CURRICULUM AND SYLLABUS

2018

DEPARTMENT OF

ELECTRICAL AND ELECTRONICS ENGINEERING

Kalasalingam Academy of Research and Education

(Deemed to be University)

(Under Section 3 of the UGC Act 1956)

Anand Nagar, Krishnankoil – 626126

Srivilliputhur (Via); Virudhunagar (Dt.), Tamil Nadu, INDIA

(www.kalasalingam.ac.in)

Kalasalingam Academy of Research and Education

VISION

To be a Centre of Excellence of International Repute in Education and Research.

MISSION

To Produce Technically Competent, Socially Committed Technocrats and Administrators through Quality Education and Research.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION

To become a centre of excellence in teaching and research in the field of Electrical and Electronics Engineering.

MISSION

To produce technically competent Electrical and Electronics Engineering graduates who are able to offer viable solutions to meet the energy security of the nation.

To provide opportunities and resources to carry out cutting edge research on energy systems.

Program Student Outcomes (PSOs):

PSO1 – Engineering Knowledge: Apply the knowledge of Mathematics, Science, Engineering fundamentals and Electrical and Electronics Engineering to the solution of complex problems in engineering

PSO2 – Problem analysis: Identify, formulate and analyze the complex problems in Electrical and Electronics Engineering using first principles of mathematics, science and Engineering to derive conclusions.

PSO3 – Design/development of solutions: Design and development of Electrical and Electronics products/Systems that meets specified needs with the consideration for the public health and safety, cultural, societal and environmental issues

PSO4 – Conduct investigations of complex problems: Analysis of complex problems in electrical apparatus and energy systems using research based knowledge and research methods to provide valid solutions.

PSO5 – Modern Tool Usage: Apply appropriate tools and techniques for the modelling and analysis of Electrical and Electronics devices and systems.

PSO6 – The Engineer and Society: Apply Knowledge gained to assess societal, safety and cultural issues relevant to the professional engineering practice.

PSO7 – Environment and Sustainability: Understand the impact of solutions in electrical engineering field in societal and environmental contexts and demonstrate the importance of sustainable development

PSO8 – Ethics: Apply ethical principles and professional responsibilities in electrical and electronics engineering practice.

PSO9 – Individual and Team Work: Ability to function as an individual and as a member or leader in diverse teams in the multidisciplinary environment.

PSO10 – Communication: Ability to communicate effectively with the engineering community and society on complex engineering activities.

PSO11 – Project Management and Finance: Ability to apply the knowledge of engineering and management principles to implant the projects in multidisciplinary environment.

PSO12 – Life-long learning: Ability to recognize the need for and engage in life-long learning.

PSO13– Analysis & Solution of complex problems in Electrical & Electronics Engineering using modern tools.

PSO14– Design and Development of Electrical & Electronics products /systems that meets specified needs.

PSO15– Understand and demonstrate the importance of sustainable energy development.

Program Educational Objectives:

PEO1: Pursue higher studies or be employed in Electrical and Electronics Engineering or related disciplines.

PEO2: Be a successful entrepreneur in creating jobs related to Electrical and Electronics Engineering or related engineering fields.

PEO3: Promote ethics, sustainability and environmental responsibility in their practice.

B.Tech EEE

S.No	Category		Credits
I	Basic Science and Mathematics		25
	Open electives from Basic Science and Mathematics		6
II	Humanities and Social Science	3	12
	Soft Skills	3	
	Humanities Elective	6	
III	Basic Engineering		24
IV	**Program Core**		61
	a) Core Courses	48	
	b) Community Service Project	3	
	c) Project Work	10	
V	**Elective Courses**		30
	a) Major Elective	18	
	b) Open Elective	12	
VI	Internship / Industry Training		2
VII	Mandatory Courses		-
Total Credits			**160**

SCHEME OF INSTRUCTION

Basic Science and Mathematics:

Course code	Course Name	Course Type	L	T	P	C
MAT18R101	Calculus and Linear Algebra	T	3	1	0	4
PHY18R173	Oscillations, Waves and Optics	IC	3	1	2	5
CHY18R171	Chemistry	IC	3	1	2	5
MAT18R104	Multiple Integration, Ordinary Differential Equations and Complex Variable	T	3	1	0	4
MAT18R206	Laplace Transform, Partial Differential Equations and Numerical Methods	T	3	1	0	4
BIT18R101	Biology for Engineers	T	3	0	0	3
XXX18RXXX	Open Elective I from basic Science and mathematical components	T	3	0	0	3
XXX18RXXX	Open Elective II from basic Science and mathematical components	T	3	0	0	3
Total						**31**

Humanities and Social science

Course code	Course Name	Course	L	T	P	C

		Type				
HSS18R151	English for Technical Communication	TP	2	0	2	3
Soft Skills						
HSS18R101	Soft skills I	T	3	0	0	1
HSS18R102	Soft skills II	T	3	0	0	1
HSS18R201	Soft skills III	T	3	0	0	1
Total						**3+3**

Basic Engineering

Course code	Course Name	Course Type	L	T	P	C
EEE18R171	Basic Electrical and Electronics Engineering (Common to Food, Biomedical, Biotech& Chemical)	IC	3	1	2	5
EEE18R172	Basic Electrical Engineering	IC	3	1	2	5
MEC18R101	Engineering Graphics and Design	T	1	0	3	3
MEC18R103	Engineering Mechanics	T	3	1	0	4
CSE18R171	Programming for Problem Solving	IC	3	1	2	5
MEC18R181	Engineering Practice	L	1	0	3	3
EEE18R151	Electric Circuit Analysis	TP	3	1	1	4
Total						**24**

Program Core

a) Core Courses

Course code	Course Name	Course Type	Pre requisite	Co requisite	L	T	P	C
EEE18R201	Electromagnetic Fields	TT			3	1	0	3.5
EEE18R202	Electrical Machines – I	T			3	0	0	3
ECE18R276	Analog Electronics	IC			3	0	2	4
EEE18R281	Electrical Machines Laboratory - I	L		EEE18R201	0	0	3	2
EEE18R251	Control Systems	TP	MAT18R206		3	0	1	3.5
EEE18R203	Electrical Machines – II	T	EEE18R202		3	0	0	3
EEE18R271	Measurement and Instrumentation	IC			3	0	2	4
EEE18R252	Digital Electronics	TP			3	0	1	3.5
EEE18R282	Electrical Machines Laboratory - II	L		EEE18R203	0	0	3	2
EEE18R301	Power Electronics	T	ECE18R276		3	0	0	3

EEE18R381	Power Electronics Laboratory	L		EEE18R301	0	0	2	1
EEE18R302	Transmission and Distribution	TP			3	0	1	3.5
EEE18R371	Microprocessor and Microcontroller	IC	EEE18R252		3	0	2	4
EEE18R471	Power System	IC	EEE18R151		3	1	2	5
EEE18R401	Power System Protection	T			3	0	0	3
Total								**48**

b) Community Service Project

Course code	Course Name	L	T	P	C
EEE18R399	Community Service Project	0	0	3	3

c) Project Work

Course code	Course Name	L	T	P	C
EEE18R499	Project work	0	0	26	10

Elective Courses

a) Professional Elective Courses:

Course code	Course Name	Course Type	Pre requisite	L	T	P	C
Stream 1: Energy System							
EEE18R317	High voltage engineering	T	EEE18R302	3	0	0	3
EEE18R318	Electric energy generation and Utilization	T		3	0	0	3
EEE18R304	Special Electrical Machines	T	EEE18R203	3	0	0	3
EEE18R426	Electrical and Hybrid Vehicles	T	EEE18R203	3	0	0	3
EEE18R316	Design of Electrical Machines	T	EEE18R203	3	0	0	3
EEE18R320	Power System Transients	T	EEE18R471	3	0	0	3
EEE18R404	Digital Protection	T	EEE18R401	3	0	0	3
EEE18R406	Renewable Energy Sources	T		3	0	0	3
EEE18R330	Electrical System Design	T		3	0	0	3
EEE18R331	Electrical Hazards and Protection	T		3	0	0	3
EEE18R402	Energy Conservation	T		3	0	0	3

