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

ELECTRICAL ENGINEERING

W.E.F 2015

DEPARTMENT OF ELECTRICAL ENGINEERING

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

DELHI TECHNOLOGICAL UNIVERSITY

(Formerly Delhi College of Engineering)

CONTENTS

VISION

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

MISSION

1. To establish centres of excellence in emerging areas of science, engineering, technology, management and allied areas.
2. To foster an ecosystem for incubation, product development, transfer of technology and entrepreneurship.
3. To create environment of collaboration, experimentation, imagination and creativity.
4. To develop human potential with analytical abilities, ethics and integrity.
5. To provide environment friendly, reasonable and sustainable solutions for local & global needs.

DEPARTMENT OF ELECTRICAL ENGINEERING

VISION

To be a knowledge centre for Electrical Engineering fraternity committed to excellence in Research & Development and teaching at par with the best academic Institutions in country and abroad for the benefit of society.

MISSION

1. To impart quality Electrical Engineering education to foster enterprising spirit, skill development, broad vision and lifelong learning attitudes amongst students.
2. Keeping abreast with progressing technologies and innovations necessary for conducive academic environment and professional excellence.
3. To create state-of-the-art facilities for R&D work.
4. To create synergetic Industry-Institute interface.
5. Establishment of Incubation Center for Entrepreneurship development

Program Educational Objectives (PEOs)

PEO-1 To produce Graduate Electrical Engineers who have the necessary knowledge, skill and aptitude so as to get recruited in various Industries in the power sector, transportation sector, Industrial automation sector, Communication and Information Technology sector and other sectors of the economy at national and international level.

PEO-2 To prepare the students for higher education in the field of Engineering and Management.

PEO-3 To inculcate the habit of lifelong learning so as to adapt to changing needs of the profession.

PEO-4 To enable the graduates for taking up entrepreneurship, and sensitize them to the needs of the community in general and under privileged groups in particular.

DEPARTMENT OF ELECTRICAL ENGINEERING
BACHELOR OF TECHNOLOGY (ELECTRICAL ENGINEERING)

I Year: Odd Semester

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

II Year: Odd Semester

S.No.	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	MC261	Numerical and Engineering Optimization Methods	AEC	4	3	1	0	3	0	25	-	25	50	-
2.	EE201	Network Analysis & Synthesis	DCC	4	3	1	0	3	0	25	-	25	50	-
3.	EE203	Electronic Devices and Circuits	DCC	4	3	0	2	3	0	15	25	20	40	-
4.	EE205	Electromechanical Energy Conversion and Transformers	DCC	4	3	0	2	3	0	15	25	20	40	-
5.	EE207	Engineering Analysis and Design	DCC	4	3	0	2	3	0	15	25	20	40	-
6.	HU201	Engineering Economics	HMC	3	3	0	0	3	0	25	-	25	50	-
7.		**Total**		**23**										

II Year: Even Semester

S.No.	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	ME252	Power Plant Engineering	AEC	4	3	0	2	3	0	15	25	20	40	-
2.	EE202	Electromagnetic Field Theory	DCC	4	3	1	0	3	0	25	-	25	50	-
3.	EE204	Digital circuits and Systems	DCC	4	3	1	0	3	0	25	-	25	50	-
4.	EE206	Control Systems	DCC	4	3	0	2	3	0	15	25	20	40	-
5.	EE208	Asynchronous and Synchronous Machines	DCC	4	3	0	2	3	0	15	25	20	40	-
6.	MG202	Fundamentals of Management	HMC	3	3	0	0	3	0	25	-	25	50	-
7.		**Total**		**23**										

III Year: Odd Semester

S.No.	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	EE301	Power Electronics	DCC	4	3	0	2	3	0	15	25	20	40	-
2.	EE303	Power Transmission and Distribution	DCC	4	3	0	2	3	0	15	25	20	40	-
3.	EE3xx	Departmental Elective Course- 1	DEC/ GEC	4	3	0/1	2/0	3	0	15 /25	25/0	20 /25	40 /50	
4.	EE3xx	Departmental Elective Course- 2	DEC/ GEC	4	3	0/1	2/0	3	0	15 /25	25/0	20 /25	40 /50	
5.	UExxx	Open Elective Course	OEC	3	3	0	0	3	0	25		25	50	
6.	HU303	Professional Ethics and Human Values	HMC	2	2	0	0	3	0	25	-	25	50	-
7.		**Total**		**21**										

III Year: Even Semester

S.No.	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	EE302	Electric Drives	DCC	4	3	0	2	3	0	15	25	20	40	-
2.	EE304	Power System Analysis	DCC	4	3	0	2	3	0	15	25	20	40	-
3.	EE306	Microprocessors & Microcontroller Applications	DCC	4	3	0	2	3	0	15	25	20	40	-
4.	EE3XX	Departmental Elective Course- 3	DEC/ GEC	4	3	0/1	2/0	3	0	15 /25	25/0	20 /25	40 /50	
5.	EE3XX	Departmental Elective Course- 4	DEC/ GEC	4	3	0/1	2/0	3	0	15 /25	25/0	20 /25	40 /50	
6.	HU302	Technical Communication	HMC	2	2	0	0	3	0	25		25	50	
7.		**Total**		**22**										

IV Year: Odd Semester

S. No	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	EE401	B.Tech Project-I	DCC	4										
2.	EE403	Training Seminar	DCC	2										
3.	EE405	Digital Signal Processing	DCC	4	3	0	2	3	0	15	25	20	40	-
4.	EE407	Instrumentation and Measurement	DCC	4	3	0	2	3	0	15	25	20	40	-
5.	EE409	Switchgear and Protection	DCC	4	3	0	2	3	0	15	25	20	40	-
6.	EE4xx	Departmental Elective Course-5	DEC/ GEC	4	3	0/1	2/0	3	0	15 /25	25/0	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.	EE402	B.Tech Project-II	DCC	8										
2.	EE4xx	Departmental Elective Course-6	DEC/ GEC	4	3	0/1	2/0	3	0	15/ 25	25 /0	20 /25	40/ 50	
3.	EE4xx	Departmental Elective Course-7	DEC/ GEC	4	3	0/1	2/0	3	0	15/ 25	25 /0	20 /25	40/ 50	
4.	EE4xx	Departmental Elective Course-8	DEC/ GEC	4	3	0/1	2/0	3	0	15/ 25	25 /0	20 /25	40/ 50	
		Total		20										

List of Departmental Elective Courses

S. No.	Elective Code	Title of Elective	Elective no.
1.	EE-305	Signals and Systems	DEC 1 and DEC 2
2.	EE-307	Power Station Practices	
3.	EE-309	Special Electrical Machines	
4.	EE-311	Energy Efficient Motors	
5.	EE-313	Linear Integrated Circuits	
6.	EE-315	Digital Control and State Variable Analysis	
7.	EE-317	Renewable Energy Systems	
8.	EE-319	Digital System Design	
9.	EE-321	Soft Computing Techniques	
10.	EE-323	CMOS Analog Integrated Circuits	
11.	EE-308	Power System Operation and Control	DEC 3 and DEC 4
12.	EE-310	Communication Systems	
13.	EE-312	Power System Optimization	
14.	EE-314	Power Electronic Applications to Power Systems	
15.	EE-316	Electrical Energy Storage Systems	
16.	EE-318	Switched Mode Power Supplies	
17.	EE-320	VLSI Design	
18.	EE-322	IC Technology	
19.	EE-324	Design, Estimation & Costing of Industrial Electrical Systems	
20.	EE-326	Process Instrumentation & Control	
21.	EE-411	Power System Modeling & Simulation	DEC-5
22.	EE-413	Power System Reliability	
23.	EE-415	Design of Electrical Machines	
24.	EE-417	Advanced Topics in Electrical Machines	
25.	EE-419	Pulse Width Modulation for Power converters	

26.	EE-421	Advanced Communications	
27.	EE-423	Microcontroller and Embedded Systems	
28.	EE-425	Advanced Analog Circuit Design	
29.	EE-427	Computer Architecture	
30.	EE-404	Power System Dynamics & Stability	DEC 6, DEC 7 and DEC 8
31.	EE-406	Distribution Systems Analysis & Control	
32.	EE-408	Restructured Power Systems	
33.	EE-410	Power System Planning	
34.	EE-412	High Voltage Engineering	
35.	EE-414	Distributed Generation	
36.	EE-416	Grid Integration of Renewable Energy Sources	
37.	EE-418	Selected Topics in Power Electronics	
38.	EE-420	Power Quality	
39.	EE-422	HVDC Transmission	
40.	EE-424	Flexible AC Transmission Systems	
41.	EE-426	Smart Grid	
42.	EE-428	Digital Image Processing	
43.	EE-430	Filter Design	
44.	EE-432	AI and Expert Systems	
45.	EE-434	Computer Control of Processes	
46.	EE-436	Nonlinear and Adaptive Control	
47.	EE-438	DSP Applications to Electromechanical Systems	
48.	EE-440	SCADA & Energy Management Systems	
49.	EE-442	Robotics and Machine Vision	
50.	EE-444	Utilization of Electrical Energy & Traction	
51.	EE-446	Data Communication and Computer Networks	

List of Open Elective Courses

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

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

SYLLABUS

1. Subject Code: **ME 101/104** : Course Title: **Basic Mechanical Engineering**
2. Contact Hours : L: 04 T: 00 P: 00
3. Examination Duration (Hrs.) : Theory: 3 Practical: 00
4. Relative Weight : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00
5. Credits : 04
6. Semester : I / II
7. Subject Area : AEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with the concepts of thermodynamics, fluid mechanics, power plants, engineering materials, manufacturing processes and metrology.
10. Details of Course :

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

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

11. Suggested Books:

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

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

1. Subject Code: **AC 101/102** : Course Title: **Chemistry**
2. Contact Hours : L: 03 T: 00 P: 02
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 00
5. Credits : 04
6. Semester : I / II
7. Subject Area : ASC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with the concepts of Engineering Chemistry, Material characterization and green Chemistry.
10. Details of Course :

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

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

11. Suggested Books:

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

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

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

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

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

5. Credits : 04

6. Semester : I

7. Subject Area : ASC

8. Pre-requisite : NIL

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

10. Details of Course :

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

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

11. Suggested Books:

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

1. Subject Code: **AP 102** : Course Title: **Applied Physics-II**
2. Contact Hours : L: 03 T: 00 P: 02
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 00
5. Credits : 04

6. Semester : II

7. Subject Area : ASC

8. Pre-requisite : NIL

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

10. Details of Course :

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

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

11. Suggested Books:

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

1. Subject Code: **EE-101/102** : Course Title: **Basic Electrical Engineering**
2. Contact Hours : L: 03 T: 00 P: 02
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 00
5. Credits : 04
6. Semester : I / II
7. Subject Area : AEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with the concepts of electrical circuits, magnetic circuits, transformer and measuring instruments.

10. Details of Course :

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

11. Suggested Books:

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

1. Subject Code: **ME-102/105** : Course Title: **Engineering Graphics**
2. Contact Hours : L: 00 T: 00 P: 03
3. Examination Duration (Hrs.) : Theory: 0 Practical: 03
4. Relative Weight : CWS: 00 PRS: 50 MTE: 00 ETE: 00 PRE: 50
5. Credits : 02
6. Semester : I / II
7. Subject Area : AEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with drafting and engineering drawing practices.

10. Details of Course :

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

11. Suggested Books:

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

1. Subject Code: **EN-101/102** : Course Title: **Introduction to Environmental Science**
2. Contact Hours : L: 03 T: 00 P: 00
3. Examination Duration (Hrs.) : Theory: 03 Practical: 0
4. Relative Weight : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00
5. Credits : 03
6. Semester : I / II
7. Subject Area : AEC
8. Pre-requisite : NIL
9. Objective : To introduce basic fundamentals of Environmental Science.

10. Details of Course :

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

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

1. Subject Code: **MA-101** : Course Title: **Mathematics – I**
2. Contact Hours : L: 03 T: 01 P: 00
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00
4. Relative Weight : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00
5. Credits : 04
6. Semester : I
7. Subject Area : ASC
8. Pre-requisite : NIL
9. Objective : To acquaint the students with the knowledge of series & sequence, single & multiple variable calculus, knowledge of vector calculus and their applications.

10. Details of Course :

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

11. Suggested Books:

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

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

1. Subject Code: **MA-102** : Course Title: **Mathematics – II**
2. Contact Hours : L: 03 T: 01 P: 00
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00
4. Relative Weight : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00
5. Credits : 04
6. Semester : II
7. Subject Area : ASC
8. Pre-requisite : NIL
9. Objective : To impart knowledge of matrices and applications closed form and series solutions of Differential equations, Laplace Transform, Fourier series, Fourier Transform & their applications.
10. Details of Course :

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

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

11. Suggested Books:

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

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

1. Subject Code: **HU 101/102** : Course Title: **Communication Skills**
2. Contact Hours : L: 03 T: 00 P: 00
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00
4. Relative Weight : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00
5. Credits : 03
6. Semester : I / II
7. Subject Area : HMC
8. Pre-requisite : NIL
9. Objective : To impart essential skills required for effective communication in English language.
10. Details of Course :

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

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

Text Books:

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

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

11. Suggested Books

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

1. Subject Code: **CO 101/102** : Course Title: **Programming Fundamentals**
2. Contact Hours : L: 03 T: 00 P: 02
3. Examination Duration (Hrs.) : Theory : 3 Practical : 00
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 00
5. Credits : 04

6. Semester : I / II

7. Subject Area : AEC

8. Pre-requisite : NIL

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

10. Details of Course :

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

11. Suggested Books

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

1. Subject Code: **ME 103/106** : Course Title: **Workshop Practice**
2. Contact Hours : L: 00 T: 00 P: 03
3. Examination Duration (Hrs.) : Theory : 00 Practical : 03
4. Relative Weight : CWS: 00 PRS: 50 MTE: 00 ETE: 00 PRE: 50
5. Credits : 02
6. Semester : I / II
7. Subject Area : AEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with manufacturing shops like Carpentry, Foundry, Welding, Machining, Fitting and Smithy.

10. Details of Course :

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

1. Subject Code: **MC-261** Course Title: **Numerical and Engineering Optimization Methods**

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

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

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

5. Credits : 4

6. Semester : III

7. Subject Area : AEC

8. Pre-requisite : Mathematics

9. Objective : To familiarize the students with the various numerical and engineering optimization methods.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Numerical techniques :** Root finding in one dimension, bisection method, Newton-Raphson method and regula-falsi method, solution of ordinary differential equations, multistep method, Runge-Kutta method with fixed step size and variable step size	8
2.	**Linear programming** –formulation-Graphical and simplex methods-Big-M method-Two phase method-Dual simplex method-Primal Dual problems	5
3.	**Unconstrained one dimensional optimization techniques** -Necessary and sufficient conditions –Unrestricted search methods-Fibonacci and golden section method-Quadratic Interpolation methods, cubic interpolation	8
4.	**Unconstrained n dimensional optimization techniques** – direct search methods –Random search –pattern search and Rosenbrock's hill claiming method- Descent methods-Steepest descent, conjugate gradient, quasi -Newton method	8
5.	**Constrained optimization Techniques**- Necessary and sufficient conditions –Equality and inequality constraints-Kuhn-Tucker conditions-Gradient projection method-cutting plane method- penalty function method	8
6.	**Intelligent optimization techniques**: Particle swarm optimization, genetic algorithm, ant colony optimization , neural and fuzzy optimization techniques	5

Note: solution of problems using matlab.	
Total	**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Rao, S.S.,"Optimization :Theory and Application" Wiley Eastern Press, 2nd Ed	1984
2.	Taha, H.A., Operations Research –An Introduction, Prentice Hall of India	2003
3.	Fox, R.L., Optimization methods for Engineering Design", Addition Welsey	1971

1. Subject Code: **EE-201** Course Title: **Network Analysis and Synthesis**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight **:** CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 00
5. Credits : 4
6. Semester : III
7. Subject Area : DCC
8. Pre-requisite : EE-101/102
9. Objective : To familiarize the students with the concepts of network analysis

10. Details of Course:

Unit No.	Contents	Contact Hours
1	**Introduction:** Introduction to continuous and discrete signals, their classification and types, periodic waveforms and signal synthesis, Fourier representation of continuous time periodic and aperiodic signals, LTI systems and their properties; system modeling in terms of differential equations and transient response of R, L, C circuits for impulse, step, ramp, sinusoidal and exponential signals.	8

2	**Network Topology and Graph Theory:** Introductory concepts of network graphs, cut sets, loops, cut set and loop analysis	6
3	**Network Theorems:** Superposition, Thevenin's theorem, Norton's theorem, maximum power transfer theorem, reciprocity theorem, Miller's theorem	6
4	**Laplace Transform:** Review of properties and applications of Laplace transform of complex waveform and transient response of R-L- C series, parallel, series-parallel circuits for all kinds of excitations	10
5	**Two Port Networks and:** z, y, h, g, ABCD, inverse ABCD parameters, their inter conversion, interconnection of two 2-port networks, concept of transform impedance.	5
6	**Elements of Realizability:** Positive real functions; definition & properties, Foster's I and II, Cauer's I and II forms, Synthesis of LC, RC, RL Networks, image parameters and basics of two-port synthesis	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1	M.E. Van Valkenburg, "Network Analysis", PHI	2000
2	Decarlo & Lin "Linear circuit Analysis: Time Domain, Phasor, and Laplace Transform Approaches", Oxford	2001
3	F.F. Kuo, "Network Analysis and Synthesis", John Wiley and Sons	2006
4	Hayt, Kemmerly & Durbin, "Engineering Circuit Analysis", Tata McGraw Hill Publishing Company Ltd	2007
5	Desoer and Kuh, "Basic Circuit Theory", McGraw Hill International	2009

1. Subject Code: **EE-203** Course Title: **Electronic Devices & Circuits**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight **:** CWS: 15 PRS: 25 MTE: 20 ETE: 40 PRE: 0
5. Credits **: 4**
6. Semester **:** III

7. Subject Area : DCC

8. Pre-requisite : EE-101/102

9. Objective : To introduce the fundamentals of electronic devices and circuits.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	Introduction to Electronic Signals, frequency spectrum of signals, analog and digital signals, amplifiers, circuit models of amplifiers, frequency response, digital logic inverters. Diodes; Ideal diodes, physical operation and terminal characteristics, small signal models, operation in reverse breakdown region, Zener diode, rectifier circuits, limiting and clamping circuits etc.	6
2.	**Bipolar Junction Transistors:** Physical structure and modes of operation, symbols, operation in active mode, graphical representation of transistor characteristics, DC analysis of transistor circuits, transistor as an amplifier and small signal model, transistor biasing, CE, CC and CB amplifier configurations, transistor as switch, large signal model of the transistor.	8
3.	**MOSFETs and Field Effect Transistors:** Structure and physical operation of enhancement type MOSFET, current-voltage characteristics, depletion type MOSFET, MOSFET as an amplifier, basic single stage MOSFET amplifiers, all NMOS amplifier stages, JFETs, etc.	7
4	**Differential Amplifiers:** BJT differential pair, small signal model and operation, differential amplifiers with active loads, MOS differential amplifiers, multistage amplifiers, etc.	6
5.	**Frequency Response:** Low frequency response of CE and CS amplifier, high frequency response of CS and CE amplifier, CB, CC and cascade configurations and their frequency response	6
6.	**Feedback amplifiers and Oscillators:** Principles of feedback in amplifiers, advantages of negative feedback, effect of feedback on impedances, MOS/ Bipolar realization of feedback amplifiers, Barkhausen criterion for sinusoidal oscillators, phase shift oscillator, Wien-bridge oscillator, resonant circuit oscillators, crystal oscillators, frequency stability.	9
Total		**42**

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Behzad Razavi, " Fundamentals of Microelectronics", Wiley India Pvt. Ltd.	2009
2.	A. S. Sedra and K. C. Smith , "Microelectronic Circuits", Oxford university Press, 6th Edition	2013
3.	Robert L Boylestad and Louis Nashelsky, "Electronic Devices & Circuit Theory", PHI	2001
4.	B. G. Streetman and S. Banerjee, "Solid State Electronic Devices", 7th ed., Pearson Ed	2014

1. Subject Code: **EE-205** Course Title: **Electromechanical Energy Conversion and Transformers**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 25 MTE: 20 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : III
7. Subject Area : DCC
8. Pre-requisite : EE-101/102
9. Objective : To familiarize the students with the construction and operation of dc machines and single-phase and three-phase transformers.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Principle of Electromechanical Energy Conversion:** Energy stored in electric and magnetic fields, energy conversion in single and multi-excited systems and torque production, reluctance torque; Reluctance and hysteresis motors.	4

2.	**General Description of Electrical Machines:** Constructional details of dc and ac machines, description of magnetic and electric circuits in cylindrical rotor and salient pole machines, mmf distribution of current carrying single and multiple coils; Armature winding as a current sheet, associated mmf and flux density waves; Harmonic analysis of induced voltage; Torque as a function of flux and mmf.	6
3.	**DC Machines:** Simplex lap and wave windings, emf and torque equations, interaction of the fields produced by field and armature circuits.	
4.	**Commutation**: Causes of bad commutation, methods of improving commutation, effect of brush shifts; Compensating winding; Interpole winding.	4
5.	**DC Generators**: Methods of excitation, shunt, series and compound generators, characteristics, testing.	4
6.	**DC Motors**: Methods of excitation, characteristics, starting and speed control methods; Losses and their estimation, efficiency.	6
7.	**Single-phase Transformers**: Principle of operation, equivalent circuit, voltage regulation and efficiency; Parallel operation.	4
8.	**Three-phase Transformers**: Various connections and their comparative features, harmonics in emf and magnetizing current, effect of connections and construction on harmonics; Parallel operation of three-phase transformers, sharing of load, 3-phase to 2-phase conversion, 3-phase to 6-phase conversion.	6
9.	**Autotransformers:** Principle of operation and comparison with two winding transformer	3
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Fitzgerald A. E., Kingsley C. and Kusko A., “Electric Machinery”, 6th Ed., McGraw-Hill International Book Company.	2008
2.	Say M. G., “The Performance and Design of Alternating Current Machines”, CBS Publishers and Distributors.	2005

3.	Say M. G. and Taylor E. O., "Direct Current Machines", 3rd Ed., ELBS and Pitman.	1986
4.	Nagrath I. J. and Kothari D. P., "Electrical Machines", 3rd Ed., Tata McGraw-Hill Publishing Company Limited.	2008
5.	Clayton A. E. and Hancock N., "The Performance and Design of DC Machines", CBS Publishers and Distributors.	2003
6.	Langsdorf A. S., "Theory of AC Machines", 2nd Ed., Tata McGraw-Hill Publishing Company Limited.	2008

1. Subject Code: **EE-207** Course Title: **Engineering Analysis and Design**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 25 MTE: 20 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : III
7. Subject Area : DCC
8. Pre-requisite : EE-101/102 and MA-101, MA-102
9. Objective : To introduce fundamentals of design and simulation using software packages.

10. Details of Course:

Unit. No.	Contents	Contact Hours
1.	**Model of Physical Systems:** Introduction to physical systems: Mass-spring-damper system, accelerometer, rotational mechanical system, gear trains, liquid level system; Circuit models: RL, RC, LC, RLC series and parallel circuits with sinusoidal and non-sinusoidal excitations, diode rectifier.	6
2.	**Solution of Differential Equations:** Systems of linear equations, homogeneous and non-homogeneous linear equations, Polynomial equations, least squares fit; ordinary differential equations: Euler's method, Runge-Kutta method, Newton-Raphson method, Predictor-Corrector methods; Numerical integration: Forward and backward integration rules, Trapezoidal rule, Simpson's rule, Errors of integration.	12

3.	**Simulation Techniques:** Continuous state simulation: circuit level simulators, Discrete-event simulation: Fixed time step, variable time step; Response analysis of circuits: DC analysis, AC Analysis, Transient analysis.	6
4.	**Programming in MATLAB**: Programming a function, repetitive and conditional control structures, Iterative solution of equations, polynomial interpolation; Plotting and analysis: two-dimensional and three-dimensional plots, Histograms, Polar plots, Function evaluation; Handling external files: saving and loading data.	8
5.	**PSPICE Circuit Simulator**: Introduction, circuit descriptions, Input files, nodes, circuit elements, element values, sources, output variables; Analysis: DC sweep, Transient and AC analysis. PSPICE models.	4
6.	**Design Case Studies**: DC Motor speed control, State space model, heater systems with temperature control.	6
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Biran A. and Breiner M., "MATLAB 5 for Engineers", 2nd edition, Addison Wesley.	1999
2.	Rashid M. H. and Rashid H. M., "SPICE for Power Electronics and Electric Power", 2nd edition, Taylor & Francis.	2009
3.	William J. P., "Introduction to MATLAB for Engineers", 3rd edition, McGraw Hill.	2010

1. Subject Code: **HU201** Course Title: **Engineering Economics**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 03 Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PR 0
5. Credits : 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:

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

11. Suggested Books:

S. No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Engineering Economy, Engi G.J. Thuesen, & W.J. Fabrycky, Prentice-Hall of India Private Limited.	2007
2.	Engineering Economy, William G. Sullivan, James A. Bontadelli & Elin M. Wicks, Pearson Education Asia,(First Indian reprint).	2009
3.	Engineering Economic Analysis, Donald G. Newman, Jerome P. Lavelle & Ted G. Eschenbach, , Engineering Press.	2001
4.	Economics for Engineering Students, Seema Singh, , IK International Publishing House Pvt. Ltd	2014

1. Subject Code: ME-252 Course Title: Power Plant Engineering
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 25 MTE: 20 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : IV
7. Subject Area : AEC
8. Pre-requisite : ME-104, AC-103, EE-113, EE-204
9. Objective : To familiarize the students with familiar with operation of various power plants.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Introduction:** Conventional & Non-Conventional Sources of Energy and their availability in India, Different Types of Power Plants, Layout of Steam , Hydel , Diesel , MHD, Nuclear and Gas turbine power plants, Combined Power cycles – comparison and selection , Load duration Curves, Steam boilers and cycles – High pressure and Super Critical Boilers – Fluidized Bed Boilers	10

2.	**Thermal Power Plants:** Basic thermodynamic cycles, various components of steam power plant-layout-pulverized coal burners-Fluidized bed combustion-coal handling systems-ash handling systems- Forced draft and induced draft fans- Boilers-feed pumps-super heater- regenerator-condenser- de-aerators, cooling towers, electrostatic precipitators	10
3.	**Hydel Power Plant**: Principle of working, Classification, Site selection; Different components & their functions; Types of Dams; Types, Characteristics & Selection of Hydro-Turbines; Mini & Micro Hydro Power Plants, Pumped Storage Power Plants	08
4.	**Diesel And Gas Turbine Power Plant:** Types of diesel plants, components, Selection of Engine type, applications. Gas turbine power plant- Fuels- Gas turbine material, open and closed cycles, reheating, Regeneration and intercooling, combines cycle	08
5.	**Co-Generation:** Concept; Schemes; Brief Description; Benefits & Limitations; Applications. Non-Conventional Energy Sources, Types, Brief Description, Advantages & Limitations	06
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	P.K.Nag, “Power Plant Engineering”, Tata McGraw Hill Publications.	2007
2.	EI-Wakil M.M, “Power Plant Technology,” Tata McGraw-Hill	1984
3.	Power Plant Engineering, Gautam S, Vikas Publishing House.	2012
4.	Power station Engineering and Economy by Bernhardt G.A.Skrotzki and William A. Vopat- Tata McGraw Hill Publishing Company Ltd.	2002

5.	"Modern Power Station Practice", Volume B, British Electricity International Ltd., Central Electricity Generating Board, Pergamon Press, Oxford.	1991
6.	'Power Plant Familiarisation – Vol. II', NPTI Publication.	----

1. Subject Code: **EE-202** Course Title: **Electromagnetic Field Theory**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.): Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 4
6. Semester : IV
7. Subject Area : DCC
8. Pre-requisite : EE-101/102, MA-101, MA-102, AP-101, AP-102
9. Objective : To deepen the understanding of Electromagnetic Theory by building on the concepts learnt in Engineering Physics and Basic Electrical Engineering and application of vector integral and differential calculus for solving abstract electromagnetic problems.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Mathematical Orientation:** Over view of Electromagnetics, Electrostatics, Magnetostatics, Electromagnetic field, Maxwell's equations, wave equation and Electromagnetic wave propagation. Review of scalars, vectors, vector multiplication- dot and vector products, component of a vector, Co-ordinate system- Cartesian, cylindrical and spherical co-ordinate system. Transformation of different co-ordinate system, cylindrical to Cartesian, spherical to Cartesian, cylindrical to spherical and vice versa. Gradient, Curl and Divergence. Divergence theorem, Stroke's theorem. Line integrals, Surface integrals, Volume integrals. Significance of line integral, surface integral and volume integrals. Differential length, area and volume in Cartesian, cylindrical and spherical co-ordinate system. Dirac- Delta function.	6

2.	**Electrostatic Fields:** Overview of electrostatic field, Coulomb's Law and field intensity. Electric fields due to point charge, continuous charge distributions like line charge, surface charge and volume charge distributions. Electric flux density, Gauss's Law. Application of Gauss's law - Point charge, Infinite line charge, Infinite sheet of charge and uniformly charged sphere. Electric potential, Relationship between E and V - Maxwell's equation. Scalar potential. Electric Dipole, Electric field intensity due to electric dipole. Electric flux lines. Properties of Electric flux lines- flux lines due to point charge and dipole. Energy density in Electrostatic filed, Energy density. Classification, of materials based on conductivity-Conductors, Dielectric, Semi conductors. Convection and Conduction currents and current densities. Conductors, Point form of Ohm's law. Polarization in Dielectric. Effect of Polarization in Dielectric on flux density(D). Polar and Non-Polar Dielectric, linear, homogeneous, isotropic Dielectric. Dielectric constant and strength in Dielectric material, Continuity equation of current and Relaxation time. Electrostatic Boundary conditions - Dielectric- Dielectric, Conductor- Dielectric, Conductor- Free Space. Boundary value problems. Poisson's and Laplace's equations, Uniqueness Theorem. General procedure for solving Poisson's and Laplace's equations. Resistance and capacitance, Capacitance of parallel plate capacitor, coaxial cable, Spherical capacitor. The method of images used for finding V, E, D and r due to charges in the presence of conductors. Image theory- A point charge above a grounded conducting plane. Image theory- A line charge above a grounded conducting plane.	13
3.	**Magnetostatic Fields :** Introduction to magnetostatic fields, Biot-Savart's law. Numerical. Ampere's circuit law- Maxwell's equation. Application of Ampere' law - Infinite Line current, Infinite Sheet of current, Infinitely long co-axial Transmission line. Magnetic flux density. Maxwell's equation for static EM fields . Magnetic scalar and vector potentials. Biot- Savart's Law and Ampere's law. Forces due to magnetic fields - Force on a charged particle, Force on a current element and Force between two current elements. Magnetic Torque and Moment, Magnetic Dipole. Magnetization in materials- M vector, Classification of magnetic materials. Magnetic boundary conditions. Inductance for simple geometry. Magnetic energy, magnetic circuits. Statement and Interpretation of Maxwell's equation.	13

