQPSK, QPSK, OQPSK, $\pi/4$ QPSK, 8-PSK, 16 QAM, 64 QAM. Trellis Coded Modulation, A discussion on various Modulation Schemes used in various standards such as GSM, IS-95, IS-56, CDMA. A review on adaptive Modulation Schemes for Transmission of Voice and Data over Fading Channel.	10
6.	Spread Spectrum Modulation: Pseudo-Noise Sequences, Direct Sequence Spread Spectrum [DSSS], Resistance to Jamming, Signal-Space Dimensionality, Processing Gain, Frequency-Hop Spread Spectrum, Acquisition and Synchronization, Applications.	4
TOTAL		42

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Operational Amplifier: The ideal Op Amp, Building blocks of analog ICs: current mirrors and repeaters, current and voltage sources, differential amplifiers, input stages, active load, gain stages, output stages, level shifters, non ideal parameters, Monolithic IC operational amplifiers, specifications, slew rate and methods of improving slew rate.	10
2.	Linear applications of IC op-amps: Inverting and non-inverting amplifier configurations, integrators, differentiators, summers, effect of infinite GBP, stability consideration, active and passive compensation of op-amp. Non-Linear applications of IC op-amps: Log/ antilog modules, Precision Rectifier, Op-amp as comparator, Schmitt Trigger, Square and Triangular wave generator, mono stable and astable multivibrators.	10
3.	Analog filter design : Basics second order functions, op-amp RC and active filter design, immittance converters and inverters, generalized impedance converter, inductance simulation, Sinusoidal oscillators, amplitude stabilization and control. Operational Transconductance Amplifier (OTA), Basic building blocks using OTA, Application examples	10
4.	Analog Multiplier and its applications: Gilbert multiplier cell 2-quadrant and 4-quadrant operations, IC analog multiplier AD534, modulation, demodulation and frequency changing, voltage-controlled filters and oscillators.	6
5.	IC timer and phase locked loop: the IC 555 timer, operational modes, time delay, asable and monostable operations , voltage-controlled oscillators, IC PLL: basic PLL principle, three modes of operation, PLL as AM detector, FM detector, frequency synthesis, FM demodulator, PLL motor speed control and voltage to frequency converter.	6
Total		42

10. Details of Course :

S.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 Ethics Engineering 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 :

S.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. Senthil kumar 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

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, Ratioed logic, 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	Year of Publication/ Reprint
1.	Digital integrated circuits a design perspective by Jan M Rabaey, Anantha Chadrakasan Borivoje Nikolic, Pearson education.	2011
2.	CMOS digital integrated circuits by Sung MO Kang Yusuf Leblebici, Tata McGraw Hill Publication	2002
3.	Principle of CMOS VLSI Design by Neil E Weste and Kamran Eshraghian, Pearson education.	2000

3.	Design of Digital Filters: FIR Filters : Design of FIR filters using windows, Design of FIR filters using frequency sampling method, Design of FIR differentiator. Design of IIR Filter: Impulse Invariance Method, Bilinear transformations, design examples: Butterworth low pass, Frequency transformations and Least square inverse method.	8
4.	Multirate Digital Signal Processing: Decimation, Interpolation, sampling rate conversion, polyphase representation, multistage implementation, 2 channel maximally decimated perfect reconstruction filter banks, 2 channel Paraunitary filter banks , Applications.	6
5.	Concept of finite word length in DSP, fixed and floating point numbers, representation of negative number, effect of truncation, finite word length effect in realization of IIR and FIR system. Fundamentals of adaptive filters and applications, system identification, adaptive channel equalization, echo cancelation in data transmission,	6
6.	Introduction to Digital Signal Processors: Fixed point and Floating point processors, architectures. TMS 320C54XX and TMS320C67XX Architecture, Memory, Addressing Modes, filter implementation on fixed and floating point processors.	6
TOTAL		42

11. Suggested Books :

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Digital Signal Processing/ Oppenheim and Schaffer/ PHI	2005
2	Digital signal Processing-Principles ,algorithms ,and applications , J G Proakis, DG Manolakis and D. Sharma, Pearson Education	4 TH Edition / 2004
3.	Digital Signal Processing, S.K. Mitra THM	Third Edition
4.	Digital Signal Processing Matlab Based Approach/ Ingle/ Cengage Learning.	1990
5.	Digital signal Processor: Architectures, Implementations and Applications/ Sen M. Kuo and Woon-Seng Gan/ Pearson Education	2005

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

1. Subject Code: **HU 302** Course Title: **Technical Communication**
2. Contact Hours : L: 2 T: 0 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory: 3 Practical: 0
4. Relative Weightage : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0

5. Credits : 2
6. Semester : VI
7. Subject Area : HMC
8. Pre-requisite : Nil
9. Objective Processes : To train students for business communication to enhance employability skills with special emphasis on placement interviews and public speaking.

10. Details of Course :

S. No.	Contents	Contact Hours
1.	English for Professional Purposes: 1. Technical Communication- Methods, Strategies and Skills 2. 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 (Continuous 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 :

S.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 Bannerji, Macmillan Publishers India Ltd. ISBN 13: 978=0230-63843-3	2009

1. Subject Code: **EC401**

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 Weightage

: 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: **EC403** Course Title: **Training Seminar**

2. Contact Hours : L: 0 T:0 P:0
3. Examination Duration (Hrs.) : Theory: 0 Practical: 0
4. Relative Weightage : 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: **EC 405** Course Title: **Microwave Engineering**

2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (ETE)(Hrs.) : Theory: 3 Practical: 0
4. Relative Weightage : CWS: 15 PRS: 25 MTE: 20 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VII

7. Subject Area : DCC
8. Pre-requisite : Nil
9. Objective : To introduce fundamentals of microwave components.

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Introduction, advantages and applications of Microwave Systems : Microwave sub-bands, Scattering matrix : Reflection and Transmission coefficients . Symmetry, reciprocity and power properties, zero property and unitary property.	10
2.	Microwave components : Waveguide couplings, bends and twists, Directional couplers, hybrid couplers, Matched load, Attenuators and phase shifters, E-plane, H-plane and Hybrid Tees, Hybrid ring, Waveguide discontinuities, Windows, Irises and Tuning screws, Detectors, wave meters; Isolators and Circulators, tunable detector, slotted line carriage.	10
3.	Microwave Tubes : Limitation, of conventional active devices at Microwave frequency. Velocity modulation, Principle of operation, performance characteristics and application of two cavity Klystron, Multi-cavity Klystron, Reflex Klystron, TWT, Magnetron. Slow wave structures and their applications.	10
4.	Microwave Semiconductor Devices : PIN diode, Tunnel diode, LSA diode, varactor diode, Parametric Amplifier, Gunn Devices, IMPATT and TRAPATT, their Principal of operation, characteristics and applications.	12
TOTAL		42

3.	Photo-detectors : PN, PIN, APD and RAPD photodetectors, detector responsivity, noise, optical receivers. Optical link design, BER calculation, quantum limit, Thermal noise limit, power penalties.	10
4.	Optical switches : Coupled mode analysis of directional couplers, electro-optic switches, Performance of Optical Receivers, SNR calculations.	6
5.	Non-linear effects in fiber links : Concept of self-phase modulation, group velocity dispersion and soliton based communication.	8
6.	Optical amplifiers and Networks : EDFA, Raman amplifier, and WDM systems. Hybrid optical amplifier, Optical amplifiers for next generation, WDM optical communication networks, SDH, SONET, Review of High-Speed Mode-Locked Quantum-Dot Lasers and Optical Amplifiers.	6
TOTAL		42

11. Suggested Books :

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Fibre Optic communication, 5th Edition, by Gerd Keiser; McGraw-Hill.	2013
2.	Optical communication systems by J.Gowar; Prentice Hall India,	1987
3.	Integrated optics, by T. Tamir, Springer-Verlag	1975
4.	Optical fibers for transmission, by J.E. Midwinter; John Wiley	1979
5.	Optical fibres telecommunications, by S.E. Miller and A.G. Chynoweth, Academic Press	1979
6.	Nonlinear fibre optics by G.Agrawal, Academic Press, 2nd Ed.	1994
7.	Fiber optic Communication Systems, by G. Agrawal; John Wiley and sons, New York	1992
8.	Fiber Optics Handbook for engineers and scientists, by F.C. Allard; McGraw Hill, New York	1990

