ELECTRICAL ENGINEERING DEPARTMENT

B.Tech. ELECTRICAL

Course of Study & Scheme of Examination

2016-17

Maulana Azad National Institute of Technology

Bhopal

SCHEME & SYLLABUS OF B.TECH. ELECTRICAL ENGINEERING

First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
MTH111/ MTH121	Mathematics I / Mathematics II	3	-	-	3
CE112	Basic Civil Engineering	3	-	-	3
PHY113	Physics	3	-	-	3
HUM114	Communication Skill	3	-	-	3
CS115	Computer Programming	3	-	-	3
ME116	Engineering Graphics	2	2	-	3
CS117	Computer Programming Lab	-	-	3	2
PHY118	Physics Lab	-	-	3	2
				Total credit	22

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
MTH121/ MTH111	Mathematics II/Mathematics I	3	-	-	3
CHM122	Engineering Chemistry	3	-	-	3
CE123	Environment Engineering	3	-	-	3
EE124	Basic Electrical and Electronics Engineering	3	-	-	3
ME125	Basic Mechanical Engineering	3	-	-	3
AM126	Solid Mechanics	3	-	-	3
ME127	Workshop Practice	-	-	2	1
EE128	Basic Electrical and Electronics Lab	-	-	2	1
CHM129	Chemistry Lab	-	-	3	2
				Total credit	22

Third Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
MTH211	Mathematics III	3	-	-	3
EE212	Electrical Materials & Electromagnetic Fields	3	-	-	3
EE213	Electrical Measurement	3	-	-	3
EE214	Networks	3	-	-	3
EE215	Electrical Machines I	3	-	-	3
EE216	Electronics I	3	-	-	3
EE217	Networks Lab	-	-	3	2
EE218	Electrical Machines I Lab	-	-	3	2
EE219	Electronics I Lab	-	-	3	2
EE-210	Electrical Measurement Lab	-	-	3	2
				Total credit	26

Fourth Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
EE221	Utilization of Electrical Energy	3	-	-	3
EE222	Power System I	3	-	-	3
EE223	Generation of Electrical Power	3	-	-	3
EE224	Electrical Machines II	3	-	-	3
EE225	Instrumentation	3	-	-	3
EE226	Electronics II	3	-	-	3
EE227	Instrumentation Lab	-	-	3	2
EE228	Electrical Machines II Lab	-	-	3	2
EE229	Electronics II Lab	-	-	3	2
				Total credit	24

Fifth Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
EE311	Electrical Machines III	3	-	-	3
EE312	Power Electronics	3	-	-	3
EE313	Power System II	3	-	-	3
EE 331- EE342	Departmental Elective I	3	-	-	3
EE 331- EE342	Departmental Elective II	3	-	-	3
EE 351- EE361	Open Elective I	3	-	-	3
EE316	Electrical Machines III Lab	-	-	3	2
EE317	Power Electronics Lab	-	-	3	2
EE 318	Power System II Lab	-	-	3	2
					Total credit 24

Sixth Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
EE321	Linear Control System	3	-	-	3
EE322	Electrical Drives	3	-	-	3
EE323	Microprocessor	3	-	-	3
EE 331- EE342	Departmental Elective III	3	-	-	3
EE 331- EE342	Departmental Elective IV	3	-	-	3
EE 351- EE361	Open Elective II	3	-	-	3
EE324	Linear Control System Lab	-	-	3	2
EE325	Microprocessors Lab	-	-	3	2
EE326	Minor Project	-	-	3	2
					Total credit 24

List of Department Electives (V & VI Semesters)

EE331 Electrical Engineering Graphics
EE332 Installation, Commissioning and Testing of Electrical Equipments
EE333 Reliability Engineering
EE334 Prime Mover
EE335 Electrical Machine Design
EE336 Computer Applications in Power Systems
EE337 Energy Economics Modeling and Analysis
EE338 Evolutionary Techniques
EE339 Renewable Energy Sources
EE341 EHVAC & DC
EE342 Digital Electronics

List of Open Electives (V & VI Semesters)

EE351 Modelling and Simulation of Electrical Systems
EE352 Mechatronics
EE353 Network Synthesis
EE354 Optimization Techniques
EE355 Embedded System
EE356 Biomedical Instrumentation
EE357 Project Management
EE358 Intellectual Property Rights (shifted from departmental to open elective)
EE359 Data Structure (CSE211)
EE361 Analysis and Design of Algorithms (CSE225)

Seventh Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
EE411	Modern Control System	3	-	-	3
EE421	Power System Stability and Control	3	-	-	3
EE431-EE443	Departmental Elective V	3	-	-	3
EE451-EE463	Open Elective III	3	-	-	3
EE451-EE463	Open Elective IV	3	-	-	3
EE412	Modern Control System Lab	-	-	3	2
EE413	Major Project/Seminar	-	3	3	4
EE414	Educational Tour and Training	-	-	3	2
					Total credit 23

Eighth Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
EE431-EE443	Departmental Elective VI	3	-	-	3
EE431-EE443	Departmental Elective VII	3	-	-	3
EE431-EE443	Departmental Elective VIII	3	-	-	3
EE451-EE463	Open Elective V	3	-	-	3
EE451-EE463	Open Elective VI	3	-	-	3
EE428	Major Project and Seminar	-	6	3	5
EE429	General Proficiency	-	-	3	3
					Total credit 23

List of Department Electives (VII & VIII Semesters)	**List of Open Electives (VII & VIII Semesters)**
EE431 Reactive Power Control and FACTS	EE451 Artificial Neural Network
EE432 Power Quality	EE452 Microcontroller and its Applications
EE433 Energy Conservation	EE453 Operating System
EE434 Entrepreneurship Development	EE454 Digital Signal Processor (TMS28XX Series)
EE435 Demand Side Management	EE455 Power Controller
EE436 Solar PV Applications	EE456 Fuzzy Logic System
EE437 Special Machines	EE457 System Engineering
EE438 Advanced Microprocessor	EE458 VLSI Design
EE439 Power System Deregulation	EE459 Robotics
EE441 Digital Signal Processing	EE461 Industrial Electronics
EE442 Electronics Instrumentation	EE462 Communication Engineering
EE443 High Voltage Engineering.	EE463 Digital Image Processing

FIRST SEMESTER

Course Number: **EE124**
Title of Course: **BASIC ELECTRICAL & ELECTRONICS ENGG.**
Designation as a required or elective course: Required
Pre-requisites: Engineering Physics
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Students will get an overview of fundamentals of Electrical and Electronics engineering.
Topics:
DC circuits: Voltage & Current sources, KCL, KVL, loop and nodal equations, Network theorems. Star Delta transformations, Simple series and parallel circuits, AC Circuits: Alternating quantities, RMS & average value, phase, phase difference Power and power factor, Series & Parallel AC circuits, resonance. Faraday's law of electromagnetic induction, Transformers: construction, principle of operation, phasor diagrams, equivalent circuit, tests, losses and efficiency, DC machines: Construction, emf equation and principle of operation. Semiconductor devices and applications: Characteristics of PN Junction Diode, Zener Effect, Zener Diode and its characteristics, half wave and full wave rectifiers, ripple factor, conversion efficiency, Bipolar Junction Transistor: Principle of operation, Input/output & transfer characteristics of BJT in CB, CE, CC configurations.

Reference Books:

1. D.P.Kothari & I.J. Nagrath, Basic Electrical Engineering, MC Graw Hill Education, 20 Jun 2006
2. V.N.Mittle, Basic Electrical Engineering, MC Graw Hill Education, 10 Sep 2005
3. Schaum's Outline Series, Electrical Circuits, 6th, MC Graw Hill Education, 1 Jan 2014
4. Boylestad & Nashelsky, Electronic Devices and circuit Theory, Pearson, 1 Jan 2009
5. Albert Malvino, Electronics principles, 7th, MC Graw Hill Education, 1 May 2006

THIRD SEMESTER

Course Number: **MTH211**
Title of Course: **MATHEMATICS III**
Designation as a required or elective course: Required
Pre-requisites: Knowledge of Engineering Mathematics
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Knowledge of soft computing techniques.
Topics:
Numerical Methods: Solution of algebraic and transcendental equations, Solution of linear Simultaneous Equations, Finite Differences, Interpolation and Extrapolation, Inverse Interpolation, Numerical Differentiation and Integration, Numerical solution of Ordinary & Partial Differential Equations. Statistics: Curve fitting, Correlation and Regression Analysis Probability Distribution, Sampling and Testing of Hypothesis.

Reference Books:

1. F.B. Hildebrand, Introduction to Numerical Analysis, 2 edition, Mcgraw Hill,1956
2. J.B. Scarborough, Numerical Mathematical Analysis, Oxford and IBH Publishing Company Pvt. Limited,1958
3. E. Balaguruswamy, Numerical Methods, Tata McGraw-Hill Education
4. M.K.Jain, Numerical Methods for scientific and Engineering, New Age International, 2003
5. M. Ray, Mathematical Statistic, Ram Prasad and Sons, 1966
6. John E. Freund, Mathematical Statistic, Pearson Education India, 2004

Course Number: **EE212**
Title of Course: **ELECTRICAL MATERIALS & ELECTROMAGNETIC FIELDS**
Designation as a required or elective course: Required
Pre-requisites: Knowledge of Vector Algebra, Differential Equations, Differentiation, Integration, Engineering Physics.
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Develops conceptual and analytical power to understand advanced subjects of Electrical Engineering.
Topics:
Electrostatic Fields -Coulomb's law, electric field intensity, Gauss's Law, boundary relations, physical concepts of divergence, gradient and curl. Electric potentials, electric boundary conditions, capacitance, continuity equation, Poisson's and Laplace's equations, Magnetic Fields - Biot–Savart's Law, Stoke's theorem, Ampere's circuital law, magnetic boundary conditions, energy storage in magnetic fields, Scalar and vector magnetic potential, Maxwell's equations, EM Wave, Propagation, Poynting theorem, instantaneous, average and complex, Polarization of waves, reflection and refraction of waves, Insulating & Dielectric Materials**,** Conducting Materials, Magnetic Materials, superconductivity.

Reference Books:

1. William & Haytt, Electromagnetic field, 7 edition, McGraw Hill Education, 25 April 2006
2. Jorden, Electromagnetics, 2 edition, Pearson India, January 6, 2015
3. C.S. Indulkar, Electrical Engineering Material, 4th Edn., S Chand & Company, 1 December 2006
4. Sadiku, Elements of Electromagnetics, 6 edition, Oxford Univ Press, 31 January 2014

Course Number: **EE213**
Title of Course: **ELECTRICAL MEASUREMENT**
Designation as required or elective course: Required
Pre-requisites: Concept of Basic Electrical Engineering
Contact Hours: 3
Type of Course: Lecture
Course Assessment Methods: Both Continuous and End-Semester Examination
Course Outcomes: To acquire knowledge of analog instruments and methods of measuring electrical and magnetic quantities.
Topics:
Indicating Instruments, Sources of errors, deflecting, controlling and damping torque, Moving Iron, Moving coil, Dynamometer. Induction & electrostatic type of instruments, Rectifier type instruments, Potentiometers, Measurement of Phase and Frequency, Ohm-meters, Megger, CRO, Measurement of Energy, Magnetic Measurements: B-H curve, determination of hysteresis loop, permeameters.

Reference Books:

1. E.W.Golding, Electrical Measurement & Measuring Instruments, Reem Publications Pvt. Ltd, 2011
2. A.K.Sawhney, Electrical Measurement, 14th, DhanpatRai & Sons Publication, 2005
3. Doebelin, Measurement system, 6 edition , McGraw-Hill Education (India) Pvt Limited, 15 June 2011
4. J.B.Gupta, A Course in Electronic and Electrical Measurements & Instrumentation, Reprint 2013 edition, S K Kataria and Sons, 2013

Course Number: **EE214**
Title of Course: **NETWORKS**
Designation as a required or elective course: Required
Pre-requisites: Differential equation, Laplace Transform and basic electrical.
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Analysis of networks, application of theorems.
Topics Covered
Circuit Concept, Network Topology, Coupled circuits, Steady State Analysis, Transient Analysis, Initial conditions, Laplace transform, Waveform synthesis, Network theorems, Network function-Poles & zeros, two port networks, Driving point & transfer impedances, Fourier series, Network synthesis, Conditions for realizing an immittance function of passive elements, Foster form & Cauer form of RC, RL & LC networks.