4.	**Time Dependent Fields:** General introduction, Faraday's Law. Transformer and motional emf - stationary loop in time varying B field (Transformer emf), Moving loop in static B field (Motional emf). Moving loop in time varying fields, Displacement current. Maxwell's equation in final forms, Time varying Potentials. Time harmonic fields. Introduction of Electromagnetic wave propagation, waves in general, wave propagation in lossy dielectric. Plane waves in loss less Dielectric, Plane waves in free space, Plane waves in good conductors. Power and Poynting vector. Reflection of Plane wave at normal incidence. Reflection of Plane wave at Oblique incidence - Parallel Polarization and Perpendicular Polarization.	10
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Matthew N. O. Sadiku, "Elements of Electromagnetics", Oxford University Press	2014
2.	William H. Hyat, "Engineering Electromagnetics", Mc Graw-Hill Int. Edition	2011,8th Edition
3.	Kraus and Fleisch, "Electromagnetics with Applications", Mc Graw-Hill Edition	2010
4.	N. N. Rao, "Elements of Engineering Electromagnetics", Pearson Education	2006,6th Edition

1. Subject Code: **EE-204** Course Title **Digital Circuits and Systems**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : **Theory: 3** **Practical: 0**
4. Relative Weight : **CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0**
5. Credits : **4**
6. Semester : **IV**
7. Subject Area : **DCC**
8. Pre-requisite : **EE-101/102 and EE-203**
9. Objective : To familiarize the students with the fundamentals of logic gates, Boolean algebra and designing of combinational and sequential logic circuits.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Boolean Function:** Canonical forms of representing Boolean function, Karnaugh map, simplification of 3, 4 and 5 variables function using Karnaugh map and McCluskey method.	6
2.	**Combinational Logic Circuits:** Design procedure & analysis of combinational logic circuits, decoder, encoder, binary adder, binary subtractor, binary comparator, BCD adder, multiplexers, realisation of Boolean function using multiplexers and decoders.	8
3.	**Memories**: ROM, PROM, EPROM, Boolean function implementation using ROM.	4
4.	**Flip Flops:** Analysis of basic memory element, Development of R-S flip flop, D flip flop, J-K flip flop and T flip flop, characteristic tables, excitation table, Master-slave flipflop.	6
5.	**Design of sequential circuits**: state diagram, state table and state equations, design and analysis of sequential circuits	4
6.	**Counters**: Synchronous and asynchronous counters, design of counters, shift register	6
7.	**Registers:** Sequential registers, shift registers, bidirectional shift registers, Data transfer using shift registers	4
8.	**Digital logic families**: RTL, DTL, TTL and MOSFET, circuits and characteristics.	4
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Malvino A. P. and Leach D. P., "Digital Principles and Applications", 6th Ed., Tata McGraw-Hill Publishing Company Ltd.	2008
2.	Mano M. M. and Ciletti M. D., "Digital Design", 4th Ed., Pearson Education.	2008
3.	Mano M.M., "Digital Logic and Computer Design", First Ed., Pearson India	2004
4.	A. Anand Kumar, "Fundamentals of Digital Circuits", Third Ed., PHI.	2014

5.	Wakerly J. F., "Digital Design – Principles and Practices", 4th Ed., Pearson Education.	2008
6.	Ciletti M., " Advanced Digital Design with the Verilog HDL", 2nd Eition, Prentice Hall	2010

1. Subject Code: **EE-206** Course Title: **Control Systems**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 25 MTE: 20 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : IV
7. Subject Area : DCC
8. Pre-requisite : AM-101, AM-111, EE-113, EE-202, EE-205
9. Objective : To introduce the fundamentals of modeling, analysis and response of control systems in continuous and discrete data systems.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Introduction:** Concepts of system**,** open loop and closed loop systems, model classification; Mathematical modeling and representation of physical systems, analogous systems.	4
2.	**Transfer Function Analysis:** Transfer functions for different types of systems, block diagrams; Signal flow graphs and Mason's gain formula.	4
3.	**Control System Components:** Potentiometers, synchros, principles and applications of dc and ac servomotors, analysis and transfer function, servo amplifiers, modulators and demodulators, magnetic amplifiers; Position and speed control systems.	6

4.	**Time Domain Analysis:** Time domain performance criterion, transient response of first order, second order and higher order systems; Steady state errors: static and dynamic error constants, system types, steady state errors for unity and non unity feedback systems, performance analysis for P, PI and PID controllers.	8
5.	**Stability Analysis:** Concept of stability by Routh stability criterion, root-loci and root contours, sensitivity analysis,	5
6.	**Frequency Response Analysis:** Polar and inverse polar plots, logarithmic plots, Bode plots, Nyquist stability criterion, gain and phase margins, relative stability, frequency response specifications, correlation with time domain M and N circles, Nichol's chart, closed loop frequency response from open loop response.	8
7.	**Compensation Techniques:** Compensation - lag, lead and lag-lead networks, design of compensation networks using time response and frequency response of the system; Feedback compensation using P, PI, PID controllers, ON-OFF control.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Nagrath I. J. and Gopal M., "Control System Engineering", 5th Ed., New Age International.	2011
2.	Kuo B. C., "Automatic Control Systems", 8th Ed., Wiley India.	2009
3.	Ogata K., "Modern Control Engineering", 5th Ed., Pearson Education.	2009
4.	Dorf R. C. and Bishop R. H., "Modern Control Systems", 8th Ed., Pearson Education.	2008
5.	Norman S. N., "Control Systems Engineering", 4th Ed., Wiley India	2008

1. Subject Code: **EE-208** Course Title: **Asynchronous and Synchronous Machines**

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

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

4. Relative Weight : CWS: 15 PRS: 25 MTE: 20 ETE: 40 PRE: 0

5. Credits : 4

6. Semester : IV

7. Subject Area : DCC

8. Pre-requisite : EE-101/102, EE-201, EE-202, EE-205

9. Objective : To familiarize the students with the construction and operation of asynchronous and synchronous machines in motoring and generating modes.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	Classification and constructional features of wound rotor and squirrel cage induction machines, Qualitative description of working of poly-phase induction machine from rotating field view point; Coupled circuit model of an idealized three-phase machine, concept of leakage reactance and its importance on machine performance and design; Equivalent circuit, determination of equivalent circuit parameters, phasor diagram, circle diagram; methods of excitation, torque-slip characteristics, Generator action, self excited induction generators.	9
2.	Methods of starting induction motors; Principles of speed control (i) stator voltage control (ii) slip speed control (iii) rotor resistance control (iv) V/f control; Effect of voltage injection in secondary of slip-ring induction motor, action of commutator as a frequency converter, Double-cage and deep-bar squirrel cage rotor induction motor; Space and time harmonics and their effect on motor performance.	10
3.	Single-phase induction motor working, double revolving field theory, equivalent circuit, torque-speed characteristic, performance	3
4.	Generated emf, winding coefficients, harmonics in generated emf, tooth ripples and armature reaction; Phasor diagram, Coupled circuit model of an idealized salient pole synchronous machine, two-reaction theory, operation under balanced steady state conditions; effect of variation of field excitation and prime mover input, Power-angle equations of salient pole and cylindrical rotor synchronous machines. Classification and constructional features of salient pole and cylindrical rotor three-phase synchronous machine	9

5.	Voltage regulation of salient pole and cylindrical rotor machine, effect of saturation on voltage regulation, Steady state operating characteristic of synchronous motor; O and V-curves and phasor diagram, hunting, starting of synchronous motors, power factor control by synchronous motors, synchronous condensers.	7
6.	Parallel operation of synchronous machines, synchronization and load division, synchronous machine on infinite bus, effect of variation of field excitation and prime mover input, active and reactive power control, stability and hunting in synchronous machine(already mentioned in motors).	4
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Fitzgerald A. E., Kingsley C. and Kusko A., "Electric Machinery", 6th Ed., McGraw-Hill International Book Company.	2008
2.	Say M. G., "The Performance and Design of Alternating Current Machines", CBS Publishers and Distributors.	2005
3.	Nagrath I. J. and Kothari D. P., "Electrical Machines", 3rd Ed., Tata McGraw-Hill Publishing Company Limited.	2004
4.	Langsdorf A. S., "Theory of AC machines", 2nd Ed., Tata McGraw-Hill Publishing Company Limited.	2008
5.	Kimbark E.W., "Power System Stability, Vol. III: Synchronous Machines", Wiley India.	2008
6.	Chapman S. J., "Electric Machinery Fundamentals", 4th Ed., McGraw-Hill International Book Company.	2005

1. **Subject Code : MG: 202** Course Title : **Fundamentals of Management**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 03 Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PR 0

5. Credits : 3

6. Semester : III/IV

7. Subject Area : HMC

8. Pre-requisite : Nil

9. Objective : The basic objective of this paper is to acquaint the students with the basic concepts of management necessary to deal with emerging business environment besides sensitizing them about societal challenges.

10. Details of Course:

S.No.	Detail Contents	Contact 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 Pulication,(ISBN: 8125918523)	2005
3.	Management, James A F Stonner, Pearson Education, (ISBN: 9788131707043)	2010
4.	Marketing Management, 14th ed., Philip Kotler , Kevin Lane Keller, Abraham Koshy and Mithileswar Jha, Pearson Education, (ISBN: 9788131767160)	2013
5	Knowledge Management in Organizations: A Critical Introduction, Donald Hislop, Oxford University Press, ISBN: 9780199691937.	2013

1. Subject Code: **EE-301** Course Title: **Power Electronics**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 25 MTE: 20 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : V
7. Subject Area : DCC
8. Pre-requisite : EE-201, EE-203, EE-205, EE-206, EE-208
9. Objective : To familiarize the students with the characteristics of semiconductor devices, triggering circuits and their applications for power control.

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; Heat sink design.	7
2.	**Modern Power Devices:** Principle of operation of MOSFET, IGBT, GTO, MCT, SIT, SITH, IGCT, their operating characteristics.	2
3.	**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.	6
4.	**Dual Converter**: Control principle, circulating current and circulating current free modes of operation of single-phase dual converter.	2
5.	**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,	6
6.	**AC Regulator:** Principle of operation of single-phase ac regulator, effect of load inductance, firing pulse requirement.	2
7.	**AC-AC Converters:** Principle of operation of cycloconverter, waveforms, control technique; Introduction of matrix converter.	3
8.	**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.	5
9.	**Inverters:** Voltage source and current source inverters, Principle of operation of single-phase half bridge and full bridge voltage source inverters, voltage and current waveforms; Three-phase bridge inverter, 120^0 and 180^0 modes of operation, voltage and current waveforms with star and delta connected RL load; Voltage and frequency control of inverters; PWM techniques-single pulse, multiple pulse, selective harmonic elimination, sinusoidal PWM.	9
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Dubey G. K., Doradla S. R., Joshi A. and Sinha R. M. K., "Thyristorised Power Controllers", New Age International Private Limited.	2010
2.	Mohan N., Undeland T. M. and Robbins W. P., "Power Electronics-Converters, Applications and Design", 3rd Ed., Wiley India.	2002
3.	Rashid M. H., "Power Electronics Circuits Devices and Applications", 3rd Ed., Pearson Education.	2004
4.	Lander C. W., "Power Electronics", 3rd Ed., McGraw-Hill International Book Company.	2007
5.	Ramshaw R.S., "Power Electronics Semiconductor Switches", Chapman & Hall.	1993

1. Subject Code :**EE-303** Course Title: **Power Transmission & Distribution**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 25 MTE: 20 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : V
7. Subject Area : DCC
8. Pre-requisite : EE-101/102, ME-252, EE-201, EE-205, EE-208
9. Objective : To introduce the design aspects of power system transmission and distribution systems and to familiarize students with the practical operation of power systems.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Transmission and Distribution Systems:** Introduction, electrical supply system, comparison of AC and DC systems, overhead versus underground systems, choice of working voltages for transmission and distribution, transmission and distribution system architecture.	5

2.	**Overhead Transmission Lines:** Mechanical design, line support, types of conductors; Overhead line insulators, types of insulators-pin, suspension and strain insulators, insulator materials, insulator string; Calculation of voltage distribution and string efficiency, methods of equalizing voltages, use of guard rings.	6
3.	**Corona:** Theory of corona formation, factors affecting corona, calculation of potential gradient, disruptive critical voltage and visual critical voltage, corona power loss, minimizing corona, merits and demerits of corona.	3
4.	**Line Parameters**: Line resistance, inductance and capacitance calculations, effect of earth on capacitance of overhead transmission lines, short and medium transmission lines, line performance and compensation.	8
5.	**Underground Cables:** Elements of a power cable, properties of the insulation and sheath materials, classification of power cables: belted, screened and pressure cables, dielectric stress in cable insulation, grading of cables: capacitance grading and inter-sheath grading, measuring capacitances and charging current in a cable.	6
6.	**HVDC**: Advantages and limitations of HVDC transmission over HVAC transmission, elementary ideas about converter and inverter operation, classification of HVDC links: mono-polar, bipolar and homopolar, economic comparison of HVDC and ac systems.	4
7.	**Surge Performance and Protection:** Switching surges, origin and mechanism of lightening strokes, direct and induced strokes, protection from surges- lightning arrestors (rod gap, horn gap, multi-gap and expulsion type) and surge diverters, evaluation of surge impedance, energy and power of a surge.	6
8.	**Introduction to Traveling Waves:** Introduction and mechanism of traveling waves, wave equation, characteristic impedance of a line, incident and reflected waves, transmission and refraction of waves, velocity of traveling waves, behavior of traveling waves for different terminations: inductor, capacitor, open-end, short-end and over the junction of dissimilar lines, attenuation of traveling waves.	4
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Glover J. D., Sarma M.S. and Overbye, T. J. "Power System Analysis & Design", 5th Ed., Cengage Learning India Pvt. Ltd.	2011
2.	Bergen A.R. and Vittal V., "Power Systems Analysis", 2nd Ed., Pearson Education	2002
3.	Kundur P., "Power System Stability & Control", Tata McGraw Hill, 2006	2006
4.	Weedy B.M. and Cory B.J., "Electric Power Systems", 4th Ed., Wiley India.	2008
5.	Grainger J. J. and Stevenson W.D., "Elements of Power System Analysis", Tata McGraw-Hill Publishing Company Limited.	2008
6.	Gonen T., "Electric Power Transmission System Engineering: Analysis and Design", John Wiley and Sons.	1990
7.	Nagrath I. J. and Kothari D. P., "Modern Power System Analysis", 3rd Ed., Tata McGraw-Hill Publishing Company Limited.	2008

1. Subject Code: **HU 303** Course Title: **Professional Ethics and Human Values**

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

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

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

5. Credits : 2

6. Semester : V

7. Subject Area : HMC

8. Pre-requisite : Nil

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

10. Details of the Course:

Sl No.	Name of Books, Authors, Publishers	Contact Hours
1	**Human Values and Ethics:** Morals, Values, Ethics and Integrity, Need for Value Education for Engineers, Happiness, Prosperity, Harmony.	6
2	**Code of Ethics and Professionalism:** Professionalism and the Code of Ethics, Technical Education, Human Values and Coexistence, Universal Human Order, Natural acceptance.	6
3	**Professional Ethics and Technology :**Science, Technology and Professional EthicsEngineering Ethics, Environmental Ethics, Safety, Responsibility and Rights	8
4	**Case Studies:** Holistic Technologies, Eco-friendly production systems, The role of responsible engineers and technologists, Global Issues concerning Engineers	8
Total		**28**

11. Suggested Books:

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

1. Subject Code: **EE-302** Course Title: **Electric Drives**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 25 MTE: 20 ETE: 40 PRE: 0
5. Credits : 4

6. Semester : VI

7. Subject Area : DCC

8. Pre-requisite : EE-205, EE-206, EE-208, EE-301

9. Objective : To introduce the fundamentals of electric drives, operation and analysis of solid state control of ac/dc drives and estimation of drive rating for different duty cycle operations.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Introduction**: Definition of electric drive, type of drives; Speed-torque characteristic of driven unit/loads, motors, joint speed-torque characteristic; Classification and components of load torque; Review of power converters used in drives, multi-quadrant operation of electric drive, example of hoist operation in four quadrant.	5
2.	**Estimation of Drive Motor Rating**: Selection of motor power capacity for continuous duty at constant load and variable loads; Selection of motor capacity for short time and intermittent periodic duty, permissible frequency of starting of squirrel cage motor for different duty cycles; Load equalization.	6
3.	**DC Drives:** Single-phase half controlled and fully controlled converter fed dc motor drives, operation of dc drives with continuous armature current, voltage and current waveforms; Concept of energy utilization and effect of free-wheeling diode; Operation of drive under discontinuous current, expression for speed-torque characteristic.	8
4.	**Chopper fed DC Drives**: Principle of operation and control techniques, chopper circuit configurations used in dc drives: Type A, B, C, D and E; Motoring operation of chopper fed separately excited dc motor, steady state analysis of drive with time-ratio control.	4
5.	**Closed Loop Control of DC Drives:** Drives with current limit control, single-quadrant closed loop drive with inner current control loop, advantage of inner current control loop in drives.	5
6.	**AC Drives:** Variable voltage, rotor resistance and slip power recovery control of induction motors, torque-speed characteristics under different control schemes; Variable frequency control of induction motor, analysis of induction machine under constant V/f operation, constant flux operation and controlled current operation.	6

7.	**Inverter fed AC Drives**: Voltage source inverter fed induction motor drive in open loop, frequency and voltage control in PWM VSI; Operation of closed loop slip-speed controlled VSI fed induction motor drive; Current source inverter, advantage of CSI fed drives, closed loop slip speed controlled CSI fed drive.	8
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Dubey G. K., "Fundamentals of Electric Drives", 2nd Ed., Narosa Publishing House.	2007
2.	Pillai S. K., "A First Course in Electric Drives", 2nd Ed., New Age International Private Limited.	2008
3.	Sen P. C., "Thyristor DC Drives", John Wiley and Sons.	1991
4.	Dubey G. K., "Power Semiconductor Controlled Drives", Prentice Hall International Edition.	1989
5.	Murphy J. M. D. and Turnbull F. G., "Power Electronics Control of AC Motors", Peragmon Press.	1990
6.	Bose B. K., "Power Electronics and Variable Frequency Drives", IEEE Press, Standard Publisher Distributors.	2001

1. Subject Code: **EE-304** Course Title: **Power System Analysis**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 25 MTE: 20 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VI
7. Subject Area : DCC
8. Pre-requisite : AM-201, EE-205, EE-215, EE-302
9. Objective : To familiarize the students with the methods/ techniques for analysing a power system during normal operation and under faulted conditions.

10. Details of Course:

Unit No.	Contents	Contact Hrs
1.	**Review of Power System Components:** Synchronous machines, transformers, transmission lines, one line diagram, impedance and reactance diagram, per unit system	08
2.	**Load Flow Analysis:** Introduction, nodal admittance matrix analysis (Y_{BUS}), bus classifications, development of load flow equations, load flow solution using Gauss Siedel, load flow solution using Newton-Raphson, load flow solution using fast decoupled methods, line flow equations	11
3.	**Economic Operation of Power Systems:** Input-output characteristics of thermal and hydro plants, Optimum generator allocations without and with transmission losses, calculation of penalty factors, incremental transmission loss, transmission loss coefficients and their calculations, Hydro-Thermal Scheduling, Unit commitment, Concept of optimal power flow	14
4.	**Symmetrical Faults:**	
5.	Concept of bus impedance matrix and Z_{bus} building procedure, Use of Z_{bus} in computation of short circuit currents, Selection of circuit breakers, Use of current limiting reactors	09
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	A. Bergen and V. Vittal, Power Systems Analysis, Pearson Education Asia, Second Edition	2002
2.	Glover J. D., Sarma M.S. and Overbye, T. J. "Power System Analysis & Design", 5th Ed., Cengage Learning India Pvt. Ltd.	2011
3.	Grainger J. J. and Stevenson W.D., "Elements of Power System Analysis", Tata McGraw-Hill Publishing Company Limited.	2008
4.	Kothari & Nagrath, "Power System Engineering" Tata Mc. Graw Hill.	2006
5.	Hadi Saadat ,"Power System Analysis" TATA McGRAW-HILL	2003
6.	Nagrath I. J. and Kothari D. P., "Modern Power System Analysis", 3rd Ed., Tata McGraw-Hill Publishing Company Limited.	2008
7.	P.S.R. Murthy " Power System Analysis" B.S. Publications	2007

1. Subject Code: **EE-306** Course Title: **Microprocessors & Microcontroller Applications**

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

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

4. Relative Weight : CWS: 15 PRS: 25 MTE: 20 ETE: 40 PRE: 0

5. Credits : 4

6. Semester : VI

7. Subject Area : DCC

8. Pre-requisite : Nil

9. Objective : To familiarize the students with the basics of microprocessors, their architectures, memory organisation, operation through timing diagrams, assembly language programming, interfacing with peripherals and applications to Electrical Engineering.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	**Microprocessor Architecture** Functional block diagram, signals, buses, memory and its interfacing, I/O ports and mapping, timing diagram, interrupt structure, concepts of data transfer, basic idea regarding fetching and execution of simple programs from CPU	6
2	**Programming in Assembly Language** Instruction format and addressing modes, assembly language format, and data transfer, data manipulation and control instructions, programming for-loop structure with counting and indexing application of look up table, subroutine, stack operation, polling and interrupt based control transfer.	8
3	**Arithmetic Operators and Algorithms** Fixed point, floating point and fractional arithmetic operations (addition, subtraction, multiplication and division), signed arithmetic, overflow conditions, Boolean algorithm.	6

4	Peripheral Interfacing Hand shaking, bidirectional data transfer, study of architecture and programming peripheral interface, 8255 PPI, 8251 USART, 8279 keyboard and display controller, 8253 timer/counter interface, A/D and D/A converter interfacing, serial communication.	8
5	**Applications**: Keyboard and display interface, motor control, PWM operations, applications to measurement and instrumentation, distributed data acquisition system, assessment of power factor, real and reactive power.	8
6	**Architecture of Micro controllers** Overview of the architecture of 8051 microcontroller, Instructions. addressing schemes, Special function registers, Assembly software programs with Algorithms, Timer applications for PWM control, Serial interface.	6
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	R.S. Gaonkar, "Microprocessor Architecture: Programming and Applications", Wiley Eastern Ltd, New Delhi	1995
2.	Muhammad Ali Mazidi & Janice Gilli Mazdi, "The 8051 Micro Controller and Embedded Systems", Pearson Eduction, 5th Indian reprint	2003
3.	William Kleitz, "Microprocessor and Microcontroller Fundamentals: The 8085 and 8051 Hardware and Software", Prentice Hall, 1st edition,	1997
4.	M. Rafiquzzaman, "Microprocessors-Theory and Applications: Intel and Motorola", PHI	1993
5.	B. Ram, "Advanced Microprocessor & Interfacing", TMH,	2001
6.	Kant Krishna, "Microprocessors and Microcontrollers: Architecture, Programming and System Design 8085, 8086, 8051, 8096", PHI,	2007
7.	Gibson Gleen A and Liu Yu-Cheng, "Microcomputer Systems: The 8086/8088 Family Architecture Programming And Design", 2nd Edition, PHI	2011
8.	The 8051 Microcontroller and Embedded systems, Muhammad Ali Mazidi, Janice Gillispie Mazidi. Pearson Education	2012

1. Subject Code: **HU 302** Course Title: **Technical Communication**

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

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

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

5. Credits : 2

6. Semester : 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:

Sl. No.	Contents	Contact Hours
1.	**English for Professional Purposes:** A.Technical Communication- Methods, Strategies and Skills B.Communication in Global Contexts- Social, Cultural, Political and Technical, especially in formal set up	 1 2
2.	**Communication at the Workplace: Oral and Written:** **A.Written Communication**- Letters, Orders (Sale/Purchase) Report Writing, Technical proposals Resume, SOP, Memo, Notice, Agenda, Minutes, Note Taking/Making, **B.Oral Communication**: Seminars, Conferences, Meetings, Office Etiquettes/ Netiquettes, Presenting Written Material Negotiation, Demonstration, Group Discussion, Interview	 6 6
3.	**Group Discussion** and **Report Writing:** i)Group Discussion (Continous assessment through the semester) ii)Minor Report Writing(to be submitted before Mid- Semester Examination) iii}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
7.	Soft Skills: Enhancing Employability, Rao, M.S. Connecting Campus with Corporate ISBN: 978-93-80578-38-5	2011
8.	Developing Communication Skills (2nd Ed), Mohan, Krishna and Meera Banerji, Macmillan Publishers India Ltd. ISBN 13: 978=0230-63843-3	2009

1. Subject Code: **EE-405** Course Title: **Digital Signal Processing**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 25 MTE: 20 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VII

7. Subject Area : DCC

8. Pre-requisite : EE-213, EE-214

9. Objective : To familiarize the students with the basics of discrete time signal processing, sampling requirements, quantisation, discrete filter design and Fourier transformation for designing the requisite programmable digital solution for interface with analog world.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Introduction:** Classification of Systems : Continuous , discrete , Linear , Casual Stable Dynamic recursive , time variant ; Classification of Signals : Continuous and discrete Energy and Power; Mathematical representation of Signals, Spectral density , Sampling Techniques, Quantization, Quantization error, Nyquist state and Aliasing Effect. Digital Signal Representation, Analog to Digital Conversion.	8
2.	**Discrete Time System Analysis:** Z transform and its properties Inverse Z Transform; Difference equation-Solution by Z transform Application to Discrete System, Stability Analysis, Frequency response , convolution – Fourier transform of Discrete Sequence , Discrete Fourier Series.	10
3.	**Discrete Fourier Transformation& Computation:** DFT Properties , magnitude & phase representation ,Computation of DFT using –DIT & DIF – FFT using radix 2 – Butterfly structure	10
4.	**Digital filter design: FIR & IIR** filter realization – parallel & cascade forms, FIR design Windowing Techniques – need And choice of windows – liner phase characteristics, IIR Design , Analog filter design – Butterworth &Chevyshev approximation ; digital design using impulse and variant and bilinear transformation- Warping , pre warping – frequency transformation	7
5.	**Programmable DSP Chips :** Architecture and features of TMS320C2407 Signal Processing Chip- Quantization effects designing digital Filters	7
Total		42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	John G. Proakis, D.G. Manolakis, “Digital Signal Processing”.	**2006**
2.	Ashok Ambardar,“ Analog and Digital Signal Processing”.	**1999**
3.	L. R.Rabiner, B. Gold, “Theory and Applications of Digital Signal Processing”, PHI	1975
4.	Richard G. Lyons, “Understanding Digital Signal Processing”.	**2011**
5.	Roman Kuc , “ Introduction to Digital Signal Processing”.	**1988**
6.	V. Oppenheim and R. W. Schafer, “Discrete-Time Signal Processing”.	**2009**
7.	S.K Mitra “Digital Signal Processing – A Computer based Approach” , Tata Mcgraw Hill	2010

1. Subject Code: **EE 407** Course Title: **Instrumentation and Measurements**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PR 0
5. Credits : 4
6. Semester : VII
7. Subject Area : DCC
8. Pre-requisite : Nil
9. Objective : To introduce fundamentals instrumentation and measurement

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Errors and Interface Signals in Measurement:** Definitions, accuracy, precision, resolution, sensitivity, relative error, absolute error, types of error, capacitive interference, inductive interference and shielding, electromagnetic interference and shielding, ground loop interference, input guarding to reduce ground loop interference	4
2.	**Bridge Measurement**: Wheat stone bridge, Kelvin double bridge, Maxwell bridge, Hays bridge, Anderson bridge, Desauty bridge, Schering bridge, Weins bridge.	10
3.	**Electronic Measurement of Basic Electrical quantities:** Brief introduction of electromechanical voltmeters, ammeters, electro dynamo type meters, analog electronic DC voltmeters, analog electronic AC voltmeters like true r.m.s AC voltmeters, peak reading electronic ac voltmeters, Ac Amplifier-Rectifier ac voltmeters, Electronic ac ammeters, analog phase measurements, digital phase detectors, frequency and time measurement, Resistance, capacitance and inductance measurement	10
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.	Iintroduction to Instrumentation and Measurements by R. B. Northrop, CRC, 2nd 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: **EE-409** Course Title: **Switchgear and Protection**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 15 PRS: 25 MTE: 20 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VII
7. Subject Area : DCC
8. Pre-requisite : EE-303 and EE-304
9. Objective : To introduce the concept and necessity of protection in generation and transmission, and applications of switchgears including internal operation of different types of circuit breakers.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	Various types of electromechanical relays, construction and principle of operation and characteristic, applications and limitations; Over and under current, directional, differential, distance and other types of relay; Concept of static relays; Protection system and properties; Introduction to numerical relays.	8
2.	Protection of transmission lines using overcurrent, differential, directional-overcurrent and distance relays, back-up protection, carrier relaying; Busbar protection.	6

3.	Protection of transformers against internal faults such as short circuit and turn-to-turn fault using differential and overcurrent relays, protection for other abnormal conditions.	6
4.	Protection of generators against short circuit and turn-to-turn fault, stator ground fault, field ground fault, loss of excitation, loss of synchronism using different types of relays.	6
5.	Switchgear, arc and interruption theory, application in different conditions, ratings and selection, principle of operation of air break, oil filled, air blast, vacuum and SF_6 circuit breakers, elementary idea of testing methods.	12
6.	Necessity of grounding of system neutral and substation equipments, methods of grounding.	4
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Mason C. R., "The Art and Science of Protective Relaying", Wiley Eastern Limited.	1987
2.	P.M. Anderson, "Power System Protection", IEEE Press.	1999
3.	S. H. Horowitz and A. G. Phadke, "Power System Relaying" , 4th Edition, Wiley.	2014
4.	Kundur P., "Power System Stability & Control", Tata McGraw Hill, 2006	2006
5.	J. L. Blackburn and T. J. Domin, "Protective Relaying: Principles & Applications", 4th Edition, CRC Press	2014
6.	A. G. Phadke and J.S. Thorpe, "Computer Relaying for Power Systems", 2nd Edition, Wiley India.	2012
7.	Van A. R. and Warrington C., "Protective Relays - Theory and Practice", Vol. I and II, 3rd Ed., Chapman and Hall.	1982
8.	Paithankar Y. G. and Bhide S. R., "Fundamentals of Power System Protection", Prentice Hall of India Private Limited.	2007
9.	Ravindranath B. and Chander M., "Power System Protection and Switchgear", New Age International Private Limited.	2008

DEPARTMENTAL ELECTIVE COURSES (DEC)

1. Subject Code: **EE-305** Course Title: **Signals and Systems**

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

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

4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0

5. Credits : 4

6. Semester : V

7. Subject Area : DEC

8. Pre-requisite : AM-101, AM-111, EE-202, EE-205, EE-214

9. Objective : To introduce signal characteristics and analysis, theory related to systems and its analysis.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Introduction:** Size of a signal, classification of signals, elementary signals, signal operations, signal models, even and odd functions, systems, classification of systems, properties of systems, system model.	3
2.	**Linear Time-Invariant Systems:** Properties of linear, time – invariant systems, convolution, interconnection of LTI systems, zero- input response, zero state response, impulse response, and stability, systems represented by differential and difference equations.	4
3.	**Fourier Representations of Continuous – Time Signals:** Signals and vectors, correlation, orthogonal set, continuous – time Fourier series, trigonometric and exponential Fourier series, continuous – time Fourier transform, properties, Parseval relationships, Fourier transform properties.	9
4.	**Fourier Representations of Discrete – Time Signals:** Sampling, discrete – time signals, models, operations, discrete – time systems, zero input response, zero state response, stability, discrete – time Fourier series, discrete – time Fourier transform, reconstruction of continuous – time signals from samples, interpolation.	9

5.	**Laplace Transform:** Properties, solution of differential and integro - differential equations, bilateral Laplace transform, transfer function, causality and stability, continuous – time second order systems, poles and zeros.	5
6.	**Z-Transform:** Properties, region of convergence, solution of linear difference equations, system realization, bilateral transfer function, causality and stability, poles and zeros, Z- transform connection between the Laplace and Z- transform, sampled-data systems.	5
7.	**Applications:** Modulation, types, benefits, window functions, Filtering, digital filters, frequency response, mapping continuous filters to discrete time filters, digital filters and equalizers, simulation examples: signal representation, system response, Fourier spectrum, pole-zero plots in s-domain and z-domain.	7
Total		**42**

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Oppenheim A.V., Willsky A.S., Nawab S.H.,"Signals and Systems", 2nd edition, Prentice Hall.	1997
2.	Haykin S., Veen B.V., "Signals and Systems", 2nd edition, John Wiley.	2004
3.	Lathi B.P., "Principles of Signal processing and Linear Systems", Oxford International Version.	2009
4.	Lee E.A., Varaiya P., "Structure and Interpretation of Signals and Systems", 2nd edition, Addison-Wesley.	2011
5.	Hsu H.P., "Schaum's Outline of Signals and Systems, 3rd edition, McGraw Hill Education.	2013

1. Subject Code: **EE-307** Course Title: **Power Station Practices**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : V

7. Subject Area : DEC

8. Pre-requisite : ME-211

9. Objective : To familiarize the students with power plant operations, economics of power generation, safety practices in power plants.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Introduction:** Overview of conventional power plants, structure of electric power system, load curve, load factor, demand factor, diversity factor, base load, peak load, plant capacity factor and plant use factor, maximum demand number and size of generation units, interconnected grid system, advantages of coordinated operation of different types of power plants	10
2.	**Economics of Power Generation:** cost analysis of power generation, running cost and fixed cost, tariffs, types of tariffs- flat rate, block rate, two-part and three-part, comparison of tariffs and computation of monthly/ annual bill, methods of determining depreciation, availability based tariff (ABT), power trading, economics of power factor improvement.	8
3.	**Sub-station Design and Automation:** Classification, Outdoor, indoor, transformer, switching, power factor correction, frequency changer, underground, pole mounted substations, different equipments, bus bar arrangement, layout/key diagram of a typical substation, substation automation.	8
4.	**Electrical Plant & Auxiliary Equipment Maintenance:** Switchgears, Isolators, Motors, Transformers, Batteries, Cable & earthing, Actuators. **Industrial Safety & Hazards:** Industrial Hazards, Safe Working Practices in Power Plant, Permit to work system, Safety in Movement and storage of Materials, Safety Rules	8
5	**Neutral Grounding:** Grounding, equipments grounding, system grounding, ungrounded neutral system, neutral grounding, methods of neutral grounding, voltage transformer earthing, grounding transformer.	8
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Weedy B.M. and Cory B.J., "Electric Power Systems", 4th Ed., Wiley India.	2008
2.	Grainger J. J. and Stevenson W.D., "Elements of Power System Analysis", Tata McGraw-Hill Publishing Company Limited.	2008
3.	Hadi Saadat, Power System Analysis, Mc-Graw Hill, Newyork.	1999
4.	M.V. Deshpande, "Elements of Electrical Power Station Design", A. H. Wheeler and Co. Pvt. Ltd. Allahabad	2008
5.	C.L. Wadhwa," Generation Distribution and Utilization of Electrical Engineering", Wiley Eastern Ltd., New Delhi.	1989
6.	NPTI Manual on Power Plant Maintenance.	---
7.	BHEL Operation & Maintenance Manual.	----

1. Subject Code: **EE-309** Course Title: **Special Electrical Machines**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : V
7. Subject Area : DEC
8. Pre-requisite : EE-101/102, EE-202, EE-205, EE-208, EE-301
9. Objective : To familiarize the students with the working principles of various fractional /sub fractional horse power electrical motors.