10. Details of Course :

S. No.	Contents	Contact Hours
1.	History of Wireless Communication, Introduction to Mobile Communication Systems, Generation of Wireless Networks, Evolution of Wireless Systems, Introduction to Spectrum Allocation for various Wireless services: Methods for Spectrum Allocation, Spectrum Allocations for existing systems, Current Wireless Systems: Cellular Telephone Systems, Cordless Phones, WLAN, Wide Area Wireless Data Services, Broadband Wireless Access, Paging Systems, Satellite Networks, Low Cost-Low Powered Radios: Bluetooth and Zigbee.	6
2.	Cellular Mobile Telephone Architecture Overview. Cellular System Fundamentals: Cellular System Components, Operation of Cellular Systems, Channel Assignment, Frequency Assignments, Frequency Reuse Channels, Handover in Cellular Systems, Handoff Algorithms, Cellular Interferences, Antennas for Cellular Systems, Concept of Cell Splitting, Sectorization, Mobile Traffic Calculation, Dynamic Resource Allocation: Scheduling, Dynamic Channel Assignment, Power Control, Orthogonal Systems [TDMA/FDMA], Non-orthogonal Systems [CDMA].	8
3.	Cellular Systems: Narrowband Cellular Systems: GSM, Wideband Cellular Systems: CDMA, OFDM- Pulse Shaping, Windowing, Spectral Efficiency, Synchronization, Amplitude Limitation, Hybrid OFDM. Practical Cellular mobile systems—AMPS, D-AMPS, GSM system architecture overview, CDMA: IS-95 & IS-136. Call Management and System Operation. CDMA Based Cellular System.	6
4.	Radio Wave Propagation, Transmit and Receive Signal Models, Free Space Path Loss, Shadow Fading, Combined Path Loss and Shadowing, Cell Coverage Area. Capacity of Wireless Channels: Capacity in AWGN, Resources of AWGN Channels, Capacity of Flat Fading Channels, Capacity of Frequency- Selective Fading Channels. Multiuser Systems, Multiuser Channels: The Uplink and Downlink, Multiple Access: FDMA, TDMA, CDMA, SDMA, Random Access:-Pure Aloha, Slotted Aloha, CSMA.	6

5.	Multi Carrier Modulation: Data Transmission using Multiple Carriers, OFDM, Challenges in Multicarrier Systems, MC-CDMA. Ad Hoc Wireless Networks: Data Networks, Home Networks, Device Networks, Sensor Networks. Point to Point Communication: Time Diversity, Antenna Diversity, Frequency Diversity, Impact of Channel Uncertainty. MIMO: Narrow Band MIMO Model, MIMO Channel Capacity, MIMO Diversity Gain, Frequency –Selective MIMO Channels, Smart Antennas, MIMO Multiuser Systems.	8
6.	Broadcast Networks: Introduction to Broadcast Systems, DAB, HD Radio Technology, DVB, DTH. Cellular Networks:- Introduction to cellular networks, GSM System, GPRS, EDGE Technology, CDMA- Based Digital Cellular Standards, WLL, UMTS/WCDMA-HSUPA & HSDPA, DECT, CorDECT. Convergence in Networks:- 3G and beyond, LTE, IoT, Wi-Fi Standards, Wi-MAX, UWB, PCS-Wireless Personal Communication Systems, Personal Mobile Satellite Communication Systems.	8
Total		42

11. Suggested Books :

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Mobile Cellular Telecommunications Systems by WCY Lee; McGraw Hill International Editions	1990
2.	Mobile Communications Design Fundamentals by WCY Lee; Prentice Hall	1993
3.	CDMA: Principles of Spread Spectrum Communications by AJ Viterbi, Addison Wesley, New York	1995
4.	Wireless and personal Communication Systems by VK Garg and JE Wilkes; Prentice Hall	1996
5.	Mobile Radio Communications by Raymond Steele; IEEE Press, New York,	1992
6.	Wireless Communication Principle and Practices by Rappaport, Pearson.	2002
7.	Wireless Communication and Networking By Vijay K. Garg, Elsevier	2008

DEPARTMENTAL ELECTIVES

5.	Bipolar Junction Transistors: BJT Fabrication, BJT Operation, Minority Carrier Distributions, Terminal Currents, Biasing, Amplification with BJT, Switching, Frequency Limitation of Transistors, Hetero-Junction BJT .	8
TOTAL		42

11. Suggested Books :

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Solid State Electronic Devices by Streetman B.G. & Banerjee, Sanjay , Prentice Hall (India) / 5 th Ed	2006
2.	Physics of Semiconductor Devices by Sze, S.M. ,Wiley Eastern Limited	2007
3.	Microwave Semiconductor Devices and Their Circuit Applications by Watson, H.A. ,Tata McGraw-Hill.	1969
4.	Electronic Devices & Circuits by Bell David A. /Prentice Hall (India).	2009
5.	Electronic Devices & Applications by Nair, B. Somanathan Prentice Hall (India)	2004
6.	Microwave Semiconductor Devices by Roy, Sitiesh Kumar & Mitra, Monojit ,Prentice Hall (India)	2003
7.	Electronic Devices & Circuits by Salivahanan, S. & Kumar, Suresh N. & Vallavraj , Tata McGraw-Hill.	2008
8.	Semiconductor Physics & Devices by Neamen, Donald A, Tata McGraw-Hill..	2002
9.	Semiconductor Devices Modeling & Technology by Das Gupta, N. , Prentice Hall (India)	2000
10.	Device Electronics for IC by Muller, Richard & Kamins, Theodone L ,John Wiley.	1983
11.	Advance Theory of Semiconductor Devices by Karl, Hess ,Prentice Hall (India)	2000

10. Details of Course :

S. No.	Contents	Contact Hours
1.	Principles of biomedical instrumentation and techniques, Interfacing problems of biomedical, electronic equipments with living systems. ECG, EEG, EMG instruments for measuring bio signals.	06
2.	Biomedical transducers. Bio-magnetic measurement and imaging. Cardiac output measurement techniques. Diagnostic and therapeutic instruments, Prosthetic devices such as pacemaker, hearing aid and myoelectric arm.	08
3.	Functional electrical stimulation and algorithms for extremity control. Biotelemetry of biological signals, biosensors. Neonatal monitoring. Special aspects such as safety of medical electronic equipment.	06
4.	Introduction to analog and digital computer simulation in biological sciences. Simulation of normal and pathological states. Pattern identification and tissue and cell typing. Automated examination and interpretation of X-ray films of lungs and hearts. Assembly of three-dimensional images.	10
5.	Artificial intelligence, Robotics and expert systems in biomedical electronics and medicines. Overview of Patient Monitoring Systems, Arrhythmia and Ambulatory Monitoring Instruments, Patient Safety, Digital Radiography, Nuclear Medical Imaging Systems, Magnetic Resonance Imaging System, Ultrasonic Imaging Systems, Thermal Imaging Systems, Pacemakers and Defibrillators, Automated Drug Delivery Systems.	12
Total		42

11. Suggested Books :

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1	Biomedical Instrumentation: Technology and Applications by R. S. Khandpur. Tata McGraw Hill Publishers.	2003

5. Credits : 4
6. Semester : V
7. Subject Area : DEC
8. Pre-requisite : Basics of Digital Electronics
9. Objective : To introduce basic and pipeline architecture of microprocessors and assembly language programming. It also focuses on interfacing different peripherals like USART, Priority Interrupt Controller, Programmable Timers, Memory etc.

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Introduction to microprocessor, history of computers, timing and control, memory devices-semiconductor memory organization, category of memory, 8-bit microprocessor (8085): Architecture, Instruction set, Addressing mode, assembly language programming	4
2.	16-bit microprocessor (8086): architecture, physical address, segmentation, memory organization, bus cycle, addressing modes, assembly language programming of 8086.	12
3.	Data transfer scheme: introduction, types of transmission, 8257(DMA), 8255(PPI), serial data transfer (USART 8251), programmable priority controller (8259).	8
4.	Programmable interval timer/ counter (8253/8254): introduction , modes, interfacing of 8253, application. ADC/DAC: introduction DAC methods, ADC converters, Types of ADC, ADC IC (0808/0809) , DAC and ADC interfacing and applications.	6
5.	Alphanumeric displays, LCD, Graphic Displays, high power Devices. Communication Bus protocols: RS 232,RS 485,SPI, Inter integrated circuits interfacing I2C standard.	4
6.	Introduction to 80186/80286, Advance microprocessor: introduction to 32-bit and 64-bit microprocessor, power PC.	8
TOTAL		42

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Introduction to computer networks : Layered architecture- OSI reference model, TCP/IP architecture, circuit switching networks, Data link layer-ARQ protocols, framing, point –to-point protocol, HDLC data link control	6
2.	Medium Access Control – ALOHA. Slotted ALOHA, CSMA, CSMA-CD, polling, token passing ring, reservation, channelization. LANs- Ethernet, token ring, LAN Bridges & Ethernet switches.	6
3.	Network Layer: ARP and RARP, Routing algorithms and protocols, Congestion control algorithm, Router Operation, Internet Routing Protocols, IPv6 (an overview). Transport Layer: UDP, TCP (Flow Control, Error Control, Connection Establishment)	10
4.	Session layer & Application layer: DNS, SNMP, Electronic Mail, WWW, ISDN, Frame Relay, ATM	6
5.	Network Security: Firewalls (Application and packet filtering), Cryptographic algorithms –DES, AES, RSA	8
6.	Introduction to Adhoc Networks : Routing Protocols- AODV, DSR, Advances in computer communication. Introduction to wireless sensor networks, An analysis of coverage prediction of sensor networks in various fading environments such as Rayleigh, Rician and Nakagami-m. A survey on coverage and connectivity, a discussion on the application of wireless sensor networks.	6
TOTAL		42

11. Suggested Books :

S.No.	Name of Books / Authors/ Publishers	Year of publication/ Reprint
1.	Computer Communication Networks” by W. Stallings; PHI	1999
2.	Communication Networks: Fundamental Concepts and Architectures” by Alberto Leon Garcia, Indra Widjaja; TMH	2007
3.	TCP/IP Protocol Suite”, 2nd Ed., by B. A. Forouzan; TMH.	2004

7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To lay good foundation on the design and analysis of CMOS analog ICs. To study large signal model of MOS transistor and second order effects. Designing of analog sub circuits, two op-amp circuits, voltage reference circuits and ADCs, DACs.