Reference Books :

1. Van Valkenberg, Network Analysis, Prentice-Hall,
2. Schaum's Outline Series, Circuit theory,
3. C.L.Wadhwa, Network Analysis & Synthesis, New Age International,
4. S.Ghosh, Network theory: analysis and synthesis, PHI,
5. Pankaj Swarnkar, Network Analysis and Synthesis, Satya Prakashan

Course Number: **EE215**
Title of Course: **ELECTRICAL MACHINES-I**
Designation as a required or elective course: Required
Pre-requisites: Fundamentals of Basic Electrical Engineering.
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Knowledge of Machines in electrical systems.
Topics:
Polyphase circuits: Three-phase systems with balanced & unbalanced load. Energy in electromagnetic system, DC Generators- emf equations, characteristics of DC generators, DC motors- Torque equation, characteristics, Losses & Efficiency of DC machine, testing of DC machine, Single phase Transformer: review, transformer tests: polarity test, Sumpner's test**,** Three phase transformers, 3 phase to 2 and 6 phase conversion, parallel operations of single & three phase transformers, load division between transformers in parallel.
IS codes & industrial testing of DC Machines and Transformer.

Reference Books:

1. P.S.Bhimbra, Electrical Machine, Khanna, 1 January 2011
2. G. Say, Performance & design of A.C. Machines, 3rd edition , CBS, 1 December 2005
3. Fitzerald Kingsley Otmans, Electrical Machines, 7 edition , McGraw-Hill Education, 1 March 2013
4. Nagrath & Kothari, Electrical Machines, 4 edition, McGraw Hill Education, 7 July 2010
5. Charles. I. Hubert, Electric Machine, 2 edition, Prentice Hall, 16 October 2001
6. J.R. Cogdell, Foundation of Electric Power, Pck edition , Addison Wesley Longman, May 1, 2003

Course Number: **EE216**
Title of Course: **ELECTRONICS-I**
Designation as a required or elective course: Required
Pre-requisites: Basic knowledge of semiconductor physics, basic electrical and circuit theory.
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Applications of semiconductor devices in regulator, amplifier.
Topics:
Special Purpose Diodes- Diode Applications, Zener voltage regulators, photodiode etc. Transistor Biasing -Purpose of biasing, dc operating point, dc load line, different biasing techniques Thermal Runaway, Thermal stability. Small Signal Amplifiers- Transistor as an amplifier, classification of amplifiers RC coupled CE-amplifier, ac equivalent circuits, analysis using h-parameters, frequency response, cascading, Analysis of transistor amplifier at high frequency, miller theorem, Gain band width product, function generator IC FET & MOSFET, FET biasing, The common source and common drain amplifier at low frequency and high frequencies, MOSFET as a switch, MOSFET driver circuits.
Prevailing trends in semiconductor devices and applications.

Reference Books:

1. Millman & Halkias, Electronic Devices, McGraw Hill Education, 1 September 1967
2. A.P.Malvino, Electronics Principles, 7th edition, McGraw-Hill Higher Education, May 1, 2006
3. Donald I. Schilling, Electronic Circuit Discrete and Integrated, 3rd Revised edition , McGraw-Hill Inc.,US, 1 March 1989
4. David Bell, Electronic Devices, Anna edition, OUP India, 11 October 2010

FOURTH SEMESTER

Course Number: **EE221**
Title of Course: **UTILIZATION OF ELECTRICAL ENERGY**
Designation as a required or elective course: Required
Pre-requisites: Knowledge of Basic Electrical & Electrical Machines
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Knowledge of illumination, electric welding and traction.
Topics:

Nature of light, units, sensitivity of the eye, luminous efficiency, glare, Production of Light, different types of lamps, polar curves, effect of voltage variation on efficiency and life of lamps, Distribution and control of light, factory lighting, flood lighting and street lighting, Electrical heating-advantages, methods and application, resistance over general construction, design of heating elements, efficiency and losses control. Induction heating: core type & core less furnaces and high frequency eddy current heating, dielectric heating: principle and special applications, arc furnaces, Different methods of electrical welding and electrical equipment for them, welding transformers, Advantages and disadvantages, system of electric traction, diesel electric locomotives, Mechanics of train movement: simplified speed time curves, average and schedule speed, tractive effort, specific energy consumption, factors affecting specific energy consumption.

Modern 25 KV AC single phase traction systems: advantages, equipment and layout of 25 KV, single phase power frequency AC traction.

Reference Books:

1. E.O. Taylor, Utilization of Elect. Energy, Blackie & Son Ltd., 1948
2. H. Pratab, Utilization of Elect. Energy, 2012 edition, S.K. Kataria & Sons, 2012
3. J.B. Gupta, Utilization of Elect. Energy, 2012 edition , S.K. Kataria & Sons, 2013
4. G. Weinberg & J.Mares, Traction , Portfolio , October 6, 2015

Course Number: **EE222**
Title of Course: **POWER SYSTEM I**
Designation as a required or elective course: Required
Pre-requisites: Knowledge of basic electrical engineering and circuit analysis.
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Understanding of technical aspects of power system transmission and distribution system and its working.
Topics:
General Structure of Power System, Single line diagram, transmission line constants, performance of transmission lines, Power Transmission at different voltage level, mechanical design of overhead lines, Type of overhead conductors, Bundle conductors, Skin effect, Proximity effect, line insulators, corona loss, travelling waves on transmission line, , underground cables, distribution systems and their application, HVDC transmission system and its control.
Substation layout, Design of substation and power capacitors, selection of CB and isolator.

Reference Books:

1. C.L.Wadhwa, Electric Power System, John Wiley & Sons, 11 April 1984
2. Asfaq Husain, Electric Power System, 5 edition , CBS, 1 January 2010
3. William D.Stevenson, Elements of Power System Analysis, 4th Revised edition, McGraw Hill Higher Education , 1 September 1982
4. B.R.Gupta, Power System Analysis & Design, Re-issue edition , S. Chand & Company, 8 August 2005
5. D.P. Kothari and I.J.Nagrath, Power System Engineering, 2 edition, McGraw Hill Education, 9 July 2007

Course Number: **EE223**
Title of Course: **GENERATION OF ELECTRICAL POWER**
Designation as a required or elective course: Required
Pre-requisites: Knowledge of Prime movers, Electrical Machinery
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Develops the knowledge of economical operation, maintenance and design of power plants which is useful in power industry.
Topics:
Introduction of electrical power generation and classification of conventional & non-conventional power generation, Hydro-Electric Stations**,** Thermal Power Stations: Choice of coal fired station site, arrangement of plant and principal auxiliaries, coal handling plant, Nuclear Power Stations**-**Nuclear Physics, Economic Aspects of Power Plant Operation**,** power factor improvement by static and synchronous capacitors, Economic Scheduling of Power Stations, Hydro power generation.

Reference Books:

1. B.R. Gupta, Generation of Electrical Energy, S Chand, 1 December 2010
2. G.D. Rai, Non-conventional Energy Sources, Khanna, 1 December 2004
3. M.V.Deshpande, Elements of power station design, Prentice Hall India Learning Private Limited , 2009
4. L. R. Kirchmare, Economic Load Dispatching, iitk

Course Number: **EE224**
Title of Course: **ELECTRICAL MACHINES II**
Designation as a required or elective course: Required
Pre-requisites: Concept of rotating electrical machines.
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Knowledge of rotating electrical machine and their applications.
Topics:
3-phase Induction Machine: Construction, Principle, Operation and applications, No-load and blocked rotor test, circle diagram, Starting & speed control of Induction Machines, Synchronous Generators- armature windings, e.m.f. equation, harmonics in the induced e.m.f., armature reaction, OC & SC tests, voltage regulation, parallel operation, operation on infinite bus**.** Two reaction theory, power expressions for cylindrical and salient pole machines, OC & SC characteristics, Synchronous motor: Principle of operation, starting methods, phasor diagram, torque angle characteristics, V-curves, power factor control of synchronous motor, Single Phase Induction Motor-Double revolving field theory, equivalent circuit, no load & block rotor tests, starting methods.
IS codes for testing of AC machines and their applications in electrical systems.

Reference Books:

1. P.S.Bhimbra, Electrical Machines, Khanna, 1 January 2011
2. M.G. Say, Performance & design of A.C. Machines, 3rd edition , CBS, 1 December 2005
3. Fitzerald Kingsley, Electrical Machines, 7 edition , McGraw-Hill Education, 1 March 2013
4. Nagrath & Kothari, Electrical Machines, 4 edition, McGraw Hill Education, 7 July 2010
5. Charles. I. Hubert, Electric Machine, 2 edition, Prentice Hall, 16 October 2001
6. J.R. Cogdell, Foundation of Electric Power, Pack edition , Addison Wesley Longman, May 1, 2003

Course Number: **EE225**
Title of Course: INSTRUMENTATION
Designation as required or elective course: Required
Pre-requisites: Basics of Engineering Physics, Electrical and Electronics Engineering.
Contact Hours: 3
Type of Course: Lecture
Course Assessment Methods: Both Continuous and End-Semester Examination
Course Outcomes: Knowledge of different techniques for measuring physical quantities. Components measurement using standard methods and different types of signal generators.
TOPICS:
Transducers- Resistance, Inductance and Capacitance transducers, Measurement of Displacement, Strain, Force, Liquid level, Pressure, Temperature, Speed, Optical, Piezo-Electric Transducer, Hall Effect Devices, D.C. & A.C. Bridges, Instrument Transformers, Pulse and Square-Wave Generator, Harmonic Distortion Analyzer, Function Generator, Triangular Waveshape Generator.
Instrumentation using Virtual Instruments.

Reference Books:
1. A.K.Sawhney, Electrical Measurement, Dhanpat Rai & Sons Publication,
2. Kalsi, Electronic Instrumentation, 3 edition , McGraw Hill Education, 28 June 2010
3. Helfric and Cooper, Modern Electronic Instrumentation and Measurement Techniques, Prentice Hall India Learning Private Limited, 1992
4. Doeblin D.O., Measurement Systems- Applications and Design, 5 edition, McGraw-Hill Higher Education, 1 September 2003

Course Number: **EE226**
Title of Course: **ELECTRONICS II**
Designation as a required or elective course: Required
Pre-requisites: Knowledge of semiconductor devices and characteristics and Digital number system.
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Theoretical and practical exposure to semiconductor devices with their applications in analog and digital electronics devices.
Topics:
The differential amplifier, Amplifier and its applications- Op-Amp instrumentation amplifier, current to voltage and voltage to current converter, Feed back concept, topologies voltage series current series, voltage shunt and current shunt, Wien bridge oscillator RC phase shift, Hartley and Colpitt oscillator, Multivibrators - Astable, Monostable and Bistable, Large signal amplifiers class A, class B and basic idea of push pull action, distortion, the current mirror, darlington and complementary pairs. Number system, Boolean algebra, logic gates, Half/ Full Adder, Half/ Full Subtractor, Multiplexer/ Demultiplexer, Flip flops & their Application, Registers and Counters.
Audio power amplifier (LM 380), IC fabrication Process and Op-Amp application in Industry.

Reference Books :

1. Millman & Halkies, Electronic Devices & Circuits, , McGraw Hill Education , 1 September 1967
2. A. P. Malvino, Electronics Principles, 7th edition, McGraw-Hill Higher Education, May 1, 2006
3. Ramakant A. Gayakwad, Op-Amp & Linear Integrated Circuits, 3rd Revised edition edition , Prentice-Hall, 2 January 1993
4. William H.Gothmann, Digital Electronics, 9 edition, Pearson, July 28, 2011

FIFTH SEMESTER

Course number: EE311
Title of course: **ELECTRICAL MACHINES-III**
Designation as a required or elective course: Required
Pre-requisites: Knowledge of electrical machines
Contact hours: 3 Hours
Type of course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course outcomes: Knowledge of modeling and study sate and transient analysis of electrical machine.
Topics:
Kron's primitive machines, Park's transformations. Generalized model of DC machine, Interconnection of machines, Generalized model of 3-phase synchronous machine , steady state and transient analysis, generalized model for 3-phase induction machine, performance equation & steady state analysis, effect of voltage & frequency variations on the induction motor performance, operation of I.M. on unbalanced supply voltage, Induction motor starting analysis. Constructional features, working principle and analysis of Universal Motor, Stepper motor, Linear Induction Motor, Hysteresis motor, Reluctance motor, brushless DC motor, Schrage motor, repulsion motor.
Industrial applications of special machines.