10. Details of Course :

Unit No.	Contents	Contact Hours
1.	**FHP Universal Commutator motors:** Principle of operation and performance characteristics of universal commutator motor without and with compensating windings, phasor diagrams and expressions for power and torque, speed-torque characteristics with DC and AC excitations.	6

2.	**FHP Synchronous Motors:** permanent magnet synchronous motors, hysteresis motors, synchronous reluctance motors, switched reluctance motors, brushless dc motors.	12
3.	**Stepper motors:** Introduction, Multi-stack variable-reluctance stepping motors, Principles of operation , Aspects of design ,Single-stack variable-reluctance stepping motors, Hybrid stepping motors, Comparison of motor types, design of drive circuits, torque/rotor position characteristics.	12
4.	**Servomotors:** DC and AC servomotors, transfer function analysis, Synchros	6
5	**Tacho generators:** DC tachogenerators, Induction and synchronous AC tachgenerators, characteristics and applications	6
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	P.C. Sen, "Principles of Electric Machines and Power Electronics", 2nd Edition, Wiley India Ltd.	2007
2.	E. Openshaw Taylor, "The Performance and Design of AC Commutator Motors", Wheeler Publishing,	1997
3.	R. Krishnan, "Switched Reluctance Motor Drives", 1st Edition, CRC Press.	2001
4.	T.J.E. Miller and J.R. Hendershot, "Switched Reluctance Motors & Their Control", Magna Physics Publishing, 1st Edition	1993
5.	T.J.E. Miller, "Electronic Control of Switched Reluctance Machines", 1st Edition, Newnes.	2001
6.	K.Venkataratnam, "Special Electrical Machines", Universities Press	2008
7.	E.V. Armensky and G.B. Falk, "Fractional Horsepower Electrical Machines", Mir Publishers	1978
8.	John Chiasson "Modeling and High-Performance Control of Electric Machines" John Wiley & Sons, Inc., Publication	2005
9.	P. P. Acarnley "Stepping Motors : a guide to theory and practice" IET Control Engineering series	2002

1. Subject Code: **EE-311** Course Title: **Energy Efficient Motors**

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

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

4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0

5. Credits : 4

6. Semester : V

7. Subject Area : DEC

8. Pre-requisite : EE-101/102, EE-202, EE-205, EE-208, EE-301

9. Objective : To familiarize the students with the concept of energy auditing and energy efficient motors.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Electrical Systems:** Different sources of energy - Primary and Secondary energy, Commercial and Non commercial energy, Renewable and Non-Renewable energy, Overall Electrical system, load management, power factor issues, capacitor sizing & location, performance assessment of PF capacitors, case studies.	10
2.	**Energy Audit:** Definition, need and types of energy audit. Energy management (audit) approach-understanding energy costs, benchmarking and audit instruments, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, case studies.	8
3.	**Lighting Systems:** Basic terms, Domestic/commercial/ industrial lighting systems, performance characteristics of lamps, energy efficient practices in lighting systems, Electronic ballast, Occupancy sensors, Energy efficient lighting controls, case studies.	6

4.	**Electric Motors:** Types and operating characteristics of electric motors – Factors affecting energy efficiency Energy efficient control and starting –Load matching – Selection of motors – Efficiency and load analysis – Energy efficiency High efficiency motors – Industrial drives – Control schemes – Variable speed drives and Energy conservation schemes – Efficient control strategies – Over-sizing - Case studies.	10
5	**Energy Efficient Electrical System Technologies:** Maximum demand controllers, Automatic power factor controllers, Energy efficient transformers, Energy efficient pumps & fan.	8
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1	Steven R. Patrick, Dale R. Patrick, Stephen W. Fardo, "Energy Conservation Guidebook", The Fairmont Press, Inc.	1993
2	S.C. Tripathy, "Electric Energy Utilization and Conservation", Tata McGraw Hill, India	1991
3	. IEEE Bronze Book: IEEE Standard 739-1995 – IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities, IEEE	1996
4	Books of Energy Management & Auditors, Bureau of Energy Efficiency, http://beeindia.in/ volume 1, 2, 3 & 4.	2011
5.	Sunil S. Rao, "Utilization generation & conservation of electrical energy", Khanna Publishers, India	2011

1. Subject Code: **EE-313** Course Title: **Linear Integrated Circuits**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4

6. Semester : V

7. Subject Area : DEC

8. Pre-requisite : EE-101/102, EE-203

9. Objective : To familiarize the students with the concepts of linear integrated circuits

10. Details of Course:

Unit No.	Contents	Contact Hours
1	**Feedback Amplifiers:** General feedback structure, properties of negative feedback, basic feedback topologies, determination of loop-gain, stability problem	6
2	**IC OP-AMP Applications:** OP-AMP fundamentals (Brief review of differential amplifier, current mirror, active load, level shifter, output stage; ac and dc characteristics), basic building blocks using OP-AMPS, inverting/non inverting VCVS, integrators, differentiators, CCVS, Instrumentation amplifiers, Biquad filter (LP, HP, BP and notch), Oscillators, A/ D & D/A convertors	6
3	**Non-linear Amplifiers:** Logarithmic amplifiers, Log/antilog modules, Precision rectifier, Peak detector, Sample and Hold circuits	10
4	**Comparators and Timers:** OP-AMP as comparator, Schmitt Trigger, Square and Triangular wave generator, mono stable and astable multi vibrator, IC timers and their applications. IC Analog multipliers: Basic circuits, applications	10
5	**IC OTA Applications:** Basic building blocks using OTA, electronically programmable functional circuit examples. Voltage regulators: (78/79, XX), 723 IC regulators (current limiting, current fold back), SMPS. Applications of analog switches: programmable gain amplifiers	10
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1	A. S. Sedra and K.C. Smith, “Microelectronic Circuits”, Oxford University Press,	2003

2	M.H. Rashid, "Microelectronic Circuits: Analysis and Design", Oxford University Press.	2003
3	M. Jacob, Dorlin Kindersley. "Applications and Design with Analog Integrated Circuits", PHI	1996
4	Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", TMH.	2002

1. Subject Code: **EE-315** Course Title: **Digital Control and State Variable Analysis**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : V
7. Subject Area : DEC
8. Pre-requisite : EE- 206
9. Objective : To make the students conversant with the techniques of discrete-time control systems being used for industrial control.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	Review of z-transform and stability analysis, relationship between the s-plane and the z-plane, inverse z-transform; Theorems and properties of the z-transform, applications of z-transform; Delayed z-transform.	6
2.	z-Transform analysis of digital control systems, sample and hold devices, sampled data control system, pulse transfer function, z-transfer function, characteristic equation of closed loop systems.	8
3.	Concept of state, state variable and state vector. State model of electrical and mechanical systems, state equations, eigen value and eigen vector, phase variable and canonical variable forms, state equations, Time domain and Laplace transform solution of state equations, derivation of transfer function from state model.	10

4.	State-space analysis of sampled data systems, state equations of discrete data systems, phase variable and canonical variable forms, state transition matrix, properties of state transition matrix, solution of state equations.	8
5.	Concept of Controllability & Observability, Kalman's method and Gilbert's test, Effect of adding poles & zeros, Pole placement design technique and observer design.	6
6.	Design using state-space techniques; Stability tests of discrete data systems: Bilinear transformation method, Jury's stability test.	4
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Gopal M., "Digital Control and State Variable Methods", 2nd Ed., Tata McGraw-Hill Publishing Company Limited.	2008
2.	Kuo B. C., "Digital Control Systems", 2nd Ed., Oxford University Press.	2007
3.	I.J.Nagrath and M.Gopal,"Control Systems Engineering", New Age International (P) Limited Publisher	2008
4.	D.Roy Choudhury, "Modern control Engineering", Prentice-Hall of India Pvt Ltd.	2005
5.	R. Anandanatrajan and P.Ramesh Babu, "Control Systems Engineering", SCITECH Publications (India) Pvt. Ltd.	2012

1. Subject Code: **EE-317** Course Title: **Renewable Energy Systems**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : V

7. Subject Area : DEC

8. Pre-requisite : EE-215, EE-302, EE-301

9. Objective : To familiarize the students with general power scenario, various renewable energy technologies and grid integration of renewable energy resources.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Introduction:** Basics of energy, conventional energy sources, fossil fuels limitations, renewable energy sources, advantages and limitations, global energy scenario, energy scenario of India, new technologies (hydrogen energy, fuel cells, bio fuels).	6
2.	**Solar Energy:** Theory of solar cells, solar cell materials, I-V characteristics of solar cell, PV module, PV array, MPPT, PV systems, Stand alone and grid connected PV systems, storage, PV based water pumping, solar radiation and its measurement, flat plate collectors and their materials, applications and performance, solar thermal power plants, limitations.	12
3.	**Wind Energy:** Wind power and its sources, site selection, power in the wind, impact of tower height, classification of wind turbine and rotors, wind energy extraction, betz'z limit, wind characteristics, performance and limitations of wind energy conversion systems	10
4.	**Biomass Small Hydro and geothermal energy:** Availability of bio-mass and its conversion theory, types of biomass, gasification, biogas plant, biomass cogeneration, small hydro power development, types of small hydro plants, small hydro power plants, resources of geothermal energy, thermodynamics of geo-thermal energy conversion, geothermal power generation, environmental considerations.	8
5	**Emerging technologies for power generation:** Introduction to tidal energy, tidal characteristics, tidal power plant, tidal power development in India, introduction to wave energy, factors affecting wave energy, principles of wave energy plant, OTEC, applications of OTEC, principle of working of various types of fuel cells and their working, performance and limitations, future potential of fuel cells, Emergence of hydrogen, cost analysis of hydrogen production, hydrogen storage.	6
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Duffie and Beckmen, Solar Engineering of Thermal Processes, Wiley Publications.	1991
2.	S. P. Sukhatme, Solar Energy, TMH, India.	2008
3.	John Twiden and Tony Weir, Renewable Energy Resources, BSP Publications.	2006
4.	D. P. Kothari, Rakesh Ranjan, Renewable Energy Sources and Emerging Technologies, PHI, India.	2011
5.	C. S. Solanki, Renewable Energy Technologies, A Practical Guide for Beginners, PHI, India	2012
6.	G. D. Rai, Non Conventional Energy Resources, Dhanpat Rai, India	2006

1. Subject Code: **EE-319** Course Title: **Digital System Design**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : V
7. Subject Area : DCC
8. Pre-requisite : EE-203, EE-213
9. Objective : To familiarize the students with the various combinational and sequential circuits and VHDL language.

10. Details of Course:

Unit No.	Contents	Contact Hrs
1.	INTRODUCTION: Logic families and their salient features, specifications. Fan-in, Fan-out Considerations, Noise Margins Propagation Delays, Wires, Inter-Connect parameters, Capacitance, Resistance & Inductance.	4

2.	DESIGNING COMBINATIONAL LOGIC GATES IN CMOS: CMOS Inverter, Evaluating robustness of the CMOS inverter; Dynamic behavior static CMOS Design, Complementary CMOS. Ratioed Logic, Pass Transistor Logic. Dynamic CMOS Design; basic principles.	8
3.	DESIGNING SEQUENTIAL LOGIC CIRCUITS: Timing metrics for sequential circuits, Classification of Memory elements. Static Latches and Registers. Multiplexer Based latches. Low voltage static latches. Dynamic Latches and Register; Transmission- Gate Edge Triggered Registers. C²MOS- a clock-skew insensitive approach	8
4.	VHDL PROGRAMMING: VHDL: Introduction. Structure and components. Behavioural, structural models. Concurrent, sequential parts. Data types. Subprograms and packages	10
5.	XILINX FOUNDATION SERIES SOFTWARE: Introduction. Overview of the package. Implementation of digital designs using XILINX foundation series software	12
Total		**42**

11. Suggested books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	J. M Rabaey, A Chandrakasan, & B Nikolic: Digital Integrated Circuits: A Design Perspective, PHI, 2nd Edition, India	2003
2.	R. Jaeger and T. Blalock, Microelectronic Circuit Design, McGrawhill, 4th Edition	2010
3.	V. A. Pedroni: Circuit Design and Simulation With VHDL, MIT Press, 2nd Edition	2010

1. Subject Code: **EE-321** Course Title: **Soft Computing Techniques**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4

6. Semester : V

7. Subject Area : DEC

8. Pre-requisite : EE-202, EE-204

9. Objective : To familiarize the students with the concepts of soft computing techniques

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Introduction:** Conventional and Modern Control System, Intelligence, Soft and Hard Computing, Artificial Intelligence.	4
2.	**Fuzzy Logic System:** Introduction to crisp sets and fuzzy sets, examples. basic fuzzy set operation.. Fuzzification, rule base, inference engine and defuzzification. Membership functions: triangular, trapezoidal, bell shaped, guassian, sigmoidal etc. Introduction to fuzzy logic modeling and control. Fuzzy knowledge and rule bases. Fuzzy modeling and control schemes for nonlinear systems. Fuzzy logic control for nonlinear time-delay system.	9
3.	Hybrid Fuzzy Control: Fuzzy P Controller, Fuzzy PI controller, Fuzzy PD and Fuzzy PD+I Control, Fuzzy Logic Toolbox in MATLAB.	6
4.	**Artificial Neural Networks:** Concept of ANN and its basic mathematical model. McCulloch-Pitts neuron model, simple perception Adalineand Madaline. Feed –Forward Multilayer Perceptron, Learning and Training the neural network. Hopfield network, Elman network, Self-organizing network and Recurrent network.	8
5.	Neural Network based control, Neural Network Toolbox in MATLAB	6
6.	**Genetic Algorithm-**Basic concept of Genetic algorithm and detail algorithm steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept of some other search techniques like tabu search and ant-colony search techniques for solving optimization problems	9
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Roland S Burns, Advanced Control Engineering, published by Butterworth Heinemann.	2001
2.	Laxmidhar Behera, I Kar, Intelligent Systems and Control, Oxford University Press	2009
3.	M.E. E1- Hawary , Artificial Intelligence application in Power Systems, IEEE Press	2009
4.	Jan Jantzen, Foundations of Fuzzy Control, A practical approach, Wiley	2013
5.	M Gopal, Digital Control and State Variable Methods, conventional and neural-fuzzy control system, Published by Tata McGraw Hill Education Private Ltd.	2012
6.	David E Goldberg, Genetic Algorithms, published by Pearson	2008

1. Subject Code: **EE-323** Course Title: **CMOS Analog Integrated Circuits**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : V
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To introduce fundamentals of CMOS Integrated Circuits

10. Details of Course

S. No.	Contents	Contact Hours
1.	Introduction	2
2.	MOS fundamentals and single stage amplifiers	5
3.	Cascode and other amplifier configurations	4
4.	MOS differential amplifiers	4
5.	MOS current sources and voltage sources	3
6.	Frequency response of MOS amplifiers	4
7.	NMOS and CMOS opamp	4
8.	Transconductance amplifiers	4
9	Fully differential amplifier architectures	4
10	CMOS oscillators and data converters	6
11	Noise considerations	2
TOTAL		**42**

11. Suggested Books

S. No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Behzad Razavi, " Design of Analog CMOS Integrated Circuit", Mac-Graw-Hill (ISBN: 0071188398)	2003
2	T. C. Carusone, David A. Jones and Ken Martin, " Analog Integrated Circuit Design", 2nd Edition John Wiley(ISBN:0470770104)	2011
3	P. R. Gray , P. J. Hurst , S. H. Lewis and R. G. Meyer, "Analysis and Design of Analog Integrated Circuits", John Wiley Ltd. ,5th Edition(ISBN: 0471321680)	2009
4	R. Gregorian and G. C. Temes, " Analog MOS ICs for Signal Processing", John Wiley Ltd. (ISBN: 0471097977)	1986

1. Subject Code: **EE-308** Course Title: **Power System Operation and Control**

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

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

4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0

5. Credits : 4

6. Semester : VI

7. Subject Area : DEC

8. Pre-requisite : EE-214, EE-215, EE-302

9. Objective : To familiarize the students with the load frequency control, voltage control and stability of power systems.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Load Frequency Control:** Concept of load frequency control, load frequency control of single area system, effect of governor droop and load damping, block diagram representation of single area system, steady-state frequency error, dynamic response, and supplementary control of generating units (PI control).	10
2	**Multi area System**: Concept of control area, load frequency control of two area system, tie line control, concept of area control error, block diagram representation of two area system, static and dynamic response.	06
3.	**Power System Stability:** Stability and stability limit, steady state stability study, derivation of swing equation.	08
4.	**Transient stability** studies by equal area criterion and step-by-step method, factors affecting steady state and transient stability and methods of improvement.	08
5.	**Reactive Power Control:** Schematic diagram and block diagram representation, different types of excitation systems, regulating transformers and tap changing, reactive power control, introduction and use of FACTS Controllers.	10
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	A.J. Wood and B.F. Wollenberg, "Power Generation, Operation and Control", John Wiley and Sons,	2011
2.	Olle. I.Elgerd, "Electric Energy Systems Theory – An Introduction", TMH	2003
3.	P. Kundur, "Power System Stability and Control", TMH,	2006
4.	A.R. Bergen and V. Vittal, "Power System Analysis", Pearson education Asia	2006
5.	Glover J. D., Sarma M.S. and Overbye, T. J. "Power System Analysis & Design", 5th Ed., Cengage Learning India Pvt. Ltd.	2011
6.	J. Grainger and W. D. Stevenson, "Power System Analysis", TMH	2006
7.	Hadi Saadat ,"Power System Analysis" TATA McGRAW-HILL	2003
8.	Nagrath and Kothari, "Power System Engineering", TMH	2006

1. Subject Code: **EE-310** Course Title: **Communication Systems**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : VI
7. Subject Area : DEC
8. Pre-requisite : EE305
9. Objective : To familiarize the students with the communication systems.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Introduction to Electronic Communication systems**: Introduction, Electronic communication system, Types of communication system: Frequency spectrum of EM waves, Modulation, Bandwidth and information capacity, Transmission **Noise:** Internal noise (Thermal, shot , Transit time Miscellaneous); External noise (Atmospheric , Industrial , Extra Terrestrial); Noise calculations; Noise figure; Noise temperature.	10
2	**Amplitude Modulation systems:** Transmission (Principle, spectrum, efficiency, power and current calculation); AM envelop; AM Modulator circuits; AM transmitters; QAM; AM, Receivers: Receiver Parameters; (Selectivity, sensitivity, dynamic range, fidelity); TRF Receiver; Superhetrodyne receiver, Low noise Amplifier, Mixer / converter, Noise limiter,Automatic Gain Control circuit **Single sideband communication systems:** Single Sideband system, AM SSB full carrier, AM SSB reduced carrier, AM SSB suppressed carrier, AM independent sideband, AM vestigial sideband, Comparison of single sideband transmission to conventional AM, Single sideband generation methods; Single sideband transmitter.	06
3.	**Angle Modulation system:** Mathematical Analysis, Deviation sensitivity, Waveforms, Phase deviation and modulation index, Frequency analysis of angle modulated system, Bandwidth requirement of angle modulated system; Noise and angle modulation, Pre-emphasis and de-emphasis, Generation of FM waves, Demodulation of FM waves, Angle Modulation vs. amplitude modulation.	08
4.	**Sampling Theory &** Pulse Modulation Sampling process, sampling theorem, signal reconstruction, flat top sampling of band pass signals, Analog Pulse Modulation: Types of analog pulse modulation, Method of generation and detection of PAM, PWM, PPM, Spectra of pulse modulation, concept of time division multiplexing. Noise in CW modulation: Noise calculation in communication system, Noise in Amplitude modulation system, Noise in Angle modulated system, Narrow band noise.	08
5.	**Probability Theory:** Concept of Probability, Random variable, Statistical averages, Correlation, SumofRandom Variables, Central Limit Theorem, Random Process, Classification of Random Processes, Power spectral density, Multiple random processes	10
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	B. P. Lathi, " Modern Digital and Analog Communication System" Oxford University Press	3rd Edition
2.	Taub Schilling, "Principles of Communication Systems"	2nd Edition
3.	Simon Haykin , "Communication Systems" John Wiley & Sons Inc	4th Edition
4.	W. Tomasi, " Electronic Communication Systems" Pearson Education,	5th Edition
5.	Kennedy, George & Davis, Bernard / "Electronic Communication Systems"	4th Edition
6.	Singh, R.P. & Sapre, S.D. / "Communication Systems: Analog & Digital" / Tata McGraw-Hill	

1. Subject Code: **EE-312** Course Title: **Power System Optimization**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : VI
7. Subject Area : DCC
8. Pre-requisite : AM-201, EE-205, EE-215, EE-302
9. Objective : To familiarize the students with the methods/ techniques of analysis for optimal solution of power system problems.

10. Details of Course:

Unit No.	Contents	Contact Hrs
1.	**Introduction** : A perspective, the components of a Power System, Power System and Computers, Planning and Operating Problems- Resources and Equipment Planning, Operation Planning, Real time Operation	2
2.	**Load Flow Studies:** Introduction, Bus Classification, Nodal Admittance Matrix Formulation, Impedance Matrix Formulation, Development of Load Flow Equations, Computation of Line Flows, Modelling of Regulating transformers, Gauss Seidel Method, Newton Raphson Method, and Fast Decoupled Load Flow	10
3.	**Economic Load Dispatch :** Introduction, Generator Operating Cost, Economic Dispatch neglecting losses, Economic Dispatch Including Transmission Losses, Classical Method to Calculate Loss Coefficients, Loss Coefficent calculation Using Admittance Matrix.	8
4.	**Unit Commitment:** Introduction, Spinning Reserve,Thermal Unit Constraints, Unit Commitment Solution Methods.	6
5.	**Economic Scheduling Of Hydrothermal Plants And Optimal Power Flows:** Introduction, Problem Formulation, Optimal Power Flow, Problem Formulation	8
6.	**Multiobjective Optimal Power Flow:** Introduction, Problem Formulation, Weighting Method, Constraint Method, Non-Inferior Set Estimation Method, Minimum Distance Method, Surrogate Worth Trade Off Method, Sequential Goal Programming	8
Total		**42**

11. Suggested Readings:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Power System Optimization, Kothari & Dhillon, PHI Learning Pvt. Ltd.	2009
2.	A. Bergen and V. Vittal, Power system Analysis, Pearson Education Asia, Second Edition	2002

3.	J.D. Glover, M.S. Sharma, T.J.Overbye, “Power System Analysis and Design” Thomson,	2008
4.	P.S.R. Murthy “ Power System Analysis” B.S. Publications	2007
5.	Kothari & Nagrath, “Power System Engineering” Tata Mc. Graw Hill.	2006
6.	Hadi Saadat ,”Power System Analysis” TATA McGRAW-HILL	2003
7.	Electrical Power System, C.L. Wadhwa, New Age International Pvt. Ltd.	2010

1. Subject Code: **EE-314** Course Title: **Power Electronic Applications to Power Systems**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : VI
7. Subject Area : DEC
8. Pre-requisite : EE-301, EE-303
9. Objective : To familiarize the students with the development of HVDC and FACTS technology, the concept of power quality and its improvement.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**DC Power Transmission Technology:** Introduction, comparison of AC and DC transmission, application of DC transmission, description of DC transmission system, planning for HVDC transmission, modern trends in DC transmission. Analysis of HVDC converter: pulse number, choice of converter configuration, simplified analysis of Graetz circuit, analysis with and without ignition delay, commutation overlap.	8

2.	**HVDC System Control:** General principles of DC link control, converter control characteristics, combined rectifier and inverter characteristics, alternative inverter control modes, mode stabilization, system control hierarchy, harmonics and filters.	6
3.	**Overview Of Power Quality:** Classification of power quality issues, characterization of electric power quality, power acceptability curves, power quality problems, poor load power factor, nonlinear and unbalanced loads, transients, voltage sags and swells, over voltages and under voltages, outage, harmonic distortion, voltage notching, flicker, electrical noise, power quality indices, distortion index, IEEE guidelines and recommended practices	6
4.	**Power Quality Improvement:** Instantaneous reactive power theory, synchronous reference frame theory, instantaneous real and reactive powers, instantaneous symmetrical components, load compensation using DSTATCOM, configuration and control, introduction to dynamic voltage restorer and unified power quality conditioner.	6
5.	**Compensation with FACTS Controllers:** Reactive power control in power systems, transmission system compensation, static series and shunt compensations. Thyristor Controlled FACTS Controllers: TCR, SVC and TCSC. Concept of voltage sourced converters, multi-level and PWM converters. Voltage sourced converter based FACTS Controllers: STATCOM, SSSC, UPFC and IPFC. Objectives of shunt compensation, methods of controllable VAR generation, SVC and STATCOM characteristics, comparison between SVC and STATCOM, applications. Objectives of series compensation, principles of TCSC and SSSC, basic operating principles of UPFC and IPFC	16
Total		**42**

11. Suggested Books:

S. No.	**Name of Authors /Books / Publishers**	**Year of Publication/ Reprint**
1.	K.R.Padiyar, “HVDC Power Transmission System”, NewAge Publishers,2011	2011
2.	Arindam Ghosh and Gerard Ledwich, “Power Quality Enhancement Using Custom Power Devices”, Penguin Books Ltd.	2009

3.	N.G. Hingorani and L. Gyugyi, “Understanding FACTS”, IEEE Press, 2000.	2000
4.	P. Kundur, “Power System Stability and Control”, TMH.	2006
5.	R. Verma and R.M. Mathur, “Thyristor Based FACTS Controllers in Electrical Transmission Systems”, 1st Edition, IEEE Press.	2002
6.	K.K. Sen and M.L. Sen, “Introduction to FACTS Controllers”, 1st Edition, IEEE Press.	2009

1. Subject Code: **EE-316** Course Title: **Electrical Energy Storage Systems**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 3
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : VI
7. Subject Area : DEC
8. Pre-requisite : EE-301
9. Objective : To familiarize the students with the basic Electrical Energy Storage Systems, viz, different kinds of Batteries, Super Capacitors, Fuel Cell, Flywheel Storage, Compressed Air Storage systems and Pump storage systems, their charging/discharge cycle, control of converters for their operation and their suitability to curb intermittency.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Battery :** Introduction, energy storage parameters, lead–acid batteries constructional features, battery charge–discharge cycles operating limits and parameters, maintenance, sizing, types, applications, performance measurement, charging and discharging of a battery, storage density, energy density, and safety issues in lead-acid, nickel-cadmium, zinc manganese dioxide batteries, modern batteries as zinc-air, nickel hydride, lithium battery, flow batteries.	6