	Practices						
Stream 2: Power Electronics							
EEE18R324	Linear Integrated Circuits	T	ECE18R276	3	0	0	3
EEE18R319	Electrical Drives	T	EEE18R203 & EEE18R301	3	0	0	3
EEE18R305	Power Quality	T	EEE18R301	3	0	0	3
EEE18R408	HVDC Transmission System	T	EEE18R301	3	0	0	3
EEE18R409	Flexible AC Transmission System	T	EEE18R301	3	0	0	3
EEE18R410	MEMS	T	ECE18R276	3	0	0	3
EEE18R329	Auto Electrical and Electronics System	T		3	0	0	3
Stream 3: Control and Automation							
EEE18R306	Control system design	T	EEE18R251	3	0	0	3
EEE18R307	Network analysis and synthesis	T	EEE18R151& MAT18R206	3	0	0	3
EEE18R328	Smart Grid	T	EEE18R302	3	0	0	3
EEE18R303	Signals and System	T	MAT18R206	3	0	0	3
EEE18R323	Digital Signal Processing	T	MAT18R206	3	0	0	3
EEE18R414	Soft Computing Techniques	T	MAT18R101	3	0	0	3
EEE18R415	PLC and Industrial Automation	T	EEE18R371	3	0	0	3
EEE18R416	Introduction to IoT	T	EEE18R371	3	0	0	3
EEE18R405	Intelligent Building Energy Management Systems	T		3	0	0	3
EEE18R407	Embedded Computing System Design	T		3	0	0	3

b) Open Elective Courses offered from department of Electrical and Electronics Engineering:

Course code	Course Name	Course Type	Pre-requisite	L	T	P	C
EEE18R309	Principles of Power System	T	EEE18R172 or EEE18R171	3	0	0	3
EEE18R310	Solar and Wind Energy Conversion	T		3	0	0	3
EEE18R311	Principles of Power Electronics	T	EEE18R171 or EEE18R172	3	0	0	3
EEE18R312	Electrical Machines	T	EEE18R171 or EEE18R172	3	0	0	3

EEE18R313	Auto Electrical System	T		3	0	0	3
EEE18R314	Smart Grid Technology	T		3	0	0	3
EEE18R315	Electrical wiring Estimation and costing	T		3	0	0	3
EEE18R417	Electrical Safety	T		3	0	0	3
EEE18R418	Power Generation Systems	T		3	0	0	3
EEE18R419	Soft Computing Techniques	T	MAT18R101	3	0	0	3
EEE18R420	Industrial Electronics	T		3	0	0	3
EEE18R421	Evolutionary Computation Techniques	T	MAT18R101	3	0	0	3
EEE18R422	Energy Conservation and Management	T		3	0	0	3
EEE18R423	Embedded System Design	T	EEE18R371	3	0	0	3
EEE18R424	Hydro power generation	T		3	0	0	3
EEE18R425	Building Management System	T		3	0	0	3

c) Open Electives (Basic Science and Maths)

Course code	Course Name	Course Type	Pre-requisite	L	T	P	C
OEE18R008	Photonics and optoelectronic devices	T	-	3	0	0	3
OEE18R009	Laser technology	T	-	3	0	0	3
OEE18R006	Industrial chemistry for engineers	T	-	3	0	0	3
OEE18R005	Combinatorics	T	-	3	0	0	3
OEE18R003	Mathematical biology	T	-	3	0	0	3
OEE18R004	Mathematical modelling	T	-	3	0	0	3

d) Humanities Elective Courses:

Course code	Course Name	Course Type	L	T	P	C
HSS18R001	Management Concepts and Techniques	T	3	0	0	3
HSS18R002	Marketing Management	T	3	0	0	3
HSS18R003	Organizational Psychology	T	3	0	0	3
HSS18R004	Project Management	T	3	0	0	3
HSS18R005	Stress Management and Coping Strategies	T	3	0	0	3
HSS18R006	Engineering Economics	T	3	0	0	3
HSS18R007	Human Resource Management and Labour Law	T	3	0	0	3
HSS18R008	Entrepreneurship Development	T	3	0	0	3
HSS18R009	Cost Analysis and Control	T	3	0	0	3
HSS18R010	Product Design and Development	T	3	0	0	3
HSS18R011	Business Process Reengineering	T	3	0	0	3
HSS18R012	Political Economy	T	3	0	0	3
HSS18R013	Professional Ethics	T	3	0	0	3
HSS18R014	Operations Research	T	3	0	0	3
HSS18R015	Total Quality Management	T	3	0	0	3
HSS18R016	Advanced Soft skills	T	3	0	0	3

e) Honors Electives:

S.No	Course Code	Course Name	Course Type	Prerequisite	Credits
1.	EEE18R321	Energy Storage System	T		3
2.	EEE18R326	Artificial Neural network	T	MAT18R101	3
3.	EEE18R308	Advanced control Theory	T	EEE18R251	3
4.	EEE18R322	Modern Optimization Techniques	T	MAT18R101	3
5.	EEE18R325	Distributed Generation and Microgrid	T		3

6.	EEE18R327	Power Electronics for Renewable energy system	T	EEE18R301	3
7.	EEE18R431	Power System Dynamics	T	EEE18R471	3
8.	EEE18R432	Power System Stability	T	EEE18R471	3
9.	EEE18R433	Power System Restructuring	T	EEE18R471	3
10.	EEE18R434	Computer Relaying and Phasor Measurement Unit	T	EEE18R401	3
11.	EEE18R403	Power System Optimization	T	EEE18R471	3
12.	EEE18R412	SCADA and DCS	T	EEE18R251	3

Course code	Course Name	L	T	P	C
EEE18R397	Internship / Industry Training	-	-	-	**2**
EEE18R398	Mandatory Courses	-	-	-	-

Online Courses

Course Code	Course Name
EEEO004	Demand Response and the Smart Grid
EEEO005	Energy Efficiency Fundamentals for Industrial Automation and Control Professionals
EEEO006	Semiconductor Devices and Circuits
EEEO003	Internet of Things: Communication on Technologies

One-Credit Courses

Course Code	Course Name
EEEX008	Real Time Monitoring and Control of Modern Power System
EEEX009	Design and Installation Guideline on Lightning Protection System and Surge protection Devices
EEEX006	Model Based Design for Power Electronics and Electrical Drives
EEEX007	Thermal Power Plant Familiarization, Equipment Operation and Control

BASIC SCIENCE AND MATHEMATICS

MAT18R101 Calculus and Linear Algebra

MAT18R101 Calculus and Linear Algebra		*L*	*T*	*P*	*C*
		3	**1**	**0**	**4**
Pre-requisite: NIL	**Course Category:** Basic Science and Mathematics **Course Type:** Theory				

Course Objective:

To enable the students to acquire knowledge and skills in basic components of calculus, to handle the situations involving multivariable calculus, and to diagonalize a symmetric matrix using eigenvalues and eigenvectors.

Course Outcomes:

Upon successful completion of this course, students will be able to

1. Know the fundamental theorems such as Rolle's Theorem, Mean value theorem, Taylor's theorem and its applications.
2. Understand the basic concepts of limit, continuity, derivative, partial derivative and total derivative and its applications.
3. Solve the real world problems using differentiation and integration.
4. Understand the concepts of sequence, convergent of sequences, series and testing of convergent of series using different methods.
5. Find the solution of simultaneous linear equations using matrices and to find the Eigen values and Eigen vectors of a matrix, Cayley-Hamilon theorem and orthogonal transformations.

Unit 1: Calculus:

Rolle's Theorem- Mean value theorems - Taylor's and Maclaurin theorems with remainders -indeterminate forms and L'Hospital's rule - Maxima and minima.