Reference Books :

1. P.S.Bhimbra, Generalised Theory of Electrical Machines, Khanna publishers, July 2015
2. P.S.Bhimbra , Electrical Machines, , 7th Edition, Khanna publishers, 2011
3. J. Nagrath and D.P.Kothari,Electrical Machines, 4th Edition, Mcgraw Hill Education, 2010
4. Fitzgerald & Kingsley, Electric Machinery, 7th Edition, McGraw-Hill, 2013

Course Number : EE312

Title of Course : **POWER ELECTRONICS**

Designation as a required or elective course : Required

Pre-requisites : Knowledge of Basic Electrical Engg, Networks and Basic Electronics

Contact hours : 03

Type of Course : Lecture

Course Assessment methods : Both continuous and semester-end assessment

Course Outcomes : Application of power converters in electrical systems

Topics:

Introduction to SCR and Thyristor family, I-V Characteristics of self Commutated Self commutated switches such as MOSFET, IGBT etc., Basic concepts of firing and control circuit, gate/base drive circuits and protection, design of snubber circuit, AC/DC uncontrolled and Controlled converters, DC-DC, DC-AC and AC-AC converter circuits : topologies, operation, waveform analysis and applications,

Datasheet Ratings for Power Semiconductor Devices. Selection of devices/modules, thermal design, driver circuits etc.

Reference Books :

1. C W Lander, Power Electronics, 3rd Edition, McGraw-Hill, 1993
2. M. H. Rashid, Power Electronics : Circuits Devices and Application, 2nd Edition, 2006
3. P S Bimbhra, Power Electronics , Khanna Publishsers-Delhi, edition 2012
4. Ned Mohan Tore M. Undeland William P. Robbins, Power Electronics : Converters, Applications & Design, 3rd Edition, John Wiley & Sons
5. Joseph Vithayathil, Power Electronics: Principles and Applications, McGraw-Hilll

Course Number: **EE313**
Title of Course: **POWER SYSTEM II**
Designation as a required or elective course: Required
Pre-requisites: Knowledge of basic electrical engineering and power system structure and its components
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: knowledge of switch gear and power system protection.
Topics Covered:
Faults in power system, Symmetrical components and sequential networks, Symmetrical and unsymmetrical faults, current limiting reactors, load flow solutions, various type of protective relays and their applications, transformer, generator and Bus Bar protection, protection of transmission line, Theory of current interruption, different types of circuit breakers and their applications, LT switch gears, HRC fuse.
Auto reclosure and multifunction relays.

Reference Books:

1. C.L.Wadhwa, Electrical Power Systems, New Age International, 6th Edition, 2010
2. Nagrath & Kothari, Modern Power System Analysis, 3rd Edition, Springer Verlag, 2003
3. Y.G.Paithankar & S.R.Bhinde, Fundamentals of power system protection, 2nd Edition, PHI LEARNING PVT. LTD-NEW DELHI, 2010
4. A.R.Van C.Warrington, Protective relays: Their theory and practice, Edition, Springer, 2013
5. P.M. Anderson, Power system protection, CBS PUBLISHERS & DISTRIBUTORS-NEW DELHI, Edition, 2012
6. B. Ram, Power system protection & Switchgear, 2nd Edition, Mcgraw Hill Education, 2011

SIXTH SEMESTER

Course Number: **EE321**
Title of Course: **LINEAR CONTROL SYSTEM**
Designation as a required or elective course: Required
Pre-requisites: Knowledge of Laplace transforms
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Mathematical analysis of system components, stability, design of controller and compensating network.
Topics:
System concept, mathematical modeling of system components, Transfer function of linear systems, Time response, relation between Time and frequency domain, different types of controllers, Stability analysis of linear systems using Routh Hurwitz, root locus, Nyquist and Bode plot, Design of compensating networks using Bode plots and root locus.
Modeling and design of process control system, servo application in industries.

Reference Books:

1. B. S. Manke, Linear control system, Khanna Publishers, January 2012
2. B.C.Kuo, Automatic control system, 9th Edition, Wiley India Pvt Ltd, October 2014
3. Nagrath Gopal, Control system Engineering, 5th Edition, New Age International, 2007
4. K Ogata, Modern control Engineering, 5th Edition, PHI LEARNING PVT. LTD-NEW DELHI, 2010
5. Pankaj Swarnkar, Automatic Control System, Satya Prakashan, 2015-2016
6. Dorf Bishop, Automatic Control System, 12th Edition, Pearson Education, January 2014.

Course Number: **EE322**
Title of Course: **ELECTRICAL DRIVES**
Designation as a required or elective course: OPEN ELECTIVE
Pre-requisites: Knowledge of Electrical Machines, Power Electronics & Control
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: To learn about the operation & control of Electrical Drives & their Industrial Applications.
Topics:
Introduction of Electrical Drives, Modes of operation, Dynamics of electrical drives, closed loop control of drives speed control of multi-motor drives, speed sensing, current sensing, phase locked loop (PLL) control. DC Motor Drives - Review of DC Motors & their performances, starting, braking & speed control by single-phase and three-phase controlled converter and chopper. Closed loop control of DC drive. Induction Motor Drives, Review of three-phase induction motor, Analysis & performance, starting, braking, speed control, Stator voltage control, frequency control, V/F control, current control, rotor-resistance control, slip-energy recovery control. Synchronous motor drives – review of synchronous motor, speed control by variable frequency, VSI, CSI and Cycloconverter, Energy conservation in Electrical Drives.
Industrial Applications of DC Motor & Induction Motor Drives.

Reference Books :

1. G.K.Dubey, Fundamental of Electrical Drives, 2nd Edition, CRC Press, 01-May-2002.
2. G.K.Dubey, Power Semiconductor controlled drives, Prentice Hall, 1 December 1988.
3. P.C.Sen, Thyristor DC Drives, Krieger Publishing Company,31 December 1991.
4. B.K.Bose, Power Electronics and AC Drives, Prentice Hall PTR, 2002.
5. Werner Leonhard, Control of Electrical Drives, 3rd Edition, Springer, 10 August 2001.

Course Number : EE323
Title of Course : MICROPROCESSORS
Designation as a required or elective course : Required
Pre-requisites : Knowledge of Electronics & Digital Electronics
Contact hours : 03
Type of Course : Lecture
Course Assessment methods : Both continuous and semester-end assessment
Course Outcomes : Fundamental knowledge and applications of Digital Controllers
Topics :
Evolution and overview of Microprocessor, 8-bit Microprocessor Architecture (viz 8-bit Intel 8085), timing and control signals, Instruction set and programming, Interrupts, Memory types and organization, Programmable Peripherals Interface (8255), Programmable Interval Timer 8253, A/D and D/A Converters and interfacing, Applications, 16-bit Microprocessor (viz – Intel 8086) and its internal architecture,.

Reference Books :

1. B.Ram, Fundamentals of Microprocessors and Microcomputers, Dhanpat Rai Publications, 2012
2. Ramesh Gaonkar, Microprocessors Architecture Programming and Applications, 6th Edition, Penram International Publishing, 1 October 2013
3. Roger L. Tokheim, Schaum's outline of Theory & Problems of Microprocessor Fundamentals, 2nd Revised Edition, Schaum Outline Series, 1 November 1989.
4. K J Ayala, The 8051 Microcontroller, 3rd Edition, Cenage Learning, 2007

LIST OF ELECTIVES THIRD YEAR (V& VI Semester)

List of Departmental Electives

EE331 Electrical Engineering Graphics
EE332 Installation , Commissioning & Testing of Electrical Equipments
EE333 Reliability Engineering
EE334 Prime Mover
EE335 Electrical Machine Design
EE336 Computer Applications in Power Systems
EE337 Energy Economics Modeling and Analysis
EE338 Evolutionary Techniques
EE339 Renewable Energy Sources
EE341 EHVAC & DC
EE342 Digital Electronics

List of Open Electives

EE351 Modelling & Simulation of Electrical Systems
EE352 Mechatronics
EE353 Network Synthesis
EE354 Optimization Techniques
EE355 Embedded System
EE356 Biomedical Instrumentation
EE357 Project Management
EE358 Intellectual Property Rights
EE359 Data Structure and Algorithms (CSE211)
EE361 Analysis and Design of Algorithms (CSE225)

DEPARTMENTAL ELECTIVES THIRD YEAR (V & VI Semester)

Course Number: **EE331**
Title of Course: **ELECTRICAL ENGINEERING GRAPHICS**
Designation as a required or elective course: DEPARTMENTAL ELECTIVE
Pre-requisites: Fundamental of Engineering Graphics
Contact hours: 03
Type of Course: Lecture + Drawing Class
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Students will get an overview of drawing and designing of electrical equipments using software as well as manual.
Topics:
Introduction to general purpose graphics software: AutoCAD, Conventional Symbols and brief introduction to electrical equipments, measuring instruments, Sketches of transmission line structures, insulating equipments, Sectional drawing: Cables, overhead conductors. Wiring systems: domestic, staircase and godown wiring, wiring installation in small residences. Types of transformer and their parts, core construction, sectional view of 1-phase and 3-phase transformers, H.T. and L.T. windings, DC machine : construction of pole, yoke and field coils, commutator.
Design of layout of Primary and Distribution substations, Bus bar arrangement and substation equipments.

Reference Books:

1. K.L.Narang, Electrical Engineering Drawing, SATYA PRAKASHAN-NEW DELHI, 2014.
2. N.D.Bhatt, Engineering Drawing, 53rd Edition, CHAROTAR PUBLISHING HOUSE PVT.LTD., 2014.
3. T.Jayapoorva, Engineering Drawing and graphics with AutoCAD, 3rd Edition, Vikas Publishing, 2010
4. Surjit Singh, Electrical Engineering Drawing (Part I & II), S.K. Kataria & Sons, 2013
5. Autodesk Inc. CA, USA, User's Guide, AutoCAD 2012

Course number: EE-332
Title of course: INSTALLATION AND COMMISSIONING
Designation as a required or elective course: DEPARTMENTAL ELECTIVE
Pre-requisites: Knowledge of electrical machines, Engineering graphics and power system
Contact hours: 3 Hours
Type of course: Lecture
Course Assessment methods: both continuous and semester-end assessment
Course outcomes: Trends and practices knowledge of electrical equipments installation, testing and commissioning.
Topics:
Tools, accessories and instruments required for installation, maintenance and repair work, Substation and Earthing, Testing of electrical equipments, Domestic installation, Environmental pollution prevention, Electrical Accident & Safety measures, treatment of shock.
Condition Monitoring and Maintenance of electrical equipments: transformers, machines, switchgears, cables, Fault location in cable and transmission / distribution feeders.

Reference Books:

1. P.P. Gupta, Installation, Commissioning & Maintenance of Electrical Equipment, Dhanpat Rai Publications, 2012
2. K. B. Bhatia, Fundamentals of Maintenance of Electrical Equipments, Khanna Publihers, 1983
3. S. Rao, Testing Commissioning Operation & Maintenance of Electrical Equipment, Khanna publishers, 1st January 2004.
4. S.L.Uppal, Electrical Power System, Khanna Publishers Delhi, 2009.
5. B.K.N.Rao, Hand book of condition monitoring, Elsevier Advanced Technology, 22 November 1996.
6. S. K. Shastri, Preventive Maintenance of Electrical Apparatus, Katson Publication House.
7. B. V. S. Rao, Operation & Maintenance of Electrical Equipment, Asia Pub. House, 1 April 1969.

Course Number: **EE333**
Title of Course: **RELIABILITY ENGINEERING**
Designation as a required or elective course: DEPARTMENTAL ELECTIVE
Pre-requisites: Basic concepts of Probability theory
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Knowledge of reliability theory will enable students in understanding system planning with greater efficacy.
Topics:
Basic Concepts of Reliability-indices and criteria, use of probability theory for reliability evaluation, System Reliability Evaluation using Probability Distributions- series, parallel and series-parallel, MTTF, MTBF, concept of redundancy, Markov Modeling, Frequency and Duration techniques, Generating System Reliability Analysis-recursive model building, Distribution System Reliability analysis-application to radial networks, Effect of protection system and their failures.
Case studies concerning reliability analysis of power and distribution system.