2.	**Valve Regulated Lead Acid Batteries :** The valve-regulated battery, valve-regulated battery, heat management in lead–acid batteries, heat generation, heat dissipation, lead alloys for valve-regulated lead–acid batteries, hardening mechanism in lead–calcium alloys, aluminum addition, formation of structure of positive and negative active masses, manufacture of lead–acid battery plates, soaking and formation phenomena, positive-plate additives to enhance formation and battery performance, modeling the effects of additives, conductive additive, negative-plate additives, function of the separator in the VRLA battery, characteristics of absorptive glass materials, separator properties and function, separator materials, applications in automotive applications, telecommunications and UPS Applications, remote-area power-supply systems(RAPS), recovery and recycling of lead–acid batteries.	6
3.	**Ultra Capacitors / Super Capacitors :** Introduction, double-layer ultra capacitors, high-energy ultra capacitors, rating, size and applications, super capacitors, basic components of super capacitors, several types of electrodes and electrolytes, electrode materials, high surface area activated carbons, metal oxide, conducting polymers, types of electrolyte, disadvantages, advantages of super capacitors, comparison with battery systems, applications in public transport vehicles, private vehicles, and consumer electronics, aspects of energy density, power density, price, and market.	4
4.	**Fuel Cell:** Fuel cells for direct energy conversion by electro chemical means, focus on the maximum intrinsic efficiency of an electrochemical converter, physical interpretation of the Carnot efficiency factor, electro chemical energy convertors, power outputs, types of fuel cells, hydrogen oxygen cells, hydrogen air cell, hydrocarbon air cell, alkaline fuel cell, and phosphoric fuel cell and redox flow batteries, detailed analysis of the advantages and drawbacks.	8
5	**Other Storages**: Pumped hydroelectric energy storage, storage capabilities of pumped systems, compressed air energy storage, storage heat , energy storage as an economic resource, flywheels, advanced performance of flywheels, applications of flywheels, design strategies, superconducting magnetic storage system, SMES system capabilities , developments in SMES systems.	6

6	**Power Electronics for Charging Control :** Battery management systems, battery data acquisition, battery state-of-charge, control of charge and discharge, multiple battery systems, thermal management of batteries, safety management of batteries, charging techniques for VRLA batteries, constant-voltage charging, constant-current charging, constant voltage–constant current combinations, taper-current charging, pulsed-current charging, charging of VRLA products, oxygen cycle and saturation effects, overcharge processes, ac-dc and dc-dc converters, isolated converters, multi pulse converters, multilevel converters, P2 cell, resonant converters, protection circuits, charger design and calculation of losses.	12
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Rand D.A.J., Moseley P.T., Garche J. and Parker C.D. , " Valve-regulated Lead–Acid Batteries", Elesevier	2004
2.	Osaka T., Datta M. , "Energy Storage Systems in Electronics-New Trends in Electrochemical Technology" , CRC Press	2000
3.	Broussely M. and Pistoia G., "Industrial Applications of Batteries from Cars to Aerospace and Energy Storage", Elsevier.	2007
4.	Nazri G. A. and Pistoia G., "Lithium Batteries – Science and Technology", Kluwer Academic Publishers	2004
5.	Larminie J., Dicks A. and Wiley-Blackwell , "Fuel Cell Systems Explained" , 2nd edition	2003

1. Subject Code: **EE-318** Course Title: **Switched Mode Power Supplies**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4

6. Semester : VI

7. Subject Area : DEC

8. Pre-requisite : EE-301

9. Objective : To familiarize the students with control operation and design of switch mode power converters for power supplies.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Introduction:** Classification of Power Supplies, Basic Functions of Voltage Regulators, Power Relationships in DC–DC Converters, Topologies of PWM DC–DC Converters.	4
2.	**Buck, Boost PWM DC–DC Converter:** Analysis of PWM Buck, Boost & Buck-Boost Converter. Design of Buck, Boost & Buck-Boost Converters. Power Losses and Efficiency of Buck, Boost & Buck-Boost Converters.	6
3.	**Flyback and Forward PWM DC–DC Converter :** Introduction, Transformers, DC Analysis of PWM Flyback and Forward Converter, Boundary between CCM and DCM, Ripple Voltage in Converter, Power Losses and Efficiency of Converter, Multiple-output Converters, Bidirectional Converter.	8
4.	**Half, Full-bridge & Push-Pull PWM DC–DC Converter :** Introduction, DC Analysis of PWM Half, Full-bridge & Push Pull Converter, Boundary between CCM and DCM, Ripple Voltage in Converters, Power Losses and Efficiency of Converters, Phase-controlled Full-bridge Converter, Comparison of PWM DC–DC Converters	6
5.	**Soft-switching DC–DC Converters:** Introduction, Zero-voltage-switching DC–DC Converters, Buck ZVS Quasi-resonant DC–DC Converter, Multi resonant Converters.	8
6	**Small-signal Models of PWM Converters for CCM and DCM:** Averaged Model of Ideal Switching Network, Model Reduction, Large-signal Averaged Model, DC and Small–signal Circuit Linear Models of Switching Network, PWM Small-signal Switch Model Control-to-output Transfer Function, Audio Susceptibility, Voltage & Current mode Control, PWM Converters with Peak-current-mode Control, Instability of Closed-current Loop.	10
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Kazimierczuk M. K. , "Pulse-width Modulated DC–DC Power Converters", John Wiley & Sons	2008
2.	Basso C. "Switch-Mode Power Supplies Spice Simulations and Practical Designs", Tata McGraw-Hill Publishing Company Limited.	2008
3.	Pressman A. Billings K. and Morey T. , "Switching Power Supply Design", Tata McGraw-Hill Publishing Company Limited.	2009
4.	Steven M. Sandler , "Switch-Mode Power Supply Simulation: Designing with SPICE" , Tata McGraw-Hill Publishing Company Limited	2005
5.	Keng C. Wu , "Switch-Mode Power Converters: Design and Analysis", Elsevier Science Publishing	2005
6.	K. Kit Sum, Marcel Dekker , "Switch Mode Power Conversion"	1984

1. Subject Code: **EE-320** Course Title: **VLSI Design**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : VI
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To introduce fundamentals of CMOS Integrated Circuits

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Fabrication & Electrical Properties Of MOS:** Introduction to MOS, CMOS and Bi-CMOS technology, Fabrication of NMOS and CMOS, basic Electrical Properties of MOS & BiCMOS Circuits: I_{ds} - V_{ds} relationships, Threshold Voltage V_T, g_m, g_{ds} and Pass Transistor, nMOS inverter, Pull up to pull down ratio for an NMOS inverter, CMOS & Bi-CMOS Inverters.	9
2.	**CMOS Circuit Design Process:** VLSI design flow, MOS layers, stick diagrams, n-MOS design style, CMOS design style, lambda based design rules, layouts for inverters, sheet resistance, capacitances of layers, Gate delays, Delay estimation, Driving large capacitive loads, Fan-in and Fan-out, choice of layers, Scaling and	10
3.	**CMOS adders, Shifters and Multipliers:** Adders - Transmission based Adder, Carry look-ahead adder, Manchester carry chain adder, Carry Bypass Adder, Carry Skip Adder, Carry Select Adder , Shifters- Barrel Shifter, Logarithmic Shifter, Multipliers - Array Multiplier, Carry Save multiplier, Booth Multiplier, ALUs, Parity generators, Comparators, Zero/ One Detectors	9
4.	**Counters, Memory and Other Elements:** Counters- Synchronous & Asynchronous Counter, High Density Memory Elements. Design Approach, PLA, PAL - 22V10 PAL architecture, Programming of PALs, FPGAs, CPLDs, Cell based Design Methodology.	9
5.	**Synthesis and Testing:** Types of Simulation, VHDL Synthesis, Layout Synthesis, Design capture tools, Design Verification Tools. CMOS Testing: CMOS Testing, Need for testing, Test Principles, Chip level Test Techniques, System-level Test Techniques, Layout Design for improved Testability.	8
TOTAL		**45**

11. Suggested Books

S. No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	K. Eshraghian, D. A. Pucknell and and S. Eshraghianl, “Essentials of VLSI Circuits and Systems”, PHI, (ISBN: 8120327721)	2005

2.	N. E. Weste and K. Eshraghian, " Principles of CMOS VLSI Design", PHI, 4th Edition (ISBN:0321547748)	2011
3.	John M. Rabaey, " Digital Integrated Circuits: A Design Perspective", PHI, 2nd edition (ISBN: 0130909963)	1997
4.	J. P. Uyemura, "Introduction to VLSI Circuits and Systems", , John Wiley, 2nd Edition (ISBN: 0130909963)	2003
5.	E D. Fabricius, " Introduction to Very Large Scale Integration Design, McGraw-Hill Education (ISBN:007100727X)	1990

1. Subject Code: **EE-322** Course Title: **IC Technology**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : VI
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To introduce fundamentals of IC fabrication processes and IC design methods

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 Equipments.	9
4.	**Deposition , Diffusion, Lon Implementation 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**

11. Suggested Books

S. No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	S. M. Sze, "VLSI Technology", 2nd edition McGraw-Hill,(ISBN: 070626863)	1983
2.	K. Eshraghian, D. A. Pucknell and and S. Eshraghianl, "Essentials of VLSI Circuits and Systems", PHI, (ISBN: 8120327721)	2005
3.	W. Wolf, " Modern VLSI design", 4th edition, PHI (ISBN: 0134186044	2015
4.	J. P. Uyemura, "Introduction to VLSI Circuits and Systems", John Wiley Ltd., 2nd Edition (ISBN: 0130909963)	2003
5.	E D. Fabricius, "Introduction to Very Large Scale Integration Design, McGraw-Hill Education (ISBN:007100727X)	1990

1. Subject Code: **EE-324** Course Title: **Design, Estimation and Costing of Industrial Electrical System**

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

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

4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0

5. Credits : 4

6. Semester : VI

7. Subject Area : DEC

8. Pre-requisite : EE-202, EE-204

9. Objective : To familiarize the students with the concepts of estimation, design and costing of electrical systems

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**General Principles Of Estimation**: Introduction to estimation & costing, Electrical Schedule, Catalogues, Market Survey and source selection, Recording of estimates, Determination of required quantity of material, Labor conditions, Determination of cost material and labour, Contingencies, Overhead charges, Profit, Purchase system, Purchase enquiry and selection of appropriate purchase mode, Comparative statement, Purchase orders, Payment of bills, Tender form, General idea about IE rule, Indian Electricity Act and major applicable I.E rules.	5
2.	**Residential Building Electrification**: Introduction to electrical symbols, their advantages and requirement. Concept of wiring diagram, schematic diagrams and their types. General Rules guidelines for wiring of residential installation and positioning of equipments**,** Principles of circuit design in lighting and power circuits Procedures for designing the circuits and deciding the number of circuits, Method of drawing single line diagram. Selection of type of wiring and rating of wires and cables Load calculations and selection of size of conductor, Selection of rating of main switch Distribution board, protective switchgear ELCB and MCB and wiring accessories, Earthing of residential Installation, sequence to be followed for preparing estimate, Preparation of detailed estimates and costing of residential installation	7

3.	**Electrification Of Commercial Installation:** Concept of commercial installation, Differentiate between electrification of residential and commercial installation, Fundamental considerations for planning of an electrical installation system for commercial building, Design considerations of electrical installation system for commercial building, Load calculation and selection of size of service connection and nature of supply, Deciding the size of the cables, busbar and bus bar chambers, Mounting arrangements and positioning of switchboards, distribution boards main switch etc, Earthing of the electrical installation, Selection of type wire, wiring system and layout, Sequence to be followed to prepare estimate, Preparation of detailed estimate and costing of commercial installation.	7
4.	**Service Connection, Inspection And Testing Of Installation**: Concept of service connection, Types of service connection and their features, Method of installation of service connection, Estimates of underground and overhead service connections, Inspection of internal wiring installations, Inspection of new installations, testing of installations, testing of wiring installations, Reason for excess recording of energy consumption by energy meter. **Electrical Installation For Power Circuits:** Introduction, Important considerations regarding motor installation wiring, Determination of input power, Determination of input current to motors Determination of rating of cables Determination of rating of fuse, Determination of size of Condit, distribution Board main switch and starter.	7
5.	**Design And Estimation Of Overhead Transmission & Distribution Lines:** Introduction, Typical AC electrical power system, Main components of overhead lines, Line supports, Factors governing height of pole, Conductor materials, Determination of size of conductor for overhead transmission line, Cross arms, Pole brackets and clamps, Guys and Stays, Conductors configuration spacing and clearances, Span lengths, Overhead line insulators, Insulator materials, Types of insulators, Lightning Arrestors, Phase plates, Danger plates, Anti climbing devices, Bird guards, Beads of jumpers, Muffs, Points to be considered at the time of erection of overhead lines, Erection of supports, Setting of stays, Fixing of cross arms, Fixing of insulators, Conductor erection, Repairing and jointing of conductor , Dead end clamps, Positioning of conductors and attachment to insulators, Jumpers, Tee-offs, Earthing of transmission lines, Guarding of overhead lines, Clearances of conductor from ground, Spacing between conductors, Testing and commissioning of overhead distribution lines, Some important specifications.	10

6.	**Design And Estimation Of Substations:** Introduction, Classification of substation, Indoor substations, Outdoor substations, Selection and location of site for substation, Main Electrical Connections, Graphical symbols for various types of apparatus and circuit elements on substation main connection diagram, Key diagram of typical substations, Equipment for substation and switchgear installations, Substation auxiliaries supply, Substation Earthing	6
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Raina K.B. and Bhattacharya S.K., "Electrical Design, Estimating and Costing", New Age Intarnational, New Delhi	2010
2.	N. Alagappan & S. Ekambaram, "Electrical Estimating & Costing", TMH	2006
3.	Dr.S.L.Uppal., "Electrical Wiring, Estimating and Costing", 5th Edition, Khanna Publishers.	2003
4.	M.V. Deshpande, "Elements of Electrical Power Station Design", PHI	2009
5.	J. B. Gupta, "A Course in Electrical Installation Estimating and Costing", S. K. Kataria and Sons, India	2013
6.	ISI, National Electric Code, Bureau of Indian Standard Publications, New Delhi	2011

1. Subject Code: **EE-326** Course Title: **Process Instrumentation and Control**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : VI
7. Subject Area : DEC
8. Pre-requisite : EE-206, EE-407

9. Objective : To familiarize the students on various aspects of process control systems and process instrumentation.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	**Introduction:** Special Characteristics of process systems: Large time constants, Interaction, Multistaging, Pure Lag; Control loops for simple systems: Dynamics and stability	7
2	Generation of control actions in electronic pneumatic controller. Tuning of controllers Zeigler Nichols and other techniques. Different control techniques and interaction of process parameters e.g. Feed forward, cascade, ratio, Override controls. Batch and continuous process controls. Multi variable control. Feed forward control schemes.	10
3	Control valves, Valve positioners, Relief and safety valves, Relays, Volume boosters, Pneumatic transmitters for process variables. Various process schemes/ Unit operations and their control schemes e.g. distillation columns , absorbers, Heat exchangers, Furnaces, Reactors, Mineral processing industries pH and blending processes	8
4	Measurement, control and transmission of signals of process parameters like flow, pressure, level and temperature.	12
5	Computer control of processes: Direct Digital Control, Supervisory Control and advanced control strategies.	5
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1	Stephananopoulos G- Chemical Process control- An Introduction to theory and practice, PHI,	1990
2	Luyben W L – Simulation and control for chemical engineers, 1989, 2nd Edition, McGraw Hill.	1989
3	Patranabis,D.- Principals of Industrial Instrumentation, TMH NewDelhi.	

4	Johnson, C – Process Control Instrumentation Technology, PHI New Delhi.	2006
5	Coughanower and Koppel, -Process System Analysis and Control, Mc. Graw Hill.	
6	Seborg, D.E.,Edgar, T.F. and Mellichamp, D.A. “Process dynamics and control,” Wiley, New York	2003
7	Smith, C.A. and Corripio,A.B.”Principles and practice of automatic process control,” Wiley, New York	1997

1. Subject Code: **EE-411** Course Title: **Power System Modeling and Simulation**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 3
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC
8. Pre-requisite : EE-303, EE-304
9. Objective : To familiarize students with modeling and simulation solution of power system problems using various power system simulation tools.
10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Introduction:** Review of network matrices, bus impedance and admittance matrix, power system components, matlab simulink, Mi-power, ETAP, PSCAD, Power factory, Homer and other latest software	8
2.	**Modeling of Power System Components:** Synchronous generator (alternator), generator components (governor, turbine exciter), regulating transformer, three phase, single and double circuit transmission lines, shunt capacitor/inductor, series capacitor, static VAR compensator, induction motor and load	8

3.	**Power System Simulation Tools:** Electric power system components, tool boxes, various libraries of MATLAB, Mi-power, ETAP, power factory, Homer, PSCAD software	6
4.	**Simulation:** Load flow analysis, analysis of power system events, faults, power quality analysis	6
5	**Case Studies:** Model development for a given problem using MATLAB, Mi-power, ETAP, power factory, Homer, PSCAD software	14
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	E. Acha, C. R. F. Esquivel, H.A. Perez, C.A. Komacho, FACTS Modelling and Simulation in Power Networks, John Wiley & Sons, Ltd, UK.	2004
2.	J.P. Baret, P. Bornard, B. Meyer, Power System Simulation, Springer.	1996
3.	Grainger J. J. and Stevenson W.D., "Elements of Power System Analysis", Tata McGraw-Hill Publishing Company Limited.	2008
4.	P. Kundur, Power System Stability and Control, Tata McGraw-Hill Education.	1994
5.	A. Chkrabarti and Sunita Halder, Power System Analysis: Operation and Control, PHI Learning Pvt. Ltd, New Delhi, 3rd Ed.	2011
6.	MATLAB, ETAP, Mi Power, Homer, Power Factory, PSCAD Software manuals	2011

1. Subject Code: **EE-413** Course Title **Power System Reliability**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4

6. Semester : VII

7. Subject Area : DEC

8. Pre-requisite : EE-303, EE-304

9. Objective : To familiarize the students with the concept of reliability in power systems, reliability indices and the assessment of reliability indices in power transmission and distribution systems.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Basic Probability Theory:** Probability concepts, rules for combining probability, probability distributions, random variables, density and distribution functions, mathematical expectations, variance and standard deviation.	4
2.	**Basic Reliability Evaluation:** General reliability functions, probability distributions in reliability evaluation, network modeling and evaluation of series, parallel, series –parallel, network modeling and evaluation of complex systems, cut-set method, tie-set method, discrete Markov chains, continuous Markov process, frequency and duration technique concepts, application to multi-state problems, approximate system reliability evaluation**.**	6
3.	**Generation System Reliability:** Generation system models, capacity outage table, recursive algorithm, loss of load indices, inclusion of scheduled outages, load forecast uncertainty, loss of energy indices, expected energy generation, energy limited systems, Gram-Charlier series and its application to generation system reliability evaluation, generating capacity –frequency and duration method.	10
4.	**Interconnected System:** Probability array method in two inter-connected systems, effect of tie capacity, tie reliability and number of tie lines, equivalent assistance unit method for reliability evaluation of inter-connected system, elementary concepts for reliability evaluation of multi-connected systems. **Composite Generation and Transmission System Reliability:** Radial configurations, conditional probability approach, network configuration, state selection, system and load point indices**.**	12

5.	**Distribution System Reliability:** Basic technique and application to radial systems, customer–oriented indices, load and energy indices, effect of lateral distributor protection, effect of disconnects, effect of protection failures, effect of load transfer, meshed and parallel networks, approximate methods, failure modes and effects analysis, inclusion of scheduled maintenance, temporary and transient failures, inclusion of weather effects.	10
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Billinton R. and Ronald N. A., "Reliability Evaluation of Power Systems", B S Publications, India	2008
2.	Billinton R. and Ronald N. A., "Reliability Evaluation of Engineering Systems Concepts and Techniques", Springer	2008
3.	Endrenyi J., "Reliability Modeling in Electric Power Systems", John Wiley and Sons.	1978
4.	Cepin M., "Assessment of Power System Reliability: Methods and Applications", Springer	2011

1. Subject Code: **EE-415** Course Title: **Design of Electrical Machines**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC
8. Pre-requisite : EE-204, EE-205, EE-215
9. Objective : To familiarize the students with the concepts of electrical design of asynchronous and synchronous machines along with transformers.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Factors in Design:** Specifications for machines, out-put equation, limitations in design, electric and magnetic loadings, space factor, winding factor and their effects on machine performance, mechanical and high speed problems.	8
2.	**Design of Poly phase Asynchronous Machines:** Details of construction, stator design, output equation, separation of D and L, specific loadings, leakage reactance, rotor design, slip ring and squirrel cage motors, harmonic effects and slot combination, magnetizing current and losses, prediction of characteristics.	10
3.	**Design of Synchronous Machines:** Details of construction, generators, salient and non salient pole machines, specific loadings and output equation, stator design, harmonics and reduction, armature reaction, design of field winding, short circuit ratio, voltage regulation, efficiency, differences in design between salient and non salient pole machine.	10
4.	**Design of Transformers:** Design of single and three phase transformers, output equation, specific loadings, electro mechanical stresses on windings, no load current, temperature rise.	8
5	**Thermal aspects of Design:** Generation, flow and dissipation of heat losses, thermal capacity, temperature rise curves, ratings of machines, cooling media, ventilation, types of cooling, standard enclosures.	6
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	M.G. Say, “Performance and Design of Alternating Current Machines”, CBS Publishers.	2008
2.	Ion Boldea, Syed A. Nasar, “The Induction Machines Design Handbook”, CRC Press	2009
3.	Juha Pyrhonen, Tapani Jokinen, Valeria Hrabovcova, “Design of Rotating Electrical Machines”,Wiley,	2009
4.	**A.K.Sawhney** and A. Chakraborty, “A Course in **Electrical Machine. Design”**, ‘Dhanpat Rai & Co,	2013
5.	K.M. Vishnu Murthy “Computer-Aided Design of Electrical Machines”, B.S. Publications	2008

1. Subject Code: **EE-417** Course Title: **Advanced Topics in Electrical Machines**

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

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

4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0

5. Credits : 4

6. Semester : VII

7. Subject Area : DEC

8. Pre-requisite : EE-204, EE-205, EE-214, EE-215, EE-311

9. Objective : To familiarize the students with the generalised modelling of electrical machines.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Basics of magnetic circuits:** B-H characteristics of magnetic materials, magnetic circuits, Energy conversion, permanent magnet materials and magnetic circuits.	4
2.	**Analysis of Electrical Machines:** Generalized theory of electrical machines, different transformation methods, Park's Transformation, Clarke's Transformation and corresponding equivalent circuits.	8
3.	**Three phase asynchronous machine:** Circuit model of three phase asynchronous machine, machine model in arbitrary q-d-0 reference frame, voltage, flux linkage and torque equations, q-d-0 stationary and synchronous reference frames, steady state and transient model, effects of saturation, linearized model, simulation of three phase asynchronous machine	10
4.	**Three phase synchronous machine:** Transformation to the rotor's q-d-0 reference frame, rotor quantities referred to the stator, voltage equations in rotor's q-d-0 reference frame, electromagnetic torque equation, currents in terms of flux linkages, steady state operation, machine parameters, simulation of three phase synchronous machine	10

5.	**Control of three phase asynchronous machine:** Basics of multi-quadrant operation, operating region limits, speed control by variation of voltage, rotor resistance and voltage-frequency, constant flux operation, constant v/f operation, direct and indirect field oriented control.	10
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	C.M. Ong, "Dynamic Simulation of Electric Machinery", Prentice Hall Inc.	1998
2.	S. Sudoff, O. Wasynzcuk and P.C. Krause, "Analysis of Electric Machinery", John Wiley	2010
3.	N. N. Hancock "Matrix Analysis of Electrical Machinery" Pergamon Press	1974
4.	T.A. Lipo ,"Analysis of Synchronous Machines", CRC press	2012
5.	Mulukutla S. Sarma , "Electric Machines: Steady-State Theory and Dynamic Performance", Cengage Learning	1997

1. Subject Code: **EE-419** Course Title: **Pulse Width Modulation for Power Converters**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC
8. Pre-requisite : EE-301
9. Objective : To familiarize the students with the various topologies of Power Electronic Converters, modulation schemes for their operation, strategies for presentation as voltage and current sources.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Introduction to Power Electronic Converters:** Basic Converter Topologies, Switch Constraints, Bidirectional Chopper, Single-Phase Full-Bridge (H-Bridge) Inverter, Voltage Source/Stiff Inverters, Two-Phase Inverter Structure, Three-Phase Inverter Structure, Voltage and Current Waveforms in Square-Wave Mode, Switching Function representation of Three-Phase Converters, Output Voltage Control, Volts/Hertz Criterion, Phase Shift Modulation for Single-Phase Inverter, Voltage Control with a Double Bridge, Current Source/Stiff Inverters, Concept of a Space Vector, d-q-0 Components for Three-Phase Sine Wave Source/Load, d-q-0 Components for Voltage Source Inverter Operated in Square-Wave Mode, Synchronously Rotating Reference Frame, Three-Level Inverters, Multilevel Inverter Topologies, Diode-Clamped Multilevel Inverter, Capacitor-Clamped Multilevel Inverter, Cascaded Voltage Source Multilevel Inverter, Hybrid Voltage Source Inverter.	8
2.	**Modulation of One Inverter Phase Leg:** Fundamental Concepts of PWM, Evaluation of PWM Schemes, Double Fourier Integral Analysis of a Two-Level Pulse Width-Modulated Waveform, Naturally Sampled Pulse Width Modulation, Sine-Triangle Modulation, PWM Analysis by Duty Cycle Variation, Sine-Sawtooth Modulation, Regular Sampled Pulse Width Modulation, Sawtooth Carrier Regular Sampled PWM, Symmetrical Regular Sampled PWM, Asymmetrical Regular Sampled PWM, Direct Modulation, Integer versus Non-Integer Frequency Ratios, Comparison of PWM Variations..	4
3.	**Modulation of Single-Phase Voltage Source Inverters:** Topology of a Single-Phase Inverter, Three-Level Modulation of a Single-Phase Inverter, Analytic Calculation of Harmonic Losses, Sideband Modulation, Switched Pulse Position, Continuous Modulation, Switched Pulse Sequence, Discontinuous PWM- Single-Phase Leg Switched, Two-Level Single-Phase PWM.	3
4.	**Modulation of Three-Phase Voltage Source Inverters**: Topology of a Three-Phase Inverter (VSI), Three-Phase Modulation with Sinusoidal References, Third-Harmonic Reference Injection, Optimum Injection Level, Analytical Solution for Third-Harmonic Injection, Analytic Calculation of Harmonic Losses, Discontinuous Modulation Strategies, Triplen Carrier Ratios and Subharmonics, Triplen Carrier Ratios, Subharmonics.	3

5.	**Zero Space Vector Placement Modulation Strategies**: Principles of Space Vector Modulation(SVM), SVM Compared to Regular Sampled PWM, Phase Leg References for Space Vector Modulation, Naturally Sampled SVM, Analytical Solution for SVM, Harmonic Losses for SVM, Placement of the Zero Space Vector, Discontinuous Modulation, 120°,60° & 30° Discontinuous Modulation, Phase Leg References for Discontinuous PWM, Analytical Solutions for Discontinuous PWM, Comparison of Harmonic Performance, Harmonic Losses for Discontinuous PWM, Single-Edge SVM, Switched Pulse Sequence, Three-Phase Modulators as State Machines, Naturally Sampled CSI Space Vector Modulator.	8
6.	**Overmodulation of an Inverter:** The Overmodulation Region, Naturally Sampled Overmodulation of One Phase Leg of an Inverter, Regular Sampled Overmodulation of One Phase Leg of an Inverter, Naturally Sampled Overmodulation of Single- and Three-Phase Inverters, PWM Controller Gain during Overmodulation with Sinusoidal, SVM and discontinuous reference, Compensated Modulation, Space Vector Approach to Overmodulation, Optimized Space Vector Modulation, Harmonic Elimination PWM, Performance Index for Optimality, Optimum PWM, Minimum-Loss PWM.	4
7	**Modulation of Multilevel Converters:** Multilevel Converter Alternatives, Block Switching Approaches to Voltage Control, Harmonic Elimination Applied to Multilevel Inverters, Switching Angles for Harmonic Elimination Assuming Equal Voltage Levels, Equalization of Voltage and Current Stresses, Switching Angles for Harmonic Elimination Assuming Unequal Voltage Levels, Minimum Harmonic Distortion, PWM of Cascaded Single-Phase H-Bridges, Overmodulation of Cascaded H-Bridges, PWM Alternatives for Diode-Clamped Multilevel Inverters, Three-Level Naturally Sampled PD PWM, Three-Level Naturally Sampled APOD or POD PWM, Overmodulation of Three-Level Inverters, Five-Level PWM for Diode-Clamped Inverters, Five-level Naturally Sampled PD PWM, Five-Level Naturally Sampled APOD PWM, Five-Level POD PWM, PWM of Higher Level Inverters, Equivalent PD PWM for Cascaded Inverters, Hybrid Multilevel Inverter, Equivalent PD PWM for a Hybrid Inverter, Third-Harmonic Injection for Multilevel Inverters, Operation of a Multilevel Inverter with a Variable Modulation, Optimized Space Vector Sequences, Modulator for Selecting Switching States, Decomposition Method, Hexagonal Coordinate System, Optimal Space Vector Position within a Switching Period, Comparison of Space Vector PWM to Carrier-Based PWM, Discontinuous Modulation in Multilevel Inverters.	10

8	**Advance Topics in Modulation** Random Pulse Width Modulation, PWM Rectifier with Voltage Unbalance, Common Mode Elimination, Four Phase Leg Inverter Modulation, Effect of Minimum Pulse Width Modulation, PWM Dead-Time Compensation	2
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	D. Grahame Holmes and Thomas A. Lipo, "Pulse Width Modulation For Power Converters", John Wiley & Sons.	2003
2.	Euzeli dos Santos and Edison R. da Silva "Advanced Power Electronics Converters: PWM Converters Processing AC Voltages", Wiley-IEEE Press	2014
3.	Eric Monmasson "Power Electronic Converters: PWM Strategies and Current Control Techniques", John Wiley & Sons	2011
4.	Ned Mohan Tore.M. Undeland and William.P Robbins, "Power Electronics converters, Applications and Design", John Wiley and Sons.	2012

1. Subject Code: **EE 421** Course Title: **Advanced Communications**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC
8. Pre-requisite : EE-3I7
9. Objective : To familiarize the students with the concepts of advanced communication systems