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Large Signal Model of MOS Transistor: I-V Characteristics, Early Effect, Channel Length Modulation, Back Gate Effect and other Second-Order Effects. Passive Components: Properties of Resistors and Capacitors and Matching Considerations .	5
2.	Analog Sub-circuits: Basic MOS Amplifiers, Differential Pairs, Current Sources, MOS Switches, and Basic Sample/Hold Circuit .	9
3.	Basic Two-Stage Op-Amp Design: NMOS and CMOS architectures, DC Design, Frequency Compensation, Slew Rate, Power Supply Rejection, Offset Voltage calculation and Noise considerations .	10
4.	Voltage References: Basic Design and Evaluation of Band Gap Reference, and CMOS Band Gap References . MOS Voltage Comparators: Various Configurations and Offset Cancellation Techniques .	8
5.	Digital-to-Analog and analog to digital converters Current scaling DAC, Voltage scaling DAC charge scaling DAC, Extending resolution of parallel DAC, similar scaled DACs High speed ADCs, parallel or flash ADCs, interpolating ADCs, folding ADCs, Multibit pipeline ADCs, delta sigma modular, Decimators filters.	10
TOTAL		42

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Crystal Growth, Wafer Preparation: Introduction & Historical Perspective, Clean room concept – Growth of single crystal Si, surface contamination, Chemical Mechanical Polishing, wafer preparation, DI water, RCA and Chemical Cleaning. Processing considerations: Chemical cleaning, getting the thermal Stress factors etc.	6
2.	Epitaxy and Oxidation: Vapor Phase Epitaxy - Molecular Beam Epitaxy - Silicon on Insulators – Epitaxial Evaluation – Growth Mechanism and Kinetics – Thin Oxides – Oxidation Techniques and Systems – Oxide Properties.	6
3.	Lithography and Relative Plasma Etching: Optical Lithography – Electron Lithography – X-Ray Lithography - Ion Lithography Plasma - Properties – Feature Size - Control and Anisotropic Etch Mechanism – Relative Plasma Etching Techniques and Equipment.	9
4.	Deposition , Diffusion, Ion Implantation And Metallization: Deposition Processes – Polysilicon – Plasma Assisted Deposition – Models of Diffusion in Solids – Fick's One Dimensional Diffusion Equation – Atomic Diffusion Mechanism – Measurement Techniques – Range Theory – Implantation Equipment. Annealing Shallow Junction – High Energy Implantation – Physical Vapor Deposition – Patterning.	9
5.	VLSI Process Integration, Analytical, Assembly Techniques And Packaging of VLSI Devices: NMOS IC Technology – CMOS IC Technology – MOS Memory IC Technology – Bipolar IC Technology – IC Fabrication. Analytical Beams – Beams Specimen Interaction – Chemical Methods – Package Types baking Design Considerations – VLSI Assembly Technology – Package Fabrication Technology.	12
TOTAL		42

2.	Control Systems and Components DC and AC Servomotors, Synchro Error Detector, Tacho Generator and, Stepper Motors etc.	6
3.	Time Response Analysis: Standard Test Signals, Time Response of First-order Systems, Time Response of Second-Order Systems, Steady-State Error and Error Constants, Effect of Adding a Pole/ Zero to a System, P, PI and PID Control Action and Their Effect, Design Specifications of Second-Order Systems and Performance Indices. 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, MATLAB: Analysis and Design of Control Systems	10
4.	Frequency Response Analysis: Correlation Between Time and Frequency Response, Polar Plots, Nyquist plots Bode Plots. Stability in Frequency Domain: Mathematical Preliminaries, Nyquist Stability Criterion, Calculation of Gain Margin and Phase Margin in Nyquist Plot and Bode Plot, Assessment of Relative Stability Using Nyquist Criterion and Closed-Loop Frequency Response	6
5.	Compensator and Controller Design: Design of Lag, Lead, Lead Lag, Feedback compensator The Design Problem, Preliminary Considerations of Classical Design, Realization of Basic Compensators, Cascade Compensation in Time Domain Cascade Compensation in Frequency Domain, Tuning of PID Controllers. MATLAB based Frequency domain analysis of control system	8
6.	Control Systems Analysis in State Space: State-Space Representations of Transfer-Function Systems, Solving the Time-Invariant State Equation, Controllability, Observability, Pole Placement, Design of Servo Systems, State Observers, Design of Regulator Systems with Observers, Design of Control Systems with Observers, Quadratic Optimal Regulator Systems, Robust Control Systems.	6
TOTAL		42

6. Semester : VI
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To introduce fundamentals Testing and Diagnosis of Digital Systems

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Faults in digital circuits: Fault modelling, fault detection, redundancy, equivalence, fault location, fault dominance. Stuck at faults, bridging faults, stuck open faults, Transient faults, Permanent faults.	8
2.	Testing of Combinational circuits: Test generation for combinational logic circuits: Path sensitization, Boolean difference method etc CAD scheme for combinational digital circuits: D- algorithm, PODEM, FAN algorithm	6
3.	Testing of sequential circuits: State identification experiments, checking experiments and machine identification. Fault tolerance techniques for sequential circuits, Easily Testable Design and Diagnosis of Sequential Machine	7
4.	Self-checking and fail safe logic: Checking circuits & self-checking, Totally self-checking: m/n code self-checkers and equality self-checkers. Self-checking in PLAs. Self-stabilizing fault tolerant circuits Fail safe design.	8
5.	Design for testability: controllability and observability. Random test generation, transition count testing, signature analysis, syndrome testable design, RMC, Level sensitive scans design. BIST: LSSD on-chip self-test, BILBO, BIDCO.	7
6.	Fault detection in RAM and Microprocessor.	6
TOTAL		42

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Introduction to Cognitive Radio : Hardware and software architectures of cognitive radio, Smart Antennas used in Cognitive Radio; Spectrum Management; Opportunities in Spectrum Access, Policy Challenges for Cognitive Radios.	6
2.	Technologies in Cognitive Radio : Radio Flexibility and Capability, Comparison of Radio Capabilities and Properties, Available Technologies for Cognitive Radios Radio Frequency Translation for Software Defined Radio Receiver Design Considerations, Transmitter Design Considerations, Candidate Architectures for SDR.	6
3.	Spectrum awareness, sensing and identification : Primary Signal Detection, From Detecting Primary Signals to Detecting Spectrum Opportunities, Fundamental Trade-offs: Performance versus Constraint, Fundamental Trade-offs: Sensing Accuracy versus Sensing Spectrum Access and sharing Unlicensed Spectrum Sharing, Licensed Spectrum Sharing, Secondary Spectrum Access, Non-Real-Time SSA, Real-Time SSA.	9
4.	Transmission Techniques : Wireless Transmission for Dynamic Spectrum Access, Non-contiguous Orthogonal Frequency Division Multiplexing, NC-OFDM-Based Cognitive Radio: Challenges and Solutions, Overhead Interference Avoidance Problem, Spectral Footprint Minimization, Spectrum Usage Reporting, Potential Interference Analysis, Link Rendezvous, Distributed Sensing and Operation Channel Awareness and Multiple Signals in Space.	9
5.	Reconfiguration, adaptation, and optimization : Adaptation Engine Operating Parameters, Parameter Relationships, Cognitive Adaptation Engines Cognitive radio network architectures : Overview of Architectures Topology-Aware CRN Architectures Publish-Subscribe CRN Architecture Introduction to User cooperative communications Relay Channels User Cooperation in Wireless Networks Multi hop Relay Channel Cross-layer optimization for multi-hop cognitive radio networks Mathematical Models at Multiple Layers A Case Study: The Throughput Maximization Problem Numerical Results for the Throughput Maximization.	12
TOTAL		42