Reference Books:

1. R. Billinton, R.N.Allan, Reliability Evaluation of Engg. System, Springer US, 1996
2. G.H.Sandler, System Reliability Engg.
3. Endreynil, Probabilistic Reliability Evaluation

Course Number: **EE334**
Title of Course: **PRIME MOVER**
Designation as a required or elective course: DEPARTMENTAL ELECTIVE
Pre-requisites: Basics of Thermodynamics
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Application of prime movers in power generation.
Topics:
Expansion of Gases - Reciprocating Air Compressor, volumetric efficiency, Adiabatic and iso-thermal efficiency, Multistage compressor, Steam power cycles and Steam Nozzles, Carnot cycle, Ranking cycle analysis, Ranking engine, Regenerative feed heating cycle, Binary vapour cycle, Isotropic flow of steam through nozzles, Steam Turbine and Condensers, Turbine blades and different efficiencies. Condensing plant, Condensers, Vacuum and its measurement. Vacuum and condenser efficiency, Cooling water requirements, I.C. Engines, Turbines - Gas, Fluids & Hydraulic, Pelton, Francis Kaplan and Bulb.
Recent trends in turbine, compressor and IC engine design.

Reference Books:

1. Domkundwar, Thermodynamics and Heat Engines.
2. Mathur and Mehta,Thermal Engg., Jain Bros, 1 January 2002
3. R.K. Rajput, Thermal Engg. 10^{th} Edition, Laxmi Publications, 2017.
4. P. L. Ballaney,Thermal Engg., 5^{th} Edition, Khanna, 2005.
5. R.K. Bansal, Fluid Mechanics, 9^{th} Edition, Laxmi Publications, 2017.

Course Number: **EE335**
Title of Course: **ELECTRICAL MACHINE DESIGN**
Designation as a required or elective course: Required
Pre-requisites: Knowledge of Electrical Machines and materials
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Knowledge of Design of Electrical machine.
Topics:
General concepts & considerations of electrical machine design: heating and cooling characteristics of machine, Magnetic circuit calculations. Design of DC machines: Output equation, specific loadings and number of poles, main dimensions of DC machines, winding design, Design of transformers: Output equation, determination of main dimensions, design of LV and HV winding, estimation of no load current, leakage reactance and voltage regulation. Design of induction motors: Output equation, main dimensions, Stator winding design, length of air gap, design of squirrel cage and wound rotor, estimation of no load current and leakage reactance, Design of Synchronous machine: Output equation, main dimensions, Stator winding design, design of rotor, Introduction to computer aided design.
Recent Industrial Trends in Electrical Machines design.

Reference Books:

1. Clayton, Design of DC Machines, CBS, 2 July 2004
2. M.G.Say, Performance and Design of A.C.Machines, 3rd Edition, CBS, 1 December 2005.
3. G.C.Jain, Design, Operation and Testing of Synchronous Machines, Asia Publishing House, February 1967
4. Say & Sinha, Computer aided design.
5. V.N.Mittle & A.Mittal, Performance & Design of Electrical Machines.
6. A.K.Sawhney, Design of Electrical Machines.
7. B.H.E.L, Transformer, Tata McGraw-Hill Education, 01-Jan-2003.
8. J.H. Walker, Large A.C. Machines: Design, Manufacture and operation, Oxford University Press, 1 August 1981.

Course Number: **EE336**
Title of Course: **COMPUTER APPLICATIONS IN POWER SYSTEM**
Designation as a required or elective course: DEPARTMENTAL ELECTIVE
Pre-requisites: Basic knowledge of power system analysis
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Develops the skills to use computer programming in power system analysis.
Topics:
Power system components and representation, Load Flow Studies, Contingency evaluation, concept of security monitoring, Introduction to Optimal power flow analysis, calculation of loss coefficients, Sensitivity analysis, Transmission loss coefficients, transmission loss formula as a function of generation and loads.
State Estimation: power system monitoring, energy management system (EMS), SCADA, function of state estimator, maximum likelihood estimation.

Reference Books :

1. O.I. Elgerd, Electric Energy Systems Theory - An Introduction, McGraw-Hill, 1988.
2. J.J. Grainger and W.D. Stevenson, Power System Analysis, Mc Graw-Hill, New York, 1994.
3. I.J. Nagrath and D.P.Kothari, Power System Engineering, Tata Mc Graw Hill Publishing Co., 1994.
4. M.A. Pai, Computer Techniques in Power Systems Analysis, Tata Mc Graw Hill, June 18, 2014.
5. Stagg G.W. and E.L. Abiad A.H., Computer methods in power systems analysis, Mc Graw Hill, Apr 1968.

Course Number: EE337
Title of Course: **ENERGY ECONOMICS: MODELLING AND ANALYSIS**
Designation as a required or elective course: DEPARTMENTAL ELECTIVE
Pre-requisites: knowledge of energy related issues, linear programming
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: The course is designed to expose the students to major energy-economic modeling approaches and their applications to energy technology assessments and energy and environmental policy analysis.
Topics:
Models and modeling approaches, input-output analysis, energy aggregation, factor decomposition analysis, mathematical optimization techniques for energy modeling, energy system models, Formulation of Linear Programming (LP), modeling energy-economic and environmental interactions, model applications in energy technology assessment, Integrated assessment models, alternative energy resource assessment and energy and environmental policy analysis.
Energy and environmental policy analysis.

Reference Books:

1. H.G. Huntington and J.P. Weyant, Modeling Energy Markets and Climate Change Policy, Energy Modeling Forum, EMF OP 52, Stanford University, CA.
2. Intergovernmental Panel on Climate Change (IPCC), Fourth Assessment Report.
3. J-C. Hourcade, M. Jacard, C. Bataille, and F. Ghersi (eds.), Hybrid Modeling of Energy-Environment Policies: Reconciling Bottom-Up and Top-Down, The Energy Journal, Special Issue, International Association for Energy Economics, USA.
4. J.B. Taylor, Principles of Macroeconomics, South-Western College Pub., 6th edition.
5. N. G. Mankiw, Macroeconomics, 8th Edition, Worth Publishers, 1 June 2012

Course Number: EE338
Title of Course: **EVOLUTIONARY TECHNIQUES**
Designation as a required or elective course: DEPARTMENTAL ELECTIVE
Pre-requisites: Concept of optimization techniques & engineering mathematics
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Student will learn to solve the non-linear optimization problem.
Topics:
Optimization: single objective, multi-objective and constraint problem, linear, non-linear and NP hard problem, combinatorial optimization, Conventional optimization method (lambda and differential). greedy optimization technique. Simple genetic algorithm, Multi-objective genetic algorithm. Artificial neural network, Fuzzy logic, Ant colony optimization. Particle swarm optimization. Basic simulated annealing, Basic tabu search method, Bacteria forging and Fish schooling optimization, Bee flying optimization. Teaching Learning based Optimization.
AI Application in Electrical Systems.

Reference Books:

1. J.M.Zurada, Introduction to Artificial Neural System, West Publishing Co, 1 April 1992
2. V.Rao & H.Rao, C++ Neural Networks and Fuzzy Logic, 2 Pap/Dsk edition, M & T Books, October 1995.
3. Marco Dorigo and Thomas Stutzle, Ant Colony Optimization, PHI
4. D.E. Goldberg, Genetic Algorithm in Search Optimization and machine learning, 13th Edition, Addison Wesley, 1 January 1989.

Course Number: **EE339**
Title of Course: **RENEWABLE ENERGY SOURCES**
Designation as a required or elective course: DEPARTMENTAL ELECTIVE
Pre-requisites: concept of Machines, generation and Power electronics.
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Renewable energy sources and their grid synchronization.
Topics:
Energy for sustainable development, Renewable and Non-renewable Energy sources, mini-micro hydro, small hydro systems, Different type of turbines, generators & controls, Wind energy: Wind Energy Conversion, Potential, Site selection, Types of wind turbines, Wind Generation and Control. Solar Radiation, Measurement and Estimation, Solar Thermal Conversion Devices and Storage and Applications, Solar Photovoltaic Conversion, applications of solar PV, Stand alone/grid connected, Energy Alternatives: The Nuclear Option, Wave and Tidal Energy, Geothermal, Bio energy, Ocean thermal energy systems, MHD & fuel cells.
Grid Interactive and stand alone / Distributed Renewable energy systems.

Reference Books :

1. Chetan Singh Solanki, Solar Photovoltaic's: Fundamental Technologies and applications, 2nd Edition, Prentice Hall India Learning Private Limited, 2011.
2. Chetan Singh Solanki, Renewable Energy Technologies: Practical Guide For Beginners, Prentice Hall India Learning Private Limited, 2008.
3. S. P. Sukhatme, Solar Energy - Principles of thermal collection and storage, McGraw-Hill Education (India), 13 January 2009.
4. J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes, 4th Edition, Wiley, April 2013
5. D. Y. Goswami, F. Kreith and J. F. Kreider, Principles of Solar Engineering, 2nd Edition, CRC Press, 2 March 2000.

Course Number: **EE341**
Title of Course: **EHV AC & DC TRANSMISSION**
Designation as a required or elective course: DEPARTMENTAL ELECTIVE
Pre-requisites: Knowledge of Power System
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Knowledge of Extra High Voltage AC & DC Transmission System.
Topics:
EHV AC Transmission: Need of EHV transmission lines, power handling capacity and surge impedance loading, Problems of EHV transmission, bundled conductors, Electrostatic fields of EHV lines and their effects, corona effect, Methods of voltage control. Synchronous phase modifier, shunt capacitors and reactors, HVDC Transmission: Types of D.C. links Basic principles of DC link control and basic converter control characteristics, Application of HVDC transmission.
Mechanical oscillations and vibration in long transmission line, HV tower design.

Reference Books:

1. Begamudre, EHV AC & DC Transmission, New Age International, 01 Jan 2007
2. S. Rao, EHV AC & DC Transmission, 3rd Edition, Khanna Publication, 2008.
3. P.Kundur, H.V.D.C. Transmission, McGraw Hill Pub.
4. Thomas E. Kissell, Electricity, Electronics, and Control Systems for HVAC, 4th Edition, Pearson, 28 October, 2007.

Course Number: **EE342**
Title of Course: **DIGITAL ELECTRONICS**
Designation as a required or elective course: DEPARTMENTAL ELECTIVE
Pre-requisites: Basic knowledge of Electronics Devices, Digital Number Systems.
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Knowledge of digital systems for real time applications.
Topics:
Combinational circuit: Full/half adder, Full/half subtractor, Parallel adder and subtractor, BCD adder, Excess 3 adder, Magnitude comparator, Look-ahead carry generator, Encoder/Decoder. Flip-Flop: RS, clocked RS, T, D, JK, Sequential circuits: State diagrams, Minimization of sequential circuit, Designing of sequential circuit-Registers, synchronous and asynchronous counter.
Digital to analog converter (DAC), analog to digital converter (ADC), Semiconductor memories Programmable Logic Devices & Arrays, simple active filter and sample and hold circuits.

Reference Books:

1. Morris Mano, Digital Electronics, First edition, Pearson Education India, 30 June 2016
2. R. P. Jain, Modern Digital Electronics, 4th edition, McGraw Hill Education, 27 July 2009.
3. Malvino and Leach, Digital Principles and Applications, 5th Edition, McGraw-Hill Inc.,US, 1 March 1994.
4. Gothman, Digital Electronics, Prentice Hall Publications
5. Anand Kumar, Fundamentals of Digital Circuits, 3rd Revised Edition, Prentice-Hall India, 30 November 2014

OPEN ELECTIVES THIRD YEAR (V & VI Semester)

Course Number: **EE351**
Title of Course: **MODELING & SIMULATION OF ELECTRICAL SYSTEMS**
Designation as a required or elective course: OPEN ELECTIVE
Pre-requisites: Fundamental knowledge of Basic Electrical and Electronics
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Modeling and Simulation of Electrical Systems.
Topics:
Simulation Mechanism and Simulation Tools, Modeling and simulation of electrical and electromechanical systems, Transient analysis of dynamic systems, study of dynamic system using state space approach, Simulation of Non-Linear System, Handling Arrays, Control Structures, File Handling, Functions and Function Files, Differential Equation Solver, Simulation of Electrical Networks with linear and nonlinear equations, Simulink Solution of Differential Equation, Solution using Laplace Transform Approach, Study of dynamic response.
MATLAB interface with Real Time Simulators and controllers such as dSPACE, FPGA, Simulation of industrial systems.