Unit 2: Multivariable Calculus (Differentiation):

Limit, continuity and partial derivatives - directional derivatives - total derivative - Maxima, minima and saddle points - Method of Lagrange multipliers.

Unit 3: Calculus (Applications):

Curvature (Cartesian coordinates) - Evolutes and involutes; Evaluation of definite and

improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Unit 4: Sequences and series:

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions;

Unit 5: Matrices:

System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Cayley-Hamilton Theorem - Diagonalization of matrices - Orthogonal transformation- Reduction of Quadratic form to Canonical form.

TEXT BOOKS:

1. Grewal, B.S., Grewal, J.S., *Higher Engineering Mathematics*, Khanna Publish New Delhi,43rd Edition, 2015.

REFERENCE BOOKS:

1. Kreyszig, E, *Advanced Engineering Mathematics*, John Wiley and Sons (As Limited,
2. Singapore, 10th Edn, 2001.
3. Ramana B. V., *Engineering Mathematics*, Tata McGraw-Hill Publishing Compa Limited,
4. New Delhi, Edition 2005.
5. Veerarajan,T., *Engineering Mathematics (For First Year)*, Tata McGraw-H publishing company Limited, 2008.

PHY18R173 Oscillations, Waves and optics

PHY18R173 Oscillations, Waves and optics		***L***	***T***	***P***	***C***
		3	**1**	**2**	**5**
Pre-requisite: NIL	**Course Category:** Basic Science and Mathematics **Course Type:** *Integrated Course*				

Course Objectives:

- To provide the students a firm understanding of the basics of Electricity and Magnetism.
- To introduce the students, the application of Electricity and Magnetism and Electromagnetism

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: To learn the concepts of simple harmonic motion, damped and forced simple harmonic oscillators.

CO2: Understand the nature of transverse and longitudinal waves in one dimension and dispersion

CO3: Understand the basics of geometric optics and light as an electromagnetic wave.

CO4: Apply the concepts of interference and diffraction in optical instruments.

CO5: Gain the knowledge about different types of lasers and their applications.

Course Topics:

Unit 1: H**armonic oscillators**

Mechanical and electrical simple harmonic oscillators, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, forced mechanical and electrical oscillators, electrical and mechanical impedance, power absorbed by oscillator

Unit 2:Wave equations

Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, impedance matching, standing waves and their eigen frequencies, longitudinal waves and the wave equation for them, acoustics waves and speed of sound, standing sound waves.

Waves with dispersion, water waves, superposition of waves and Fourier method, wave groups and group velocity.

Unit 3: Light and geometrical optics

Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal

reflection, and evanescent wave. Lenses and optical instruments based on them, and the matrix method

Unit 4: Wave optics

Huygens' principle, superposition of waves and interference of light by wavefront splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer, Farunhofer diffraction from a single slit, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power.

Unit 5: Lasers

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (CO_2), solid-state lasers (Nd-YAG); semiconductor laser (Homo junction); Properties of laser beams, laser speckles, applications of lasers.

List of Experiments

1. Sonometer - Determination of frequency of tuning fork.
2. Melde's string - Determination of frequency of tuning fork.
3. Spectrometer – Determination of wavelength of Hg source using grating.
4. Spectrometer - Determination of dispersive power of a prism.
5. Determination of wavelength of laser light and particle size using grating.
6. Determination of Radius of curvature of convex lens using Newton's rings.
7. Determination of Refractive Index of given liquid using Newton's rings.
8. Determination of thickness of given thin wire by Air wedge method.
9. Determination of wavelength of laser source using Michelson interferometer.
10. Determination of the thickness of thin wire using laser beam
11. Determination of acceptance angle and numerical aperture of the fibre using Laser

Text Book(s):

1. Ian G. Main, vibrations and waves in physics, Cambridge University Press, 3rd edition, 2012.
2. A. Ghatak, Optics, Tata McGraw-hill, 6th edition, 2016.

Reference Books:

1. H.J. Pain, The physics of vibrations and waves, Wiley, 6th edition, 2005.
2. Brijlal and subrahmanyam, A text book of optics, 25th Edition, S. Chand, 2016.
3. O. Svelto, Principles of Lasers, 5th edition, Springer, 2010.

CHY18R171 Chemistry

CHY18R171 Chemistry		***L***	***T***	***P***	***C***
		3	**1**	**2**	**5**
Pre-requisite: NIL	**Course Category:** Basic Science and Mathematics **Course Type:** Integrated Course				

Unit -I: Atomic and Molecular Structure

Schrodinger wave equation:Derivation of time independent Schrodinger wave equation, Representation of Schrodinger wave equation in polar coordinates - Radial distribution function graphs of s, p, d and f orbitals. Molecular Orbital Theory:MOT concept, MO diagrams of homo-nuclear diatomic molecules (hydrogen, nitrogen and oxygen) and hetero-nuclear diatomic molecules (carbon monoxide and nitric oxide). Crystal field theory:CFT concept, weak and strong ligands, energy level diagrams of transition metal ions (Fe^{2+}& Fe^{3+}) in octahedral and tetrahedral complexes and their magnetic properties. Intermolecular forces - Ionic, dipolar and van der Waals interactions.

Unit-II: Periodic Properties

Effective nuclear charge - Factors affecting effective nuclear charge: Penetration or shielding of orbitals - Variation of s, p, d and f orbital energies of atoms in the periodic table - Aufbau principle(Building-up principle)**:** Application of Aufbau principle in writing electronic configuration, Deviation from Aufbau principle - Periodicity of properties in a periodic table - Periodic properties: Atomic and ionic sizes, ionization energies, electron affinity and electronegativity - Variation of periodic properties in the periodic table - Hard soft acids and bases: Concept and examples.

Unit-III: Free Energy and Chemical Equilibria

Thermodynamic functions:Definition and mathematical expression for Work, Energy, Enthalpy, Entropy and Free energy - Nernst equation:Derivation, apply Nernst equation to determine of solubility product, pH (glass electrode). Potentiometric titrations: Acid-Base, Redox and precipitation reaction - Water analysis:Hardness by EDTA method and chloride ion by Argentomentric method - Corrosion: Definition, types (dry & wet) and mechanism. and control of Dry and Wet corrosion.

Unit-IV: Organic Reactions

Nucleophilic substitution reactions: Definition, types and examples of nucleophile, Compare nucleophilicity and basicity of a nuceophile - Types of nucleophilic substitution (case RX and ArX): Mechanism of S_N1, S_N2, S_Ni and Benzyne. Electrophilic substitution reactions: Definition, types and examples of electrophile - Electrophilic substitution reactions of hydrocarbons: Halogenation, sulphonation, nitration. Friedel crafts alkylation and acylation reaction. Nucleophilic addition reactions (case aldehydes and ketones):Polarity of C=O bond. General mechanism of nucleophilic addition reactions on aldehydes and ketones: HCN, HOH, ROH and $NaHSO_3$ addition. Electrophilic addition reactions (case alkenes):General mechanism of electrophilic addition reactions on alkene - Addition of HBr [Markownikoff& Anti-Markownikoff (peroxide effect)] - Addition of alkene (polymerization of ethylene). Elimination reactions: Types of elimination reactions (case alkyl halides): Dehydrohalogenation of alkyl halides - E_1 and E_2 mechanism - Dehydration of alcohols to alkene and ethers. Greener synthesis of drug molecules (Aspirin and Ibuprofen)

Unit-V: Stereochemistry & Spectroscopic Techniques

Stereochemistry **-** Definition with examples: Geometrical isomers (alkene) and stereoisomers, symmetry, chirality, enantiomers, diastereomers, meso and racemic mixture. Representation of 3D structures: Wedge formula, Fischer projections, Newmann and Sawhorse formula (upto 2 carbons) - Conformational analysis: Ethane, butane and cyclohexane - Configurational analysis: Rules of RS nomenclature and application of RS nomenclature to molecules containing one chiral centre. Electronic spectroscopy:Principle, instrumentation, selection rules and medicinal application of fluorescence spectroscopy. Nuclear magnetic resonance spectroscopy (^{1}H-NMR): Principle, instrumentation, chemical shift, coupling constant and application (structural identification of the compound C_3H_6O from ^{1}H-NMR data). X-ray diffraction:Principle, instrumentation and applications X-ray diffraction.