10. Details of Course

UNIT No.	CONTENTS	CONTACT HRS.
1.	**Probability and Random Processes**: Random variable, Random Process, mean, moments, correlation & autocorrelation and covariance functions, ergodicity, power spectral density, Gaussian distribution. **Baseband Modulation:** Review of sampling theorem, uniform and non- uniform quantization, PCM ,DPCM ,DM ,ADM ,Mary waveforms , companding.	10
2.	**Baseband Detection:** Error performance degradation in communication system, maximum likelihood receiver structure, matched filters, error performance of binary signaling , intersymbol interference , demodulation and detection of shaped pulses , channel characterization ,eye pattern. **Bandpass modulation and demodulation :**ASK ,FSK ,PSK DPSK, QPSK MSK coherent and non-coherent detection of ASK ,FSK ,PSK and other keying techniques.	8
3.	Probability of bit error for coherently detected BPSK FSK differentially, DPSK etc and comparison of bit error performance for various modulation types.	8
4.	**Line coding:** NRZ, RZ, Walsh codes, AMI coding , High density bipolar code, binary with n-zero substitution codes. **Channel Coding:** Discrete memory less channel, Binary symmetric channel, code rate & redundancy, Parity code, linear block codes, convolution codes, Reed Soloman codes.Shannon Hartley capacity theorem, Shannon limit, entropy, Huffman coding, LZ coding.	8
5.	**V** Spread spectrum Communications: Frequency Hopping Spread Spectrum(FHSS) systems, Direct Sequence Spread Spectrum, Code Division Multiple Access of DSSS, Multiuser Detection, OFDM Communications	8
TOTAL		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	B. P. Lathi, " Modern Digital and Analog Communication System" Oxford University Press – 3rd Edition	1998

2.	Taub Schilling, “Principles of Communication Systems” TMH, 2nd Edition.	1986
3.	Simon Haykin , “Communication Systems” John Wiley & Sons Inc, 5th Edition	2009
4.	W. Tomasi, “ Electronic Communication Systems” Prentice Hall, 5th Edition	2003

1. Subject Code: **EE-423** Course Title: **Microcontroller and Embedded Systems**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC
8. Pre-requisite : EE-213, EE-313
9. Objective : To familiarize the students with the architecture, programming and designing of microcontroller based systems and expose them to the world of embedded systems.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	8051 Architecture Basic organization – 8051 CPU structure, register file, interrupts, timers, port circuits, instruction set, and timing diagram, addressing modes, simple program and applications. Peripherals and Interfacing of 8051: typical bus structure, bus memory organization, timing characteristics, extended model and memory interfacing, polling, interfacing basic I/O devices, analog and digital interfacing, PWM mode operation, serial port application.	10

2.	**Architecture, Peripherals and Interfacing of 8096** Basic Architecture of 8096, Analog interface, serial ports, watch dog timers, real time clock, multitasking, bus control, memory timing, external ROM and RAM expansion, PWM control, A/D interfacing.	8
3.	**Case Study Using 8051 and 8096:** Real time clock, dc motor speed control, Stepper motor, High Power Devices, Optical Encoders, generation of gating signals for converters and inverters, frequency measurement, temperature control, interfacing memory and I/O devices(Key/key pad/key board, LED/LED array/LCD), synchronous and asynchronous data transfer, interrupt, polling, DMA, simple program and applications. **Other Microcontrollers (any two)**: basic organization of PIC16F877, Arm 7, Arm 9, Arm Cortex, Motorola MC68HC11/12.	12
4.	**Embedded system and their components:** Embedded Systems, Processor Embedded into a system, Embedded Hardware and devices, Embedded Software, Embedded SOC, Design Process in an Embedded Systems, Design metrics, challenges and Skills required. Watch Dog timer, RTC, Network Embedded Systems, Serial and Parallel Communication protocols, programming concepts and embedded programming in C, C++, Program models, DFG Model, Real Time Operating Systems, Basic functions of RTOS, RTOS VxWorks, Case study of Embedded systems in automobile, Smart card, Digital Camera, Automatic vending machines etc.	12
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	The 8051 Microcontroller and Embedded systems, Muhammad Ali Mazidi, Janice Gillispie Mazidi. Pearson Education, 2004.	2004
2.	Microcontrollers architechture, programming, interfacing and System design, 2 edition, Rajkamal, Pearson Education	2012
3.	Embedded Sytems Architechture, Programming and Design, Raj Kamal, Tata McGraw-Hill,	2012
4.	The 8051 Microcontroller Architechture, programming and Applications, Kenneth J. Ayala, 2nd edition, Penram International	1996

5.	Microprocessors and Microcontrollers, Krishna Kant, PHI	2011
6.	8051 Microcontroller, Subrata Ghoshal, Pearson	2011
7.	8051 Microcontrollers, MCS 51 family and its variants, Satish Shah, Oxford	2011

1. Subject Code: **EE- 425** Course Title: Advanced Analog Circuit Design
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To introduce advanced concepts of analog circuit analysis and design

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Introduction:** Difference in design considerations for discrete and integrated electronic circuits; passive and active components available in biopolar and MOS technology, brief review of integrated NPN, PNP, lateral PNP, MOSFETS structures, characteristics models.	6
2.	**Basic building blocks of bipolar and MOS analog ICS:** differential amplifier, current sources, current mirrors and current repeaters, voltage references, active loads, level shifters, output stages, voltage to current converters, differential to single ended converters..	6
3.	**IC op-amp architectures:** Bipolar op-amp (IC 741) and its DC and small signal ac analysis (voltage gain Zin, Z_0 GBP and slew rate), MOS op-amp architectures.	10

4.	**IC analog multipliers:** Translinear Circuit Principle, Gilbert multiplier cell, (Transconductance multiplier), two and four quadrant multipliers etc.	6
5.	**Novel Amplifier Architectures**: IC operational transconductance amplifier (OTA), Integrated Norton amplifiers, Current feedback amplifiers, operational transresistance amplifiers (OTRA), Current Conveyors and their different variants etc.	8
6.	Recent trends in Analog Circuit design.	6
TOTAL		**42**

11. Suggested Books

S. No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Behzad Rezavi, " Design of Analog CMOS Integrated Circuit", Mac-Grawhill (ISBN: 0071188398)	2003
2	Miachael Jacob, "Applicatiojns and Design with Analog Integrated Citcuits" , Pearson 2nd Edition (ISBN:8131711285)	2007
3	Chris Tomazou, F. J Lidgey and D. G. Haigh, " Analogue IC Design: The Current-Mode Approach", IET	2014
4	T. C. Carusone, David A. Jones and Ken Martin, " Analog Integrated Circuit Design", 2nd Edition John Wiley(ISBN:0470770104)	2011
5	Raj Senani, D. R. Bhaskar and A. K. Singh, " Current Conveyors: Variants, Applications and Hardware Implementations", Springer (ISBN:3319086839)	2015

1. Subject Code: **EE-427** Course Title: **Computer Architecture**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC

8. Pre-requisite : EE- 204, EE-306

9. Objective : To familiarize students with the architecture of a processor

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	CPU structure and functions, processor organization, ALU, data paths, internal registers, status flags; System bus structure: Data, address and control buses.	4
2.	Processor control, micro-operations, instruction fetch, hardwired control, microprogrammed control, microinstruction sequencing and execution.	4
3.	Memory system, internal and external memory, memory hierarchy, cache memory and its working, virtual memory concept. I/O organization; I/O techniques: interrupts, polling, DMA; Synchronous vs. asynchronous I/O.	6
4.	Principles of linear pipelining; Instruction level parallelism and instruction pipelines, speedup, data dependency hazards, remedial measures, branch handling; Arithmetic pipelines; Pipeline control methods; Job sequencing, collision prevention and pipeline chaining; Case study of pipelined systems.	10
5.	Data level parallelism, Vector processing characteristics and requirements, pipelined vector processing, vectorization methods, examples of vector processing. Graphics processing units (GPUs), Instruction set architecture, Programming on GPU, Comparison with vector processors	10
6.	Graphics processing units (GPUs), Instruction set architecture, Programming on GPU, Comparison with vector processors. Array processing, SIMD array processors, communication between PEs, SIMD interconnection networks, algorithms for array processing	8
Total		42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Mano, M.M., “Computer System Architecture” 3rd Ed.,PHI	2004
2.	Rajaraman, V. and Radhakrishnan, T., “Computer Organization and Architecture”, PHI	2007

3.	Stallings, W., "Computer Organization and Architecture", 5th Ed., Pearson	2001
4.	Sima, D., Fountain, T. and Kacsuk, P., "Advanced Computer Architecture: A Design Space Approach", Pearson Education.	2007
5.	Michael, J.Q., "Parallel Computing: Theory and Practice", Tata McGraw-Hill.	2002
6.	Hwang, K., "Advanced Computer Architecture", Tata McGraw-Hill.	2003

1. Subject Code: **EE-404** Course Title: **Power System Dynamics and Stability**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : EE-208, EE-303, EE-304, EE-409
9. Objective : To familiarize the students with the concept of transient, small signal and voltage stability in power systems and their mitigation using PSS and FACTS devices.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**The Stability Problem:** Origin of the stability problem, definition of stability terms, power angle diagrams	6
2.	**Steady State Stability:** The steady state power limits of simple systems with synchronous loads-analytical and graphical methods, methods of improving steady state stability limits, elementary aspects of dynamic stability	8

3.	Transient Stability: Review of the laws of mechanics, swing equation for a single machine connected to an infinite bus, equal area criterion of stability, solution of swing equation by numerical methods (step by step solution), Euler's, modified Euler's and Runge Kutta methods. Critical clearing angle and time, methods of improving the transient stability, role of synchronizing torque, use AVR, power system stabilizer (PSS) and FACTS devices in improvement of transient stability	10
4.	Introduction to small signal stability, synchronising and damping torques, small signal stability of a single machine infinite bus system, state equations, modes of oscillations, rotor mode eigenvalues, participation factors, supplementary control, role of power system stabilizer (PSS) and FACTS devices in improvement of small signal stability	10
5.	**Voltage stability**: Introduction to voltage stability, P-V Curves, role of reactive power in voltage stability, reactive power compensation, use of regulating transformers, shunt capacitors, Static VAr Compensators (SVC), STATCOM, enhancement of voltage stability	8
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication
1.	P. Kundur, "Power System Stability and Control", 1st Indian Ed., Tata McGraw-Hill	2006
2.	L. Grigsby, "Power System Stability and Control", 3rd Ed., CRC Press	2012
3.	P.M. Anderson and A.A. Fouad, "Power System Control and Stability", 2nd Ed., Wiley	2008
4.	P. Sauer and M. A. Pai, "Power System Dynamics and Stability", 1st Ed., Pearson Ed	2002
5.	John J. Grainger and W.D. Stevenson Jr., 'Power System Analysis', McGraw Hill International Edition	1994
6.	Hadi Saadat. 'Power System Analysis', 3rd Ed., PSA Publishing	2011
7.	E. W. Kimbark, "Power System Stability Vol. 1, 2, 3", Wiley	1985

1. Subject Code: **EE-406** Course Title: **Distribution Systems Analysis and Control**

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

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

4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0

5. Credits : 4

6. Semester : VIII

7. Subject Area : DEC

8. Pre-requisite : EE-302, EE-312

9. Objective : To familiarize the students on various aspects of planning, design and control of distribution systems.

10. Details of Course:

UNIT No.	CONTENTS	CONTACT HRS.
1.	**DISTRIBUTION SYSTEM PLANNING:** Introduction, Distribution System Planning, Factors Affecting System Planning, Present Distribution System Planning Techniques, Distribution System Planning Models, Distribution System Planning in the Future, The Role of Computer in Distribution Planning, Load Characteristics, Load Forecasting, Load Management, Tariff Structure, Electric Meters, Distribution Transformers and its connections.	10
2	**DESIGN OF SUBTRANSMISSION LINES AND DISTRIBUTION SUBSTATIONS:** Introduction, Subtransmission Line Costs, Distribution Substations Costs and its rating, Service areas calculations, Substation application curves, Substation Grounding.	08
3.	**DESIGN OF PRIMARY AND SECONDARY SYSTEMS:** Primary and secondary system design considerations, Primary circuit configurations, Primary feeder loading, Secondary networks, Economic Design of Secondaries, Unbalanced Load and Voltage Considerations, Secondary System Costs.	10

4.	**VOLTAGE DROP AND POWER LOSS CALCULATIONS:** Three Phase Balanced Primary Lines, Four Wire Multigrounded Common Neutral Distribution System, Copper Loss, Methods of Analyzing Distribution Costs, Economic Analysis of Equipment Losses.	06
5.	**DISTRIBUTION SYSTEM CONTROL:** Effect of Series and Shunt Capacitors, Application of Capacitors and their Economic justification to Distribution Systems, Optimal Location of Capaciors, Quality of Service and Voltage Standards, Voltage Control, Feeder Voltage Regulators, Line Drop Compensation, Protection of distribution Systems.	08
TOTAL		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	TURAN GONEN, "Electric Power Distribution System Engineering", CRC PRESS.	2008
2.	William H. Kersting, "Distribution System Modeling and Analysis" , Third Edition, CRC Press	2012
3.	ANTHONY J. PANSINI, "Electrical Distribution Engineering", CRC Press.	2005
4.	JAMES J. BURKE, "Power Distribution Engineering: Fundamentals And Applications".	2004
5.	A. Pabla, "Electric Power Distribution", McGraw-Hill.	2005

1. Subject Code: **EE-408** Course Title: **Restructured Power Systems**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC

8. Pre-requisite: EE-303, EE-308

9. Objective : To familiarize the students with the effects of deregulation of the power industry and subsequently, the restructuring of power systems.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Restructuring Of Power Industry: An Introduction:** Introduction, reasons and objectives of restructuring/ deregulation of power industry, restructuring process, issues involved in restructuring/ deregulation	5
2.	Fundamentals of Economics: Introduction, consumer behavior, supplier behavior, market equilibrium, short-run and long-run costs, various costs of production, perfectly competitive market	5
3.	**Philosphy of market models:** Introduction to philosophy of market models, market models based on contractual arrangements, comparison of various market models, electricity as a commodity market architecture	5
4.	**Transmission congestion management:** Introduction, classification of congestion management methods, calculation of atc (available transfer capability), non-market methods, nodal pricing, inter-zonal/ intra-zonal congestion management, price area congestion management, capacity alleviation method	5
5.	**Locational marginal price (LMP):** Introduction, Fundamental of Locational marginal prices, LMP formulation and implementation, LMP using ACOPF (Alternating Current Optimal Power Flow), LMP using DCOPF (Direct Current Optimal Power Flow)	5
6.	**Ancillary service management:** Introduction to Ancillary services, types of Ancillary services, classification of ancillary services, load-generation balancing related services, voltage control and reactive power support services, black start capability services, getting ancillary services, co-optimization of energy and reserve services	5
7.	**Pricing of transmission network usage and loss allocation:** Introduction to transmission pricing, principles of transmission pricing, classification of transmission pricing methods, different pricing paradigms and their comparison, introduction to loss allocation, different loss allocation methods	5

8.	**Electricity market evolution:** US and European electricity market evolution, PJM, NEMMCO, ERCOT, NORDIC Markets, comparison of power markets, towards standard market design (SMD)	5
9.	**Reforms in Indian power sector:** Introduction, framework for Indian power sector, reform initiatives in India, The Electricity Act 2003, availability based tariff (ABT), open access issues, power exchange	5
Total		**45**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication
1.	L.Philipson and H. Lee Willis, "Understanding Electric Utilities and Deregulation", Marcel Dekker	1998
2.	Kankar Bhattacharya , Math Bollen and J.E. Daadler, "Operation of restructured Power Systems," Kluwer	2001
3.	M. Shahidepour and M. Alomoush, "Restructured Electrical Power Systems", Marcel Dekker	2001
4.	Steven Stoft, "Power System Economics: Designing Markets for Electricity", IEEE Press	2002
5.	Ashikur Bhuiya, "Power System Deregulation: Loss Sharing in Bilateral Contracts and Generator Profit Maximization", VDM Publishing	2008
6.	Daniel S. Kirschen, Goran Strbac, "Fundamentals of Power System Economics", WILEY	2004

1. Subject Code: **EE-410** Course Title: **Power System Planning**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : EE-302, EE-312

9. Objective : To familiarize the students on various aspects of power system planning.

10. Details of Course:

UNIT No.	CONTENTS	CONTACT HRS.
1.	**Objective of planning** –Long and short term planning , Load forecasting – characteristics of loads – methodology of forecasting – energy forecasting- peak demand forecasting – total forecasting – annual and monthly peak demand forecasting – Power planning – Power system development and growth – power sources – planning tools.	8
2.	**Feasibility project report preparation (FPR)**: Basic concepts, preparation of FPR for different type of power station.	6
3.	**Electricity regulations**: Electricity forecasting, Generation planning, Transmission and distribution, network planning.	8
4.	**New operation and planning policies** : Allocation of reserve , Demand side bidding , Pricing schemes , competitive electricity markets, Environment effects, technology and innovation (modern trends),various optimizations for electricity generation, transmission and distribution, impact of high penetration solar PV on power system planning, impact of variable renewable energy generation ,implication on generation planning.	10
5.	**Introduction to system modes of failure:** The loss of load approach, frequency and duration approach, spare value assessment, multiple bridge equivalents.	6
6.	**Power system planning in India**: Reforms,regulatory commission, national tariff policy, AT & C losses	4
	TOTAL	**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Sullivan-Power system planning, Mc Graw Hill	1977
2.	H. Seifi and M. S. Sepasian, Electric Electric Power System Planning , Springer	2011

1. Subject Code: **EE 412** Course Title: **High Voltage Engineering**

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

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

4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0

5. Credits : 4

6. Semester : VIII

7. Subject Area : DEC

8. Pre-requisite : EE-302, EE -312, AP102/112

9. Objective : To familiarize the students with the phenomenon of breakdown in insulators, generation of high voltage in laboratory, measurement of high voltage, testing of insulators and overvoltages / transients in power system.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	Introduction to High voltage Engineering, its scope, Latest Trends, HVDC Transmission	2
2.	**Generation of high voltage in lab:** Generation of HVAC: Different methods for generation of HVAC in lab, comparison between power and testing transformer, Cascaded transformer method, Resonant transformers, numericals. Generation of HVDC: Rectifier circuits, electrostatic generator, Cockroft Walton voltage multiplier circuit, numericals. Generation of Impulse voltage: Impulse wave and its characteristics, different forms of impulse wave, Different types of impulse generator circuits and their analysis. Multi stage impulse generator, its construction, layout, triggering and synchronisation, numericals.	10

3.	**High Voltage Measurement:** Purpose of HV testing in lab, sphere gap- its construction, working. Use of sphere gaps in HV measurement, factors affecting measurement by sphere gap. CRO- their types, principle and working, recurrent surge oscillograph, measurement using CRO.	6
4.	**Over Voltages:** Origin and characteristics of over voltages on transmission lines, wave propagation, use of modal theory in wave propagation. Reflection and refraction of voltage and current waves over the line, Lattice diagram, Ferro resonance, numerical. External over voltages- Lightning over voltages, theories about lightning, development of lightning stroke, direct and indirect stroke, line model for lightning. Protection against over voltages, use of ground wire, tower footing resistance, lightning arrestors, etc. Insulation co ordination.	12
5.	**Electrical Discharges**: Introduction, breakdown in gases, Townsend's criterion for breakdown, numerical. Streamers theory, Paschen's law, time lag for break down, breaks down under ac voltage, impulse voltage. Break down in electro negative gases, vacuum break down.	6
6.	**Testing of Insulators:** Definitions of various terms used in testing, testing of insulators, power transformers, cables. Non destructive Testing- Use of Schering Bridge, Partial discharge technique for testing of insulation.	6
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication
1.	Khalifa **,** **"**High Voltage Engineering**",** Marcel Dekker; 1st Printing edition	1990
2.	Kuffel, **"**High Voltage Engineering**",** Newnes	2000
3.	R.D. Begamudre, "EHV AC Transmission Engineering", New Age International	2011
4.	Kamraju and Naidu, **"**High Voltage Engineering**",** Tata McGraw-Hill Education	2004
5.	C.L.Wadhwa, **"**High Voltage Engineering**",** New Age International	2007

1. Subject Code: **EE-414** Course Title: **Distributed Generation**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : EE-301
9. Objective : To familiarize the students with the off-grid and on-grid dispatchable and non-dispatchable sources, their control in a non-stiff microgrid environment.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Distributed Generation :**Electricity generation in transition, distributed generation with fossil fuels, concentrating solar power (CSP) technologies, biomass for electricity, micro-hydropower systems, fuel cells and wind energy based generation, asynchronous generators, the Purpose of Distributed Generation Sizing of Distributed Generation, Demand-Side Management, Optimal Location of Distributed Energy Sources, Planning and Development of Integrated Energy, Grid-Supplied Electricity, Load Distributed Generation, Calculation of Electricity Generation Costs, Sustainability.	7
2.	**Control of Wind Energy Systems :** Overview of wind turbine control systems, typical grid-connected turbine operation, supervisory control overview and implementation, dynamic control theory and implementation.	6
3	**Solar Photovoltaic Power System**: Dependence of a PV Cell Characteristic, Equivalent Models and Parameters, Applications of Photovoltaic Solar Energy - Residential and Industrial, Economical Analysis of Solar Energy, typical grid-connected and off-grid operation, dynamic control theory and implementation.	4
4	**Energy Storage** Systems: Various batteries and their equivalent electrical circuit, performance characteristics, battery charging, battery management, flywheel, compressed air and superconducting coil.	3

5	**Stand-Alone System :** PV stand-alone, wind stand-alone, hybrid system, hybrid with diesel, hybrid with fuel cell, mode controller, load sharing, system sizing, power and energy estimates, battery sizing, PV array sizing, wind farm sizing.	6
6	**Grid-Connected System** Interface requirements, synchronizing with grid, inrush current, synchronous operation, load transient, safety, operating limit, voltage regulation, stability limit, energy storage and load scheduling, utility resource planning tool, Electrical Performance: voltage current and power relations, component design for maximum efficiency, electrical system model, static bus impedance and voltage regulation, dynamic bus impedance and ripple, harmonics, quality of power, harmonic distortion, voltage transients and sags, voltage flickers, renewable capacity limit, system stiffness, interfacing standards, lightning protection.Economics of Distributed Resources	10
7	**UPS & Battery Energy Storage Systems :** Uninterruptible power supplies, applications of ups systems, distributed approach, centralized approach, power factor correction in ups systems, battery energy storage systems, grid synchronization, storage & power conditioning modes, wind and solar power systems.	6
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Bollen M. H., Hassan F., Wiley-Blackwell, "Integration of Distributed Generation in the Power System".	2011
2.	Jenkins N., Strbac G. and Ekanayake J. B., "Distributed Generation" , Institution of Engineering and Technology	2009
3.	Patel M. R., "Wind and Solar Power Systems: Design, Analysis, and Operation" , 2nd edition , CRC Press.	2005
4.	Masters G. M. and Wiley-Blackwell, "Renewable and Efficient Electric Power Systems", 2nd edition	2013
5.	Antonio Moreno-Muñoz , "Power Quality: Mitigation Technologies in a Distributed Environment", 1st edition, Springer.	2010
6.	Boldea Ion, "Variable Speed Generators", CRC Press.	2012

1. Subject Code: **EE-416** Course Title: **Grid Integration of Renewable Energy Sources**

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

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

4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0

5. Credits : 4

6. Semester : VIII

7. Subject Area : DEC

8. Pre-requisite : EE-301

9. Objective: To familiarize the students with different types of converters for renewable energy sources and their interface with grid, their issues related to grid connection, their control and operation.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Grid Connected Converters:** Grid Connected Inverter Structures, Inverter structure derived from H bridge topology, basic full bridge inverter, H5 inverter (SMA), HERIC inverter, REFU inverter, full bridge inverter with DC bypass -FB -DCBP, full bridge zero voltage rectifier - FB - ZVR, summery of H bridge derived topologies. Inverter structure derived from NPC Topology, neutral point clamped (NPC) half- bridge inverter, Co-energy NPC inverter, summery of NCP-derived inverter topologies. H bridge based boost PV inverter with high frequency transformer, String Inverters for PV, Three phase PV inverters, Control structures.	8
2.	**Grid Connectivity Requirement:** International regulations, IEEE 1547 interconnection of distributed Generation, IEC 61727charactristics of utility interface, VDC 0126-1-1saefty, IEC 61000 electromagnetic compatibility (EMC- low frequency), EN 50160 public distribution voltage quality, Response to abnormal Grid condition, voltage deviations, frequency deviations, reconnection after Trip, Power quality, current harmonics, average power factor, Anti islanding requirements, Anti islanding defined by IEEE 1547/UL 1741, Anti islanding definition by IEC 62116, AI definition by VED 0126-1-1.	2

3.	**Grid Synchronization:** Grid synchronization techniques for single phase systems, Grid synchronization using Fourier Analyses, Grid synchronization using phase-locked loop. Phase Detection based on in-quadrature signals, signal generation, transport delay, Hilbert transform, park and Clarke transformations, Adaptive filtering, Second- order Adaptive Filter, second-order generalized integrator, SOIG frequency-locked loop and its analysis, Islanding Detection, Non detection Zone, Overview of islanding detection methods, Passive islanding detection methods, OUF-OUV Detection, Phase jump detection (PJD), Harmonic detection (HD), Passive method evolution, Active islanding detection methods, Frequency Drift Methods, Voltage Drift Methods, Grid Impedance Estimation, PLL-Based Islanding Detention, Comparison of active Islanding Detection Methods, The three phase voltage vector under grid faults, Unbalanced Grid Voltage during a grid fault, transient grid fault, the voltage (Dips), Propagation of voltage sags. The synchronous reference frame PLL under unbalanced and Distorted grid conditions. The Decoupled Double synchronus Reference Frame PLL (DDSRF-PLL), The double synchronous Reference Frame, The decoupling network, Analysis of DDSRF, Structure and responses of the DDSRF-PLL. The Double Second- order Generalized integration PLL (DSOGI-PLL), structure of the DSOGI, Relation between the DSOGI and the DDRF, The PLL for the DSOIG-PLL	10
4.	**Grid Converter Structures for Wind Turbine Systems**: WTS power configurations. Grid Power Converter Topologies, single- cell (VSC – CSC), Multicell (interleaved or cascaded). WTS Grid control, Generator-side control, WTS Grid control, Grid Requirements for WT Systems, Grid Code Evolution, Frequency and Voltage Deviation under Normal Operation, Active power Control Under Normal Operation, Power curtailment, Frequency control, Reactive power control in normal operation, Behaviour under Grid Disturbance, Discussion of Harmonization of Grid Code, local voltage control, inertia emulation (IE), Power oscillation damping (POD).	8
5.	**Grid Converter Control for WTS**: Model of the converter, Mathematical Model of the L- filter inverter, Mathematical Model of the LCL- filter inverter. AC and DC Voltage Control, management of the DC Link Voltage, Cascade control of the DC Voltage through the AC current, Voltage Oriented Control(VOC) and Direct Power control, synchronous frame VOC: PQ Open-Loop control, synchronous frame and stationary frame VOC, Virtual flux based control, Direct Power Control, Linear current control with separated modulation, use of averaging, PI based control, Deadbeat control, Resonant control, Harmonic compensation. Modulation Techniques, single phase, Three phase, Multilevel modulations, interleaved Modulation. Operating limits of the current controlled converter, Stand alone, Microgrid- side, Droop Control and grid supporting, Grid Connected/ Stand alone operation without load sharing, Microgrid operation with Controlled storage, Droop Control.	8

6.	**Control of Grid Converters Under Grid Fault:** Overview of Control Techniques for grid connected converter under Unbalance Grid voltage Conditions. Control structures for Unbalanced Current Injection, Decoupled double Synchronous reference frame current, controlled for unbalanced current injection, Resonant controllers for unbalanced current injection. Power control under unbalanced grid conditions, instantaneous active reactive control (IARC), Positive and negative sequence control (PNSC), average active- reactive control (AARC), balanced positive control (BPSC), Performance of the IARC, PNSC,AARC and BPSC strategies, Flexible positive and negative sequence control (FPNSC). Flexible Power control with current limitation , locus of the current vector under unbalanced grid conditions, Instantaneous Value of the three phase currents, Estimation of the maximum active and reactive power set point, Performance of the FPNSC.	6
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Remus Teodorescu, Marco Liserre, Pedro Rodríguez, Frede Blaabjerg, “Grid Converters for Photovoltaic and Wind Power Systems”, John Wiley & Sons.	2011
2.	Nick Jenkins, Ron Allan, Peter Crossley, Daniel Kirschen and Goran Strbac,’Embedded Generation’,IET	2000
3.	Ali Keyhani,Mohammad N. Marwali,Min Dai,’Integration of Green and Renewable Energy in Electric Power Systems’, John Wiley & Sons,	2010
4.	S. Chowdhury, S.P. Chowdhury and P. Crossley,’Microgrids and Active Distribution Networks’, IET	2009
5.	Ryszard Strzelecki & Grzegorz Benysek,’Power Electronics in Smart Electrical Energy Networks,’Springer	2008
6.	Amirnaser Yazdani and Reza Iravani,’Voltage Source Converters in Power systems: Modeling, Control, and Applications’, John Wiley & Sons	2010

1. Subject Code: **EE-418** Course Title: **Selected Topics in Power Electronics**

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

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

4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0

5. Credits : 4

6. Semester : VIII

7. Subject Area : DEC

8. Pre-requisite : EE-301

9. Objective : To enable the students to analyze and design switch mode power electronic converters for various applications including microprocessor power supplies, renewable energy systems, and motor drives.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	DC- DC Converters: principle of operation of buck, boost, buck-boost, Cuk, fly back, forward, push-pull, half bridge, full bridge Converters with continuous and discontinuous operation, Input & output filter design, multi-output boost converters, diode rectifier based boost converters. State space analysis of regulators.	8
2.	Resonant Pulse Converters: Series and parallel resonant inverters - zero current and Zero voltage switching resonant converters, frequency response. Two quadrant zero voltage switching resonant converters, Resonant dc link inverters, design and analysis, soft switching, load dependent problem.	8
3.	Inverters: Single and three phase bridge inverters with R, RL and RLE loads, Voltage control, Harmonic reduction, square wave inverters, PWM inverters, modulation techniques, SPWM, Selective Harmonic Elimination PWM, blanking time. harmonic spectrum and comparison among different PWM techniques. Multi level inverters: types, operations, features.	10
4.	Converter Dynamics: Feed back control for converters: regulation and control problem, control principles, model for feedback, P and PI control. Non linear dynamic modeling , Control and analysis of analysis, voltage mode and current mode control.	8

5.	Design: Design considerations: snubber circuit, driver circuit, temperature control and heat sink, materials, windings. Design of converter and chopper circuits. Triggering circuits for converter and choppers. MMF equations, magnetic. Design of transformers and inductors.	8
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication
1.	M. H. Rashid, "Power Electronics - Circuits, Devices and Applications", P.H.I Private Ltd. New Delhi, Second Edition	1994
2.	N. Mohan et.al. "Power Electronics- Converters, Applications and Design", John Wiley & Sons (Asia) Private Ltd., Singapore	1996
3.	Bimal K Bose, " Modern Power Electronics and AC Drives" PHI	2010
4.	R W Erickson and D Makgimovic, "Fundamental of Power Electronics" Springer, 2nd Edition	2008
5.	P. T. Krein, "Elements of Power Electronics", Oxford University Press	2006

1. Subject Code: **EE-420** Course Title: Power Quality
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite :
9. Objective: To familiarize the students with various power quality problems, their analysis and mitigation techniques for various power quality problems.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Overview of Power Quality:** Classification of power quality issues, characterization of electric power quality, power acceptability curves – power quality problems: poor load power factor, non linear and unbalanced loads, dc offset in loads, notching in load voltage, disturbance in supply voltage, flicker, transient phenomenon, voltage fluctuations, sags/swells, voltage unbalance, power quality indices, distortion index, C-message index, IT product, IEEE guides and recommended practices.	6
2.	**Measurement and Analysis Methods:** Voltage, current, power and energy measurements, power factor measurement and definitions, time domain methods, Instantaneous Reactive Power Theory, Synchronous Frame Theory, Synchronous Detection Method, instantaneous symmetrical components, Instantaneous real and reactive powers	8
3.	**Harmonics & Voltage Fluctuations:** Sources and effect of harmonics and inter harmonics, voltage fluctuations, flicker and impulses, flicker calculations, effect of voltage fluctuations and impulses, occurrence and causes of voltage unbalance, standardization, decomposition into symmetrical components.	8
4.	**Power Quality Improvement-I:** Utility- Customer interface, harmonic filter: passive, active and hybrid filter, compensation using shunt devices-DSTATCOM, voltage regulation using DSTATCOM, principle, working and construction, algorithms for control of DSTATCOM, some case study examples.	10
5.	**Power Quality Improvement-II:** Series compensation, protecting sensitive loads using DVR, principle, working construction and control schemes for DVR, hybrid devices –UPQC, principle, working and construction, some case study examples.	10
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Power Quality Enhancement Using Custom Power Devices, Arindam Ghosh, Gerard Ledwich, Springer, 2009	2009

2.	Power Quality: VAR Compensation in Power Systems R. Sastry Vedam, Mulukutla S. Sarma, CRC Press, 2008	2008
3.	Understanding Power Quality Problems: Voltage Sags and Interruptions, Math H.J. Bollen, Wiley India Pvt Ltd, 2011.	2011
4.	Power Quality: Mitigation Technologies in a Distributed Environment,A Moreno Munoz, Springer India Private Limited 2007.	2007
5.	Power System Quality Assessment J.Arrillaga, N.R.Watson, S.Chen, Wiley India Pvt Ltd, 2011.	2011

1. Subject Code: **EE-422** Course Title: High Voltage DC Transmission
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : EE-301
9. Objective : To familiarize the students with the features of high voltage DC systems, their configuration, control and applications in the world and compare with EHV ac systems.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**DC Power Transmission Technology:** Introduction-comparison of AC and DC transmission application of DC transmission-description of DC transmission system planning for HVDC transmission-modern trends in DC transmission	5

2.	**Analysis of HVDC Converter:** Pulse number, choice of converter configuration-simplified analysis of Graetz circuit-converter bridge characteristics, twelve pulse converter –detailed analysis of converters.	12
3.	**HVDC Converter and System Control:** General principles of DC link control-converter control characteristics-system control hierarchy –firing angle control-current and extinction angle control-starting and stopping of DC link power control higher level controllers-telecommunication requirements.	12
4.	**Harmonics and Filters:** Introduction-generation of harmonics-design of AC filters-DC filters-carrier frequency and RI noise, Reactive power requirement in HVDC system and their sources.	8
5.	**Simulations of HVDC Systems:**Introduction –system simulation: Philosophy and tools-HVDC system simulation-modeling of HVDC systems for digital dynamic simulation Introduction to MTDC systems and Protection Issues.	5
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	HVDC power transmission system, K.R.Padiyar, NewAge Publishers,2011	2011
2.	High Voltage Direct Current Transmission, Arillaga,J, Peter Pregrinus,London,1983.	1983
3.	Power System Stability and Control, P. Kundur, TMH.	2006
4.	Direct Current Transmission, Edward Wilson Kimbark, Wiley Interscience, 1971	1971
5.	E. Uhlman : Power Transmission by Direct Current , Springer Verlag, Berlin Helberg. 1985.	1985

1. Subject Code: **EE-424** Course Title: **Flexible AC Transmission Systems**

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

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

4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0

5. Credits : 4

6. Semester : VIII

7. Subject Area : DEC

8. Pre-requisite : EE-301, EE-312

9. Objective : To familiarize the students with the concepts and development of Flexible AC Transmission Systems (FACTS) technology and various types of FACTS Controllers.