Reference Books:

1. MATLAB/Simulink Users Manual, MathWorks Inc
2. Rudrapratap Getting started with MATLAB, Oxford 28 May 2010
3. William D Paul, MATLAB 7, McGraw-Hill Higher Education, 2nd Edition August 2004
4. Shailendra Jain, Modelling and simulation using MATLAB-Simulink, Wiley India, 2nd edition Jan 2015

Course Number: **EE352**
Title of Course: **MECHATRONICS**
Designation as a required or elective course: OPEN ELECTIVE
Pre-requisites: Basic knowledge of Electrical and Electronics.
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Application of electronics for control of mechanical systems.
Topics:
Elements of Mechatronics System, Evolution of Mechatronics, Architecture of Mechatronics, Sensors and Transducers, Signal Conditioning, Various OP-AMP & other electronic circuits used in signal conditioning, Active & Passive Filters, Mechanical, Electrical Hydraulic and Pneumatic Actuators and Applications, Logic Building and Processing, Logic Gates, Combinational and Sequential Logic, Fuzzy Logic, Microprocessor, PLC, Applications in CNC and FMS.

References Books:

1. W. Bolton, Mechatronics, 4th Edition, Pearson Education, 2010
2. Beckwith and Beck, Mechanical Measurements, 6th Edition, Pearson Education India, 2013
3. Sirohi and Radhekrishnan, Mechanical Measurements, 3rd Edition, John Wiley & Sons, 11 June 1993
4. Appukuttan K.K. , Mechatronics, Oxford University Press, 2 August 2007

Course Number: **EE353**
Title of Course: **NETWORK SYNTHESIS**
Designation as a required or elective course: OPEN ELECTIVE
Pre-requisites: Knowledge of network analysis and basic electrical
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Students will be able to synthesis and analyze the electrical system and design of filters.
Topics:
Positive Real Functions: Driving point functions, Brune's Positive Real Function, Hurwitz Polynomial, Driving point synthesis with LC element, Foster and Cauer Form of RC and RL network, Foster and Cauer Form of LC network, Series and parallel realizations, symmetrical Lattice and Constant-Resistance Network.
Design and implementation of active and passive filters.

Reference Books:

1. S.P. Ghosh and A. K. Chakraborty, Network analysis and synthesis, McGraw Hill Education, 1 July 2013
2. Smarajit Ghosh, Network theory: analysis and synthesis, 1st Edition, Prentice Hall India Learning Private Limited, 2005
3. M.E. Van Valkenburg, Introduction to modern network synthesis, John Wiley & Sons, 1 January 1966
4. Franklin F. Kuo, John Wiley, Network Analysis and Synthesis, Wiley, Second Edition, 16 October 2009
5. Vanvalkenburg, Network Analysis, 3rd Edition, 2009
6. Lawrence P. Huelsman, Active and Passive Analog Filter Design, McGraw-Hill Inc.,US, 1 March 1993

Course Number: **EE354**
Title of Course: **OPTIMIZATION TECHNIQUES**
Designation as a required or elective course: DEPARTMENTAL ELECTIVE
Pre-requisites: Knowledge of engineering mathematics
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Applications in various areas of engineering research.
Topics:
Optimization problem: Engineering applications and classification, classical optimization techniques: Linear programming, graphical method, simplex method, duality in LP, Non linear programming: Lagrangian's method, Kuhn Tucker conditions, quadratic programming, stochastic programming, Integer programming, branch and bound technique, dynamic programming, shortest path model, minimum spanning tree problem, maximal flow problem.

Reference Books:

1. N. D. Vohra, Quantitative Techniques in Management, 4th Edition, McGraw Hill Education, 28 October 2009
2. P.K. Gupta & D.S. Hira, Operation Research, SULTAN CHAND & SONS-NEW DELHI, 2014
3. H.M. Wagner, Principles of Operation Research, 2nd Edition, Prentice Hall India Learning Private Limited, 1980.

Course Number: **EE355**
Title of Course: **EMBEDDED SYSTEM**
Designation as a required or elective course: OPEN ELECTIVE
Pre-requisites: Knowledge of system modeling
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: knowledge of software and hardware of embedded system for engineering applications.
Topics:
Embedded systems & their characteristics, modeling of systems, system specifications, specification languages, study of specification example, Specification translation, translation of various features such as state transition, message passing communication, concurrency, exception handling, System partitioning- Introduction, partitioning issues, partitioning algorithms, functional portioning, hardware/software partitioning algorithms, functional partitioning for systems. Design quality estimation- Quality metrics, hardware estimation, software estimation, Specification refinement- Refining variable grouping, channel refinement, resolving access conflict, refining incompatible interfaces, refining hardware/software interfaces.
Study of a system design methodology and study of generic synthesis system.

Reference Books:

1. David D Gajski, Frandk vahid S. Narayan, J Garg, Specification and design of embedded systems, Pearson Education India, 2007
2. Heath Steve and Newns, Embedded system design, Second edition, Elsevier India, 17 May 2005
3. J.Gassle, Art of programming Embedded Systems, Academic Press, 3 February 1992

Course Number: **EE356**
Title of Course: **BIO-MEDICAL INSTRUMENTATION**
Designation as a required or elective course: OPEN ELECTIVE
Pre-requisites: Knowledge of Instrumentation
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Basic principle, construction and implementation of Biomedical Instrumentation.
Topics:
Introduction to the physiology, sources of biomedical signals, Medical instrumentation system, Potential, Electrodes, Cardiovascular measurement, Measurement of Blood Pressure, Blood Flow, ECG, Phonocardiography, Plethysmography, Pace-maker, Defibrillator, Measurement of Electrical Activities in Muscles and Brain, EMG, Measurement of Respiration rate, Instrumentation for Clinical Laboratory, Medical Imaging-Ultrasound Imaging, Radiography, MRI, Electrical Tomography and Applications, Biotelemetry.
Aspect of patient care monitoring, Electrical shock hazards and prevention.

Reference Books:

1. R. S. Khandpur, Handbook of Biomedical Instrumentation, 3rd Edition, McGraw Hill Edu., 4 Aug 2014
2. L. Cromwell, F. J. Weibell and E. A. Pfeiffer, Biomedical Instrumentation and Measurements, 2nd Edition, Prentice Hall India Learning Private Limited, 1990

Course Number: **EE357**
Title of Course: **PROJECT MANAGEMENT**
Designation as a required or elective course: OPEN ELECTIVE
Pre-requisites: knowledge of business organization and management
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: managerial skill to handle human resources in business organization.
Topics:
Management: Evolution, development, characteristics, principles, philosophy, Nature and function, (MBO), (MBE) their importance characteristics and applications, Organizational Behavior: Human behavior, group dynamics, Leadership theories, styles and modern philosophies, motivation approaches and theories, communication, barriers and breakdowns, management information system, use of Computer in Management, Employees, Personnel Management practices, methods, recruitment, selection, interviews, group discussions, training, placement and employees development, wages and incentives, labor welfare, conflict, Negotiations, best practices. Marketing: concept, principles, functions, market survey and research, concepts of sales and distribution, channels of distribution, salesmanship, sales promotions, methods of advertising, copy right, sales management practices. Financial Management: goals of financial management, Sources of finance, Permanent long term, Short term Sources, Interest rates, annuity cost of capital, capital structure, decisions, Break-even Analysis, Financial Planning.

Reference Books:

1. Stonner & Freeman, Management, 6th Edition, Pearson Education India, 2003
2. Philip Kotler, Principle of Marketing, European Edition, Prentice Hall, 1 Feb 1996
3. K.K. Ahuja, Industrial Management, Khanna Publisher, 2001
4. S.K. Banerjee, Financial Management

Course Number: EE358
Title of Course: **INTELLECTUAL PROPERTY RIGHTS**
Designation as a required or elective course: OPEN ELECTIVE
Pre-requisites: Technical knowledge and basic understanding of IPR laws is important
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: To know the legal process to file IPR, benefits of IPR, awareness about the international scenario in IPR, Indian laws and acts regarding IPR, offences and penalties in registration of IPR.
Topics:
Introduction to IPR: Introduction to IPR, Importance, need of IPR, Intellectual assets and value realization, Forms of IPR, Patent, Copyright, Trademarks, Protection of IC layout designs, Geographical Indicators, Protection of undisclosed information, control of anti competitive practices and industrial design. Patents: Concept of property and history of patents, Indian Patent Act and rules, Novelty, Inventiveness and usefulness, Patent application procedure, patent able and non-patent-able inventions including product vs process patents. Industrial Designs: Registration, concept of novelty, originality, utility, obviousness, rights, obligations and limitations of registration of design, offences and penalties.
Trade Marks & Copy Rights: Introduction, registration, concept of deceptive similarity, rights and limitations of trademarks, offences and penalties. International Treaties: Introduction to international treaties, conventions and organizations, TRIPS, PCT, Berne Convention, WIPO, EPO, UPOV, Introduction to WTO, Introduction to dispute settlement procedure (technical & legal), Indian position in global IPR structure, Facilitating technology transfer and Capabilities building.

Reference Books:

1. Brigitte, Anderson, Intellectual Property Right: Innovation, Governance and the Institutional Environment Edward Elgar Publishing, USA
2. Peter J.Groves, Intellectual Property Right & their Valuation, Wood head Publishing Ltd., 9 Oct 1997
3. Duncan Mathews, Globalizing Intellectual Property Rights, Rutledge Publishing
4. Jane, Lambert, Enforcing Intellectual Property Rights, Routledge Publishing Limited, 28 Feb 2009

Course Number: EE359 (CSE 211)

Title of Course: **DATA STRUCRURE**

Designation as a required or elective course: OPEN ELECTIVE

Pre-requisites: Technical knowledge and basic understanding of computer programming

Contact hours: 03

Type of Course: Lecture

Course Assessment methods: Both continuous and semester-end assessment

Course Outcomes:

Topics:

Introduction to Data Structures, Algorithm Evaluation, Arrays, Multi-dimensional, Sparse Matrices, Structure, Pointers. Stacks: applications of Stacks, Prefix, Postfix and Infix notations and conversion, Recursion, Tail Recursion, Towers of Hanoi. Queues: Types of Queue and its application. Linked lists: Types of Linked list, implementation of Stack and Queue using Linked list, Josephus Problem, Polynomial representation and Arithmetic. Trees: binary tree, n-ary Tree, Tree Traversal, Huffman Coding, Binary Search Tree, AVL Tree. Graphs: Representation, Traversing, Shortest path, Minimum Spaning Tree. searching: Sequential Search, Binary Search, Hashing, Other search techniques. Sorting:

External and Internal Sort, Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort and Heap Sort, Radix Sort, Bucket Sort.

Reference Books:

1. Aaron M. Tenenbaum, 'Data Structure Using C', Pearson Education India, 1990
2. Ellis Horowitz, Sartaj Sahni 'Fundamentals of Data Structures' Computer Science Press; Reprinted edition 1988.

Course Number: EE361 (CSE225)

Title of Course: **ANALYSIS AND DESIGN OF ALGORITHMS**

Designation as a required or elective course: OPEN ELECTIVE

Pre-requisites: Technical knowledge and basic understanding of computer programming

Contact hours: 03

Type of Course: Lecture

Course Assessment methods: Both continuous and semester-end assessment

Course Outcomes

Topics:

Fundamentals of algorithm, asymptotic complexity, recursive algorithms, recurrence relation, disjoint set structure. Algorithm Design Techniques their control abstractions and related problems: Divide and conquer, Greedy strategy dynamic programming, Backtracking, Branch and bound, least cost search. Introduction to lower-bound theory, Introduction to NP-Complete and NP Hard problems.