List of Experiments (Any 10):

1. Determination of Viscosity by Ostwald Viscometer.
2. Determination of surface tension by stalagmometer.
3. Adsorption of acetic acid by charcoal.
4. Determination of chloride content of water.
5. Estimation of hardness of water by EDTA method.
6. Determination of the rate constant of a reaction
7. Thin layer chromatography.
8. Determination of the partition coefficient of a substance between two immiscible liquids
9. Determination of Saponification /acid value of oil.
10. Preparation of Aspirin

11. Potentiometric titration of strong acid vs strong base.
12. Potentiometric titration of weak acid vs strong base.
13. Determination of cell constant and conductance of solutions.

Text Books

1. Engineering Chemistry, 2nd Edition, Wiley India (P) Ltd., 2018.
2. Stereochemistry of Organic Compounds, Ernest L. Eliel, Samuel H. Wilen Student edition, Wiley India (P) Ltd., 2017.
3. University Chemistry, by B. M. Mahan and R.J.Mayers, Pearson Publishers, 11th Edition, Noida, 2017.
4. Chemistry Laboratory Manual, Department of Chemistry, Kalasalingam University, 2018.

Reference Books

1. Fundamentals of Molecular Spectroscopy, by C. N. Banwell and E.M. McCash, Tata McGraw-Hill Publishers, 4th Edition, New Delhi, 2008.
2. Physical Chemistry, by P. W. Atkins and J.D. Paula, W H Freeman & Co Publishers, 10thEdition, 2014.
3. Modern Inorganic Chemistry, R. D. Madan, 4th Edition S. Chand & Company Ltd., 2009.
4. Organic Chemistry, Paula Y. Bruice, 7th Edition, Pearson (Dorling Kindersley India (P) Ltd.) 2014.
5. Principles of Physical Chemistry, B. R. Puri, L. R. Sharma, M. S. Pathania, 47th Edition, Vishal Publishing Co., 2017.
6. Spectrometric Identification of Organic Compounds, Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce, 8th Edition, Wiley India (P) Ltd., 2010.
7. Inorganic Chemistry, Peter Atkins, Mark Weller, Fraser Armstrong, Jonathan Rourke, Tina Overton, Michael Hangerman 5th Edition, Oxford press, 2015.
8. Organic Chemistry, Volume 1, I. L. Finar, 6th Edition, Pearson (Thomson press India (P) Ltd.) 2014.

MAT18R104Multiple Integration, Ordinary Differential Equations

And Complex Variable

MAT18R104Multiple Integration, Ordinary Differential Equatio and Complex Variable		*L*	*T*	*P*	*C*
		3	1	0	4
Pre-requisite: Nil	**Course Category:** Basic Science and Mathematics **Course Type:** Theory				

Course Objective:

To enable the students to understand the concepts of multiple integrations, their applications, and to handle analytic functions on complex plane and perform complex integration.

Course Outcomes:

Upon successful completion of this course, students will be able to

1. Understand the concepts of double and triple integral and its applications.
2. Know about the applications of double and triple integral in vector calculus.
3. Know the methods of solving differential equations of first and second orders.
4. Understand the concepts of analytic functions, conformal mappings and bilinear transformations.
5. Understand the concepts of singularity, residues and evaluation of certain improper integrals.

Unit 1: Multivariable Calculus (Integration):

Multiple Integration: Double integrals (Cartesian), change of order of integration in double

integrals, Change of variables (Cartesian to polar), Applications: areas and volume; Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds;

Unit 2: Integral theorems:

Gradient, curl and divergence. Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

Unit 3: Ordinary differential equations:

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equations.

Unit 4: Complex Variable – Differentiation:

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.

Unit 5: Complex Variable – Integration:

Contour integrals, Cauchy Integral formula (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals (Integration around small semicircles and rectangular contours).

TEXT BOOKS:

1. Grewal, B.S., Grewal, J.S., *Higher Engineering Mathematics*, Khanna Publishers, New Delhi,43rd Edition, 2015.

REFERENCE BOOKS:

1. Kreyszig, E, *Advanced Engineering Mathematics*, John Wiley and Sons (Asia) Limited, Singapore, 10th Edn. 2001.
2. Ramana B. V., *Engineering Mathematics*, Tata McGraw-Hill Publishing Company Limited, New Delhi, Edition 2005.
3. Veerarajan,T., *Engineering Mathematics (For First Year)*, Tata McGraw-Hill publish company Limited, 2008.

MAT18R206Laplace Transforms, Partial Differential Equations, and Numerical Methods	***L***	***T***	***P***	***C***
	3	**1**	**0**	**4**
Pre-requisite: NIL	**Course Category:** Basic Science and Mathematics **Course Type:** Theory			

Course Objective:

To enable the students to understand the concepts of transform techniques and apply them to solve differential equations, and to obtain numerical solutions of ordinary equations and differential equations.

Course Outcomes:

Upon successful completion of this course, students will be able to

1. Know the method of solving first and second order partial differential equations.
2. Understand the concept of Laplace transform and its application in solving ordinary differential equations and partial differential equations.
3. Know about Fourier transforms and its properties.
4. Know the method of finding the solution of polynomial and transcendental equations and finding the solution of real world problems using interpolation.
5. Know the method of finding numerical solutions of differential equations.

Unit 1:Partial Differential Equations

First order partial differential equations, solutions of first order linear and non-linear PDEs. Solution to homogenous and non-homogenous linear partial differential equations second and higher order by complementary function and particular integral method.

Unit 2:Laplace Transform

Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions, Finding inverse Laplace transform by different methods, convolution theorem. Evaluation ofintegrals by Laplace transform, solving ODEs and PDEs by Laplace Transform method.

Unit 3:Fourier Transform

Fourier series – Half range sine and cosine series - Fourier integral theorem (without proof) Fourier transform pair - Sine and Cosine transforms – Properties - Transforms of simple functions – Convolution theorem - Parseval's Identity.

Unit 4:Numerical Solutions and Interpolation

Solution of polynomial and transcendental equations – Bisection method, Newton-Raphsonmethod and Regula-Falsi method. Interpolation using Newton's forward and backward difference formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange'sformulae.

Unit 5:Numerical Solutions of Differential Equations

Ordinary differential equations: Taylor's series, Euler and modified Euler's methods. Runge- Kutta method of fourth order for solving first order equations. Partial differential equations: Finite difference solution two dimensional Laplace equation and Poisson

equation, Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods).

TEXT BOOKS:

1. Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, NewDelhi, 2010.
2. P. Kandasamy, K. Thilagavathy, K. Gunavathi, *Numerical Methods*, S. Chand Company, 2nd Edition, Reprint 2012.

REFERENCE BOOKS:

1. Kreyszig, E, *Advanced Engineering Mathematics*, John Wiley and Sons (Asia)
2. Limited, Singapore , 10th Edn., 2001.
3. Grewal, B.S., Grewal, J.S., *Higher Engineering Mathematics*, Khanna Publishers,N Delhi, 37th Edition, 5th Reprint 2004.

BIT18R101 BIOLOGY FOR ENGINEERS		***L***	***T***	***P***	***C***
		3	**0**	**0**	**3**
Pre-requisite: Nil	**Course Category:** Basic Science and Mathematics **Course Type:** Theory				

Course outcomes

CO1: Describe the fundamentals of cell structure and cell cycle

CO2: Understand the classification and functions of biomolecules

CO3: Elaborate the basic cellular mechanisms such as replication, transcription and translation

CO4: Describe the underlying concepts of infection and immunity.