10. Details of Course

Unit No.	Contents	Contact Hours
1.	**Introduction to FACTS:** Reactive power control in power systems, transmission system compensation, static series and shunt compensation	6
2.	**Voltage Sourced Converters:** Concept of voltage sourced converters, multi level and PWM converters, transformer connections for 12 pulse operation, 24 and 48 pulse operations	8
3.	**Static Shunt Compensators- SVC and STATCOM:** Objectives of shunt compensation, methods of controllable VAR generation. TCR, SVC and STATCOM characteristics, comparison between SVC and STATCOM, steady state and dynamic models of SVC and STATCOM, application principles	8
4.	**Static Series Compensators – TCSC and SSSC:** Objectives of series compensation, improvement of transient stability and power oscillation damping, sub-synchronous oscillation damping, steady state and dynamic models of TCSC and SSSC, SSR mitigation with TCSC and SSSC, application principles	8
5	**Combined Compensators – UPFC, IPFC and GUPFC:** Basic operating principles of UPFC, independent real and reactive power control capability, control schemes for P and Q control, steady state and dynamic modeling of UPFC, IPFC and GUPFC operating characteristics and control structure, application principles.	12
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	N.G. Hingorani and L. Gyugyi, “Understanding FACTS”, IEEE Press	2000
2.	E. Acha, “Power Electronic Control in Electrical Power Systems”, Penguin Books Ltd,	2008
3.	Prabha Kundur, “Power System Stability and Control”, Tata McGraw-Hill Publishing Company	2006
4.	K.R. Padiyar, “Facts Controllers In Power Transmission and Distribution”, New Age publishers,	2013
5.	Kalyan K. Sen, Mey Ling Sen, “Introduction to FACTS Controllers: Theory, Modeling, and Applications”, Wiley-IEEE Press,	2009

1. Subject Code: **EE-426** Course Title: **Smart Grid**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : EE-301, EE-303, EE-314
9. Objective : To familiarize the students with the concept of smart electrical networks using distributed generation and energy storage systems.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	Structure and Fundamental Problems of Electrical Power Systems, Principles of Electrical Power Control, Classical Power Theory & Instantaneous Power Theory Power, Flow Control, Distributed Generation and Energy Storage Benefits to Grids, Solutions of Control in Smart Power Systems, Damping of the System Oscillations, Power Quality Control, Fully Integrated Power System-The Smart Grid, Smart Electrical Energy Networks Concept-Microgrids & Picogrids.	5

2.	**Distributed Generation and Microgrid :** Active distribution network, Microgrid configuration, Interconnection of Microgrids, Technical and economical advantages and challenges of Microgrid, Distribution system issues of Microgrid, Power quality, Operational issues of a Microgrid, Dynamic interactions of Microgrid with main grid, Ride through, Grid Synchronization, syncrophasors.	5
3.	**Distributed Energy Resources :** Variable and Adjustable Speed Generation Systems (SEIG & DFIG), Wind energy conversion systems (WECS), Grid Integration of Wind Energy Systems, Power Curves of WECs, Grid Coupling, Reactive Power Requirements, Power Fluctuations, Harmonics and Flicker, Offshore Wind Energy systems, Grid Integration of Photovoltaics and Fuel Cells, Grid Interfacing and Islanding Detection, Dynamics of Small-scale hydroelectric power generation, Other renewable energy sources, Dynamics of Storage Systems, Special cases-Superconducting Magnet Energy Storage & Supercapacitors, Application of Energy Storage Devices.	6
4.	**Microgrid and Active Distribution Network Management System :** Network management needs of Microgrid, Microsource generation control, Domestic process control, Energy storage, Regulation and load shifting, Microsource controller, Integrated Communications Architecture, Energy Management, Demand-side Management, Dynamic Energy Management, Decentralized Operation, Protection co-ordination	5
5.	**Protection Issues for Microgrids :** Different islanding scenarios, Major protection issues of stand-alone Microgrid, Single generator and Generator operating in parallel with other generators on an isolated network, Microgrid distribution system protection, Protection of Microsources, Overcurrent protection of the generator intertie, Negative sequence overcurrent protection, Directional control, Earth fault overcurrent protection, Distribution transformer protection, Under/overvoltage protection, Under/overfrequency protection, Reverse power relay, Unbalanced loading, Loss of mains protection, Rate of change of frequency, Vector shift, Neutral grounding requirements.	6
6.	**Power Electronic Interfaces:** Overview of Power converter and Controls, PWM Rectifiers, Two level and Multi-level Converters, Neutral Point Clamped Voltage Source Converter(VSC), Space Vector PWM, Z-source Converters, Operation Principle of the Voltage Z-inverter, Three-level and Four-wire Inverters with Z-source, Grid-Imposed Frequency VSC System- Control in $\alpha\beta$ & dq-frames, D-STATCOM, SSSC, UPFC, Back-to-Back HVDC Conversion System, Interconnection with a Hosting Grid – Parallel Operation, Integration and Interconnection Concerns, Voltage and Current Control of a 3-Phase 4 Wire distributed Interface Converters in Islanded Mode.	6

7.	**Power Quality and Reliability issues of Distributed Generation(DG):** Power quality disturbances – Transients, Voltage sags and swells, Over-voltages and under-voltages, Outage, Harmonic distortion, Voltage notching, Flicker, Electrical noise, Power quality sensitive loads, Existing power quality improvement technologies- Preventive(Alternative power supplies) technologies, Curative(Power-conditioning technologies), Load compensation, Voltage regulation, Harmonic Filtration and Balancing of the Voltage in Three-wire Systems, Dynamic Voltage Restorer, Primary & Secondary DG system with power quality support, Soft grid-connected DG, DG with intermittent solar PV, DG with intermittent wind generator, Controllers with Energy-storage Systems, Ultra-high reliability scheme using dual link DC bus, Issues of premium power in DG integration.	6
8.	**SCADA and Active Distribution Networks:** Overview of Existing Distributed Network operator (DNO) SCADA systems, Control of DNO SCADA systems (Centralised & Distributed), Requirement of Communication in Microgrids, SCADA in Microgrids, SCADA communication infrastructure, Distributed control system (DCS), Microgrid Control, Sub-station communication standardisation, smart appliances, smart transformers, Online Condition monitoring, SCADA communication and control architecture, Automated Meter Reading, Communication devices and Media, operational issues of Serial Communication, Broadband Powerline Communication, Optical & Wireless Communication.	6
Total		**45**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	S. Chowdhary, S. P. Chowdhury and P. Crossley, “Microgrids and Active Distribution Network”, IET	2009
2.	Nick Jenkins et al., “Embedded Generation”, IET	2000
3.	R. Strzelecki, G. Benesek, “Power Electronics in Smart Electrical Energy Networks”, Springer	2008
4.	Amirnaser Yazdani & Reza Iravani, “Voltage Sourced Converters in Power Systems: Modeling, Control, and Applications”, IEEE Press	2010

1. Subject Code: **EE-428** Course Title: **Digital Image Processing**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : EE-213, EE-401
9. Objective : To familiarize the students on various aspects of image processing.
10. Details of Course :

UNIT No.	CONTENTS	CONTACT HRS.
1.	IMAGE FUNDAMENTALS: Visual perception by human eye, Brightness Adaptation and Discrimination, Image Models, Sampling and quantization, Color models, File formats.	6
2.	IMAGE ENHANCEMENT IN SPATIAL DOMAIN: Point Operations: Image negative, contrast stretching, Brightness, Grey level slicing, Bit plane slicing, Histogram Processing,Spatial Operations: Smoothing filters, Median Filter, Sharpening filters, High boost filtering, derivative filtering, Robert, Previtt, Sobel operators, Second order derivatives, Laplacian Mask.	8
3.	IMAGE ENHANCEMENT IN FREQUENCY DOMAIN: Review of Fourier Transforms, Discrete Fourier Transforms, 2-dimensional DFT, Low pass smoothing) filters, High pass filters.	8
4.	IMAGE SEGMENTATION: Point detection, line detection, edge detection, combined detection, Edge linking and boundary detection-Hough transforms, Thresholding	10
5.	IMAGE COMPRESION: Fundamentals: Coding redundancy, Inter-pixel redundancy, Psycho-visual redundancey, Fedility criterion, Compression Models: Source encoder and decoder, Channel encoder and decoder, Lossless compression: Variable length coding, bit plane coding, lossless predictive coding. Lossy compression: Lossy predictive coding, Transform coding.	10
TOTAL		**42**

Suggested Readings:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	RC Gonzalez & RE Woods: Digital Image Processing, Pearson Education	2016
2.	AK Jain: Fundamentals Of Digital Image Processing, Pearson	1988

1. Subject Code: **EE-430** Course Title: Filter Design
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
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.	**Basic Concepts** : Nature of filter specification, filter design process, Ideal low magnitude approximation, frequency transformation etc.	6
2.	**Passive Filter With Lumped Elements**: General two port reactance network, filter circuits, design of ladder networks etc.	6
3.	**Active Building Blocks For Analog Filter Design** : Ideal and Real operational amplifiers, transconductance amplifiers, current feedback amplifiers, transresistance and other amplifier topologies, characteristic and their usages in realization of summers, Integrators, Gyrators and Immittance converters	10
4.	**Biquad Filters**: Single Ampplifer biquads, biquads using composite amplifiers, GIC based biquads, two-integrator loop topologies.	6

5.	**Higher Order Filters** : Cascade and multiple loop feedback realization, LC ladder simulation by single flow graph and element substitution..	6
6.	**Unit VI Transconductance**–C (G_m-C) based filters, switched capacitor filters..	8
TOTAL		**42**

11. Suggested Books

S. No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	R. Schaumann, M.S. Ghausi and Keneth Laker, "Design of Analog Filter (Passive, Active RC and switched capacitor)", Prenticehall International (ISBN:978-0132002882)	1990
2	R.Schaumann, Haiquio Xiao and MacVan Valkenberg, "Design of Analog Filters", Oxford University Press (ISBN 0195373944)	2013

1. Subject Code: **EE-432** Course Title: **Artificial Intelligence & Expert Systems**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : EE- 206 Control Systems
9. Objective : To make the students conversant with the techniques of Artificial Intelligence and its applications.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	Fuzzy Logic: Crisp and fuzzy sets, Difference between crisp and fuzzy sets, fuzzy relations, fuzzy matrix, membership functions: triangular, trapezoidal, sigmoid, log sigmoid.	8

2.	Fuzzy Control:fuzzification, rule base, membership function, defuzzification, fuzzy inference system, defuzzification methods, fuzzy logic controller, mamdani and Takagi Sugeno's method,	9
3.	**Introduction to Neural Networks:**Artificial neuron, biological neurons, artificial neurons, Artificial neural network terminologies: weights, activation functions, bias and threshold. Types of transfer functions: hard limit transfer function, linear transfer function, sigmoid transfer function and log sigmoid transfer function. Learning methods: supervised and unsupervised learning.	8
4.	**Types of Neural Networks**: Single and multilayer feedforward neural networks, elman neural networks, recurrent neural networks, hopfield neural networks, radial basis neural networks.	9
5.	**Applications of Fuzzy Logic and Neural Networks**: System identification& control, Nonlinear function approximation, applications in electrical engineering.	8
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Rolands S Burns, "Advanced control Systems", Butterworth-Heinemann	2008
2.	Jantzen J. ,"Foundations of Fuzzy control", John Wiley & Sons	2001
3.	Gopal M., "Digital Control and State Variable Methods", 2nd Ed., Tata McGraw-Hill Publishing Company Limited.	2007
4.	S. Sumathi, Surekha Paneerselvam"Computational Intelligence Paradigms: Therory& Applications using MATLAB", CRC Publication	1981
5.	Pratihar D.K., "Soft computing",Narosa Publishing House Pvt Ltd.	2010

1. Subject Code: **EE-434** Course Title: **Computer Control Of Processes**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0

4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0

5. Credits : 4

6. Semester : VIII

7. Subject Area : DEC

8. Pre-requisite : NIL

9. Objective : To familiarize the students with the concept and technologies of computer based process control as well as to design the computer based controllers for various industrial systems.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	Introduction to Computer and interfacing: Personal Computer, operating system, peripheral devices, interface ports, signals from process instrumentation, signal conditioning (analog & digital), D/A converter, A/D converter, Data acquisition and control cards, software, standard add-on-cards, backplane buses, microcontrollers, programming concepts.	6
2.	**Introduction to Process Control:** Introduction to process control, basic control action – on / off, P, PI, PID, floating control and Electronic controller,Cascade, feedforward and ratio control, selective and adaptive control systems, tuning, Line diagram from process plant to computer system, loose coupled system and tight coupled system, P&I diagram, valves, actuators, smart sensors	8
3.	Distributed control system: Evolution of DCS, Architecture, DCS Hardware and software, SCADA Hardware and Software, SCADA protocols, evolution of data networks, OSI model, DoD model, LAN and WAN, Communication media and bus, LAN Topologies, Medium access protocols, Details of IEEE 802, X.25, Frame Relay, HDLC standards, IP address, network devices, Field bus system, Industrial field buses, HART protocol, OLE for process control	12

4.	**Programmable Logic Controllers:** Evolution of PLC, Sequential and Programmable controllers, Architecture, Programming of PLC, Relay logic, Boolean and Ladder logic, Functional blocks, virtual PLC	8
5	**Design of Intelligent Control:** Features of intelligent control, Artificial Intelligence and expert system, Application of AI in controller design, Model identification, Case studies on controller design	8
Total		**42**

Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Computer Control of Processes by M. Chidambaram, Narosa Publishing House	2010
2.	Process Control-Principles and applications by Surekha Bhanot, Oxford University Press	2013
3.	Computer Networks by Andrew S. Tanenbaum, 4th Edition, Prentice Hall of India	2003
4.	Data Communications and Networking by AchyutS.Godbole, Tata McGraw Hill	2002
5.	Computer – based Industrial Control by Krishna Kant, Prentice – Hall of India Pvt. Ltd.	1997

1. Subject Code: **EE-436** Course Title: **Non-linear and Adaptive Control**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : EE- 206
9. Objective : To make the students conversant with the techniques of nonlinear and adaptive control systems being used for industrial control.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	Non-linearities: Introduction to various types of non-linearities: saturation, deadzone, backlash, relay, friction and their transfer characteristics.	6
2.	Nonlinear methods: Concept of phase-plane and describing function methods, Describing functions of common nonlinearities, Stability analysis by the describing function method, Nonlinear sampled data systems, Second-order nonlinear system on the Phase plane, Fundamental types of portraits.	12
3.	Lyapunov Stability Analysis: concept of stability for non-linear systems, stability in the sense of Lyapunov, sign definiteness, Asymptotic stability analysis, Lyapunov's function for linear and nonlinear systems, Lyapunov's second order method, Lyapunov's theorem for stability of nonlinear systems.	10
4.	System identification techniques, estimation of parameters in models of dynamical systems: finite impulse response models, transfer function models , non-linear models and stochastic models.	8
5.	Adaptive control: Model reference and self-tuning control, properties of adaptive systems, robust adaptive controllers, application of adaptive control.	6
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Shastri S., "Nonlinear Systems", Springer	1999
2.	Boutalis, y., Theodoridis, D., Kottas, T., Christodoulou, M.A., "System Identification and Adaptive Control", Spinger	2014
3.	I.J.Nagrath and M.Gopal,"Control Systems Engineering", New Age International (P) Limited Publisher	2008
4.	Gopal M., "Digital Control and State Variable Methods", 2nd Ed., Tata McGraw-Hill Publishing Company Limited.	2008
5.	Kuo B. C., "Digital Control Systems", 2nd Ed., Oxford University Press.	2007
6.	Hassan K. Khalil, "Nonlinear Systems", Prentice Hall	2002

1. Subject Code: **EE-438** Course Title: **DSP Applications to Electromechanical Systems**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : EE 301, EE-311
9. Objective : To familiarize the students with the concept of digital signal processing of signals obtained from sensors and transducers for realizing a real time control in motion control and applications to power systems.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	Introduction: Digital Control Circuits for Power Electronics Systems, Analog Versus Digital Control Circuit, Causal and Noncausal Circuits, LTI Discrete-Time Circuits, Real-Time Control Systems, Sampling Rate, Simultaneous Sampling, Multirate Control Circuits	4
2.	Analog Signals Conditioning and Discretization: Analog Input, Galvanic Isolation, Common Mode Voltage, Isolation Amplifiers, Current Measurements sensing techniques, Total Harmonic Distortion, Analog Signal Sampling Rate, Signal Quantization, Noise Shaping Technique, Dither, Maximum Signal Frequency versus Signal Acquisition Time, Errors in Multichannel System, Amplitude and Phase Errors of Sequential Sampling, A/D Conversion, Synchronization of Sampling Process, Sampling Clock Jitter, Effective Number of Bits, A/D Converters Suitable for Power Electronics Control Circuits, Simultaneous Sampling A/D Converters.	8
3.	Signal Filtration, Separation and Their Implementation: Digital Filters, Digital Filter Specifications, Finite Impulse Response Digital Filters, Infinite Impulse Response Digital Filters, Designing of Digital IIR Filters, Calssical and Canonical form structures, Cascaded and parallel structures, Lattice Wave Digital Filters, Comparison of Classical IIR Filter and Lattice Wave Digital Filter, Realization of filter structures, Linear-Phase IIR Filters, Multirate Circuits, Signal Interpolation, Signal Decimation, Multirate Circuits with Digital Filters, Interpolators with Linear-Phase IIR Filters, Digital Filter Banks, DFT Filter Bank, Implementation of Digital Signal Processing Algorithms	8

4.	Introduction to the TMSLF2407 DSP Controller: C2xx DSP CPU, Architecure and Instruction Set, Addressing modes, memory organisation, General Purpose Input/Output (GPIO) Functionality, Interrupts on the TMS320LF2407, Analog-to-Digital Converter (ADC) interface, Event Managers (EVA, EVB), PWM control, Capture and encoders.	10
5.	DSP Implementation of algorithm for real time control: Digital control of DC-DC Buck-Boost Converters, Sequence based Control of Stepper Motors, Instanteneous reactive power theory, Park and Clarke's Transformations, Space Vector Pulse Width Modulation, Harmonic detection.	6
6.	DSP Applications to Motion Control and Power systems: DSP-Based Control of Permanent Magnet Brushless DC Machines, Permanent Magnet Synchronous Machines, Constant V/f control of Induction motor, Vector Control of Induction Motors, Switched Reluctance Motor Drives, Matrix Converters and Shunt Active Power Filters.	6
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	John G Proakis, Dimitris G Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", 4th edition, Pearson	2007
2.	Sanjit Mitra, "Digital Signal Processing", Tata McGraw-Hill Publishing Company, 3rd edition	2007
3.	Oppenheim Alan V, Schafer Ronald W, "Digital Signal Processing", Prentice-Hall	1988
4.	Paulo Sergio Ramirez Diniz, Eduardo A. B. Da Silva, Sergio L. Netto, "Digital Signal Processing: System Analysis and Design", Cambridge University Press	2005
5.	Zahir M. Hussain, Amin Z. Sadik, Peter O'Shea, "Digital Signal Processing: An Introduction with MATLAB and Applications", Springer	2011
6.	Hamid A. Toliyat, Steven G. Campbell, "DSP-Based Electromechanical Motion Control", CRC Press	2003
7.	Krzysztof Sozan´ski, "Digital Signal Processing in Power Electronics Control Circuits", Springer-Verlag London	2013

1. Subject Code: **EE-440** Course Title: **SCADA and Energy Management Systems**

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

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

4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0

5. Credits : 4

6. Semester : VIII

7. Subject Area : DEC

8. Pre-requisite : NIL

9. Objective : To familiarize the students with architecture of a SCADA system, its building blocks, operational requirements, and parameters for process selection in addition to providing an insight into its application in the field of power system control.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**SCADA :** Overview and hierarchical structure of power system. Objective of Power System. Standard Operation. Different operational modes- Normal, Alert, Emergency, Restoration. SCADA- definition, functions - data acquisition, data communication, data processing and data presentation, control. Advantages of having SCADA. Applications for which SCADA is best suited. Basic components- MTU, RTU, Communication channel, Transducers. Transmission Medium - wired and wireless, wired- coaxial cable, twisted pair, fiber optics, wireless- radio, microwave, infrared. Data Communication Fundamentals - digital, analog, serial, parallel, synchronous, asynchronous, nodes, network- characteristics, topology. Transmission capacity, data rate, Nyquist theorem, Shannon capacity. Components of Communication System- transmitter, receiver, message, medium, protocol. OSI seven layer model, different standard organization, message format- format control, error detection- CRC, checksum, parity, communication system design	9

2.	**Supervisory and Control functions:** RTU Components - communication subsystem, logic subsystem, termination subsystem , power supply, test MMI. Data Acquisition - status values, measured values- digital, analog. Energy values. Data reporting- current data, data snapshot, reporting by exception. Data Processing - ADC, DAC, current to voltage converters, voltage to current converters. Data Monitoring - Analog and Discrete, Data control - discrete control and analog control. Transducers - CT, PT, LVDT, Strain guage. Time Tagged Data - Historical data, planning data. Collected and calculated data. Disturbance data collection and analysis, reports and calculations - load forecasting, load flow, state estimation, economic dispatch algorithms. Alarms and Event Processing - Alarm presentation according to priority, override feature. Regulatory Functions - open and closed loop process control, set points, P, D,I, PI, PID controllers.	9
3.	**Man Machine Interface :** Operator Interface - definition, ergonomic features, Elements of operator interface- VDUs, key board, important works to be performed by the operator in the control room, console security and authority. VDU Displays and its Uses - static and dynamic information presentation. Poke points, mimic diagrams. Alarms and their Treatment at MTU - Status screens, control change screen, graphics and trending. Reports- classification, alarm log printer, printers for daily communication reports, printers for run reports. Master Station Performance - performance test, test criteria, selection of computer for MTU- speed, memory, MIPS, MFLOPS, whetstone test. Reliability - MTBF, MTTR, Availability of equipment/service, minimum reliable system, cold standby system, hot standby system, dual redundant system. Typical SCADA Configuration - dual redundant system with the following facilities- dual CPU, data link, MMI I/O, Communication I/O, Data acquisition I/O, local I/O, peripheral switch for connection printers archive PC, PC for programming etc. Examples of Process Configuration in MTU - a pipe line under the control of MTU, Monitoring of liquid on a 24 hr basis, on/off control of pumps and block valve for the control of liquid level through the pipe, report of the liquid going out of the pipe, handling of a leakage problem.	8
4.	**Database in SCADA:_**Database Management System - logical and physical data base structure. Need for data base, Advantages of having structured data base, important requirement of a data base for SCADA operation, logical database- hierarchical, relational, network. Real Time Operational Requirement. Protocols - Ethernet frame, Media access control- CSMA/CD. Fast Ethernet, gigabit Ethernet. TCP/IP, SMTP, HTTP, UDP. Field Bus Protocol - MODBUS-ASCII, RTU, PROFIBUS-DP,AP	6

5.	**Energy Management System:** Functions performed at the centralized management system, Overview of Regional Grid in India. Real time network modeling- Network modeling programs, Real time model validation, State estimation, Measurement errors detection/ identifier, implementation aspects. Security management- System Security, Security Analysis Function, Security Control, Security Modeling. Production control- Load Prediction, Local Control, Automatic Generation Control, Economic Dispatch Control, Unit Commitment, Security consideration. Training simulator- Education and Training, Design Aspects, Application.	10
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Stuart A. Boyer, "SCADA: Supervisory Control and Data Acquisition", ISA Publisher	2010
2.	Torsen Cegrell, "Power System Control Technology", Prentice- Hall	1986
3.	Thomas E. Kissel, "Industrial Electronics", Prentice- Hall	2002
4.	Behrouz A. Forouzan, "Data Communication and Networking", Mc-Graw Hill	2007
5.	Krishna Kant , "Computer based Industrial Control", PHI	2004
6.	George L. Kusic, "Computer Aided Power System Analysis", CRC Press	1986

1. Subject Code: **EE-442** Course Title: **Robotics and Machine Vision**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : NIL

9. Objective : To familiarize the students with the working of robot, its components, position and orientation analysis, robot kinematics, dynamics and control, sensing and vision.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	Evolution of robots and robotics, robot anatomy, links, joints, degrees of freedom, arm configuration, wrist configuration, end-effector.	4
2.	Mapping between rotated and translated frames, combined rotation and translation of vectors, fundamental rotation matrices.	5
3.	Kinematic modeling of the manipulator, Denavit-Hartenberg notation, kinematic relationship between adjacent links, manipulator transformation matrix	6
4.	The inverse kinematics, solvability of inverse kinematic model, solution techniques.	5
5.	Linear and angular velocity of a rigid body, velocity propagation along links, manipulator Jaccobian, static analysis.	6
6.	Dynamic modeling, Lagrange-Euler formulation, Newton- Euler formulation.	6
7.	Trajectory planning, joint space techniques, cartesian space formulation.	5
8.	Control of manipulator, PID control scheme, computed torque control, force control of robotic manipulators.	5
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	P. J. Mckerrow, “Introduction to Robotics”,	1991
2.	Juan Manual Ramos Arreguin, “Automation and Robotics”, Intech	2008
3.	Thomas Braunl, “Embedded Robotics: Mobile Robot Design and Applications with Embedded Systems”	2008
4.	Rolf Isennann, “Mechatronics Systems”, Springer	2005
5.	W. Bolten, “Mechatronics”, Pearson	2003
6.	Robert H. Bishop, “Mechatronics- An Introduction”, Taylor and Francis CRC press	2007

1. Subject Code: **EE-444** Course Title: **Utilization of Electrical Energy & Traction**

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

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

4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0

5. Credits : 4

6. Semester : VIII

7. Subject Area : DEC

8. Pre-requisite : EE-204, EE-215

9. Objective : To familiarize the students with the lighting, heating, welding and electric tractions.

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.	Electric Traction: Traction Principles - Types of systems, services and supply systems, Train resistance and adhesion, tractive-effort, general equation of train motion, speed time curve; energy and specific energy consumption, Riding Index.	08
5.	Traction Drive: Requirements for traction application, Consideration for motor selection, Control of Traction Motors: Starting, speed control and braking, energy consideration, rectifier system and power electronic control, OHE; current collection; feeding and distribution system, Electric cars and trolley buses, energy consideration.	08
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Dubey G. K., "Fundamentals of Electric Drives", 2nd Ed., Narosa Publishing House.	2007
2.	Taylor E. O., "Utilization of Electric Energy (in SI units)", Orient Longman, Revised in S.I. units by Rao, V.V.L	1999
3.	Hancock N. N., "Electic Power Utilisation", Wheelers.	1979
4.	Pratap H., "Modern Electric Traction", Dhanpat Rai and Sons.	2007

1. Subject Code: **EE-446** Course Title: **Data Communications And Computer Networks**
2. Contact Hours : L: 3 T: 0/1 P: 2/0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS:15/25 PRS:25/0 MTE:20/25 ETE:40/50 PRE: 0
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with the concept, technologies and processes involved in Computer network as well as design the IP based network.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Computer Networks:** Advantages of Computer Networking, Network Types, LAN, WAN, Inter connecting Networks, Client Server Computing, Architecture and Protocols, ISO Reference Model, TCP/IP protocol suite.	4
2.	**Data Communication:** Elements of Computer Communication System, Bandwidth, Channel capacity, Shannon Hartley Theorem, Data Rates, Transmission Characteristics, Transmission Techniques (Asynchronous and Synchronous Transmission, Base band & Broadband Transmission), Modem, Modulation Techniques etc.	4
3.	**Local Area Network and Link Layer:** Topology design, Communication media (Twisted pairs, co-axial cable, optical tube, Microwave satellite), Practical local area network design and implementation. IEEE LAN Standards, Network connecting devices, Media Access Control Level, Services, Problems and protocols, Logical Link Control protocols, HDLC, ALOHA, SLOTTED ALOHA, FDDI, Client Server model and related software.	10
4.	Network Layer level services, problems and protocols, WAN, MAN, interconnection networks related softwares, TCP/IP, IP address, IPv6, Routers, Bridges and Gateways their Practical implementation aspects, WAN concepts, X.25, Internet and related softwares,	12
5	Transport layer, services, problems and their protocol.	4
6	Brief functioning of upper layers, E-mail and other application.	4
7	Security in Computer Networks	4
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Computer Networking by James F. Kurose and Keith W. Ross, Pearson	2007
2.	Computer Networks by A.S. Tanebaum (4^{th} edition), PHI.	2011
3.	Data Communications and Networking by Behrouz A. Forouzan, DeAnza College (4th edition), McGraw-Hill	2007

OPEN ELECTIVE COURSES

CO351 ENTERPRISE & JAVA PROGRAMMING

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

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

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

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

11. Suggested Books

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

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

CO353 E-COMMERCE AND ERP

1. Subject Code: **CO353** Course Title: **E-Commerce and ERP**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective : To introduce E-Commerce and ERP
10. Details of Course

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

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

11. Suggested Books

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

CO355 CRYPTOGRAPHY AND INFORMATION SECURITY

1. Subject Code: **CO355** Course Title: **Cryptography and Information Security**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To study various cryptographic techniques, mathematics related to cryptography and some network security protocols.
10. Details of Course

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

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

11. Suggested Books

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

CO357 OPERATING SYSTEM

1. Subject Code: **CO357** Course Title: **Operating System**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To familiar with the fundamental principles of the operating system, its services and functionalities, the concepts of processes, synchronization and scheduling, memory management and need for protection in computer systems

10. Details of Course

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

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

11. Suggested Books

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

CO359 INTELLECTUAL PROPERTY RIGHTS

1. Subject Code : **CO359** Course Title: **Intellectual Property Rights**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory 3Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0

5. Credits : 3

6. Semester : V

7. Subject Area : OEC

8. Pre-requisite : Nil

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

10. Details of Course

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

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

11. Suggested Books

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

CO361 DATABASE MANAGEMENT SYSTEM

1. Subject Code: **CO361** Course Title: **Database Management System**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3

6. Semester : V

7. Subject Area : OEC

8. Pre-requisite : NIL

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

10. Details of Course

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

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

11. Suggested Books

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

EC351 MECHATRONICS

1. Subject Code: **EC351** Course Title: **Mechatronics**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective : To introduce fundamentals of Mechatronics

10. Details of Course

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

11. Suggested Books

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

EC353 COMPUTER VISION

1. Subject Code : **EC-353** Course Title: **Computer Vision**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective : To introduce fundamentals of Computer Vision and algorithms for object detection, recognition and tracking.