Reference Books:

1. Horowitz and Sahani, Computer algorithms, 2nd Edition, Universities Press, 2008
2. Cormen and Rivest, Introduction to algorithms, 3rd Edition, MIT Press, 4 Sep 2009

SEVENTH SEMESTER

Course Number: **EE411**
Title of Course: **MODERN CONTROL SYSTEM**
Designation as a required or elective course: Required
Pre-requisites: Linear control system
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: To acquire the knowledge of Advance control system.
Topics:
State space representation of systems, solving time invariant state equation, State Transition Matrix, Zero input and state response, Relationship between state equation and transfer function, eigen values, eigen vectors. Canonical forms, controllability and observability, pole placement, Z transform, Pulse transfer function, Data re-construction, Sampling Theorem, zero and first order hold, Time response of sampled data system, Bilinear transformation and Jury's stability criterion, stability analysis using Nyquist, Bode and root locus. Non linear systems, common physical non linearity, phase plane method, describing function method, stability analysis by describing function method, limit cycles, Liapunov and Popov's stability criterion.
Design and implementation of Modern controllers for digital and analogue systems

Reference Books:

1. K.Ogata, Discrete Time control system, 2nd Edition, Pearson Education India, 2015
2. B.C.Kuo, Automatic control system, 2nd Edition, Pearson Education India, 2015
3. Nagrath Gopal, Control system Engineering, New Age International, 2009

EIGHTH SEMESTER

Course Number: **EE421**
Title of Course: **POWER SYSTEM STABILITY & CONTROL**
Designation as a required or elective course: Required
Pre-requisites: power system
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: The student will have knowledge how to control the power system in normal operating condition of power system.
Topics:
Excitation system and their comparison, Basic concept of Governor Mechanism and their performance in steady state, Turbine and Generator model and their transfer function, Division of load between Generators, Generation and absorption of reactive power, relation between voltage, power and reactive power at a node, methods of voltage control, use of tap changing transformers, power angle curve, transfer reactance, swing equations, steady state stability, transient stability using equal area criterion and step by step method, Methods of improving stability using traditional techniques and new approaches, reduction of transmission system reactance, regulated shunt compensation.
Load frequency control at power generating station, Economic load dispatch.

Reference Books:

1. Nagarath & Kothari, Power system engineering, 2nd edition, mcgraw hill education, 2007
2. B.M.Weedy, Electric Power System,5th edition, wiley india pvt ltd, 2013
3. P.Kundur, Power System Stability & Control, 1ST edition, mcgraw hill education, 2006
4. C.L.Wadhwa, Power System Stability & Control, New Age International Private Limited, 2007

LIST OF ELECTIVES FINAL YEAR (VII & VIII Semester)

List of Departmental Electives

EE431 Reactive Power Control & FACTS
EE432 Power Quality
EE433 Energy Conservation
EE434 Entrepreneurship Development
EE435 Demand Side Management
EE436 Solar PV Applications
EE437 Special Machines
EE438 Advanced Microprocessor
EE439 Power System Deregulation
EE441 Digital Signal Processing
EE442 Electronics Instrumentation
EE443 High Voltage Engg.

List of Open Electives

EE451 Artificial Neural Network
EE452 Microcontroller & its Applications
EE453 Operating System
EE454 Digital Signal Processor (TMS28XX Series)
EE455 Power Controller
EE456 Fuzzy Logic System
EE457 System Engg.
EE458 VLSI Design
EE459 Robotics
EE461 Industrial Electronics
EE462 Communication Engg
EE463 Digital Image Processing

DEPARTMENTAL ELECTIVES FINAL YEAR (VII & VIII Semester)

Course Number: **EE431**
Title of Course: **REACTIVE POWER CONTROL AND FACTS**
Designation as a required or elective course: DEPARTMENTAL ELECTIVE
Pre-requisites: Fundamental knowledge of Power System and Power Electronics
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Knowledge of Modern power controllers to enhance the stability and capability of existing network.
Topics:
Reactive Power Requirement and necessity of Compensation, Objectives in Load Compensation, Dynamic Power Compensation, Passive Compensation: SVC, TCR, Classification of FACTS devices, Shunt Compensators: STATCOM- Characteristics and Device selection (GTO/SCR/IGBTs), STATCOM Control Strategies and applications. Series Compensation: SSSC - Compensator characteristics and control Strategies, SSC applications. TCSC- Compensator characteristics and control Strategies, TCSC applications Series-shunt Compensation: UPFC - Principle of operation, configuration and control, Simulation of UPFC, Steady State Model of UPFC.
Sub synchronous resonance and its mitigation with FACTS devices, Power system Control using FACTS devices.

Reference Books:

1. T J E Miller, John Wiley, Reactive Power Control in Power Systems, Wiley India Pvt Ltd 28 January 2010
2. J Arriliga and N R Watson, Wiley, Computer modeling of Electrical Power Systems, Wiley India Pvt Ltd, 2009
3. N G Hingorani and L Gyugyi, Understanding FACTS, Wiley India Pvt Ltd, 18 March 2011
4. Y.H. Song and A.T. Johns, Flexible ac Transmission Systems (FACTS), IEEE Press, Institution of Engineering and Technology, June 1999
5. R Mohan Mathur and Rajiv K Varma, Thyristor based FACTS controller for electrical transmission system, Wiley-IEEE Press, 12 August 2011

Course Number : **EE432**
Title of Course : **POWER QUALITY**
Designation as a required or elective course : ELECTIVE
Pre-requisites : Fundamental knowledge of Power System and Power Electronics
Contact hours : 03
Type of Course : Lecture
Course Assessment methods : Both continuous and semester-end assessment
Course Outcomes : Monitoring and improvement of Power Quality
Topics:
Power Definition and Components with sinusoidal and non-sinusoidal voltage & current, Understanding Power quality, Causes and effects of power quality disturbances, Causes and effects of harmonics, converter configuration and their contribution to supply harmonics. Elimination/suppression of harmonics, classical solutions & their drawbacks, elimination/suppression of harmonics, passive and active solutions, topologies and their control methods, design of passive and active filters, EMI Issues, Wiring & Grounding,
PQ standards, Power quality monitoring and analysis of utilities, distribution system and industrial customers, Power quality measuring instruments

Reference Books :

1. R.C. Duggan, Mark F McGranaghan, H Wayne Beaty, Electrical Power System Quality, 3rd Edition, McGraw Hill Education, 7 June 2012
2. Derek A. Paice, Power Electronic Converter Harmonics, Wiley-Blackwell, 15 September 1999
3. Math H J Bollen, Understanding Power Quality Problems, Wiley India Pvt Ltd, 18 March 2011
4. J. Arrillga, Power system harmonics, Wiley India Exclusive, 2014
5. T J E Miller, Reactive Power Control in Electric Systems, Wiley India Pvt Ltd, 28 January 2010

Course Number: **EE433**
Title of Course: **ENERGY CONSERVATION & MANAGEMENT**
Designation as a required or elective course: OPEN ELECTIVE
Pre-requisites: Basic courses of power system and Electrical Machines
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: The course is designed to expose the students to the energy conservation and management options available in the electricity sector.
Topics:
Global and National Energy Scenario, Challenges and Future Options. Energy use patterns. Energy conservation methods in various sectors like residential, commercial, transportation, energy intensive industries, Co-Generation: Benefits, types of co-generation. Energy conservation in power sector, Measures for Reduction of losses in Transmission and distribution systems, Power factor improvement, Load curve analysis and load managements, Demand side management –Benefits, Demand side management Techniques, implementation of Demand side management programme, Tariff options of Demand side management. Energy efficient motor and drives-Motor efficiency, use of variable speed drives, Economics techniques, Discount rate, payback period, internal rate of returns, Risk analysis.

Reference Books:
1. L.C.Witte, P.S.Schmidt, D.R.Brown , Industrial Energy Management and Utilisation, Hemisphere Publ, Washington
2. Industrial Energy Conservation Manuals, MIT Press, Mass
3. I.G.C.Dryden, The Efficient Use of Energy, Butterworths, London
4. W.C.Turner, Energy Management Handbook, Wiley, New York
5. Technology Menu for Efficient energy use- Motor drive systems, Prepared by National Productivity Council and Center for & Environmental Studies- Princeton Univ
6. Dr. S.C.Tripathi, Electrical Energy Utilization & Conservation
7. Thumman, Energy Conservation and Audit
8. Energy Audit and Conservation, TERI

Course Number: EE434
Title of Course: **ENTREPRENEURSHIP DEVELOPMENT**
Designation as a required or elective course: DEPARTMENTAL ELECTIVE
Pre-requisites: basic understanding of socio-economic and political environment in the country and the world, if somebody has technical knowledge he/she is more beneficial from this subject (entrepreneurship).
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: it leads to innovation and new ideas among the youth, to start a new business, retain the talent inside the country, boost up leadership qualities, growth of employment and provide opportunities to the youth.
Topics:
The Entrepreneurship revolution, equity creation, The Timmons model, The Opportunity-Creation, Shaping, Recognizing and Seizing, Entrepreneurship and the internet, Creation of New Business, Entrepreneurial Thinking, Leadership and human behavior, manager, Principal and theories, management competencies, Team building, Issues of Integrity, Entrepreneurial approaches, business Plan, market surveys, preparation and planning, the business plan process and strategies, Developing a business plan, business borrowing, banking, legal issues and taxes, Entrepreneurial finance, cash flow, financial strategy framework, financial life cycle, Valuation, structure and negotiation of venture creation skills and deals. Venture growth and management, organizational paradigms, importance of Culture and organizational climate, new developments in entrepreneurial management, gestation period crisis, threats diagnosis, intervention, the turnaround plan, ESOP, Merger, Acquisition and Strategic Alliance.

Reference Books:

1. S.Anil, & K.Jayashree, Entrepreneurship Development, New Age International Publication, April 2009
2. Robert, D.Hisrich & Michel P.Peters, Entrepreneurship, 8th Edition, McGraw Hill-Higher Education, 2009
3. Harold P.Welsch, Rutledge, Entrepreneurship: The Way Ahead, 1st Edition, Routledge, 2003
4. Alison, J.Morrison, Butterworth-Heinemann, Entrepreneurship: An International Perspective, Butterworth-Heinemann, 22 July 1998

Course Number: **EE435**
Title of Course: **DEMAND SIDE MANAGEMENT**
Designation as a required or elective course: DEPARTMENTAL ELECTIVE
Pre-requisites: Course in generation and power system operation
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: To learn importance of load curve flattening through various demand side management technologies with cost/benefit analysis.
Topics:
Concepts and Methods of DSM, DSM Planning, Designing DSM programs, Marketing, Impact Planning, Customer Load control: Direct, Distributed and local control, Interruptible load, Assessment of Impact on load shape, Strategic conservation and Load management technologies, Improving Building envelope, Air-conditioning and CCL calculations, Lighting, Energy efficient motors and other Industrial processes and equipments, Customer Incentives, Program Marketing Design and Assessment of Program Penetration, Hierarchical process for assessment of customer acceptance and program penetration, Impact of DSM Programs on load shapes.
Load management technologies and their Cost/Benefit analysis, Assessing feasibility of DSM programs, Demand management and Integrated Electric Utility Service under deregulated situation.

Reference Books:

1. Clark W. Gellings, John H. Chamberlin**,** Demand-side management : concepts and methods**,** 2nd Edition, Prentice Hall, 1 May 1993
2. Aníbal T. de Almeida, Arthur H. Rosenfeld, Demand-side management and electricity end use efficiency, 1st Edition, Springer, Softcover reprint of the original, 28 October 2011
3. R. K. Pachauri & P. Mehrotra , India Vision 2020

Course Number: **EE436**
Title of Course: **SOLAR PV APPLICATIONS**
Designation as a required or elective course: DEPARTMENTAL ELECTIVE
Pre-requisites: Knowledge of semiconductor physics and power electronics
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: solar PV technologies and its application.
Topics:
Review of Renewable energy sources, Introduction of solar cell, Optimum design of solar cells, Solar cell and its I-V characteristics, fill factor, Solar cell Technologies: thin film, Group III-V cells, Quantum well solar cells, PV string, PV module, PV array, Balance of PV systems components, Types of PV system, design of a solar PV systems. PV cell modeling and model parameters assessment.
DC-DC Converter, Maximum Power Point Tracking Schemes, Solar PV Inverter, Solar PV system design and Applications.

Reference Books:

1. Chetan Singh Solanki, Solar Photovoltaic's: Fundamental Technologies and applications, 2nd Edition, Prentice Hall India Learning Private Limited, 2011
2. H.P. Garg & Prakash, Solar Energy-Fundamentals and applications, TMH Publication, 2000
3. Tomas Markvart Solar Electricity, 2nd Edition, John Wiley Publication, 12 May 2000
4. Michael boxwell, The Solar Electricity Handbook, Greenstream publishing, 2013

Course Number: **EE437**
Title of Course: **SPECIAL MACHINES**
Designation as a required or elective course: DEPARTMENTAL ELECTIVE
Pre-requisites: Knowledge of conventional electrical machine and their operation.
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Knowledge of special machines: Constructional, operational and control features.
Topics:
Review of drives: Principle, construction, operation & control of special machines: switch reluctance motor, brushless DC motor, stepper motor, linear induction motor, hysteresis motor, Energy efficient motors.
Control and applications of special machines.