CO5: Explain various applications of biology

Unit I: INTRODUCTION **9 hours**

Fundamental difference between science and engineering- comparison between eye and camera, Bird flying and aircraft; major discoveries in biology- ; Classification based on: Cellularity- Unicellular and Multicellular; Ultra structure - prokaryotes and eukaryotes; three major kingdoms of life; Cell structure, intracellular organelles and

their functions, comparison of plant and animal cells- Overview of Cell cycle and cell division

Unit II: BIOMOLECULES **9 hours**

Chemistry of biomolecules: Carbohydrates, Lipids, Proteins; classification of amino acids; classification of proteins based on structure and functions; Nucleic acids -types, structure and function of DNA and RNA

Unit III: GENES TO PROTEINS **9 hours**

Gene, Genome and chromosome; Central dogma of molecular biology; Classical experiments of DNA: Griffith and, Avery, McCarty and MacLeod, Meselson and Stahl - DNA replication, Transcription and Translation

Unit IV:MICROBIOLOGY **9 hours**

Microscopy; Microbes as infectious agents - malaria, tuberculosis, typhoid, polio, dengue, AIDS; cultivation of bacteria. Immunity - innate and acquired immunity - organs and cells of the immune system - classification of antibodies - types of T cells - transplantation, autoimmunity overview

Unit V: APPLICATIONS OF BIOLOGY **9 hours**

Healthcare-antibiotics, vaccines, monoclonal antibodies, insulin and interferons; Beneficial bacteria - probiotic bacteria, nitrogen fixing bacteria, fermentation and fermented foods and products Environmental - waste water treatment, bioremediation; Biomaterials and biopolymers for medical and environmental applications; Biosensors;

TEXT BOOKS:

1. De Robertis, E.D.P. and De Robertis, E.M.F. - Cell and Molecular Biology- Lippincott Williams & Wilkins- Philadelphia- USA- 8th Edition- 2010.
2. Voet, D., Voet, G., - Biochemistry - John Wiley and Sons, Singapore - 3rd Edition- 2001.
3. Pelczar MJ, Chan ECS and Krieg NR - Microbiology - Tata McGraw Hill, India- 7th Edition- 2010

REFERENCES:

1. Friefelder. D. -Molecular Biology- McGraw-Hill Companies- New York, USA- 5th Edition- 2013.

HUMANITIES AND SOCIAL SCIENCE

HSS18R151 ENGLISH FOR TECHNICAL COMMUNICATION	*L*	*T*	*P*	*C*
	2	0	2	3
Pre-requisite: NIL	**Course Category:** Humanities and Social Science **Course Type:** Theory with Practice			

Course Content:

UNIT I – VOCABULARY BUILDING

The concept of word formation -Root words from foreign languages and their use in English- Prefixes and suffixes; word derivatives using them -Synonyms, Antonyms and standard Abbreviations

UNIT II – BASIC WRITING SKILLS

Sentence structures -Use of phrases and clauses in sentences - Creating Coherence- Techniques for Writing Precisely

UNIT III – IDENTIFYING COMMON ERRORS IN WRITING

Tenses - Subject – verb agreement -Noun –Pronoun Agreement -Verbs – Transitive, Intransitive-Misplaced Modifiers -Articles -Prepositions -Redundancies and Clichés - Direct, Indirect speech -Infinitives, Gerunds-Comparison of adjectives

UNIT IV – NATURE AND STYLE OF SENSIBLE WRITING

Describing -Defining -Classifying -Providing examples or evidence-Writing introduction or conclusion

UNIT V – WRITING PRACTICES

Comprehension -Precis writing-Essay writing- Letter writing – Instructions- Paragraph development

UNIT VI – ORAL COMMUNICATION

Listening comprehension -Pronunciation, intonation, stress and rhythm-Common everyday situations: Conversations and dialogues –Interviews-Formal presentations

SOFT SKILLS

HSS18R101	SOFT SKILLS - I	L	T	P	C
		3	0	0	1

UNIT I EFFECTIVE COMMUNICATION

Listening: Focus, Intuition about the speaker, Critical Listening, Writing: Reports, E-mail, Book & Movie Review, Notices & Advertisements, Speaking: Introducing Self, Just - a – Minute, Ad Zap, Story Telling

UNIT II QUANTITATIVE ABILITY

Introduction to Numerical Skills, Introduction to Logical Skills, Vedic Mathematics

UNIT III TIME MANAGEMENT

Prioritization, Procrastination, Multi-Tasking

UNIT IV SOCIAL MEDIA

Blog Writing, LinkedIn, Usage of messaging applications

UNIT V SOFT SKILLS

Importance of Soft Skills, Lateral Thinking, Begin with the End in Mind, First things First, Think Win – Win

HSS18R102	SOFT SKILLS - II	L	T	P	C

		3	**0**	**0**	**1**

UNIT I EFFECTIVE COMMUNICATION

Reading: Speed Reading techniques, News Story Analysis, Presentation: Organizing Content, Use of fonts & animations, Mock Presentations

UNIT II QUANTITATIVE ABILITY

Number Properties, Averages, Progression, Probability and Statistics

UNIT III VERBAL ABILITY

Vocabulary Building Techniques, Analogy

UNIT IV SOCIAL INTERACTION

Interpersonal Skills, Dealing with difficult people, Stress Management

UNIT V SOFT SKILLS

Seek first to understand, then to be understood, Synergy, Secret, Mind Maps, Creativity

HSS18R201	**SOFT SKILLS - III**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**1**

UNIT I EFFECTIVE COMMUNICATION

Sentence Construction, Tenses, Verbal Communication, Parts of Speech, Framing effective Sentences

UNIT II QUANTITATIVE ABILITY

Percentages, Profit-Loss-Discount, Ratio & Proportion, Mixtures &Allegation, Interest Calculations, Data Sufficiency

UNIT III LOGICAL ABILITY

Data Arrangements, Coding & Decoding, Ranking / Ordering, Venn Diagrams, Syllogisms, Introduction to Data Interpretation

UNIT IV VERBAL ABILITY

Sentence correction, Sentence Completion, Idioms & Phrases, Articles, Analytical Writing, Descriptive Writing

UNIT V SOFT SKILLS

Dining Etiquette, Hygiene, Team Work, Collaboration, Interdependence, Resume Building, Power Verbs, Group Discussion, Personal Interview

BASIC ENGINEERING

EE18R171 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

EEE18R171 Basic Electrical and Electronics Engineering (Common to EEE, Food, Biomedical, Biotech & Chemical)	*L*	*T*	*P*	*C*
	3	*1*	*2*	*5*
Pre-requisite: NIL	**Course Category:** Basic Engineering **Course Type:** Integrated Course			

Course Objective(s):

To focus the fundamental ideas of the Electrical and Electronics Engineering by providing wide exposure to the basic concepts of Electrical and Electronics Engineering such as DC Circuits, AC Circuits, electrical machines, measuring instruments, electrical installation, Basic Electronic Devices and various electronic circuits such as rectifiers, amplifiers, oscillators, etc.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Apply the basic laws of electricity in DC and AC circuits
CO2: Describe the construction and operation of static and rotating electrical machines
CO3: Explain the functioning of measuring instruments and Low Voltage Electrical Installations
CO4: Describe the constructional features and operation of fundamental electronic devices
CO5: Explain the characteristics of electronic circuits

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	M	M		M	M	L		L	M	L			M		
CO2	M	M		M	M	L		M	L	M			M		
CO3	M			M	M	L		L	M	L			S		
CO4	S	M											M		
CO5	S	S	L	M	M	L	M	M	L	M			M		

Course Topics:

Unit 1: DC Circuits and AC Circuits

Electrical quantities - resistors - inductors - capacitors - Ohm's Law - Kirchhoff's Laws - series and parallel circuits - analysis of DC circuits - mesh, nodal - simple problems- Sinusoidal functions - phasor representation - RMS and Average values - form and peak factors - RLC series circuits - power and power factor-concept of three phase system.