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Introduction: Importance of radiofrequency design, RF/microwave versus DC or low AC component: High frequency resistors, capacitors and inductors. Impedance signals, Dimensions and units, frequency spectrum. RF behaviour of passive transformers, RF impedance matching. Graphical representation (Smith Chart): Impedance transformation for general load, Standing wave ratio, Special transformation conditions. (ZY Chart)Admittance Transformations: Parametric admittance equation, Additional graphical displays. Parallel and series Connections of R, L, C.	8
2.	RF Filter Design: Filter types and parameters, Low pass filter, High pass filter, Bandpass and Band stop filter, Insertion Loss. Special Filter Realizations: Butterworth type filter, Chebyshev type filters, Demoralization of standard low pass design. Filter Implementation: Unit Elements, Kuroda's Identities and Examples of Microstrip Filter Design. Coupled Filters: Odd and Even Mode Excitation, Bandpass Filter Design, Cascading bandpass filter elements, Design examples.	10
3.	Single and multiport networks: Basic Definitions, Interconnecting Networks. Scattering Parameters: Scattering Parameters: Definition, Meaning, Chain Scattering Matrix, and Conversion between S- and Z-parameters, Signal Flow Chart Modelling. Stability and Gain Considerations - Transducer Power Gain, Additional Power Relations-Stability Considerations: Stability Circles, Unconditional Stability, and Stabilization Methods-Unilateral and Bilateral Design for Constant Gain- Noise Figure Circles- Constant VSWR Circles.	10
4.	Amplifiers design and Oscillators Design: single stage transistor amplifier design, Design for specified gain, broadband transistor amplifier design, One port negative resistance oscillators, Design procedure of Transistor Oscillators, dielectric resonator oscillator.	8
5.	RF/Microwave frequency conversion: Mixers Types, SSB versus DSB mixers, conversion loss, Noise figure.	6
TOTAL		42

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Adhoc Networks: Introduction. Routing protocols: proactive and reactive methods, backbone and position based, and power efficient routing.	10
2.	Sensor Networks: Introduction and applications. Design issues and architecture.	08
3.	Sensor deployment: Issues and challenges, Self organization, Localization.	08
4.	Data Fusion: Tree construction algorithms and analysis, Asymptotic capacity, - Lifetime optimization formulations.	08
5.	Routing protocols: data centric, hierarchical, location based, energy efficient routing etc.	4
6.	Querying, data collection and processing.	4
TOTAL		42

11. Suggested Books :

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Handbook of Algorithms for Wireless Networking and Mobile Computing by Azzedine Boukerche , Chapman & Hall/CRC.	2006
2	Handbook of Sensor Networks: Compact Wireless and Wired sensing systems by Mohammad Ilyas and Imad Mahgoub , CRC Press.	2005
3.	Wireless Sensor Network Designs by Anna Hac, John Wiley & Sons Ltd.	2003
4.	Wireless Sensor Networks: A systems perspective by Nirupama Bulusu and Sanjay Jha ,Artech House.	2005
5.	Wireless Sensor Networks : Architecture and Protocols by Jr., Edgar H. Callaway; Auerbach .	2003

8. Pre-requisite : Nil
9. Objective : To introduce fundamentals of passive and active filter design for signal processing
10. Details of Course :

S.No.	Contents	Contact Hours
1.	Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing. Artificial Intelligence : Introduction, Various types of production systems, characteristics of production systems, breadth first search, depth first search techniques, other Search Techniques like hill Climbing, Best first Search, A* algorithm, AO* Algorithms and various types of control strategies. Knowledge representation issues, Propositional and predicate logic, monotonic and non- monotonic reasoning, forward Reasoning, backward reasoning	12
2.	Neural Network : Structure and Function of a single neuron: Biological neuron, artificial neuron, definition of ANN, Taxonomy of neural net, Difference between ANN and human brain, characteristics and applications of ANN, single layer network, Perceptron training algorithm.	10
3.	Fuzzy Logic: Fuzzy set theory, Fuzzy set versus crisp set, Crisp relation & fuzzy relations ,Fuzzy systems: crisp logic, fuzzy logic, introduction & features of membership functions, Fuzzy rule base system : fuzzy propositions, formation, decomposition & aggregation of fuzzy rules, fuzzy reasoning, fuzzy inference systems, fuzzy decision making & Applications of fuzzy logic.	10
4.	Genetic algorithm : Fundamentals, basic concepts, working principle, encoding, fitness function, reproduction, Genetic modeling: Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator, Generational Cycle, Convergence of GA, Applications & advances in GA, Differences & similarities between GA & other traditional method.	10
TOTAL		42

6. Semester : VI
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To learn and understand basic and advance concepts of Nano Electronics.

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Introduction to Nano electronics, Shrink Down Approaches, CMOS Scaling, the Nanoscale MOSFET, FINFETs, Vertical MOSFETs, Strained Silicon Technology, Limits to Scaling, System Integration Limits (Interconnect Issues, etc.)	6
2.	Resonant Tunneling Diodes, Resonant Tunneling Transistors, MOBILEs (Monostable-Bistable Transition Logic Elements), Single Electron Transistors, New Storage Devices, SRAM, DRAM, MRAM (Magneto-resistive RAM), PCRAM (Phase change RAM), AFM based Mass Storage (the Millipede Concept), Optoelectronic and Spintronic Devices.	6
3.	Molecular Electronics (involving single molecules as electronic devices), Transport in Molecular Structures, Molecular Systems as Alternatives to Conventional Electronics, Molecular Interconnects. MEMS, FBARs (Film Bulk Acoustic Resonators), Cantilevers.	9
4.	Carbon Nanotube Electronics: Band structure & Transport, Devices (CNTFETs, CNT Logic Gates, CNT RTL Circuits, CNT SET, CNT RAM, CNT Field Emission Devices), Carbon Nano tube Interconnects, CNT Heat Sink, Applications. Graphene Based Electronics: Band structure & Transport, Devices (GNR FETs), Applications. Nanowire FETs, Nanowire Logic Gates.	9

5.	Nanosensors: Biological and Chemical; Electronic Sensor Arrays, CMOS 3-D Time-of -Flight Image Sensor, Nano-biomimetic Technologies: Electronic Skin, Electronic Eye, Electronic Nose (KAMINA), Electronic Tongue; Touchscreens, Robot Tactile Sensors, Fingerprint Sensors, Liquid Crystal Displays, Organic Electronic Devices: Organic Light Emitting Diodes, Organic Solar Cells, Organic Thin Film Transistors; Field Emission & Plasma Displays, Electronic Paper. Neuro-electronic Systems: Iono-electronic Interface, Neuron-Silicon Circuits, Brain-Silicon chips, Neuro-electronic Processors, Neuro-prosthetics, Electrical Dynamics of the Neuron-Chip Interface on a Nanoscopic Level, Hybrid Systems made of Neuronal Nets and Electronic Devices on a Microscopic Level, Ionoelectronic Devices, Nerve-based Ionic Processors.	12
TOTAL		42

11. Suggested Books :

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Nano electronics and Information Technology (Advanced Electronic Materials and Novel Devices) by Rainer Waser, Wiley-VCH	2012
2.	Nanoelectronics (Principles and Devices, Second Edition) by Mircea Dragoman (Artech House).	2006
3.	Silicon Nanoelectronics by Shunri Oda and David K. Ferry, Taylor & Francis	2002
4.	Molecular Nano electronics by Mark A. Reed and Takhee Lee, American Scientific Publishers	2003
5.	Nanoscale Transistors (Device Physics, Modeling & Simulation) by Mark S. Lundstrom and Jing Guo, Springer	2000
6.	Fundamentals of Nano electronics by George W. Hanson (Pearson), Research Papers	2010

1. Subject Code: **EC326**

Course Title: **Data Convertors**

2. Contact Hours

: L: 3 T: 0/1 P: 2/0

5. Credits : 4
6. Semester : VI
7. Subject Area : DEC
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 :

S.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

6. Semester : VI
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To introduce advanced concept of Information Theory and Coding

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Information Theory: Introduction, 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. Source Coding: Encoding of the source output, Shannon's encoding algorithm. Communication Channels, Discrete communication channels, Continuous channels.	12
2.	Fundamental Limits on Performance: Source coding theorem, Huffman coding, Discrete memory less Channels, Mutual information, Channel Capacity. Channel coding theorem, Differential entropy and mutual information for continuous ensembles, Channel capacity Theorem	8
3.	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	8
4.	Binary Cycle Codes, Algebraic structures of cyclic codes, Encoding using an (n-k) bit shift register, Syndrome calculation. BCH codes.	6
5.	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	8
TOTAL		42

10. Details of Course :

S.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/Disadvantages of each .	8
TOTAL		42

10. Details of Course :

S.No.	Contents	Contact Hours
1.	<p>Different Types of Biomedical Signals: Biochemical signals, Bioelectric signals, Biomechanical signals ECG: Introduction, Characteristics, frequency sub-band and measuring methods. EEG: Introduction, Characteristics, frequency sub-band and measuring methods. Major modalities for medical imaging: ultrasound, X-ray, CT, MRI, fMRI, PET and SPECT. MRI: Introduction, Basic MR Physics, MR Techniques, Artefacts, Advanced Techniques, Instrumentation, MR Safety.</p>	8
2.	<p>Biomedical Signal Processing: Fundamental Characteristics of Biomedical Signals, Link Between Physiological Modeling and Biomedical Signal Processing, Paradigm of Maximum Signal-System Integration, Characteristic Aspects of Biomedical Signal Processing. Parametric Models for the Analysis of Interactions in Biomedical Signals: Open-Loop Identification, Closed-Loop Identification, Nonlinear Interactions and Synchronization. Interpretative Models in Biological Signal Processing: Mathematical Instruments for Signal Processing, Descriptive Methods, The Black-Box Models, Interpretative Models.</p>	8
3.	<p>Artifacts in Biomedical Signals: Random noise, Structured noise, Physiological interference, Signal dependent noise in biomedical signals, Poisson noise, Film grain noise, Speckle noise. Transformation of signal dependent noise to signal independent noise, Artifacts in ECG and EEG. Synchronized or Multi-frame Averaging, Space domain local statistics based filters and Order Statistic Filters, Frequency Domain Filters.</p>	6
4.	<p>ECG and EEG denoising using following methods/Techniques: Hilbert-Huang Transform, Cauchy distribution at sub band level, EMD, Parabolic Filter, Statistical Adaptive Thresholding, Morphological Filtering, Undecimated Wavelet Transform, Non-Local Means, signal-noise residue method, S-Transform.</p>	10