Reference Books:

1. T.J.E. Miller, Brushless magnet and Reluctance motor drives, Oxford University Press, 1989
2. R.Krishnan, Switched Reluctance motor drives, 1st Edition, CRC Press, 28 June 2001
3. T.Kenjo, Stepping motors and their microprocessor controls, Clarendon Press, 19 January 1995
4. K. Venkataratnam, Special Electric Machines, 1st Edition, CRC Press, 22 May 2009
5. B.K Bose, Modern Power electronics and AC drives, Prentice Hall, 12 October 2001
6. N.Mohan, Power Electronics, 3rd Revised Edition, Wiley, 8 November 2002
7. E.G.Janardanan, Special Electric Machines, Prentice Hall India Learning Private Limited, 2014

Course Number: **EE438**
Title of Course: **ADVANCED MICROPROCESSORS**
Designation as a required or elective course: DEPARTMENTAL ELECTIVE
Pre-requisites: Knowledge of intel 8085 microprocessor.
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Knowledge of 8086 programming and peripherals programming used for electrical industries and power system relays.
Topics:
Introduction to 16-bit microprocessors, internal architecture of 8086, various types of segments used like CS, DS, ES & SS, study of various registers used in 8086, various types of addressing modes like immediate addressing, register addressing, direct addressing mode & indirect addressing modes. Instruction set of 8086, conversion of high level statements like assignment statement, if statements, for loops, while loops, procedures, functions etc. to 8086 statements, programming using 8086. Interrupts in 8086, maskable & non-maskable interrupts, hardware & software interrupts, conditional interrupts, type 0, type 1, type 2 and other such types of interrupts, timing diagrams for interrupts, steps for interrupt handling. Introduction to microcontroller 8051, architecture, instruction set, assembly language programming and applications. Introduction to PLC, architecture, programming & applications.
Application of 16-bit microprocessor to process & drives.

Reference Books:

1. R.Gaonkar, Microprocessor architecture, programming & applications with 8085, 6th Edition, Penram International Publishing, 1 October 2013
2. D.V.Hall, Microprocessors & interphasing, 2nd Revised Edition, McGraw-Hill Inc.,US, 1 September 1990
3. K.J. Ayala, Microcontroller, 3rd Edition, Cengage Learning, June 2004
4. A.Triebel, Avtar Singh ,The 8088 & 8086 Microprocessor-W, 4th Edition, Pearson, 8 September 2002
5. Peter Abbel, IBMPC & Intel processor
6. Badri Ram, Advanced Microprocessors & Interfacing, Tata Mcgraw Hill, 2001
7. A.K.Ray, K.M.Bhurchandi, Advanced Microprocessors & Peripherals, Tata Mcgraw Hill, 2006

Course Number: **EE439**
Title of Course: **POWER SYSTEM DEREGULATION**
Designation as a required or elective course: DEPARTMENTAL ELECTIVE
Pre-requisites: Knowledge of Power System Generation, Transmission and Distribution
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: The course is designed to expose the students to the new era of power system deregulation and the new market based approach for the operation of power system.
Topics:
Introduction to Electric supply industry structure under Deregulation, Regulatory and policy Developments, Introduction of Market structure, Spot market, forward markets and settlements, Electricity sector structures and Ownership /management, the forms of Ownership and management, Monopoly model, Purchasing agency model, wholesale competition model, Retail competition model, Bilateral and pool markets, Transmission pricing, LMP based markets, Power wheeling transactions ,Congestion management methods, Ancillary Services and System Security in Deregulation. Classifications and definitions, Technical, economic, & Regulatory issues involved in the deregulation of the power industry, Competitive energy bidding and auction methods.
Transmission pricing, Technical & economic aspect, Competitive energy bidding and auction methods.

Reference Books:

1. J. Wood and B. F. Wollenberg, Power generation, operation and control, 3rd Revised Edition,WileyBlackwell, 24 December 2013
2. K. Bhattacharya, M.H.J. Bollen and J.E. Daalder, Operation of restructured power systems, 1st Edition, CRC Press, 6 June 2001
3. M. Shahidehpour, H. Yamin and Z. Li, Market operations in electric power systems,WileyIEEE Press, March 2002
4. N. S. Rau, Optimization principles: Practical Applications to the Operation and Markets of the Electric Power Industry, Wiley-IEEE Press, 22 September 2003
5. Sally Hunt and Graham Shuttleworth , Competition and Choice in Electricity, Wiley, May 1996

Course Number: EE 441
Title of Course: **DIGITAL SIGNAL PROCESSING**
Designation as a required or elective course: DEPARTMENTAL ELECTIVE
Pre-requisites: Knowledge of Network Analysis and Z transform.
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: To acquire knowledge of processing of signals digitally and digital filters.
Topics:
Discrete time systems, linear time invariant (LTI) systems and important properties, Fourier Transform and Laplace transform, Z-transform, Signal flow graphs and digital system representation Discrete Fourier transform (DFT) and its properties, Fast Fourier transforms, Introduction to transformation matrices in a general form, Digital filters, FIR and IIR, FIR filters, structure, designs, IIR filters, Applications of DSP.

Reference Books:

1. S. Mitra, Digital Signal Processing, 4th Edition, McGraw-Hill Education, 13 September 2010
2. John C. Proakis & Dimities G. Manolakis, Digital Signal Processing, Algorithm and Applications, 4th Edition, Pearson Education, 2014
3. Steven W.Smith, Scientist and engineers guide to digital signal processing, 1st Edition, California Technical Pub, 1997
4. S.Salivehanan, Digital Signal Processing, TMHI, 3rd Edition, California Technical Pub, 2014

Course Number: EE442
Title of Course: **ELECTRONICS INSTRUMENTATION**
Designation as a required or elective course: DEPARTMENTAL ELECTIVE
Pre-requisites: Knowledge of Analog and Digital Electronics.
Contact Hours: 3.
Type of Course: Lecture
Course Assessment Methods: Both Continuous and End-Semester Examination
Course Outcomes: Enhanced knowledge of Digital Instruments, Data Logging and Telemetry.

Topics:

Rectifier Instruments, Electronic Voltmeter, Differential Voltmeters, Multimeters, Frequency Counter, D-A/A-D Conversion, Filers, Digital- Voltmeter, Frequency, Phase Meter, Period Measurement, Time Interval Measurement, Speedometer, Universal Counter, Measurement of Radio Frequency Power, Display devices, U-V and X-Y Recorders, Data Acquisition System (DAS), Data Logger, Methods of Data transmission, General telemetry systems, DC and AC telemetry system.
Data Acquisition System (DAS) and Data Logger.

Reference Books:

1. A. K. Sawhney, Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai & Company, 2014
2. A. D. Helfrick and W. D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, Pearson Education India, 2015
3. H. S. Kalsi Electronic Instrumentation, 3rd Edition, McGraw Hill Education, 28 June 2010
4. E.W.Golding, Electrical Measurement & Measuring Instruments, Reem Publications Pvt. Ltd. 2011

Course Number: **EE443**
Title of Course: **HIGH VOLTAGE ENGINEERING**
Designation as a required or elective course: DEPARTMENTAL ELECTIVE
Pre-requisites: Knowledge of Power System and materials
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Application of high voltage for testing of electrical equipments.
Topics:
Causes of over voltages and their effects on power system, Lightning, switching and temporary over voltages, protection against over voltages, Insulation coordination, Gaseous breakdown in uniform and non-uniform fields, corona discharges, Vacuum breakdown, conduction and breakdown in pure and commercial liquids, breakdown mechanisms in solid and composite dielectrics, Generation of high DC, AC, impulse voltages and currents, tripping and control of impulse generators, Measurement of high voltages and high currents, digital techniques in high voltage measurement.
High voltage testing of electrical power apparatus, power frequency, impulse voltage and DC testing, International and Indian standards.

Reference Books:

1. M. Naidu, High Voltage Engineering, Tata McGraw Hill Education, 4th Edition, 10 November 2008
2. E.Kuffel and W.S. Zaengl, J.Kuffel, Newnes, High voltage Engineering fundamentals, Second Edition, ELSEVIER, 2008
3. C.L. Wadhwa, High Voltage Engineering, NEW AGE, 1 January 2010

OPEN ELECTIVES FINAL YEAR (VII & VIII Semester)

Course Number: **EE451**
Title of Course: **ARTIFICIAL NEURAL NETWORKS**
Designation as a required or elective course: OPEN ELECTIVE
Pre-requisites: knowledge of engineering mathematics
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Application of ANN in engineering research.
Topics:
Neuron models, Network architectures, Learning Processes. Single layer and Multi layer perceptrons, Backpropagation Algorithm, Generalization, Function Approximations, Network pruning techniques. Radial Basis Function (RBF) Networks, Regular izat ion theory, Generalized RBF Networks, Estimation of the Regularization parameters, Approximation properties of RBF networks, Comparison of RBF and Multi layer perceptrons, Recur rent Neural Networks, Computational power of recurrent neural networks, learning algorithms, back propagation through time, Real time recurrent learning, Engineering applications of ANN, System identification, Adaptive filter design, solving interpolation and extrapolation problems using ANN, Classification, Function approximation and pat tern recognition problems.

Reference Books:

1. Simon Haykin, Neural Networks and Learning Machines, 3rd edition, pearson education, 2008
2. M.H. Hassoun, Fundamentals of artificial Neural Networks, PHI Learning, 2010
3. J.M. Zurada, Introduction to artificial Neural Networks, Jaico Publication House, 25 January 1994
4. Satish Kumar, Neural Networks, Tata McGraw Hill Education, 2009

Course Number: **EE452**
Title of Course: **MICROCONTROLLER & ITS APPLICATIONS**
Designation as a required or elective course: OPEN ELECTIVE
Pre-requisites: Knowledge of 8-bit intel processor.
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Knowledge of assembly level language programming for 8051 processor.
Topics:
Comparison of Microprocessors and Microcontrollers, Architecture of 8-bit Microcontroller (viz Intel 8051 family), Basic Assembly Language Programming, Interfacing and Microcontroller Design, Applications, Architecture of Atmel Microcontrollers (89CXX), PIC Microcontroller.
Application of microcontrollers in process & drives.

Reference Books:

1. K Ayala, The 8051 Microcontroller, 3rd Edition, Cenage Learning, 2007
2. Myke Predko, Programming and Customizing the 8051 Microcontroller, McGraw Hill Education, 20 October 2000
3. A V Deshmukh, Microcontrollers – Theory and Applications, McGraw Hill Education

Course Number: **EE453**
Title of Course: **OPERATING SYSTEMS**
Designation as a required or elective course: OPEN ELECTIVE
Pre-requisites: knowledge of computer architecture
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Knowledge of operating system design & memory management.
Topics:
Introduction to System Programs & Operating Systems, Evolution of Operating System, Operating system services, Operating System Structure, System Call & System Boots, System Protection, Buffering & Spooling, Types of Operating Systems, CPU Scheduling, Basic Concepts – Scheduling Criteria, Scheduling Algorithms, System Model, Deadlock Characterization, Methods for handling Deadlocks ,Deadlock Prevention, Deadlock Avoidance, Storage Management, Virtual Memory, Demand Paging, Process creation, Page Replacement, Memory Hierarchy, Concepts of Memory Management, Directory Structure, File System Structure, Allocation Methods, Free-space Management.

Reference Books:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne,Operating System Concepts, 8th Edition, John Wiley & Sons, 13 Feb 2009
2. Andrew S. Tanenbaum,Modern Operating Systems, 3rd Edition, Prentice Hall of India Pvt. Ltd., 2015
3. Harvey M. Deitel,Operating Systems, 3nd Edition, Pearson India, 2007
4. William Stallings,Operating System, 4th Edition, Prentice Hall of India, November 2000
5. Pramod Chandra, P. Bhatt, An Introduction to Operating Systems: Concepts and Practice, 4th Edition, PHI, 2013

Course Number: **EE454**
Title of Course: **DIGITAL SIGNAL PROCESSOR (TMS28XX Series)**
Designation as a required or elective course: OPEN ELECTIVE
Pre-requisites: Knowledge of Digital Electronics, microprocessor/microcontroller.
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and end term assessment
Course Outcomes: To learn about architecture and programming aspects of modern digital processors and their applications as digital signal controller of drives and processes.
Topics:
Architectural overview, components of CPU and Emulation feature, Modified Harvard Architecture, Memory map, circular buffer, Memory interface, CPU Registers, Multiply and shift operations, CPU Interrupts and Reset, maskable & non-maskable interrupts, Concepts of Pipelining and pipeline protection, Different Addressing modes with examples, Types and alignment of 32 bit operations, Assembly language instructions, Clock prescalars, on-chip ADC with different modes of operation, Event manager, SCI & CAN.
Applications of Digital signal processor to control electric drives and processes.