Unit 2: Electrical Machines

Construction and principle of operation of DC machines – DC generator – EMF equation – Types – DC motor – Types - single phase transformer – Construction and operation – EMF equation - Alternator - three phase induction motor – Construction – Types - single phase induction motor – Construction – Working - types.

Unit 3: Measuring Instruments and Electrical Installation

Measuring Instruments: Moving coil and moving iron instruments - dynamometer type wattmeter - Induction type energy meter

Electrical Installation: Components of LT Switchgear - Switch Fuse Unit (SFU) – MCB – ELCB – MCCB - Domestic wiring - accessories - types - staircase wiring - fluorescent tube circuits – Earthing

Unit 4: Electronic Devices

Basic concepts of PN junction diodes - Zener diode - bipolar junction transistor - Unipolar devices - FET, MOSFET, UJT - Thyristor–SCR and Triac, Photoelectric Devices- Photo diode and Photo transistor

Unit 5: Electronic Circuits

Half wave and full wave rectifier –Transistor as an amplifier –RC- phase shift oscillator - RC integrator and differentiator circuits - diode clampers and clippers - multivibrators - Schmitt trigger

Text Book(s):

1. V.K. Mehta, "Principles of Electrical Engineering and Electronics", S. Chand & Company Ltd, 2012
2. Kothari D P and Nagrath I J, "Basic Electrical Engineering", McGraw Hill, 2009.
3. Mithal G K, Electronic Devices & Circuits, Khanna Publications, 1997

Reference(s):

1. T. Thyagarajan, "Fundamentals of Electrical and Electronics Engineering", SciTech publications (Ind.) Pvt. Ltd., 3rd Edition, 2015.
2. Muraleedharan K.A, Muthususbramanian R and Salivahanan S, "Basic Electrical, Electronics and Computer Engineering" Tata McGraw Hill,2006.
3. Shanthakumar S.R.J, Basic Mechanical Engineering, Third Revised Edition (Reprint 2009), Anuradha Publications, Kumbakonam, 1999.
4. Rajput R. K., Basic Mechanical Engineering, Fourth edition, Tata McGraw Hill Publishing Co., New Delhi, 2007.

LIST OF EXPERIEMENTS:

1. Verification of Kirchoff's Laws.
2. Verification of Mesh and Nodal analysis
3. Measurement of electrical quantities-voltage current, power & power factor in RLC circuit
4. Open circuit characteristics of Separately excited DC Generator
5. Draw the characteristic between output power versus efficiency of DC shunt motor
6. Verification of turns ratio on single phase transformer
7. Study of basic electrical installation components for LT switchgear

8. Residential house wiring using fuse, two way switches and lamp
9. Wiring layout for Fluorescent lamp
10. VI characteristics of PN junction diode
11. VI Characteristics of Zener diode
12. Construct and demonstrate the Light sensor using Photo Transistor
13. Design a diode based Half wave and Full wave rectifier
14. Study of Zener diode as voltage regulator
15. Study of Clipping & Clamping circuit

EEE18R172 BASIC ELECTRICAL ENGINEERING

EEE18R172 Basic Electrical Engineering **(Common to ECE, EIE, Mechanical, Civil, Automobile, CSE, IT)**	***L***	***T***	***P***	***C***
	3	***1***	***2***	***5***
Pre-requisite: NIL	**Course Category:** Basic Engineering **Course Type:** Integrated Course			

Course Objective(s):

To focus the fundamental ideas of the Electrical Engineering by providing wide exposure to the basic concepts of Electrical Engineering such as DC Circuits, AC Circuits, electrical machines, and Electrical installations etc.

Course Outcomes

CO1: To apply basic laws of electricity in DC circuits

CO2: To apply the basic laws of electricity in AC circuits

CO3: To study the construction and working principles of DC Machines and Transformers.

CO4: To study the construction and working principle of AC Machines

CO5: To study the basic components of Low Voltage Electrical Installations

CO MAPPING WITH PSO:

CO / PSO	**PSO**														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	M	M		M	M	L		L	L	L			M		
CO2	S	M		M	M								M		

CO3	S	M		M	M			S	S	S			S		
CO4	S	M						S	S	S			M		
CO5	S	S	L	M	M	L	L	L	L	L			M		

UNIT 1: DC CIRCUITS

DC Circuits: Electrical quantities – Electric Circuit Elements - Resistors - Inductors - Ccapacitors - Ohm's Law - Kirchhoff's Laws - Series and Parallel circuits - Analysis of DC circuits – Mesh - Nodal – Superposition - Thevenin - Norton Theorems - Simple problems

UNIT II: AC CIRCUITS

Sinusoidal functions - Phasor representation - Real power - Reactive power - Aapparent power - Power factor - RMS value - Average value - Form and Peak factors - Analysis of single-phase AC series circuits consisting of RL, RC, RLC combinations – Problems - concept of three phase system.

UNIT III: DC MACHINES AND TRANSFORMERS

DC Machines: Construction and working principle of DC Generator and DC Motor - EMF equation – Torque equation - Related problems

Transformer: Construction - working and types - Ideal and practical transformer - Equivalent circuit - Losses in transformers - Regulation and Efficiency –problems

UNIT IV: AC MACHINES

Synchronous machine: Construction - working of alternator – EMF Equation – Problem – Working principle of synchronous motor

Three phase induction motor: Constructional details - Principle of operation – Types - Torque-slip characteristics - Starting torque - Relation between torque and slip - Losses and efficiency.

Single phase induction motor: Construction – Working principle - Types of single phase induction motor

UNIT V: ELECTRICAL INSTALLATIONS

Components of LT Switchgear - Switch Fuse Unit (SFU) – MCB – ELCB – MCCB - Domestic wiring - accessories - types - Staircase wiring - Fluorescent tube circuits – Earthing - Types of Batteries - Important Characteristics for Batteries - Elementary calculations for energy consumption - power factor improvement and battery Backup

LIST OF EXPERIMENTS

1. Verification of Kirchoff's Laws.
2. Verification of Mesh and Nodal analysis
3. Verification of Thevinin's and Norton's theorems
4. Measurement of electrical quantities-voltage current, power & power factor in RL and RC series circuits
5. Determine the power and power factor of RLC series circuit
6. Open circuit and load characteristics of Separately excited DC Generator
7. Open circuit and load characteristics of Self excited DC Generator
8. Draw the characteristic between output power versus efficiency of DC shunt motor
9. Verification of turns ratio on single phase transformer
10. Load test on single phase transformer
11. Load test on three phase squirrel cage induction motor.
12. Load test on single phase induction motor.
13. Load test on Alternator
14. Study of basic electrical installation components for LT switchgear
15. Residential house wiring using fuse, two way switches and lamp
16. Wiring layout for Fluorescent lamp
17. Experiment for Calculation of charging and discharging current of battery

TEXT BOOK(S):

1. V.K. Mehta, "Principles of Electrical Engineering and Electronics", S. Chand & Company Ltd, 2012
2. Kothari D P and Nagrath I J, "Basic Electrical Engineering", McGraw Hill, 2009.
3. Mithal G K, Electronic Devices & Circuits, Khanna Publications, 1997

REFERENCE(S):

1. T. Thyagarajan, "Fundamentals of Electrical and Electronics Engineering", SciTech publications (Ind.) Pvt. Ltd., 3rd Edition, 2015.
2. Muraleedharan K.A, Muthususbramanian R and Salivahanan S, "Basic Electrical, Electronics and Computer Engineering" Tata McGraw Hill, 2006.
3. Sunil S.Rao., Switchgear Protection and Power system, Khanna Publishers, New Delhi, 13th Edition, 1999.
4. Ravindranath B., Chander, N., Power Systems Protection and Switch Gear, Wiley Eastern (P) Ltd., Second Edition, 2011.