10. Details of Course

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

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

11. Suggested Books

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

EC355 EMBEDDED SYSTEM

1. Subject Code: **EC- 355** Course Title: **Embedded Systems**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Knowledge of Computer Architecture and Microprocessors
9. Objective : To introduce fundamentals of 16 and 32 bit Microcontrollers, assembly language programming. The course also focuses on interfacing of different interrupt driven peripherals. It also covers in detail Real Time Operating Systems, Bus architecture, Digital Signal Processors and System On-Chip.
10. Details of Course

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

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

11. Suggested Books

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

EC357 DIGITAL IMAGE PROCESSING

1. Subject Code: **EC 357** Course Title: **Digital Image Processing**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 3Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3

6. Semester : V

7. Subject Area : OEC

8. Pre-requisite : Signals and Systems

9. Objective : To introduce the fundamentals of visual information, representation of 2-D and 3-D information, enhancement of information, retrieval of information, and various colour models.

10. Details of Course

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

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

11. Suggested Books

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

EC359 VLSI DESIGN

1. Subject Code: **EC -359** Course Title: **VLSI Design**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V

7. Subject Area : OEC

8. Pre-requisite : Nil

9. Objective : To give the student an understanding of the different design steps required to carry out a complete digital VLSI (Very-Large-Scale Integration) design in silicon.

10. Details of Course

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

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

11. Suggested Books

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

EE351 POWER ELECTRONIC SYSTEMS

1. Subject Code: **EE-351** Course Title: **Power Electronic Systems**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0

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

5. Credits : 3

6. Semester : V

7. Subject Area : OEC

8. Pre-requisite : NIL

9. Objective : To familiarize the students with power electronics and its applications.

10. Details of Course:

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

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

11. Suggested Books:

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

EE353 ELECTRICAL MACHINES AND POWER SYSTEMS

1. Subject Code: **EE-353** Course Title: **Electrical Machines and Power Systems**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0

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

5. Credits : 3

6. Semester : V

7. Subject Area : OEC

8. Pre-requisite : NIL

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

10. Details of Course:

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

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

11. Suggested Books

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

EE-355 INSTRUMENTATION SYSTEMS

1. Subject Code: **EE-355** Course Title: **Instrumentation Systems**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC

8. Pre-requisite : NIL

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

10. Details of Course:

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

11. Suggested Books:

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

EE357 UTILIZATION OF ELECTRICAL ENERGY

1. Subject Code: **EE-357** Course Title: **Utilization of Electrical Energy**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with the concept of electrical power, energy and its utilization.

10. Details of Course:

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

11. Suggested books:

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

EE-359 NON-CONVENTIONAL ENERGY SYSTEMS

1. Subject Code: **EE-359** Course Title: **Non-conventional Energy Systems**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with the non-conventional sources of energy and their integration to the grid.

10. Details of Course:

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

11. Suggested books:

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

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

EE-361 EMBEDDED SYSTEMS

1. Subject Code: **EE-361** Course Title: **Embedded Systems**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with the concepts of embedded systems.
10. Details of Course:

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

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

11. Suggested Books:

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

EN-351 ENVIRONMENTAL POLLUTION AND E –WASTE MANAGEMENT

1. Subject Code: **EN-351** Course Title: **Environmental Pollution & E- Waste Management**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory: 3 Hrs. Practical: 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective : The overall aims of the course are for students to acquire understanding of the new and emerging contaminants from various industrial processes and their transformation products. Studying emerging environmental issues related to newer methods of manufacture of industrial products.

10. Details of Course

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

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

Course Outcome:

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

11. Suggested Books:

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

EN353 OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT

1. Subject Code: **EN- 353** Course Title: **Occupational Health and Safety Management**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Prerequisite : Nil
9. Course Objectives :
   1. Introduction about occupational health and related issues.
   2. To give a basic idea about environmental safety management, industrial hygiene.
   3. To introduce about training cycle, chemical hazards and control measures.
   4. To aware and provide knowledge about ergonomics and different disorders.
   5. To provide knowledge about different standards related to safety and health.
10. Detail of Course:

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

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

Course Outcomes:

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

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

11. Suggested Books:

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

EN-355 GIS & REMOTE SENSING

1. Subject Code: **EN-355** Course Title: **GIS & Remote Sensing**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Prerequisite : Nil
9. Course Objectives :

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

10. Detail of Course:

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

Course Outcomes:

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

11. Suggested Books:

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

EP351 PHYSICS OF ENGINEERING MATERIALS

1. Subject code: **EP351** Course title: **Physics of Engineering Materials**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject area : OEC
8. Pre-requisite : NIL
9. Objective : To familiarize the fundamentals /basic concepts and advances of the different materials keeping in view of the engineering applications. There is ample opportunity to become involved in cutting edge Materials Science and Engineering Research

10. Detail of Course:

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

11. Suggested Books:

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

EP353 NUCLEAR SECURITY

1. Subject code: **EP353** Course title: **Nuclear Security**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS:-- MTE: 25 ETE: 50 PRE: --
5. Credits : 3
6. Semester : V
7. Subject area : OEC
8. Pre-requisite : Basic knowledge of Nuclear Physics
9. Objective : This course will provide basic understanding of Nuclear Security which is essential for establishing nuclear culture in the society

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

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

11. Suggested Books

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

HU351

1. Subject Code: **HU351** Course Title: **Econometrics**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective:

10. Details of Course

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

11. Suggested books

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

MA351 HISTORY CULTURE & EXCITEMENT OF MATHEMATICS

1. 1 Subject code: **MA351** Course title: **History Culture and Excitement of Mathematics**
2. Contact Hours : L-3 T-0 P-0
3. Examination Duration (Hrs) : Theory: 3hrs
4. Relative weightage : CWS: 25 PRS: - MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre requisite : --
9. Objective: To be capable in learning the history and culture on the Mathematics subjects

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

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

11. Suggested books

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

ME 351 POWER PLANT ENGINEERING

1. Subject Code: **ME 351** Course Title: **Power Plant Engineering**
2. Contact Hours: 42 : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with thermodynamic cycles and various components of power plants.

10. Details of Course:

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

11. Suggested Books:

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

ME353 RENEWABLE SOURCES OF ENERGY

1. Subject Code: **ME 353** Course Title: **Renewable Sources of Energy**
2. Contact Hours: 42 : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with renewable energy sources like solar, geothermal, wind and tidal.

10. Details of Course:

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

11. Suggested Books:

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

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

ME355 COMBUSTION GENERATED POLLUTION

1. Subject Code: **ME 355** Course Title: **Combustion Generated Pollution**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To introduce the students to different types of fuels, emissions from various engines, exhaust treatment of various engines and instruments used for measuring emissions.

10. Details of Course:

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

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

11. Suggested Books:

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

ME357 THERMAL SYSTEM

1. Subject Code: **ME 357** Course Title: **Thermal System**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0

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

5. Credits : 3

6. Semester : V

7. Subject Area : OEC

8. Pre-requisite : NIL

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

10. Details of Course:

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

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

11. Suggested Books:

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

ME359 REFRIGERATION & AIR CONDITIONING

1. Subject Code: **ME 359** Course Title: **Refrigeration and Air Conditioning**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To learn properties of different refrigerants, and thermodynamic cycles of refrigeration.To understand comfort parameters and air conditioning.

10. Details of Course:

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

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

11. Suggested Books:

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

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

ME361 INDUSTRIAL ENGINEERING

1. Subject Code: **ME361** Course Title: **Industrial Engineering**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To make students aware of industrial engineering concepts of work study and measurement, quality control and reliability etc.
10. Details of Course:

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

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

11. Suggested Books

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

ME363 PRODUCT DESIGN & SIMULATION

1. Subject Code: **ME363** Course Title: **Product Design & Simulation**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with the process of product design and development.
10. Details of Course:

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

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

11. Suggested Books:

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

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

ME365 COMPUTATIONAL FLUID DYNAMICS

1. Subject Code: **ME 365** Course Title: **Computational Fluid Dynamics**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To provide basic concepts of CFD in terms of comprehensive theoretical study and its computational aspects.
10. Details of Course:

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

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

11. Suggested Books:

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

ME367 FINITE ELEMENT METHODS

1. Subject Code: **ME 367** Course Title: **Finite Element Methods**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC

8. Pre-requisite : NIL

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

10. Details of Course:

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

11. Suggested Books:

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

ME369 TOTAL LIFECYCLE MANAGEMENT

1. Subject Code: **ME 369** Course Title: **Total Lifecycle Management**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with the concept of Total Life Cycle, and applying life cycle thinking to define tradeoffs. This course also introduces to sustainability and use of renewable resources.

10. Details of Course:

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

11. Suggested Books:

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

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

ME371 VALUE ENGINEERING

1. Subject Code: **ME 371** Course Title: **Value Engineering**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To understand the concept and approaches of value analysis and engineering with an emphasis on case studies.
10. Details of Course:

Unit No.	Contents	Contact Hours
1	An Overview Of Value Engineering-Concepts and approaches of value analysis and engineering - importance of value, Function - identity, clarify – analysis	8

2	Evaluation of VE-Evaluation of function, Problem setting system, problem solving system, setting and solving management - decision - type and services problem, evaluation of value	8
3	Results accelerators, Basic steps in using the systems	8
4	Understanding the decision environment, Effect of value analysis on other work in the business- Life Cycle Cost (LCC), Case studies	9
5	VE Level Of Effort-VE Team, coordinator, designer, different services, definitions, construction management contracts, value engineering case studies, Effective organization for value work, function analysis system techniques- FAST diagram, Case studies	9
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Parker, D.E., "Value Engineering Theory", Sundaram publishers, 1990
2	Miles, L.D., "Techniques of Value Engineering and Analysis", McGraw Hill Book Co., 2nd End., 1972
3	Khanna, O.P., "Industrial Engineering and Management", Dhanpat Rai and Sons, 1999.

MG351 FUNDAMENTALS OF FINANCIAL ACCOUNTING AND ANALYSIS

1. Subject Code : **MG351** Course Title: **Fundamentals of Financial Accounting and Analysis**
2. Content Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS: 25 PRS MTE: 25 ETE : 50 PRE
5. Credits : 3
6. Semester : V
7. Subject Area : OEC

8. Pre-requisite : Nil

9. Objective : Familiarizing the students with the financial environment of business, especially the financial markets and acquaint them with accounting mechanics, process and system.

10. Details of Course:

Unit No.	Detail Contents	Contact Hours
1	**Introduction to Management** :Basic concepts of management, management process, principles of management, functions, levels, managerial roles and skills, managerial ethics and corporate social responsibility	8
2	**Introduction to Financial Environment and accounting:** Financial Markets - Capital Markets, Basics of capital market mechanism, instruments, financing and rating institutions. Importance, Objectives and Principles of Accounting, Accounting Concepts and conventions, and the Generally Accepted Accounting Principles (GAAP) Overview of the Accounting Process. Accounting standards as Issued by Institute of Chartered Accountants of India (ICAI).	10
3	**Overview of Business Activities and Principal Financial Statements:** Observe the types of information provided by the three principal financial statements and how firms might use this information in managing and evaluating a business. Understand the rationale and the information value of the statements of Balance Sheet, Profit and Loss statement, cash flows.	8
4	**Financial Analysis-I:** Distinction between cash profits and book profits. Understanding the cash flow statement and the funds flow statement.	8
5	**Financial Analysis –II**: Importance, objectives and concept of Ratio Analysis- Liquidity, leverage, solvency and profitability ratios.	8
Total		**42**

11. Suggested Books

S. No.	Name of Books / Authors/ Publishers
1	Fundamental of Management, Stephen P. Robbins, David A. De Cenzo and Mary Coulter, Pearson Education,2011, ISBN- 978-0273755869
2	Introduction to Accountancy, 10 ed., T.S. Grewal, S. Chand and Company (P) Ltd., New Delhi,2009, ISBN- 9788121905695
3	Advance Accounts by M.C Shukla and T.S Grewal and SC Gupta, S. Chand and Company (P) Ltd., New Delhi,1997, ISBN- 9788121902786
4	Financial Accounting, 4 ed, S.N. Maheshwari and S.K. Maheshwari, Vikas Pulication,2005, ISBN- 8125918523
5	Financial Accounting Reporting & Analysis, Cengage, 7/e, W Albrecht Stice & James Stice, Cengage Learning,2010, ISBN- 0538746955

MG353 FUNDAMENTALS OF MARKETING

1. Subject Code : **MG353** Course Title : **Fundamentals of Marketing**
2. Content Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory: 3 Hrs Practical 0
4. Relative Weightage : CWS:25 PRS MTE:25 ETE:50 PRE
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective : The basic objective of this paper is to make students aware of fundamental concepts of marketing necessary for making decisions in complex business situations by managers and start up entrepreneurs.

10. Details of Course:

Unit No.	Detail Contents	Contact hours
1	**Basic concepts of management**: management process, principles of management, functions, levels, managerial roles and skills, managerial ethics and corporate social responsibility	8
2	**Introduction to marketing**: nature and scope of marketing, marketing mix, marketing vs. sales, role of marketing in society, interface of marketing with other departments in organization, Customer Life Time Value, ethical issues in marketing Concept of market segmentation: consumer and industrial, targeting and positioning, sales forecasting	9
3	**Product mix decisions:** new product development process, test marketing, concept of Product Life Cycle, product packaging decisions	8
4	**Pricing decisions** : consideration in setting price, major pricing strategies, promotional mix decisions: advertising, sales promotion, personal selling, publicity, opportunities and avenues of online promotion	9
5	**Promotion and distribution decisions** :design and management of distribution channel for physical products and services, reasons of channel conflict, handling strategies, basic challenges in supply chain management of e-commerce firms	9
Total		**42**

11. Suggested Books

Unit No.	Name of Books / Authors/ Publishers
1	Fundamental of Management, Stephen P. Robbins, David A. De Cenzo and Mary Coulter, Pearson Education, 2011, ISBN-978-0273755869
2	Marketing Management, 14th ed., Philip Kotler , Kevin Lane Keller, Abraham Koshy and MithileswarJha, Pearson Education, New Delhi, 2013,(**ISBN-10:** 9788131767160)

3	Marketing, 14th ed., Etzel, Bruce J Walker, William J Stanton and Ajay Pandit, Mc Graw Hill Education, 2009, ISBN -9780070151567
4.	MKTG, Charles W Lamb, Joe F Hair, Carl NcDaniel and Dheeraj Sharma, Cengage Learning,2012, ISBN- 9788131517086
5.	Marketing Management, RajanSaxena, Tata Mc Graw Hill Education, 2005, ISBN-9780070599536

MG355 HUMAN RESOURCE MANAGEMENT

1. Subject Code : **MG355** Course Title : **Human Resource Management**
2. Content Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory: 3 Hrs Practical 0
4. Relative Weightage : CWS:25 PRS MTE:25 ETE:50 PRE
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective : To develop necessary understanding in design and execution of human resource strategies for the achievement of organization goals.

10. Details of Course**:**

Unit No.	Content	Contact hours
1.	**Basic concepts of management:** management process, principles of management, functions, levels, managerial roles and skills, managerial ethics and corporate social responsibility	8

2.	**Introduction:** Concept, nature, scope, objectives and importance of HRM; Evolution of HRM; Environment of HRM; Personnel Management vs HRM. Acquisition of Human Resources: HR Planning; Job analysis – job description and job specification; recruitment – sources and process; selection process – tests and interviews; placement and induction. Job changes – transfers, promotions/ demotions, separations.	9
3.	**Training and Development:** Concept and importance of training; types of training; methods of training; design of training programme; evaluation of training effectiveness; executive development – process and techniques; career planning and development.	8
4.	**Performance Appraisal:** Performance appraisal – concept and objectives; traditional and modern methods, limitations of performance appraisal methods.	8
5.	**Compensation and Maintenance:** Compensation: job evaluation – concept, process and significance; components of employee remuneration – base and supplementary; maintenance: overview of employee welfare, health and safety, social security.	9
	Total	**42**

11. Suggested Books

S. No	Name of the book /Authors /Publishers
1	Fundamental of Management, Stephen P. Robbins, David A. De Cenzo and Mary Coulter, Pearson Education, 2011, ISBN-978-0273755869
2	Human Resource Management, G. Dessler, B. Varkkey, Pearson prentice Hall, 2011, (ISBN – 978-81-317-5426-9)
3	International HRM a cross cultural approach, T. Jackson, Sage publications, London, 2002, (ISBN – 0-7619-7404-0)
4	HRM and Performance: Achievements and Challenges, D. E. Guest, J .Paauwe, P. Wright, John Wiley and sons, UK, 2013, (ISBN – 978-1-118-48261-2)
5	A Handbook of Human Resource Management Practice, M. Armstrong, Kogan Page Limited, UK, 2007 ,(ISBN – 978–0–7494–4631-4)

MG357 KNOWLEDGE AND TECHNOLOGY MANAGEMENT

1. Subject Code : **MG 357** Course Title : **Knowledge and Technology Management**
2. Content Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory: 3 Hrs Practical 0
4. Relative Weightage : CWS:25 PRS MTE:25 ETE:50 PRE
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective : Preparing the students to understand how the new age organizations are leveraging on the power of knowledge and technology. Acquiring the knowledge to address the issues faced by the corporate world for a deeper understanding.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Basic concepts of management**, management process, principles of management, functions, levels, managerial roles and skills, managerial ethics and corporate social responsibility	8
2.	Introduction to Knowledge Management: Data, Information, Knowledge Management (KM), Knowledge Society, Knowledge Economy, Types of Knowledge, Tacit knowledge and explicit knowledge, Essential components of KM model Building Knowledge Assets: Various knowledge assets, Tools of Knowledge, Knowledge Audit, AAR (After Action Review), Analyzing current knowledge state.	9

3.	Creating Strategies for Success: KM strategy, Codification, Personalization, Knowledge Management Implementation, Generating a KM-specific vision, Integrating organizational and business goals with KM, Choosing the right KM techniques, Relevant case studies in this area.	9
4.	Understanding Technology: Definition, Key concepts, Need for technology, History of technological developments, Role and importance of technology in 21st century, Recent developments in the field of technology.	8
5.	Technology-Management integration: Management as a concept, Technology management, Life cycle approach to technology management, Innovation, Creativity, Technology innovation process.	8
Total		**42**

11. Suggested Books

S. No.	Name of Books /Authors/Publishers
1.	Fundamental of Management, Stephen P. Robbins, David A. De Cenzo and Mary Coulter, Pearson Education,2011, ISBN-978-0273755869
2	Knowledge Management in Organizations: A Critical Introduction, Donald Hislop, Oxford University Press,2013, ISBN: 9780199691937.
3	The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation, IkujiroNonaka and Hirotaka Takeuchi, Oxford University Press,1995, ISBN: 0195092694.
4	Hitotsubashi on Knowledge Management (Hardcover), Hirotaka Takeuchi and IkujiroNonaka, John Wiley and Sons, 2004, ISBN: 0470820748.
5	Management of Technology: The Key to Competitiveness and Wealth Creation, Tarek Khalil and Ravi Shankar, McGraw Hill Education (India) Private Limited, 2nd Edition, 2012, ISBN: 9780070677371.

PE351 ADVANCED MACHINING PROCESS

1. Subject Code: **PE-351** Course Title: **Advanced Machining Process**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To understand basic principles of various processes and their applications. State various parameters influencing the machining process.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	Introduction, need of advanced machining processes, hybrid processes, microelectro mechanical system, (MEMS), nano electromechanical systems(NEMS),Ultrasonic micro machining - mechanics of cutting, parametric analysis, process capabilities, applications.	7
2	Abrasive jet machining: Introduction, set ups, gas propulsion system, abrasivefeeder, machining chamber, AJM nozzle, abrasive parametric analysis, processcapabilities, applications, abrasive micro machining, Water jet machining:Introduction, process characteristics, process performance, applications, Abrasive Water jet machining: Abrasive finishing process: Working principle, parametric analysis, process variables, process performance and applications,	8

3	Abrasive flow machining- Working principle, parametric analysis, process variables, process performance and applications, Magnetorheological abrasive flow finishing- Working principle, parametric analysis,process variables, process performance and applications, Magnetic float polishing,Magnetic abrasive finishing- Working principle, parametric analysis, processvariables, process performance and applications	10
4	Electro discharge machining (EDM): Introduction, Working principle, parametricanalysis, process variables, process characteristics, applications, hybrid processessuch as electro discharge grinding, diamond grinding, wire EDM, Electrodischargemicro grinding,	7
5	Laser beam machining- production of laser, working principle, types of laser, processcharacteristics and applications. Electron beam machining: Working principle,process parameter, process characteristics, and applications. Ion beam machining:Working principle, process parameter, process characteristics, and applications.	8
6	Plasma arc machining: Working principle, Plasma arc cutting system, applications.	2
Total		**42**

11. Suggested Books:

S. No.	Title, Author, Publisher and ISBN No.
1	Advanced machining process, Dr.V.K.Jain, Allied publisher, **ISBN**:978-81-7319-915-8.
2	Non traditional methods of manufacturing, Shan&Pandey, **ISBN**, 0070965536

PE353 SUPPLY CHAIN MANAGEMENT

1. Subject Code: **PE-353** Course Title: **Supply Chain Management**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3

6. Semester : V

7. Subject Area : OEC

8. Pre-requisite : NIL

9. Objective : To understand the key considerations at the various stages involved in the supply of product in order to maintain the smooth flow from source to the point of consumption so that overall organizational performance may improve.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	**Introduction:**Perspective of Supply Chain Management, Managing uncertainty, Key issue in supply chain management.	6
2	**Inventory Management and Risk Pooling:** Inventory management, Classification of inventory, Centralized versus Decentralized Warehousing and Risk pooling, Value of Information, Quantification of Bullwhip effect, Causes and remedies of Bullwhip effect.	8
3	**Resource planning:** Aggregate Production Planning- Chase and leveling strategies, MRP, MRP-II, Agile manufacturing Systems	6
4	**Procurement and Outsourcing strategies:**Introduction, outsourcing benefits and risks, Make/Buy decision, e-procurement, Vendor selection and quota allocation.	7
5	**Strategic Alliances:** Introduction, Third party logistics, Demand driven strategies, Distribution strategies- direct shipment, cross docking, transshipment, Supplier relationships management, Customer relationship management.	8
6	**International Issues in Supply Chain Management:** Concepts in Globalization, Globalization forces, Risks and Advantages of International supply chains, Issues in International supply chain management, Regional differences in logistics.	7
Total		**42**

11. Suggested Books:

S. No.	Title, Author, Publisher and ISBN No.
1.	Simchi-Levi, Kaminsky, Philip K. and 'Designing and Managing the Supply Chain: Concepts, Strategic and Case Studies', McGraw-Hill/Irwin, (ISBN, 10: 0072357568, 13: 978-0072357561).
2	Supply Chain Management by Chopra and Mendle, **ISBN**: 9780132743952
3	Supply Chain Management: Text and Cases by JannatSah.,**ISBN**-10: 8131715175.

PE355 WORK STUDY DESIGN

1. Subject Code: **PE-355** Course Title: **Work Study Design**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To provide basic understanding to the students about the concept and significance of work study and ergonomics. To impart thorough knowledge to the students about various techniques of work-study for improving the productivity of an organization.

10. Details of Course:

Unit No.	Contents	Contact Hrs
1	Productivity: Definition, reasons for low productivity, methods to improve productivity, Work-study and productivity	4

2	Human factor in work-study: Relationship of work-study man with management, supervisor & workers, qualities of a work-study man.	5
3	Method-study: Definition, objectives, step-by-step procedure, questioning techniques, charts and diagrams for recording data. Like outline process charts, flow process charts, multiple activity charts, two handed process chart, string diagram, travel chart, cycle graph, Chrono-cycle graph, therbligs, micro motion study and film analysis, Simo chart, principles of motion economy. Development and installation of new method..	9
4	Work-Measurement: Definition, various techniques of work-measurement work-sampling, stopwatch time study & its procedure, Job selection, Equipment and forms used for time study, rating, methods of rating, allowances and their types, standard time, numerical problems, predetermined - time standards and standard data techniques. Incentive: Meaning, objectives of an incentive plan, various types of incentive plans	9
5	Ergonomics: Introduction, history of development, man-machine system and its components. Introduction to structure of the body- features of the human body, stress and strain, metabolism, measure of physiological functions- workload and energy consumption, biomechanics, types of movements of body members, strength and endurance, speed of movements. NIOSH lifting equation, Lifting Index, Maximum acceptable Weights and Forces, Distal upper extremities risk factors, Strain Index, RULA, REBA.	8
6	Applied anthropometry - types, use, principles in application, design of work surfaces and seat design. Visual displays for static information, visual displays of dynamic information, auditory, tactual and olfactory displays and controls. Assessment of occupational exposure to noise, heat stress and dust .Effect of vibration/ noise, temperature, illumination and dust on human health and performance	7
Total		**42**

11. Suggested Books:

S. No.	Title, Author, Publisher and ISBN No.
1.	Barnes Ralph M., “Motion & Time study: Design and Measurement of Work”, Wiley Text Books, **ISBN-10:** 8126522178, 2009.

2	Marvin E, Mundel& David L, “Motion & Time Study: Improving Productivity”, Pearson Education,**ISBN-10:** 0136030440, 2000.
3	Benjamin E Niebel and FreivaldsAndris, “Methods Standards & Work Design”, McGraw Hill,**ISBN-10**1259064840, 1997.
4	International Labour organization, “Work-study”, Oxford and IBH publishing company Pvt. Ltd., N.Delhi, **ISBN-10** 8120406028, 2001

PE357 PRODUCT DESIGN & SIMULATION

1. Subject Code: **PE-357** Course Title: **Product Design & Simulation**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight **:** CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To allow students to develop the technical, analytical, and managerial skills necessary to perform the tasks successfully.
10. Details of Course:

Unit No.	Content	Contact Hours
1	**Stages in design process:** Introduction to various stages of the design process: Formulation of problem, Generate alternatives, Evaluation, Guided Redesign. Case study.	6

2	**Product life cycle:** New product introduction: early introduction, increased product life. Life cycle management tool, System integration, QFD, House of quality, Pugh's method, Pahl and Beitz method. Case studies.	6
3	**Value engineering:**Introduction, nature and measurement of value. Value analysis, job plan. Creativity and techniques of creativity. Value analysis test. Case studies. **Material selection:**Materials in design. The evolution of engineering materials. Design tools and material data. Functional material, shape and process. Material selection strategy, attribute limits, selection process, common methods of material selection. Case studies.	6
4	**Concurrent/ reverse engineering:** Introduction, basic principles, components, benefits of concurrent engineering. Concept of reengineering. **Process selection:** Introduction. Process classification: shaping, joining and finishing. Systematic process selection, Ranking, process cost. Computer – aided process selection.	6
5	**Design for manufacture and assembly:**Design for Manufacture and Assembly (DFMA). Reasons for not implementing DFMA. Advantages of DFMA with case studies. Design features and requirements with regard to assembly, product Design for Manufacture in relation to any two manufacturing processes: machining and injection molding. Need, objectives.	8
6	**System Simulation**: Techniques of simulation, Monte Carlo method, Experimental nature ofsimulation, Numerical computation techniques, Continuous system models, Analog andHybrid simulation, Feedback systems, Computers in simulation studies, Simulation softwarepackages. **Simulation of Mechanical Systems**: Building of Simulation models, Simulation oftranslational and rotational mechanical systems, Simulation of hydraulic systems.	10
Total		**42**

11. Suggested Books:

S. No.	Title, Author, Publisher and ISBN No.
1	**Product Design and Development**, "Karl T. Ulrich, Steven D. Eppinger"Mc GrawHill.**ISBN:**9780072296471
2	**Integrated Product and Process Development**, "John M. Usher, Utpal Roy and H. R. Parasaei.ISBN: 978-0-471-15597-3
3	**Product Design for Manufacture and Assembly**, "G. Boothroyd, P. Dewhurst and W. Knight" MarceDaker.ISBN:978-1420089271
4.	**Engineering Design and Design for Manufacturing**: A structured approach, "John R. Dixon and CPoli" Field Stone Publishers, USA. ISBN: 9780964527201
5.	**Material Selection in Mechanical Design**, "M. F. Ashby"Elsevier. ISBN: 9780080419077

PE359 TOTAL LIFE CYCLE MANAGEMENT

1. Subject Code: **PE359 Course** Title: **Total Life Cycle Management**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE:25 ETE:50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with the concept of Total Life Cycle, management of old vehicles, applying life cycle thinking to define tradeoffs. This course also introduces to sustainability, use of renewable resources.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Introduction :** Definition of Total Life Cycle (TLC) – Conceptof TLC - Life Cycle Impacts - Integrating Life Cycle Technologies- Products and Processes Within TLC - TLC Methodology- TLC AccessementData to Complex Products – ResultantImprovement for Product	8
2	**Vehicles End of Life** : Design for End of Old VehicleManagement - Problems of Old Vehicles in EmergingMarkets - Recovery and Economic Feasibility of MaterialsSuch As Plastic, Rubber, Aluminium, Steel, etc.	8
3	**Trade-offs :** Applying Life Cycle Thinking to Define TradeoffsAlong the Supply, Manufacture - Use and End of Life Chain- Effects on the Customer - Expectation of the Customer -Evaluate Product Cost on Fuel Consumption, Emission,Durability, Environment and Health	10
4	**Sustainability:**What Is Sustainability - Use of RenewableResources - View to Design Horizon.	8
5	**Harmonization of Environmental Goals:** TLC for Emerging Vs Developed Markets - Rules and Regulations to Guide Designers - International Common Practices for End of LifeVehicles.	8
Total		**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Life Cycle Management Case Study of an Instrument Panel /SAE, 1997/
2	Accident Reconstruction: Automobiles, Tractor-semitrailers, Motorcycles, and Pedestrians /Society of Automotive Engineers, 1987 /0898834546, 9780898834543.