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Power Semiconductor Devices (PSD):Power Diodes, Enhancement of Reverse blocking capacity, Reverse Recovery Silicon Controlled Rectifier (SCR) Structure, v-I characteristics, turn ON and turn OFF characteristic, ratings, control circuits design and protection circuits. Gate turn off thyristor (GTO) v- characteristic, turn ON, turn OFF characteristic, limitation of power handling capability, GTO snubber consideration exc., Triac and its application, power MOSFETs, operation modes, switching characteristics, power BJT, second breakdown, saturation and quasi saturation state.	8
2.	Insulated Gate Bipolar Transistors (IGBT): Basis structure, V-I characteristics, switching characteristics, device limitations and safe operating area (SOA) etc. Introduction to emerging devices and circuits, MOS controlled thyristors, integrated Gate Commutated Thyristor (IGCT), Power Integrated Circuits (PIC's) and smart power control chips.	6
3.	Power Electronic Converters: Single phase and three phase uncontrolled and controlled AC to DC converters analysis, DC to AC converters (inverters) single phase half bridge, full bridge and switch mode inverters, three phase inverter with 120o and 180o mode of control, Series inverter and parallel inverters.	8
4.	Choppers principle, first quadrant, second quadrant and multi quadrant and multi quadrant choppers and their analysis. Switch mode converters AC to AC converters, cycloconverters topology and structure of matrix power electronics converters, converter protection and future converter applications.	6
5.	Pulse width Modulation for Power Electronics Converters: PWM methods, voltage control PWM, SPWM, selected harmonic elimination, minimum ripple current , current control PWM, Adaptive hysteresis band method, space vector method, performance criterion, open loop and closed loop PWM schemes etc.	6

6. Semester : VII
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To introduce basics of SOC design and modelling techniques with emphasis on architectural exploration.

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Introduction to the System Approach: System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory and Addressing. System level interconnection, An approach for SOC Design, System Architecture and Complexity.	7
2.	Processors: Introduction , Processor Selection for SOC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Basic elements in Instruction handling. Buffers: minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors.	9
3.	Memory Design for SOC: Overview of SOC external memory, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split – I, and D – Caches, Multilevel Caches, Virtual to real translation , SOC Memory System, Models of Simple Processor – memory interaction.	9
4.	Interconnect Customization and Configuration: Inter Connect Architectures, Bus: Basic Architectures, SOC Standard Buses , Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time, SOC Customization: An overview, Customizing Instruction Processor, Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance- Specific design, Customizable Soft Processor, Reconfiguration - overhead analysis and trade-off analysis on reconfigurable Parallelism.	9

VLSI (Very-Large-Scale Integration) design in silicon.

10. Details of Course :

S.No.	Contents	Contact Hours
1.	VLSI Physical Design Automation, VLSI Design Cycle, New Trends in VLSI Design Cycle, Physical Design Cycle, New Trends in Physical Design Cycle, Design Styles, System Packaging Styles.	7
2.	Partitioning – Problem formulation, Classification of Partitioning algorithms, Kernighan-Lin Algorithm, Simulated Annealing, Floor Planning – Problem formulation, Classification of floor planning algorithms, constraint based floor planning, Rectangular Dualization, Pin Assignment – Problem formulation, Classification of pin assignment algorithms, General and channel Pin assignments. Placement – Problem formulation, Classification of placement algorithms, Partitioning based placement algorithms.	10
3.	Global Routing – Problem formulation, Classification of global routing algorithms, Maze routing algorithms, Detailed Routing – Problem formulation, Classification of routing algorithms, Single layer routing algorithms.	8
4.	Physical Design Automation of FPGAs: FPGA Technologies, Physical Design cycle for FPGAs, Partitioning, Routing – Routing Algorithm for the Non-Segmented model, Routing Algorithms for the Segmented Model; Physical Design Automation of MCMs: Introduction to MCM Technologies, MCM Physical Design Cycle.	9
5.	Chip Input and Output Circuits: ESD Protection, Input Circuits, Output Circuits and noise, On-chip clock Generation and Distribution, Latch-up and its prevention.	8
TOTAL		42

10. Details of Course :

S.No.	Contents	Contact Hours
1.	SRAM technologies – MOS, SOI , SRAM Cell structures and architecture, peripheral circuit operation, SOI technology, Advanced SRAM architectures and technologies, Application specific SRAMs, DRAM – DRAM technology development, CMOS DRAM, cell theory and advanced cell structures, soft error failure in DRAM.	8
2.	Non-volatile Memories: Masked ROMs, High density ROM, PROM, CMOS PROMS, EPROM, Floating gate EPROM cell, One time programmable EPROM, EEPROM, EEPROM technology and architecture, Non-volatile SRAM, Flash Memories .	8
3.	RAM fault modelling, Electrical testing, Pseudo Random testing, Megabit DRAM Testing, non-volatile memory modelling and testing, IDDQ fault modelling and testing, Application specific memory testing, RAM fault modelling, BIST techniques for memory.	8
4.	General reliability issues, RAM failure modes and mechanism, Non-volatile memory reliability, reliability modelling and failure rate prediction, Design for Reliability, Reliability Test Structures, Reliability Screening and qualification, Radiation effects, Single Event Phenomenon (SEP).	9
5.	RAMs (FRAMs), GaAs FRAMs, Analog memories, magneto resistive RAMs (MRAMs), Experimental memory devices, Memory Hybrids and MCMs (2D), Memory Stacks and MCMs (3D), Memory MCM testing and reliability issues, Memory cards, High Density Memory Packaging Future Directions.	9
TOTAL		42

11. Suggested Books :

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Semiconductor Memories Technology by Ashok K. Sharma, Wiley.	2002
2.	Advanced Semiconductor Memories by Architecture, Design and Applications - Ashok K. Sharma- Wiley.	2002

3.	Variational Methods: Operators in Linear Spaces, Calculus of Variations, Construction of Functionals from PDEs, Rayleigh-Ritz Method, Weighted Residual Method: Collocation Method, Subdomain Method, Galerkin Method and Least Squares Method, Eigenvalue Problems, Practical Applications.	10
4.	Moment Methods :Classification of Integral Equations, Connection Between Differential and Integral Equations, Green's Functions:for Free Space and for Domain with Conducting Boundaries. Quasi-Static Problems, Scattering Problems, Radiation Problems, Hallen's Integral Equation, Pocklington's Integral Equation, Expansion and Weighting Functions, EM Absorption in the Human Body Derivation of Integral Equations, Transformation to Matrix Equation (Discretization), Evaluation of Matrix Elements, Solution of the Matrix Equation.	10
5.	Finite Element Method: Solution of Laplace's Equation: Finite Element Discretization, Element Governing Equations, Assembling of All Elements, Solving the Resulting Equations, Solution of Poisson's Equation, Solution of the Wave Equation, Automatic Mesh Generation using Rectangular Domains and Arbitrary Domains. Bandwidth Reduction, Higher Order Elements: Pascal Triangle, Local Coordinates, Shape Functions and Fundamental Matrices, Three-Dimensional Elements, Finite Element Methods for Exterior Problems using Infinite Element Method, Boundary Element Method and Absorbing Boundary Conditions.	4
6.	Transmission-line-matrix Method: Solution of Diffusion Equation, Solution of Wave Equations, Inhomogeneous and Lossy Media in TLM, Three-Dimensional TLM Mesh, Error Sources and Correction, Absorbing Boundary Conditions	4
TOTAL		42

11. Suggested Books :

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Numerical Techniques in Electromagnetics with MATLAB, Third Edition by Matthew N.O. Sadiku	2011

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Switched Capacitor Circuits: Introduction to Switched Capacitor circuits-basic building blocks, Operation and Analysis, Non-ideal effects in switched capacitor circuits, Switched capacitor integrators first order filters, Switch sharing, biquad filters.	11
2.	Phased Lock Loop (PLL):Basic PLL topology, Dynamics of simple PLL, Charge pump PLLs-Lock acquisition, Phase/Frequency detector and charge pump, Basic charge pump PLL, Non-ideal effects in PLLs-PFD/CP non-idealities, Jitter in PLLs, Delay locked loops, applications	10
3.	Data Converter Fundamentals: DC and dynamic specifications, Quantization noise, Nyquist rate D/A converters- Decoder based converters, Binary-Scaled converters, Thermometer-code converters, Hybrid converters	11
4.	Nyquist Rate A/D Converters: Successive approximation converters, Flash converter, Two-step A/D converters, Interpolating A/D converters, Folding A/D converters, Pipelined A/D converters, Time-interleaved converters.	10
TOTAL		42