Reference Books:

1. W.D.Stanley, Digital Signal Processing, 2nd Edition, Reston Publoshing, 1 August 1983
2. Ashok Ambardar, Analog & Digital Signal Processing, 2nd Edition, Nelson Engineering, 14 March 1999
3. System Control & Interrupts reference guide literature no. SPRU078 www.ti.com
4. Data Manual of TMS 320F2812 literature no. SPRS257 & SPRS1747 www.ti.com

Course Number: **EE455**
Title of Course: **POWER CONTROLLER**
Designation as a required or elective course: OPEN ELECTIVE
Pre-requisites: knowledge of power electronics
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Application of power electronics in electrical engineering.
Topics:

Review of power semiconductor devices, series-parallel operation, various firing/driving circuit, Switching loss calculations, SOA and Heat Sink design, Analysis of 1-ϕ / 3-ϕ AC/DC bridge converter with and without freewheeling diode, Effect of source impedance, Multi pulse (12,18,24) rectifier, PWM rectifier, Analysis of non-isolated Buck, Boost, Buck-boost, Sepic & Cuk Converter in CCM and DCM with ideal and non-ideal components, Analysis of Isolated flyback, forward, push-pull, full bridge, half-bridge, & current fed DC-DC converter with ideal components, Dynamic modelling of DC/DC converter and controller design. Analysis of 1-ϕ & 3-ϕ VSI (180° mode, 150° mode & 120° mode of conduction), Amplitude & harmonic control/reduction techniques, 1-ϕ and 3-ϕ CSI Inverter.

Analysis of various 1-ϕ / 3-ϕ ac-ac regulator circuit..

Reference Books :

1. Dubey, Doradla, Joshi & Sinha, Power Controller, 2nd Edition, New Age International Pvt Ltd, 14 June 2010
2. P.S. Bhimbra, Power Electronics, Khanna Publication, 1 January 2012
3. Rashid, Power Electronics, 3rd Edition, Pearson Education India, 2014

Course Number: EE456
Title of Course: **FUZZY LOGIC SYSTEM**
Designation as a required or elective course: OPEN ELECTIVE
Pre-requisites: Knowledge of Basic Engineering & Control
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Implementation of fuzzy decision making.
Topics:
Fuzzy Logic Introduction, Advantages, Examples, Areas and applications, Fuzzy sets, membership functions and their design, Fuzzy Logic Systems, Fuzzification, Implication, Aggregation, Deffuzification, Fuzzy inference system, Design of Fuzzy control rules, Fuzzy controller design.
Implementation of Fuzzy Controllers for Industrial Applications.

Reference Books :

1. Yang, Fuzzy logic system
2. Zdenko K., Stjepan Bogdan, Fuzzy Controller Design, CRC Press, 12 Dec 2005

Course Number: **EE457**
Title of Course: **SYSTEM ENGINEERING**
Designation as a required or elective course: DEPARTMENTAL ELECTIVE
Pre-requisites: Knowledge of network theory, control system and soft computing Techniques
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Modelling of system components and Implementation of soft computing techniques to real time system.
Topics:
System modeling, analysis, classification, topological models, Analogy among different systems, linear graph theory, development of system model using branch formulation, interconnection equation and chord formulation and state space formulation, Modeling of systems with multi-terminal components, component graph, linear perfect couplers and Gyrators, model of two port components, system models using multi-terminal components using graph theoretic approval fuzzy logic, fuzzification, defuzzification, Applications of fuzzy logic control. Artificial Neural Network, Multilayer feed-forward networks, Applications & implementation of Neural Algorithms and systems, Stability, sensitivity, controllability, observability of the system, system optimization using linear and dynamic programming.
Load Forecasting Methods.

Reference Books:

1. I.J. Nagrath & M.Gopal, Systems Modelling and Analysis, McGraw Hill Education, 1 Jan 1983
2. M Gopal, Modern control system theory, New Age International Pvt Ltd, 1 Oct 2015
3. Koenig and Tokad, Analysis of Discrete Physical System,
4. J.M.Zurada, Introduction to Artificial Neural Systems, Jaico Publishing House, 25 Jan 1994
5. Simon Haykin, Neural Networks, PHI Pvt Ltd, 2003

Course Number: **EE458**
Title of Course: **VLSI DESIGN**
Designation as a required or elective course: OPEN ELECTIVE
Pre-requisites: knowledge of microprocessor
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Application of VLSI for chip design.
Topics:
Review of IC manufacturing, Basics of CMOS technology, well and pwell process, twin tube process, ASIC's, PLA & PAL, MOS transistor theory, basic physical design of simple logic gates, CMOS logic structure, circuits and system representations, inverters, power dissipation in CMOS, Design strategies, CMOS Chip design opt ions, program logic, program logic structure, Program interconnect, reprogrammable, gate arrays, Design Method behavioral synthesis, Flow diagram, clocked system, latches and registers, set-up and hold time, meta stability, clock skew, timing issues, constraints, static timing and dynamic timing analysis, FSM, Need of testing, manufacturing test principles, design strategies for test, chip level test techniques, system level test techniques.

Reference Books:

1. Wyne wolf , VLSI Technology, 4th Edition, PHI Learning Pvt Ltd, 2009
2. Allen & Homberg, CMOS design, 3rd Edition, Oxford University Press, 3 Oct 2013
3. Neil H.E. Weste &Kamran Eharghian, Principles of CMOS VLSI design, 2nd Edition, 30 April 1993
4. J. baker, Harrywili , D. Boyce, CMOS Circuit design, Wiley India Pvt Ltd, 2009

Course Number: **EE459**
Title of Course: **ROBOTICS**
Designation as a required or elective course: OPEN ELECTIVE
Pre-requisites: knowledge of modern control system
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Application of mechatronics and system automation.
Topics:
Introduction: Automation and Robotics, CAD/CAM and Robotics – An over view of Robotics – present and future applications, Components of the Industrial Robotics, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, determination of the end effectors, comparison of Electric, Hydraulic and Pneumatic types of locomotion devices, Motion Analysis, Manipulator Kinematics, Differential transformation and manipulators, Trajectory planning and avoidance of obstacles, Robot actuators and Feedback components, position sensors, Robot Application.

Reference Books:

1. M P Groover,Industrial Robotics, International Edition,McGraw Hill Edu., 1 March 1987
2. R K Mittal & I J Nagrath, Robotics and Control, TMH Edu., 6 Feb 2003
3. K S Fu, Robotics, McGraw Hill, 26 Aug 2008
4. Richard D. Klafter, Robotic Engineering , Prentice Hall, 4th April 1989
5. Asada and Slotine,Robot Analysis and Intelligence, Wiley Inter-Science, 27 Feb 2013
6. John J Craig, Introduction to Robotics, 3rd Edition, Pearson Edu., 2008
7. Mark W. Spong and M. Vidyasagar, Robot Dynamics & Control , John Wiley & Sons (ASIA), 4 Aug 2008

Course Number: **EE461**
Title of Course: **INDUSTRIAL ELECTRONICS**
Designation as a required or elective course: OPEN ELECTIVE
Pre-requisites: Basic knowledge of Power Electronic Devices, basic electrical and circuit theory.
Contact hours: 03
Type of Course: Lecture
Course Assessment methods: Both continuous and semester-end assessment
Course Outcomes: Practical application for power electronics converters in conditioning the power supply, welding and Heating circuit.
Topics:
Review of power devices with driver and protection circuits, Half controlled and fully controlled converters, Series and shunt Voltage regulators, Switched mode power supply, Online and offline UPS, Characteristics of AC and DC drives with their speed control & braking, Closed loop control schemes, Static rotor resistance control and Slip power recovery scheme of induction motor, Self control of synchronous motor, Principle and application of induction and dielectric heating with their industrial controller. Resistance welding and Seam Welding with their industrial controller, Flasher circuits, Time delay circuits, Fan regulator using Electronic timers and Digital counters.
Static Contactors and circuit breaker, Industrial timers.

Reference Books:

1. M. H. Rashid,Power Electronics Circuits, Devices and Application", 3rd edition, Pearson Edu. India, 2014
2. G. M. Chute and R. D. Chute, Electronics in Industry, 2nd Edition, McGraw Hill Ltd, 1 Jan 1979
3. F. D. Petruzulla, Industrial Electronics, McGraw Hill, 1st Feb 1995

Course Number: **EE-462**

Title of Course: COMMUNICATION ENGINEERING

Designation as a required or elective course: OPEN ELECTIVE

Pre-requisites: Knowledge of Engineering Mathematics and Analog and Digital Electronics.

Contact Hours: 3

Type of Course: Lecture

Course Assessment: Both Continuous and End-Semester Examination

Course Outcomes: To understand analog and digital communication techniques.

Topic Covered:

Need of Modulation, Modulations Techniques-Amplitude modulation, Introduction to SSB and VSB Transmission, Frequency and Phase Modulation, NBFM and WBFM, Bandwidth comparison of Modulation Techniques, Sampling of Signal, Sampling Theorem, Pulse Amplitude Modulation (PAM), Time Division Multiplexing (TDM), Channel Bandwidth for PAM-TDM signal, Introduction to Pulse Position and Pulse Duration Modulations, Digital Signal, Pulse Code Modulation, Signal to Noise Ratio, Companding, Data rate, Baud rate and Bit rate, Differential PCM (DPCM), Delta Modulation (DM), Adaptive Delta Modulation (ADM), Comparison of Various Systems, Digital Modulations Techniques-Generation, Detection, Equation and Bandwidth of Amplitude Shift Keying (ASK), Binary Phase Shift Keying (BPSK), Differential Phase Shift Keying (DPSK), Offset and Non-Offset Quadrature Phase Shift Keying (QPSK), M-Ary PSK, Binary Frequency Shift Keying (BFSK), M-Ary FSK Quadrature Amplitude modulation (QAM), MODEM.

Use of communication in electrical industries.

Reference Books:

1. Singh & Sapre, Communication System, 3rd Edition, TMH Edu., 6 July 2012
2. Taub & shilling, Communication System, 3rd Edition,TMH Edu., 5 Sep 2007
3. B.P. Lathi, Modern Digital and analog communication system, 4th Edition, Oxford University Press, 23 Feb 2011
4. Simon Haykins, Communication System, 4th Edition, John Willy Publication, 5 Aug 2006

Course Number: **EE463**

Title of Course: **DIGITAL IMAGE PROCESSING**

Designation as a required or elective course: OPEN ELECTIVE

Pre-requisites: knowledge of Digital Signal Processing

Contact hours: 03

Type of Course: Lecture

Course Assessment methods: Both continuous and semester-end assessment

Course Outcomes: Use of computer algorithms in image processing.

Topics:

Introduction, Digital Image Representation, fundamentals steps in Image processing, Elements of Image processing system, simple Image model, Sampling and Quantization, Basic relationship between pixels, Imaging geometry. Manipulation on image, image transformation: introduction to Fast Fourier transformation, Walsh transformation, Hadmard transformation, Hotelling transformation, DCT transform. Image Enhancement: Spatial domain method, frequency domain method, Enhancement by point processing, Image Restoration: Degradation model, effect of diagonalization on degradation models, Algebraic approach to restoration. Least mean square filter, interactive restoration, Geometric Transformation. Image Compression: Fundamentals, image compression model, lossy compression, loss–less compression, image compression standards. Image segmentation: Detection of discontinuation by point detection, line detection edge detection. Edge linking & boundary detection, Thresholding, Region oriented segmentation. Simple methods of representation : Representation Schemes, Signatures, boundary segments, skeleton of a region, Polygonal approximation, chain codes, Boundary descriptors and regional descriptors, recognition and interpretation.

Reference Books:

1. R.C.Gonzalez Richard E woods, Digital Image Processing, 3rd Edition, Pearson India, 23 June 2016
2. Chanda & Majumdar, Digital Image Processing & Analysis, 2nd Edition, PHI Learning Pvt Ltd, 2011