MEC18R101 ENGINEERING GRAPHICS & DESIGN

MEC18R101 ENGINEERING GRAPHICS & DESIGN	L	T	P	C
	1	0	3	3
Pre-requisite: Nil	**Course Category:** Basic Engineering **Course Type**: Theory			

Course Objective(s):

This course aims to introduce the concept of graphic communication, develop the drawing skills for communicating concepts, ideas and designs of engineering products, Demonstrate skills in interpreting, and producing engineering drawings accurately and to give exposure to national standards relating to engineering drawing

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Create the projection of points in all quadrants and straight lines

CO2: Construct the projections of planes and solid objects with refer to reference planes

CO3: Illustrate the true shape of truncated solids in both the manual and computerized manner

CO4: Develop surfaces of truncated solids in both the manual and computerized man

CO5: Apply orthographic and isometric projections in both the manual and computerized man

Mapping of Course Outcome(s):

CO/ PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	M		M												
CO2		S										L			
CO3	M		S		S		S					M			
CO4	L	M			S		S					S			
CO5	S		S		S		S					S			

S- Strong Correlation; M- Medium Correlation; L- Low Correlation

Course Topics:

Unit 1: Projection of Points and Straight Lines **9 Hours**

Importance of graphics – use of drafting instruments – BIS conventions and specifications – size, layout and folding of drawing sheets – lettering dimensioning

and scales - Projection of points, located in all quadrants - projection of straight lines located in the first quadrant, determination of true lengths and true inclinations

Unit 2: Projection of Planes and Solids **9 Hours**

Projection of polygonal surface and circular lamina located in first quadrant inclined to one or both reference planes-Projection of solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method

Unit 3: Section of Solids **9 Hours**

Section of simple solids like prisms, pyramids, cylinder and cone in vertical position by cutting planes inclined to any one of the reference planes, obtaining true shape of section

Unit 4: Development of Surfaces **9 Hours**

Development of lateral surfaces of simple and truncated solids – prisms, pyramids, cylinders and cones

Unit 5: Orthographic and Isometric Projection **9 Hours**

Orthographic principles – missing view - free hand sketching in first angle projection from pictorial views. Principles of isometric projection – isometric view and projections of simple solids, truncated prisms, pyramids, cylinders and cones. Introduction to CAD software – menus and tools – drafting platform demonstration

Practical Modules

1. Construction of conic sections using CAD software
2. Construction of simple planes using exclusive commands like extend, trim etc.,
3. Construction of 3D model – solids and sectional views
4. Generating 2D orthographic blue prints from 3D part models
5. Vectorization of simple building plan and elevation

Text Book(s):

1. Basant Aggarwal and C. Aggarwal, Engineering Drawing, McGraw-Hill, 2013.
2. N.S. Parthasarathy, Vela Murali, Engineering Drawing, Oxford University Press, 2015.
3. K. Venugopal, Engineering Drawing + AutoCAD, New Age; Fifth edition, 2011.

Reference(s):

1. Shah, M.B., and Rana, B.C., Engineering Drawing, Pearson 2009
2. Natarajan, K.V., A Text Book of Engineering Graphics, 21st Edition, Dhanalakshmi Publishers, Chennai, 2012.
3. Paul Richard, Jim Fitzgerald., Introduction to AutoCAD 2017: A Modern Perspective, Pearson, 2016.
4. Bhatt, N.D., Engineering Drawing, Charotar publishing House, New Delhi, 53trd Edition, 2014.
5. Luzadder and Duff, “Fundamentals of Engineering Drawing”, Prentice Hall of India Pvt. Ltd., 2009.

6. Venugopal, K., Engineering Graphics, New Age International (P) Limited, 2009.

MEC18R103 ENGINEERING MECHANICS	L	T	P	C
	3	1	0	4
Pre-requisite: Nil	**Course Category:** Basic Engineering **Course Type:** Theory			

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Explain the vectorial and scalar representation of forces and moments of particles and rigid bodies both in two dimensions and in three dimensions.

CO2: Apply the knowledge of trusses in frames, beams and machine components.

CO3: Contrast the effect of friction on equilibrium.

CO4: Illustrate the importance of properties of surfaces and solids.

CO5: Demonstrate the dynamic equilibrium equation.

Mapping ofCourseOutcome(s):

CO /PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S	S	M	L											
CO2	S	M	M	L											
CO3	S	S	M	L											
CO4	S	M	M	L											
CO5	S	L	L	L											

Unit 1. Statics of Particles and Rigid bodies (9+3)

Six Fundamental principles and concepts - vector algebra - Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D - System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant - Equations of Equilibrium of Coplanar Systems and Spatial Systems.

Rigid Body equilibrium in 2-D & 3-D - Moment of Forces and its Application - Couples and Resultant of Force System - Equilibrium of System of Forces, Free body diagrams - Equations of Equilibrium of Coplanar Systems and Spatial Systems.

Unit 2. Analysis of Trusses (9+3)

Basic Structural Analysis- Equilibrium in three dimensions - Method of Sections- Method of Joints- How to determine if a member is in tension or compression- Simple Trusses- Zero force members- Beams & types of beams- Frames & Machines.

Unit 3. Friction (9+3)

Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction - Motion of Bodies, simple contact friction, sliding block, wedge friction, screw jack & differential screw jack, rolling resistance.

Unit 4. Properties of Surfaces and Solids (9+3)

Centroid of simple figures from first principle, centroid of composite sections - Centre of Gravity and its implications - Area moment of inertia - Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections (T section and I section) - Mass moment inertia of circular plate, Cylinder, Cone, Sphere- Principal moment of inertia.

Unit 5. Dynamics (9+3)

Review of particle dynamics - Displacements, velocity and acceleration, their relationship - Equations of motions - Rectilinear motion- Plane curvilinear motion - Newton's 2nd law- Impulse, momentum, impact - D'Alembert's principle and its applications in plane motion and connected bodies - Work energy principle and its application in plane motion of connected bodies - Virtual Work and Energy Method - Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies.

Text Book(s):

1. Beer, F.P., and Johnson, E.R., Vector Mechanics for Engineers – Statics and Dynamics, McGraw Hill, Tenth Edition in SI units

Reference(s):

1. Merriam, J.L., Engineering Mechanics, Volume I – Statics, and Volume – II, Dynamics 2/e, Wiley International, Seventh Edition.

2. Irving, H., Shames, Engineering Mechanics, Statics and Dynamics, Prentice Hall of India Ltd., Fourth Edition

CSE18R171	PROGRAMMING FOR PROBLEM SOLVING	L	T	P	C
		3	1	2	5
Pre-requisite : NIL		Course Category :Basic Engineering Course Type :Integrated Course			

Course Objectives:

To make the students to understand the basic concepts of programming language, rules to be followed while writing a program and how to compile and execute C programs.

Course Outcomes:

CO1 : Understand the basic programming concepts and syntax of C language
CO2 : Develop efficient code using pointers, arrays and dynamic memory allocation
CO3 : techniques
CO4 : Create user defined data types and functions to solve given problems.
CO5 : Design an efficient algorithm for a given problem
CO6 : Build efficient code to solve the real world problem
CO7 : Elucidate the programming constructs of C during interviews

UNIT 1: INTRODUCTION TO PROGRAMMING 12 hours

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.), Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/ Pseudocode with examples, From algorithms to programs; source code, variables (with data types) variables and memory, locations, Syntax and Logical Errors in compilation, object and executable code, Arithmetic expressions and precedence, Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching, Iteration and loops.