11. Suggested Books :

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	CMOS Mixed Signal Circuit Design by J. Baker, Wiley Student Edition	2000
2.	CMOS Analog Circuit Design by Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/ Indian Edition,	2010
3.	Analog Integrated Circuit Design by David A. Johns, Ken Martin, Wiley Student Edition	2013
4.	CMOS Integrated Analog-to- Digital and Digital-to-Analog converters by Rudy Van De Plassche, Kluwer Academic Publishers	2003

3.	Low Power Techniques : Circuit level: Power consumption in circuits. Dynamic Power Optimization: multiple supply voltages, transistor sizing, Static power Optimization: Multiple thresholds transistor Flip Flops and Latches design, high capacitance nodes, low power digital cells library. Logic level: Gate reorganization, signal gating, logic encoding, state machine encoding, pre-computation logic.	9
4.	Low power Architecture and Systems Power & performance management, switching activity reduction, parallel architecture with voltage reduction, flow graph transformation, low power arithmetic components, low power memory design. Low power Clock Distribution: Power dissipation in clock distribution, single driver Vs distributed buffers, Zero skew Vs tolerable skew, chip & package co design of clock network.	9
5.	Design of low power arithmetic elements: addition, Multiplication, Division. Optimizing Power at Standby: Clock gating, power gating, body biasing, supply voltage ramping, Power reduction of memory in standby mode using voltage scaling and body biasing. Optimizing Power at Runtime: Dynamic voltage and frequency scaling, adaptive body biasing, Power domains and power management.	8
TOTAL		42

11. Suggested Books :

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Low Power Design Methodologies by J. M. Rabaey, M.Pedram, KAP	2006
2.	Practical Low Power Digital VLSI Design by Gary K. Yeap, KAP, 2002	2002
3.	Digital Integrated Circuits: A Design Perspective, Second Edition by J. M. Rabaey, A. P. Chandrakasan and B. Nikolic, PH/Pearson.	2000
4.	Low-Power CMOS VLSI Circuit Design by K. Roy and S. C.Prasad Wiley.	1996
5.	Low-Power CMOS Design,P. Chandrakasan and RW Broderon, IEEE Press.	2000

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Introduction to Machine Learning :Learning Associations; Classification, Regression, Annotation, Supervised Unsupervised, Semi supervised, learning Basic tools: Linear classification, regression, Feature maps, Trees, Instance based classifiers.	4
2.	Supervised Learning :Learning a Class from Examples like Optical character recognition Bioinformatics Computational advertising Self-driving cars Network security, Vapnik-Chervonenkis Dimension, Probably Approximately Correct Learning, Noise, Learning Multiple Classes, Regression, Model Selection and Generalization, Dimensions of a Supervised Machine Learning Algorithm.	10
3.	Decision Tree Learning: Univariate trees Objective functions & criteria for splitting Pruning rule extraction from trees Learning rules from data multivariate trees Fast implementations Acceleration by Chernoff bounds Data distribution.	10
4.	Linear Decision Functions & Perception Learning, Linear Discrimination: Generalizing the Linear Model, Geometry of the Linear Discriminant, Pairwise Separation, Parametric Discrimination, Gradient Descent Logistic Discrimination, Discrimination by Regression.	10
5.	Multi-Layer Perception Networks: Perceptron, Training a Perceptron Learning Boolean Functions Backpropagation Algorithm Convergence proof, Properties Training procedures, tuning the network size, Bayesian view of learning, dimensionality reduction, Learning time, deep learning, Kernel trick: Basic idea, Kernel Perceptron, Kernel expansion, Kernel examples.	4
6.	Reinforcement Learning ,Single State Case: K-Armed Bandit, Elements of Reinforcement Learning, Model-Based Learning Value Iteration Policy methods Policy evaluation Policy iteration Policy gradient Policy Iteration Temporal Difference Learning Exploration Strategies Deterministic Rewards and Actions Nondeterministic Rewards and Actions Eligibility Traces.	4
TOTAL		42

10. Details of Course :

S.No.	Contents	Contact Hours
1.	BASIC CONCEPTS: History and concepts of EMI, Definition of EMI and EMC with examples, Classification of EMI/EMC - CE, RE, CS, RS, Units of Parameters, Sources of EMI/EMC, EMI coupling modes - CM and DM, ESD Phenomena and effects, Transient phenomena and suppression, electromagnetic pulse (EMP), Radiation Hazards, frequency spectrum conservation, mechanisms of EMI generation, EMI testing, Methods of elimination and Biological effects of EMI	8
2.	EMI MEASUREMENTS: Basic principles of RE, CE, RS and CS measurements, EMI measuring instruments- Antennas, LISN, Feed through capacitor, current probe, EMC analyzer and detection technique open area site, shielded ferrite lined anechoic chamber, Tx/Rx Antennas, Sensore, Injectors/Couplers and coupling factors, TEM cell.	9
3.	EMC STANDARD AND REGULATIONS: National and International standardizing organizations- FCC, CISPR, ANSI, DOD, IEC, CENEEC, FCC CE and RE standards, CISPR, CE and RE Standards, IEC/EN, CS standards, Frequency assignment, spectrum conservation, EN emission and susceptibility standards and specifications	9
4.	EMICONTROLMETHODSAND FIXES : Shielding, Grounding, Bonding, Filtering, Filter installation and evaluation, Isolation transformer, opto isolator, Transient suppressors, EMI gasket	9
5.	MC DESIGN AND INTERCONNECTION TECHNIQUES :Cable routing and connection, signal control, Component selection and mounting, PCB design- Trace routing, Impedance control, decoupling, Zoning and grounding, VIAs connection, Terminations, Electromagnetic pulse-Noise from relays and switches, Power decoupling.	7
TOTAL		42

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Introduction to pattern recognition, machine perceptron, pattern recognition system, design cycle, learning and adaptation, applications of pattern recognition, pattern representations.	4
2.	Introduction to probability theory, conditional probabilities, random variables, binomial distribution, Poisson distribution, uniform distribution, normal distributions, joint distribution and densities, moment of random variables, bivariate distributions, multivariate normal distributions, Maximum likelihood estimate, unbiased estimate, minimum risk estimate.	8
3.	Bayesian decision theory; state of nature, prior probabilities, posterior probabilities, decision rule, likelihood, loss function, two-category classification, decision boundary, minimum error rate classification, discriminant function for normal density, conditionally independent features, Bayesian belief network, leave-one-out scheme, characteristic curve.	8
4.	Non-parametric decision techniques, kernel and window estimator, nearest Neighbor classification, nearest Neighbour error rate, K-nearest Neighbour techniques, convergence of nearest Neighbour, computational complexity of K-nearest Neighbour, Fisher linear discriminant, Multiple discriminant analysis.	8
5.	Introduction to Linear and Nonlinear Classifiers: linear discriminant functions and decision hyperplanes, perceptron algorithms, least square method, mean square error estimation, stochastic approximation, sum of error square estimation, mean square error regression, logistic discrimination, support vector machine separable class and non-separable class.	8
6.	Data transformation and dimensionality reduction, basis vector and images, The Karhunen-Love transform, the singular value decomposition, independent component analysis, non-negative matrix factorization, non-linear dimensional reduction techniques; KPCA, LLE, ISOMAP.	6
TOTAL		42

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Review of Gaussian variables and processes; problem formulation and objective of signal detection and signal parameter estimation in discrete-time domain Statistical Decision Theory: Bayesian, minimax, and Neyman-Pearson decision rules, likelihood ratio, receiver operating characteristics, composite hypothesis testing, locally optimum tests, detector comparison techniques, asymptotic relative efficiency.	10
2.	Detection of Deterministic Signals: Matched filter detector and its performance; generalized matched filter; detection of sinusoid with unknown amplitude, phase, frequency and arrival time, linear model.	6
3	Detection of Random Signals: Estimator-correlator, linear model, general Gaussian detection, detection of Gaussian random signal with unknown parameters, weak signal detection.	6
4	Nonparametric Detection: Detection in the absence of complete statistical description of observations, sign detector, Wilcoxon detector, detectors based on quantized observations, robustness of detectors.	6
5	Estimation of Signal Parameters: Minimum variance unbiased estimation, Fisher information matrix, Cramer-Rao bound, sufficient statistics, minimum statistics, complete statistics; linear models; best linear unbiased estimation; maximum likelihood estimation, invariance principle; estimation efficiency; Bayesian estimation: philosophy, nuisance parameters, risk functions, minimum mean square error estimation, maximum a posteriori estimation.	8
6	Signal Estimation in Discrete-Time: Linear Bayesian estimation, Weiner filtering, dynamical signal model, discrete Kalman filtering.	6
TOTAL		42