PE361 TOTAL QUALITY MANAGEMENT

1. Subject Code: **PE-361** Course Title: **Total Quality Management**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0

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

5. Credits : 3

6. Semester : V

7. Subject Area : OEC

8. Pre-requisite : NIL

9. Objective : To understand the philosophy and core values of Total Quality Management (TQM); determine the voice of the customer and the impact of quality on economic performance and long-term business success of an organization;

10. Details of Course:

Unit No.	Content	Contact Hours
1	**Introduction to Quality-** Definition of Quality- product, user, value, and manufacturing based perspectives, Dimensions of Quality, Quality Planning, Quality costs- optimization of quality costs, seven tools of quality control;Philosophies of Quality Gurus- Deming, Juran, Crosby, Feigenbaum, Ishikawa, Taguchi. Comparison of Quality Philosophies.	9
2	**Statistical Process Control-**Introduction to Quality characteristics-variables and attributes, Types and causes of variations, Control Charts for variables and attributes, Process capability.	8
3	**Acceptance Sampling-**Sampling process and lots formation; Advantages and applications of acceptance sampling; characteristics of O.C. Curve; Single, double, multiple, sequential sampling; ASN, ATI, AOQL, AOQ, AQL, LQL, Producer's and Consumer's risks.	7
4	**Six Sigma and ISO 9000:2000-** Principles of Six Sigma, Statistical basis, Tools and techniques, DMAIC principle, application of six sigma in manufacturing and service organizations, structure of ISO standards, Factors leading to ISO, Implementation and registration, Benefits of ISO.	6

5	**Life Testing-Reliability-**Life testing: objective, failure data analysis, MTTF, MTBF, hazard rate, exponential and Weibull models, system reliability-series, parallel and mixed configurations, Markov model.	6
6	**Reliability Design and Allocation-** Design for reliability, reliability improvement techniques, active redundancy and standby redundancy, K-out-of-N redundancy and maintenance policies.	6
Total		**42**

11. Suggested Books:

S. No.	Title, Author, Publisher and ISBN No.
1.	Evans JR,Lindsay WM, "The Management and Control of Quality", Cengage learning, India, **ISBN-10:** 8131501361, 2011
2	BediKanishka,"Quality Management",Oxford University Press India, **ISBN-10:** 0195677951, 2006
3	Besterfield,"Total Quality Management", Pearson Education, **ISBN-10:** 9332534454, 2015
4	Gryna FM, Chua RCH, Defeo JA, "Juran"s Quality Planning and Analysis for Enterprise Quality", McGraw Hill Education (India) Private Limited, **ISBN-10:** 0070618488, 2006

PT361 HIGH PERFORMANCE POLYMERS

1. Subject Code: **PT361** Course Title: **High Performance Polymers**
2. Contact Hours : L: 03 T: 00 P: 00
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00
4. Relative Weight : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00
5. Credits : 03
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL

9. Objective : To impart knowledge about heat resistant polymers, liquid crystalline polymers, conducting and other special polymers.

10. Details of Course

S. No.	Contents	Contact Hours
1	Heat resistant polymers: Requirements for heat resistance, Determination of heat resistance, Synthesis, Structure-property relationships, Applications of heat resistant polymers like polyamides, polyimides and its derivatives, polyquinolines, polyquinoxalines, PBT, PBO, PBI, PPS, PPO, PEEK, engineering plastic blends.	9
2	Liquid crystalline polymers, Concept of liquid crystalline phase, Theories of liquid crystallinity, Characteristics of LC state and LCPs, Rheology of liquid crystalline polymers, Blends of LCPs, Self reinforced composites, Applications.	9
3	Conducting polymers, Conduction mechanism, semi-conductors and conducting polymers, Band theory, Doping of polymeric systems, Processing and testing of conducting polymers, Applications and recent advances in conducting polymers.	9
4	Synthesis and applications of photosensitive polymers, Curing reactions.	6
5	Polymers in specialty applications: Polymers in agricultural applications, Green houses, Mulches, Control release of agricultural chemicals, Seed coatings, Polymers in construction and building applications.	9
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publisher
1	Encyclopedia of Polymer science and Engineering Vol.1-17/ J.I. Kroschwitz, 2007
2	Additive for coatings/ John Bieleman/ Wiley-VCH, 2000.
3	Fire Properties of Polymeric Composites Materials/ A.P. Mouritz, A G. Gibson/ Springer, 2006.

4	Modern Biopolymers science: Bridging the divide between fundamentals treatise and industrial application/S. Kasapis, I.T. Nortan, J.B. Ubbink/ Elsevier 2009

PT363 SEPARATION TECHNOLOGY

1. Subject Code: **PT363** Course Title: **Separation Technology**
2. Contact Hours : L: 03 T: 00 P: 00
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00
4. Relative Weight : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00
5. Credits : 03
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To familiarize students with various separation techniques.
10. Details of Course

Unit No.	Contents	Contact Hours
1	Separation factors and its dependence on process variables, classification and characterization, thermodynamic analysis and energy utilization, kinetics and mass transport, Theory of cascades and its applications.	7
2	Membrane Separations, Merits and demerits, Commercial, pilot plant polarization of membrane processes and laboratory membrane permeators, Dialysis, Reverse osmosis, Ultrafiltration, Membrane operations, Design controlling factors.	7
3	Separation by Sorption Techniques, Types and choice of adsorbents, chromatographic techniques, Retention theory mechanism, Design controlling factors, ion exchange chromatography equipment and commercial processes, recent advances in sorption technology.	7

4	Ionic Separations: Theory, mechanism and equipments for electrophoresis, dielectrophoresis and electro dialysis, Controlling factors, Applications, Design considerations.	7
5	Thermal Separation: Thermal diffusion, Rate law, Theories of thermal diffusion for gas and liquid mixtures, Equipments design and applications, Zone melting, Equilibrium diagrams, Controlling factors, Apparatus and applications.	7
6	Other Techniques: Adductive crystallization, Molecular addition compounds, Clathrate compounds and adducts, Equipments, Applications, Economics and commercial processes. Foam Separation: Surface adsorption, Nature of foams, Apparatus, Applications and Controlling factors.	7
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publisher
1	New Chemical Engineering Separation Techniques/ Schoen/ Wiley Interscience, New York, 1972.
2	Separation Processes/ C.J. King/ Tata McGraw Hill, New Delhi,1982.
3	Bioseparations – Principles and Techniques/ B. Sivasankar/ Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4	Separation process Principles/ Seader, Henley and Roper/ John Wiley & Sons 2010
5	Membrane Separation processes/ Kaushik Nath/ PHI , 2008.

PT365 NON-CONVENTIONAL ENERGY

1. Subject Code: **PT365** Course Title: **Non-Conventional Energy**
2. Contact Hours : L: 03 T: 00 P: 00
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00
4. Relative Weight : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00

5. Credits : 03

6. Semester : V

7. Subject Area : OEC

8. Pre-requisite : NIL

9. Objective : To make student aware about the fundamentals and applications of non-conventional energy.

10. Details of Course

Unit No.	Contents	Contact Hours
1	Renewable and non-renewable energy sources, trends in energy consumption, Global and National scenarios, Prospects of renewable energy sources, Energy Management.	6
2	Solar Energy: Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, measurement of solar radiation, flat plate collectors, concentrating collectors, Solar air heaters-types, solar driers, Storage of solar energy-thermal storage, Photo voltaics - solar cells & its applications.	6
3	Wind Energy: Basic system principles, Assessment of wind available, Design principles, Manufactured designs, Sizing and storage of energy, System efficiency, Overview of wind industry.	4
4	Energy from Biomass: Calorific value of Biomass samples, Pyrolysis, Biomass conversion technologies, Biogas generation plants, classification, advantages and disadvantages, constructional details, site selection, digester design consideration, filling a digester for starting, maintaining biogas production, Fuel properties of bio gas, utilization of biogas.	6
5	Geothermal Energy: Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages, and application of geothermal energy.	4

6	Ocean Energy: Ocean Thermal Electric Conversion systems like open cycle, closed cycle, Hybrid cycle. Energy from tides, basic principle of tidal power, single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy. Wave energy and power from wave, wave energy conversion devices, advantages and disadvantages of wave energy.	4
7	Magnetohydrdynamic Power Generation: Principle of MHD power generation, MHD system, Design problems and developments, gas conductivity, materials for MHD generators and future prospects.	4
8	Fuel Cells: Design principle and operation of fuel cell, Types of fuel cells, conversion efficiency of fuel cell, applications of fuel cells.	4
9	Hydrogen Energy: Hydrogen Production methods, Hydrogen storage, hydrogen transportation, utilization of hydrogen gas, hydrogen as alternative fuel for vehicles.	4
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publisher
1	Principles of Sustainable Energy Systems, Second Edition/ Frank Kreith, Susan Krumdieck/ CRC Press, 2013.
2	Non-conventional energy sources/ G.D. Rai/ Khanna Publishers, 2004.
3	Solar Energy: Fundamentals and Applications/ H.P. Garg & Jai Prakash/ Tata McGraw Hill, 2000
4	Solar Engineering of Thermal Processes/ Duffic and Beckman/ John Wiley, 2013
5	Non Conventional Energy Resources/ Saeed and Sharma/ S.K. Kataria& Sons ,2013

PT367 POLYMER WASTE MANAGEMENT

1. Subject Code: **PT367** Course Title: **Polymer Waste Management**
2. Contact Hours : L: 03 T: 00 P: 00
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00

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

5. Credits : 03

6. Semester : V

7. Subject Area : OEC

8. Pre-requisite : NIL

9. Objective : To impart knowledge about polymer waste and their management.

10. Details of Course

Unit No.	Contents	Contact Hours
1	Polymer and Plastics Waste: Definition of plastics waste and the associated problems, Identification, collection methods and separation. Integrated waste management – source reduction, recycling, energy recovering process through thermal and biological destruction, Land filling and composting.	8
2	Plastics waste management: Source reduction, reuse, repair, recycling, and incineration with examples. Plastics recycling: Classification, Code of practice, Primary, secondary, territory and quaternary recycling with examples, Waste plastics as fillers.	8
3	Recycling and degradation of plastics: Recycling and sustainability correlation, Basic principles and recovery, recycling and resource conservation.	9
4	Recycling of plastics by surface refurbishing, Application of a coating, polishing, Plastics, Environmental and Thermal ageing, Chemical degradation, Wear and erosion, Biodegradable plastics – an overview.	9
5	Environmental issues, policies and legislation in India.	8
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publisher
1	Plastics Recycling – Products and Processes/ Ehrig (Ed.)/ Hanser Publication, 1993
2	Recycling and recovery of plastics/ Brandrup/ Hanser Publishers, New York, 1996
3	Handbook of Plastics Recycling/ By Francesco La Mantia/ Rapra Tech Ltd , 2002
4	Introduction to Plastics Recycling/ By VannessaGoodship/ Rapra Tech Ltd ,2007

PT369 NANOTECHNOLOGY IN POLYMERS

1. Subject Code: **PT369** Course Title: **Nanotechnology in Polymers**
2. Contact Hours : L: 03 T: 00 P: 00
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00
4. Relative Weight : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00
5. Credits : 03
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To make student aware about the applications of nanopolymers in various fields.
10. Details of Course

S. No.	Contents	Contact Hours
1	Concepts of nanotechnology, Time and length scale in structures, Nanosystems, Dimensionality and size dependent phenomena, Surface to volume ratio-Fraction of surface atoms, Surface energy and surface stress, surface defects, Properties at nanoscale (optical, mechanical, electronic, and magnetic).	8
2	Nano-materials, Classification based on dimensionality, Quantum Dots, Wells and Wires, Carbon-based nano-materials, Metal based nano-materials, Nanocomposites, Nanopolymers, Nanoglasses, Nanoceramics, Biological nanomaterials.	8
3	Synthesis of nanopolymers, Chemical Methods, Metal Nanocrystals by Reduction, Solvothermal Synthesis, Photochemical Synthesis, Sonochemical Routes, Chemical Vapor Deposition, Metal Oxide - Chemical Vapor Deposition, Physical Methods such as ball Milling, electrodeposition, spray pyrolysis, flame pyrolysis, DC/RF magnetron sputtering, Molecular beam epitaxy.	9
4	Nanofabrication, Photolithography and its limitations, Electron beam lithography, Nanoimprint, Soft lithography patterning, Characterization with Field Emission Scanning Electron Microscopy, Environmental Scanning Electron Microscopy, High Resolution Transmission Electron Microscope, Scanning Tunneling Microscope, Surface enhanced Raman spectroscopy, X-ray Photoelectron Spectroscopy, Auger electron spectroscopy, Rutherford back scattering spectroscopy.	9
5	Applications of nanomaterials, Solar energy conversion and catalysis, Molecular electronics and printed electronics, Nanoelectronics, Polymers with aspecial architecture, Applications in displays and other devices, Nanomaterials for data storage, Photonics, Plasmonics, Nanomedicine, Nanobiotechnology and Nanotoxicology.	8
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publisher
1	Organic and Inorganic Nanostructures/ Nabok/ Artech House, 2005.
2	Nanoscience: Nanotechnologies and Nanophysics/ Dupas, Houdy, Lahmani/ Springer-Verlag Berlin Heidelberg ,2007

3	Nanostructured Materials and Nanotechnology/ H.S. Nalwa/ Academic Press , 2002
4	A Textbook of Nanoscience and Nanotechnology/ Pradeep/ Tata McGraw Hill Education Pvt. Ltd. , 2012

PT371 APPLICATIONS OF POLYMER BLENDS AND COMPOSITE

1. Subject Code: **PT371** Course Title: **Applications of Polymer Blends and Composite**
2. Contact Hours : L: 03 T: 00 P: 00
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00
4. Relative Weight : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00
5. Credits : 03
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To make student aware about the applications of polymers, blends and composites.
10. Details of Course

Unit No.	Contents	Contact Hours
1	Concepts of polymer blends, Advantages of blends over conventional polymers, Significance of polymer blend technology, Different steps involved in designing of a blend, Different methods of blending, Characterization of polymer blends.	8
2	Compatibilization and Phase Morphology, Role of compatibilizers in blend technology, techniques of compatibilization, Phase structure development in polymer blends, Factors affecting morphology of polymer blends, Properties of polymer blends.	8

3	Reinforcements, Properties and applications of Glass, Carbon, Kevlar, polyethylene, boron, ceramic and natural fibers. Concepts of matrix material, Thermoset matrix materials like - epoxy, polyester, vinyl esters, phenolic resin, polyimides, Thermoplastic matrix materials like - polyolefins, polyether ether ketones, polyphenylene sulfide, thermoplastic polyimides.	9
4	Concept of composites, particulate and fibrous composites, Properties of composites, Fabrication of continuous and short fiber composites and particulate composites, mechanical and physical properties	9
5	Applications of blends and composites for civil, aerospace, automobiles etc	8
Total		**42**

11. Suggested Books

S. No.	Name of Books/Authors/Publisher
1	Fibre Reinforced composites/ P. K. Malik/ Marcel Deckar, 1988.
2	Composites Manufacturing: Materials, Product, and Process Engineering/ S.K. Mujumdar/ CRC press ,2002
3	Fibre-glass Reinforced Plastics/ N. P. Cheremisinoff (Ed)/ Noyce Pub, 1988.
4	Design Data for Reinforced Plastics/ N. L. Hancex, R. M. Mayer/ Chapman Hall, 1994.
5	Reinforced Plastics: Properties and Applications/ Raymond Seymour/ The Materials Information Society, 1991.

IT351 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

NAME OF DEPTT: **Information Technology**

1. Subject Code: **IT351** Course Title: **Artificial Intelligence and Machine Learning**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0

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

5. Credits : 3

6. Semester : V

7. Subject Area : OEC

8. Pre-requisite : Knowledge of discrete mathematics

9. Objective : The student should be able to understand the different supervised, unsupervised and reinforcement learning algorithms and choose the appropriate machine learning tool for different real world examples.

10. Details of Course

S.No.	Contents	Contact Hours
1.	**Introduction** to Artificial Intelligence and Machine learning, State Space representation of problems, Concept of Search, overview of different tasks: classification, regression, clustering, control, Concept learning.	6
2.	**Heuristic Search Techniques:** Generate and Test, Hill Climbing, Best-first search, Branch and bound, A* algorithm, Game playing.	6
3.	**Knowledge Representation:**Propositional logic, Predicate Logic, semantic nets, frames	8
4.	**Supervised Learning:** Decision trees, nearest neighbors, linear classifiers and kernels, neural networks, linear regression; Support Vector Machines.	8
5.	**Unsupervised Learning:** Clustering, Expectation Maximization, Dimensionality Reduction, Feature Selection, PCA, factor analysis, manifold learning.	8
6.	**Applications &Research Topics**: Applications in the fields of web and data mining, text recognition, speech recognition	6
TOTAL		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
	Text Book	
1.	Artificial Intelligence by Elaine Rich, K. Knight, McGrawHill	2009
1.	Introduction to Machine Learning, Alpaydin, E., MIT Press, 2004	
2.	Machine Learning, Tom Mitchell, McGraw Hill, 1997.	1997
3.	Elements of Machine Learning, Pat Langley Morgan Kaufmann Publishers, Inc. 1995. ISBN 1-55860-301-8	1995
	Reference Book	
4.	The elements of statistical learning, Friedman, Jerome, Trevor Hastie, and Robert Tibshirani. Vol. 1. Springer, Berlin: Springer series in statistics, 2001.	2001
5.	Machine Learning: A probabilistic approach, by David Barber.	2006
6	Pattern recognition and machine learning by Christopher Bishop, Springer Verlag, 2006	2006

IT353 DATA STRUCTURES AND ALGORITHMS

NAME OF DEPTT: **Information Technology**

1. Subject Code: **IT353** Course Title: **Data Structures and Algorithms**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : ODD
7. Subject Area : OEC

8. Pre-requisite : Nil

9. Objective : The objective of the course is to familiarize students with basic data structures and their use in fundamental algorithms.

10. Details of Course

S.No.	Contents	Contact Hours
1.	**Introduction:** Introduction to Algorithmic, Complexity- Time-Space Trade off. Introduction to C programming through Arrays, Stacks, Queues and Linked lists.	8
2.	**Trees:** Basic Terminology, Traversals, Binary search trees, optimal and average BST's. 2-4 trees, Applications of Binary search Trees, Complete Binary trees, Extended binary trees.	7
3.	**Introduction to algorithms:** Concept of algorithmic efficiency, run time analysis of algorithms, Asymptotic Notations. Growth of Functions, Master's Theorem, **Searching and Searching:** Linear Search, Binary search, Insertion Sort, Quick sort, Merge sort, Heap sort, Radix Sort.	9
4.	**Graphs:** Terminology and Representations, Graphs & Multi-graphs, Directed Graphs, Representation of graphs, Breadth first search and connected components. Depth first search in directed and undirected graphs and strongly connected components.	8
5.	**Spanning trees:** Prim's and Kruskal's algorithm, union-find data structure. Dijkstra's algorithm for shortest paths, shortest path tree. Directed acyclic graphs: topological sort and longest path. **Dynamic programming**: Principles of dynamic programming. Applications: Matrix multiplication, Travelling salesman Problem.	10
Total		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
	Text Books:	
1.	Horowitz and Sahni, “Fundamentals of Data structures”, Galgotia publications	1983
2.	Tannenbaum, “Data Structures”, PHI	2007(Fifth Impression)
3.	T .H . Cormen, C . E . Leiserson, R .L . Rivest “Introduction to Algorithms”, 3rd Ed., PHI.	2011 (reprint)
4.	E. Horowitz, S. Sahni, and S. Rajsekaran, “Fundamentals of Computer Algorithms,” Galgotia Publication	
	Reference Books	
1.	R.L. Kruse, B.P. Leary, C.L. Tondo, “Data structure and program design in C”, PHI	2009(Fourth Impression)
2.	Aho ,Ullman “Principles of Algorithms ”	

IT355 COMMUNICATION AND COMPUTING TECHNOLOGY

NAME OF DEPTT: **Information Technology**

1. Subject Code: **IT355** Course Title: **Communication and Computing Technology**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC

8. Pre-requisite : Operating systems, Algorithm Design and Analysis and data structures

9. Objective : To introduce the concept of Communications in Computer networks

10. Details of Course

S.No.	Contents	Contact Hours
1.	**Introduction** to Goals and Applications of Networks, Network structure and architecture, The TCP/IP reference model, services, Network Topology.	6
2.	**Data Link Layer and Medium Access sub layer** - Channel Allocations, LAN protocols -ALOHA protocols - Overview of IEEE standards - FDDI. - Elementary Data Link Protocols, Sliding Window protocols.	6
3.	**Network Layer**: Routing, Congestion control, Internetworking -TCP / IP, IP packet, IP address, IPv6 and Mobile IP.	8
4.	**Transport Layer:** Design issues, TCP and UDP, connection management, Congestion control, Leaky bucket, Token bucket algorithm. QoS.	8
5.	**Application Layer:** File Transfer, Access and Management, Electronic mail, Virtual Terminals, Internet and Public Networks, Firewalls	6
6.	**Information and Web security**: IP Security, Architecture, Authentication header, Encapsulating security payloads, combining security associations, Secure Socket Layer(SSL) and transport layer security, TSP, Secure Electronic Transaction (SET), Electronic money.	8
TOTAL		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
Text Book		
1.	S. Tananbaum, “Computer Networks”, 3rd Ed, PHI	1999

2.	U. Black, “Computer Networks-Protocols, Standards and Interfaces”, PHI	1996
3.	W. Stallings, “Computer Communication Networks”, PHI	1999
3.	Data Communications and Networking, Behrouz A. Forouzan 5/e	2013
Reference Book		
4.	William Stallings, “Cryptography and Network Security: Principals and Practice”, Prentice Hall, New Jersy.	2001
5.	Behrouz A. Forouzan, “Cryptography and Network Security”, TMH.	2006

IT357 INTERNET AND WEB PROGRAMMING

NAME OF DEPTT: Information Technology

1. Subject Code : **IT357** Course Title: **Internet and Web Programming**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective : To introduce the concept of internet and web programming

10. Details of Course

S.No.	Contents	Contact Hours
1.	**Internet and WWW:** Internet basic, Introduction to internet and its applications, E- mail, telnet, FTP, e-commerce, video conferencing, e-business. Internet service providers, domain name server, internet address World Wide Web (WWW): World Wide Web and its evolution, uniform resource locator (URL), browsers - internet explorer, netscape navigator, opera, firefox, chrome, mozilla. Search engine, web saver - apache, IIS, proxy server, HTTP protocol.	6
2.	**WEBSITES BASIC ANDWEB 2.0**: Web 2.0: Basics-RIA Rich Internet Applications - Collaborations tools - Understanding websites and web servers: Understanding Internet – Difference between websites and web server- Internet technologies Overview – Understanding the difference between internet and intranet; HTML and CSS: HTML 5.0 , XHTML, CSS 3.	6
3.	**E-MAIL SECURITY & FIREWALLS** : PGP - S/MIME - Internet Firewalls for Trusted System: Roles of Firewalls - Firewall related terminology- Types of Firewalls - Firewall designs - SET for E-Commerce Transactions, intellectual property: copyright, patents, trademarks, cyber laws	8
4.	**SERVELETS AND JSP**: JSP Technology Introduction-JSP and Servelets- Running JSP Applications Basic JSP- JavaBeans Classes and JSP-Tag Libraries and Files- Support for the Model- View- Controller Paradigm- Case Study- Related Technologies.	8
5.	**XML**: Introduction to XML, uses of XML, simple XML, XML key components, DTD and Schemas, Well formed, using XML with application.XML, XSL and XSLT. Introduction to XSL, XML transformed simple example, XSL elements, transforming with XSLT	6
6.	**PHP:** Starting to script on server side, Arrays, function and forms, advance PHP, Basic command with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, PHP my admin and database bugs.	8
TOTAL		**42**

11. Suggested Books

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

IT359 JAVA PROGRAMMING

NAME OF DEPTT: Information Technology

1. Subject Code: **IT359** Course Title: **Java Programming**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil

9. Objective : To introduce the concept of java programming

10. Details of Course

S.No.	Contents	Contact Hours
1.	**Introduction to Java**: Programming language Types and Paradigms, Computer Programming Hierarchy, How Computer Architecture Affects a Language? , Why Java?, Flavors of Java, Java Designing Goal, Role of Java Programmer in Industry, Features of Java Language, JVM –The heart of Java , Java's Magic Byte code.	6
2.	**The Java Environment:** Installing Java, Java Program Development, Java Source File Structure, Compilation, Executions. Lexical Tokens, Identifiers, Keywords, Literals, Comments, Primitive Datatypes, Operators Assignments.	6
3.	**Object Oriented Programming**: Class Fundamentals , Object & Object reference, Object Life time & Garbage Collection, Creating and Operating Objects , Constructor & initialization code block, Access Control, Modifiers, methods Nested , Inner Class &Anonymous Classes, Abstract Class & Interfaces Defining Methods, Argument Passing Mechanism, Method Overloading, Recursion, Dealing with Static Members, Finalize() Method, Native Method.	8
4.	**Extending Classes and Inheritance**: Use and Benefits of Inheritance in OOP, Types of Inheritance in Java, Inheriting Data members and Methods, Role of Constructors in inheritance, Overriding Super Class Methods, Use of "super", Polymorphism in inheritance, Type Compatibility and Conversion Implementing interfaces.	8
5.	**Package**: Organizing Classes and Interfaces in Packages, Package as Access Protection, Defining Package, CLASSPATH Setting for Packages, Making JAR Files for Library Packages Import and Static Import Naming Convention For Packages.	6
6.	**GUI Programming**: Designing Graphical User Interfaces in Java, Components and Containers, Basics of Components, Using Containers, Layout Managers, AWT Components, Adding a Menu to Window, Extending GUI Features Using Swing Components, Java Utilities (java.util Package) The Collection Framework: Collections of Objects, Collection Types, Sets , Sequence, Map, Understanding Hashing, Use of Array List & Vector.	8
TOTAL		**42**

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
	Text Books	
1.	The Complete Reference Java,, Herbert Schildt, ISBN: 978-0-07163177-8, Publisher: McGraw Hill	7th Edition
2.	Thinking in Java, Bruce Eckel, ISBN: 0-13-187248-6, Publisher: Prentice Hall	4th Edition
3.	The Java Programming Languages,, Ken Arnold, ISBN-13: 978-032134980, Publisher: Sun	4th Edition,
4.	Java in Nutshell,, Benjamin,ISBN: 9781449371296, Publisher: O'Reilly Media, Inc.	6th Edition

1. Subject Code: **CE351** Course Title: **Geoinformatics and its Applications**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective : To familiarize the students with the concepts of the subject and its related applications in Civil Engineering and allied fields.

10. Details of Course

S. No.	Contents	Contact Hours
1	**Introduction to Geoinformatics, Remote Sensing, GIS and GPS:** Definitions of Geoinformatics, Remote Sensing, GIS and GPS, sources of energy, electromagnetic spectrum, electromagnetic radiation, reflection, transmission and absorption, Platforms and sensors, active and passive sensors, PAN, Multi and hyperspectral remote sensing data acquisition systems	8
2	**Maps, Datums, Projections Systems and spatial data analysis** - Plane and Geodetic surveying, Classification of surveys, Basic Principles of Surveying, Type of maps, scales and uses, plotting accuracy, map sheet numbering. Datums, coordinates and map projection systems. Data retrieval and querying, measurements in GIS, classification, accuracy.	8
3	**Optical, Thermal and Microwave Remote Sensing**. Brief review of Optical, thermal and microwave remote sensing, their utility, merit and demerits, Interaction of EMR with atmosphere, scattering, refraction, absorption, transmission, atmospheric windows, interaction of EMR with earth surface, spectral characteristics of remote sensing data,	8
4	**Basic Photogrammetry and Digital Image Processing:** Photogrammetry, aerial and terrestrial, applications of photogrammetry, types and geometry of aerial photograph, flying height and scale, relief (elevation) displacement. Digital image, digital image processing introduction to, preprocessing, enhancement, classification, visual image interpretation, Introduction to software - MATLAB, ENVI, ERDAS, AutoCAD etc	10
5	**Applications of Geoinformatics, Remote Sensing, GIS and GPS:** Land cover classification survey and Mapping, Digital elevation model (DEM), Introduction to SAR data, Applications in Disaster management, geology, forest security and military projects.	8
Total		**42**

11. Suggested Books:

S.N.	Name of Books/ Authors	
1	Agarwal, C.S. and Garg, P.K., “Remote Sensing in Natural Resources Monitoring and Management”, Wheeler Publishing House(ISBN 6-74-268173-4)	2000
2	Bossler, J.D., “Manual of Geospatial Science and Technology”, Taylor and Francis. (ISBN 0-74-68914355-7)	2002
3	Burrough, P.A. and McDonnell, R.A., “Principles of Geographic Information System”, Oxford University Press. (ISBN 0-07-985256-4)	2000
4	Chandra, A.M. and Ghosh, S.K., “Remote Sensing and Geographical Information Systems”, Alpha Science. (ISBN 0-07-8452567-1)	2005
5	Gopi, S., “Global Positioning System: Principles and Applications”, Tata McGraw Hill. (ISBN 0-07-7691528-1)	2005

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