10. Details of Course :

S.No.	Contents	Contact Hours
1.	<p>Overview of Computing Paradigm, Recent trends in Computing: Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing, Evolution of Cloud Computing and it's vision, features.</p> <p>Clouds: Introduction, History, components, types, services, challenges, technologies, Current applications of Cloud Computing (Microsoft Azure, Google App Engine, Amazon Web services, Hadoop etc).</p> <p>Cloud Computing Architecture: Cloud computing stack, Reference Model (Services: IaaS, PaaS, SaaS), various cloud management platforms and tools, Deployment Models: Public cloud, Private cloud, Hybrid cloud, Community cloud.</p>	6
2.	<p>Virtualization of Clouds</p> <p>Virtualization: Introduction, Evolution, Virtualized Environment characteristics, Server Virtualization, VM Provisioning and Manageability, VM Migration Services, VM Provisioning in the Cloud Context, and Future Research Directions. Cloud Security Mechanisms (Encryption, PKI, SSO, IAM)</p>	8
3.	<p>Service Models:</p> <p>Infrastructure as a Service (IaaS):Introduction, definition, virtualization, Different approaches to virtualization, Hypervisors, Machine Image, Virtual Machine (VM), Resource Virtualization: Server, Storage, Network Virtual Machine (resource) provisioning and manageability, storage as a service, Data storage in cloud computing(storage as a service), Examples: Amazon EC2 Renting, EC2 Compute Unit, Platform and Storage, pricing, customers, Eucalyptus</p> <p>Platform as a Service(PaaS):Introduction, Service Oriented Architecture (SOA), Cloud platform and management, computation, storage, Examples: Google App Engine, Microsoft Azure, Salesforce.com</p> <p>Software as a Service (SaaS):Introduction, Web services, Web 2.0, Web OS and Case Study .</p>	12
4.	<p>Service Management in Cloud Computing: Service Level Agreements(SLAs), Billing & Accounting, Economics of scaling, Managing Data: Looking at Data, Scalability & Cloud Services, Database & Data Stores in Cloud, Large Scale Data Processing.</p>	6

8. Pre-requisite : Nil
9. Objective : To introduce fundamentals of robotics and machine vision and to learn about the perception, navigation and path planning for an autonomous mobile robot.

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Introduction to Robotics: Mathematical modelling of Robots, Different kinematic arrangement of manipulators, Rigid motion and homogeneous transformations: Rotational transformation, composition of rotations and Parameterization of rotation.	6
2.	Mobile Robot :,Kinematic Models and Constraints :Representing robot position ,Forward kinematic models, Wheel kinematic constraints , Robot kinematic constraints, Examples: robot kinematic models and constraints, Mobile Robot Maneuverability :Degree of mobility, Degree of steerability, Robot maneuverability, Mobile Robot Workspace : Degrees of freedom ,Holonomic robots ,Path and trajectory considerations, Beyond Basic Kinematics ,Motion Control (Kinematic Control): Open loop control (trajectory-following), Feedback control.	8
3.	Perception :Sensors for Mobile Robots :Sensor classification ,Characterizing sensor performance ,Wheel/motor sensors, Heading sensors ,Ground-based beacons, Active ranging, Motion/speed sensors, Vision-based sensors ,Representing Uncertainty : Statistical representation, Error propagation: combining uncertain measurements, Machine vision: edge, corner , line detection algorithms, filtering, feature extraction, object recognition and tracking algorithms Feature Extraction : Feature extraction based on range data (laser, ultrasonic, vision-based ranging) , Visual appearance based feature extraction .	11

4.	Mobile Robot Localization : The Challenge of Localization (Noise and Aliasing) : Sensor noise, Sensor aliasing ,Effector noise ,An error model for odometric position estimation, To Localize or Not to Localize: Localization-Based Navigation versus Programmed Solutions, Belief Representation :Single-hypothesis belief , Multiple-hypothesis belief, Map Representation :Continuous representations, Decomposition strategies, State of the art: current challenges in map representation, Probabilistic Map-Based Localization :Introduction, Markov localization, Kalman filter localization, Other Examples of Localization Systems : Landmark-based navigation ,Globally unique localization, Positioning beacon systems ,Route-based localization ,Autonomous Map Building ,The stochastic map technique	11
5.	Planning and Navigation :Introduction, Competences for Navigation (Planning and Reacting):Path planning, Obstacle avoidance ,Navigation Architectures : Modularity for code reuse and sharing, Control localization , Techniques for decomposition ,Case studies: tiered robot architectures.	6
TOTAL		34

11. Suggested Books :

S.No	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Robot Modeling and Control Mark W. Spong, Seth Hutchinson, and M. Vidyasagar JOHN WILEY & SONS, INC	2005
2.	Visual Perception and Robotic Manipulation 3D Object Recognition, Tracking and Hand-Eye Coordination Geoffrey Taylor Lindsay Kleeman	2009
3.	Introduction to Autonomous Mobile Robots by Roland Siegwart, MIT press	2011
4.	Robot Vision (MIT Electrical Engineering and Computer Science) MIT Press	1986
5.	Robotics, Vision and Control Peter Corke Springer	2011

5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To introduce fundamentals of Neuro Electronics
10. Details of Course :

S.No.	Contents	Contact Hours
1.	Introduction to Neuro electronics; neuron: architecture, resting membrane potential, action potentials, axon hillock, synapse, presynaptic cell, postsynaptic cell, synaptic cleft, communication between neurons, neuro-transmitters, synaptic potential, depolarization, hyperpolarization.	6
2.	Recording electrical signals from neurons: voltage-clamp technique, patch-clamp technique. EEG (Electroencephalography) Neuro electronic Interfacing: Iono-Electronic Interface, Neuron-Silicon Circuits, Brain-Silicon Chips. Electrical Dynamics of the Neuron-Chip Interface on a Nanoscopic Level. Interfacing neurons with carbon nanotubes: Electrical signal transfer and synaptic stimulation in cultured brain circuits. Nanowire Integrated Microelectrode Arrays for Neuro-electronic Applications	6
3.	Techniques for neuro electronic interfacing: thin-film technology, micro-electrode arrays (MEAs), Field-Effect-Transistor arrays (FETs), CMOS integrated systems, Nano technology and Bio-chemistry, EOSFET (Electrolyte Oxide Silicon Field Effect Transistor), EOS Capacitors(Electrolyte Oxide Silicon Capacitors).	9
4.	Elementary neuro electronic hybrids: Cellular neuro-prostheses, neuronal memory on chip. Neuronal networks on chip. Iono-electronic Devices, Neuro electronic Processors.	9
5.	Neuro-prosthetics: sensory prosthetics, motor prosthetics, cognitive prostheses. Artificial pacemakers, cochlear implants, deep brain stimulation, brain-computer interface, MRI, Image-Guided Surgery.	12
TOTAL		42

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Review of Basic Organization and Architectural Techniques, RISC processors, Characteristics of RISC processors, RISC Vs CISC, Classification of Instruction Set Architectures, Review of performance measurements, Basic parallel processing techniques: instruction level, thread level and process level, Classification of parallel architectures.	8
2.	Instruction Level Parallelism, Basic concepts of pipelining, Arithmetic pipelines, Instruction pipelines, Hazards in a pipeline: structural, data, and control hazards, Overview of hazard resolution techniques, Dynamic instruction scheduling, Branch prediction techniques, Instruction-level parallelism using software approaches, Superscalar techniques, Speculative execution, Review of modern. Pentium Processor: IA 32 and P6 micro architectures, ARM Processor.	10
3.	Memory Systems: Cache Memory, main memory design, and Virtual Memory I/O Systems: Design Issues, Performances Measures. Loosely Coupled & Tightly Coupled Systems, Concurrency & Synchronization, RAID .	4
4.	Peripheral Devices, Bus structures and standards, Synchronous and asynchronous buses, Types and uses of storage devices, Interfacing I/O to the rest of the system, Reliability and availability, I/O system design, Platform architecture.	8
5.	Thread Level Parallelism, Centralized vs. distributed shared memory, Interconnection topologies, Multiprocessor architecture, Symmetric multiprocessors, Cache coherence problem, Synchronization, Memory consistency, Multicore architecture, Review of modern multiprocessors.	8
6.	Process Level Parallelism, Distributed computers, Clusters, Grid, Mainframe computers, Multi-core Architecture .	4
TOTAL		42

10. Details of Course :

S. No.	Contents	Contact Hours
1.	Electrolytics: Ionic and electronic dc conduction, ionization molecular bonds, Bulk electrolytic dc conductance, interface phenomena, Electrodes and ac phenomena, Dielectrics: Polarization in uniform dielectric, basic membrane experiment, Dispersion and dielectric spectroscopy.	06
2.	Electrical properties of tissues, basic biomaterials, cells, tissue and organs, Special electrical properties, tissue, anisotropy, Tissue dc properties, Nerves and muscles excited, Piezo electric and triboelectric effect.	08
3.	Instrumentation and measurements: General network theory, The black box, admittance, Impedance, Immittance, Two port Network, Reciprocity Theorem, Extended Immittance concepts, Signal and measurements; dc static values and ac, periodic waveforms, Aperiodic waveforms, spectrum analysis, Fourier transforms, Signal generators, Operational Amplifiers and Filters, Neural Networks and Wavelets Analysis.	08
4.	Bridges, Impedance Analyzers, Lock in amplifiers, Digital Lock in amplifiers, Analogue lock in amplifiers, Current mode lock in amplifiers, Impedance analyzers and LCR meters.	06
5.	Applications, Electrodes, Design and Properties, ECG, Impedance plethysmography, EEG, ENG/ERG/EOG, Electrotherapy, Body Composition, Cardiac pacing, Defibrillation, Electroshock, Electro-surgery.	08
6.	Latest trends in bio-impedance measurements, validation & calibration of bio-impedance, challenges in measurement, analysis, validation of bio-impedance, Calibration of bio-impedance measuring instruments. Future scope of bio-impedance based non-invasive medical diagnostics.	06
Total		42

5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To introduce fundamentals of Advance Microwave and Antenna Design

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Transmission lines for Microwave Integrated Circuits: MIC transmission line structures, Monolithic microwave integrated circuits(MMCs),quasi TEM mode propagation, static TEM parameters(Z_0, ϵ_{eff}) Synthesis: the width to height ratio (w/h), formulae for accurate static TEM calculations, analysis formulae(w/h), examples of static TEM synthesis.	10
2.	Behaviour and design at microwave frequencies: effect of finite strip thickness, metallic enclosure, dispersion in microstrip, discontinuities in microstrip lines: Foreshortened open circuit, series gap microstrip short circuits, right angle bend or corner, matched microstrip bends, frequency dependence of discontinuities effects.	8
3.	Antennas: Review of Basic Fundamental Concepts of antenna and its parameters, Aperture antenna: Huygen's principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, design concepts.	8
4.	Microstrip Antennas: Basic characteristics of microstrip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas.	8
5.	Basic Concepts of Smart Antennas: Concept and benefits of smart antennas, fixed weight beam forming basics, Adaptive beam forming.	8
TOTAL		42

9. Objective : To introduce fundamentals of Radar and Satellite Communication

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Radar Introduction : Principle of detection and ranging, Radar frequencies and bands. Applications, Radar block diagram and operation, Radar Range Equation, Range prediction, Minimum detectable signal, Receiver noise, SNR, Integration of radar pulses, Radar cross section of targets, Transmitter Power, PRF and system losses & Propagation effects.	6
2.	CW FM Radar : Doppler effect, CW Radar, Frequency-modulated CW Radar, Multiple-frequency CW Radar. MTI and Pulse Doppler Radar, MTI delay lines, Delay line Cancelers, Coherent and Non-Coherent MTI, Pulse Doppler Radar.	6
3.	Satellite orbits : Solar day and sidereal day, orbital parameters, satellite trajectory, period, velocity and position of a satellite, geostationary satellites, non-geostationary constellations. Launching of geostationary satellites, Communication satellites, spacecraft subsystems, payload, repeater, antenna, attitude and control systems, tracking and command	10
4.	Earth stations : fixed and mobile satellite service earth stations. Communication link design - frequency bands used, antenna parameters - transmission equations - noise considerations - link design - very small aperture terminals (VSAT).	6
5.	Multiple access techniques : frequency division multiple access - time division multiple access - code division multiple access - access protocols for data traffic. Performance analysis and comparative analysis of FDMA, TDMA and CDMA.	6
TOTAL		42

11. Suggested Books :

S.No.	Name of Books / Authors/ Publishers
1.	Introduction to Radar Systems, by Merrill I. Skolnik; Tata McGraw-Hill (3rd Edition) 2003
2.	Satellite Communication, Dennis Roddy, McGraw Hill
3.	Radar Principles, by Peyton Z Peeble; John Wiley 2004
4.	Principles of Radar, by J C Toomay 2004
5.	Satellite Communication Systems, by Richharia M.; Macmillan Press
6.	Satellite Communication, by Gagliardi R.M.; CBS
7.	Digital Satellite Communication, by Ha T.T.; McGraw Hill

OPEN ELECTIVE COURSES

CO351 ENTERPRISE & JAVA PROGRAMMING

1. Subject Code: **CO351** Course Title: **Enterprise & Java programming**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective : To introduce fundamentals of Enterprise Java Programming, concepts of program development using beans.
10. Details of Course :

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

2.	<p>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.</p>	6
3.	<p>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</p>	6
4.	<p>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.</p>	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 EnterpriseBeans : 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 Persistence - 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.	Web Security: Security Issues on web, Importance of Firewall, 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, Forms of 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, Diffe-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 Jersey. 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 Schneier, "Applied Cryptography". 2015

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

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.	<p>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.</p> <p>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.</p>	7
2.	<p>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.</p>	7
3.	<p>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.</p>	6
4.	<p>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</p> <p>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.</p>	8

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 (Basic Architecture 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 in 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 Optimization of Mechatronic Systems: Optimization Methods, Principles of Optimization : Parametric Optimization, General Aspects of the Optimization Process, Types of Optimization Methods, Selection of a Suitable Optimization Method, Optimum Design of Induction Motor (IM), IM Design Introduction : Classical IM Design, Use of a Neuron Network for the Identification of the Parameters of a Mechanical dynamic system, Mechatronics and Computer Modeling and Simulation, Mechatronics and the Real-Time use of Computers, Communications and Computer Networks, Control with Embedded Computers and Programmable Logic Controllers	8
Total		42

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

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

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, MOS capacitances, Modeling of MOS transistors using SPICE, level I II and equations, capacitance models. The Wire: Interconnect parameters: capacitance, resistance and inductance. Electrical wire models: The ideal wire, the lumped model, 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. 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 of MOSFET, 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

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 and phasor 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

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, 5 th edition , 2003
3	Instrumentation, Measurement and Analysis, B.C. Nakra& K. Chaudhry, Tata McGraw Hill, 2 nd Edition, 2001.
4	Advanced Measurements and Instrumentation, A.K. Sawhney, DhanpatRai& Sons, 2010
5	Process Control Instrumentation Technology, Curtis D. Johnson, Pearson, 6 th edition, 1999
6	Programmable Logic Controllers, Frank D. Petruzella McGraw-Hill Higher Education, 4 th 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", 2 nd 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 geothermal 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, 2 nd edition, 2005.

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

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, Global 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.	<p>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</p>	10
2.	<p>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.</p>	10
3.	<p>Dielectric and Magnetic Materials <i>Dielectric Materials:</i> Dielectric polarization and dielectric constant, Various polarization processes, Applications of Dielectric Materials <i>Magnetic Materials:</i> Concept of Magnetism, Classification of dia-para, Ferro, Antiferro and Ferrimagnetism, ferrites, soft and hard magnetic materials, Applications of Magnetic Materials</p>	07
4.	<p>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.</p>	07
5.	<p>Advanced Engineering Materials: Introduction, Synthesis, characterization and applications of Photonic glasses, Phosphors and Nanophosphors, other selective topics in advanced materials.</p>	08
Total		42

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

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, Cengage 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 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, beneficiation 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 beneficiation, 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. 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 by Rogers, Pearson Education, ISBN- 631197036.
3	Thermodynamics by Kenneth Wark, Mcgraw-hill Book Company, 5 th edition, ISBN- 0070682860, 1988.
4.	Engineering Thermodynamics: work and heat transfer by Gordon Rogers and Yon Mayhew, Longman, 4 th edition, ISBN – 0471861731, 1992.
5.	Fundamentals of Classical Thermodynamics by Van Wylen and Sonntag, John Wiley & Sons Inc., 3 rd 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, 8 th edition, ISBN: 0073398179, 2014.
8.	Applied Thermodynamics for Engineering Technologists by T.D. Eastop, Prentice Hall, 5 th edition, ISBN- 05820919344, 1993.
9.	Treatise on Heat Engineering by V. P.Vasandani and D.S. Kumar, Metropolitan Book Co. (p) Ltd., ISBN- 810003500.

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.

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, 3 rd edition, Oxford and IBH publishing Co. Pvt. Ltd, New Delhi, ISBN- 8120406028, 2008.
3	Industrial Engineering and Management, Pravin Kumar, Pearson Education, 1 st edition, ISBN- 9789332543560, 2015.

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

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. Cletus CE Research Centre, Morgantown
3	Concurrent Engineering Fundamentals: Integrated Product Development Prasad Prentice hall India

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

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, 14 th ed., Philip Kotler , Kevin Lane Keller, Abraham Koshy and MithileswarJha, Pearson Education, New Delhi, 2013,(ISBN-10: 9788131767160)

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)

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

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

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	<p>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.</p>	6
3	<p>Value engineering:Introduction, nature and measurement of value. Value analysis, job plan. Creativity and techniques of creativity. Value analysis test. Case studies.</p> <p>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.</p>	6
4	<p>Concurrent/ reverse engineering: Introduction, basic principles, components, benefits of concurrent engineering. Concept of reengineering.</p> <p>Process selection: Introduction. Process classification: shaping, joining and finishing. Systematic process selection, Ranking, process cost. Computer – aided process selection.</p>	6
5	<p>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.</p>	8
6	<p>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.</p> <p>Simulation of Mechanical Systems: Building of Simulation models, Simulation oftranslational and rotational mechanical systems, Simulation of hydraulic systems.</p>	10
Total		42

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.

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

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, tertiary 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 Vanessa Goodship/ 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	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 Dekkar, 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", 3 rd 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 Jersey.	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, Pierre Baldi, Paolo Frasconi, 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

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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