UNIT 2: ARRAYS AND STRINGS 12 hours

Introduction - One dimensional and two dimensional arrays – Declaration of arrays – Initializing and Accessing array elements – Strings: One dimensional character arrays - Declaration and String Initialization - String Manipulation - Multidimensional Arrays - Arrays of Strings

UNIT 3: BASIC ALGORITHMS 12 hours

Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

UNIT 4: FUNCTION **12 hours**

Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Recursion, Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

UNIT 5: STRUCTURE, POINTERS & FILE HANDLING **12 hours**

Structures, Defining structures and Array of Structures, Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation), File handling (only if time is available, otherwise should be done as part of the lab)

TEXT BOOKS

(i) Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill

(ii) E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

REFERENCE BOOKS

(i) Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

LIST OF EXPERIMENTS **15 hours**

Tutorial 1: Problem solving using computers:

Lab1: Familiarization with programming environment

Tutorial 2: Variable types and type conversions:

Lab 2: Simple computational problems using arithmetic expressions

Tutorial 3: Branching and logical expressions:

Lab 3: Problems involving if-then-else structures

Tutorial 4: Loops, while and for loops:

Lab 4: Iterative problems e.g., sum of series

Tutorial 5: 1D Arrays: searching, sorting:

Lab 5: 1D Array manipulation

Tutorial 6: 2D arrays and Strings

Lab 6: Matrix problems, String operations

Tutorial 7: Functions, call by value:

Lab 7: Simple functions

Tutorial 8 &9: Numerical methods (Root finding, numerical differentiation, numerical integration):

Lab 8 and 9: Programming for solving Numerical methods problems

Tutorial 10: Recursion, structure of recursive calls

Lab 10: Recursive functions

Tutorial 11: Pointers, structures and dynamic memory allocation

Lab 11: Pointers and structures

Tutorial 12: File handling:

Lab 12: File operations

MEC18R181 ENGINEERING PRACTICE	**L**	**T**	**P**	**C**
	1	**0**	**3**	**3**
Pre-requisite: Nil	**Course Category:** Basic Engineering **Course Type:** Lab			

Lectures & videos:

Detailed contents

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(3 lectures)**

2. CNC machining, Additive manufacturing **(1 lecture)**

3. Fitting operations & power tools **(1 lecture)**

4. Carpentry **(1 lecture)**

5. Plastic moulding, glass cutting **(1 lecture)**

6. Metal casting **(1 lecture)**

7. Welding (arc welding & gas welding), brazing **(1 lecture)**

Suggested Text/Reference Books:

(i) Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of

Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.

(ii) Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology",4th edition, Pearson Education India Edition, 2002.

(iii)Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson

Education, 2008.

(iv) Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.

(v) Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House,2017.

Course Outcomes

Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

(ii) Workshop Practice:

1. Machine shop **(10 hours)**

2. Fitting shop **(8 hours)**

3. Carpentry **(6 hours)**

4. Welding shop **(8 hours (Arc welding 4 hrs + gas welding 4 hrs)**

5. Casting **(8 hours)**

6. Smithy **(6 hours)**

7. Plastic moulding& Glass Cutting (6 hours)

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Laboratory Outcomes

- Upon completion of this laboratory course, students will be able to fabricate components with their own hands.
- They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
- By assembling different components, they will be able to produce small devices of their interest.

EEE18R151ELECTRIC CIRCUIT ANALYSIS

EEE18R151ELECTRIC CIRCUIT ANALYSIS	***L***	***T***	***P***	***C***
	3	***1***	***1***	***4***
Pre-requisite: NIL	**Course Category:** Basic Engineering **Course Type:** Theory with Practice			

Course Objective(s):

To acquire knowledge about the basics of circuit analysis, network theorems, concepts of AC circuits, coupled circuits, three phase circuits and transient analysis.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Describe the various types of Sources and Network and apply Mesh, Nodal analysis to solve electrical circuits.
CO2: Analyze the electrical circuits using various network theorems.
CO3: Solve AC Circuits with Series/parallel combinations.
CO4: Discuss the basic concepts of Resonance and three phase circuits.
CO5: Analyze the steady state and transient behaviour of electric circuits.

Mapping of Course Outcome(s):

CO / PSO	**PSO**														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	M	M	S												
CO2	S	S	S	S								M			
CO3	S	S	S	S								M			
CO4	S	S	S	M								M			
CO5	S	S	S	S											

Course Topics:

Unit 1: DC Circuit Analysis

Ideal sources - source transformation - voltage division - current division - network reduction - star and delta transformation - concept of duality - dual networks -

formation of matrix equations and analysis of complex circuits using mesh-current and nodal-voltage methods.

Unit 2: Network Theorems

Thevenin's theorem, Norton's theorem, superposition theorem, maximum power transfer theorem, substitution theorem, reciprocity theorem, Millman's theorem, Tellegen's theorem - statement, application to AC and DC circuits.

Unit 3: Steady State Analysis of Ac Circuits

Concept of phasor and complex Impedance/Admittance – Analysis of series and parallel circuits-Solution of RLC circuits, power, and power factor - series resonance, parallel resonance - Q factor – bandwidth- locus diagram

Unit 4: Coupled Circuits and Three Phase Circuits

Self inductance - mutual Inductance - coefficient of coupling - dot rule - ideal transformer - effective inductance of coupled coils in series and in parallel - analysis of coupled circuits - single tuned and double tuned circuits. Three phase star delta connections - phasor diagram - solution of three phase balanced circuits and unbalanced circuits - three phase power measurement using watt meters.

Unit 5: Transient Analysis

Concept of complex frequency - representation of network elements in time domain and frequency domain –Source free and forced responses of RL - RC - RLC circuits with DC and sinusoidal excitation- Time constant and natural frequency of oscillation – Laplace transform application to the solution of RL, RC and RLC circuits.

Text Book(s):

1. A Sudhakar and Shyam Mohan SP, “Circuits and Networks: Analysis and Synthesis”, TMH, 5th Edition, New Delhi, 2015.
2. William H. Hayt, Jack E. Kemmerly and Steven M. Durbin, “Engineering Circuit Analysis”, TMH,8th Edition, 2012.

Reference(s):

1. Paranjothi S.R., 'Electric Circuit Analysis', New Age International Publisher, 2011
2. Mahmood Nahvi, Joseph A. Edminister, Schaum’s outline of Electric Circuits', McGraw Hill Book Company, 6th Edition,2014.
3. Dorf R.C., Introduction to Electric Circuits, John Wiley & Sons Inc, New York, Nineth Edition, 2013.
4. Charles K.Alexander, Mathew N.O. Sadiku., Fundamentals of Electric Circuits, Mcgraw Hill Education 5th Edition, 2013.

List of Experiments:

1. IntroductiontoElectric CircuitsSimulation andTesting
2. Electric CircuitsFundamentalsLaws
3. Voltage &CurrentDividersandSuperpositionPrinciple
4. EquivalentSource ModelsandMaximumPower Transfer

5. SinusoidalAC CircuitAnalysis
6. Three-Phase Circuits
7. TransientCircuitAnalysis
8. Verification of Superposition Theorem
9. Verification of Thevenin's Theorem
10. Verification of Norton's Theorem
11. Verification ofMaximumPowerTransferTheorem

PROGRAM CORE

EEE18R201 ELECTROMAGNETICFIELDS

EEE18R201 Electromagnetic fields	*L*	*T*	*P*	*C*
	3	*1*	*0*	*4*
Pre-requisite: Nil	**Course Category:** Programme Core – Theory with Tutorial			

Course Objective(s):

To provide the students with a solid foundation in engineering fundamentals required to solve problems and also to pursue higher studies.

To acquire the knowledge of Electromagnetic field theory that allows the student to have a solid theoretical foundation to be able in the future to design emission, propagation and reception of Electro -magnetic wave systems.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understand the concept of co-ordinate system and solve the electrostatic problems using coulombs law and gauss's law
CO2: Understand the concept of conductors, dielectrics and capacitance
CO3: Solve the magnetic field problems using the laws of magnetism and vector calculus
CO4: Apply the Maxwell's equations to understand the electromagnetic wave propagation
CO5: Apply the boundary conditions and numerical methods to solve the electromagnetic problems

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S	S	M	M	M							M	S	S	
CO2	S	S	S	S	M							M	S	S	
CO3	S	S	S	S	M							M	S	S	
CO4	S	S	S	S	S							M	S	S	
CO5	S	S	S	S	S							M	S	S	

Course Topics:

Unit 1: ELECTROSTATICS

Review of vector algebra - co-ordinate system - rectangular, cylindrical and spherical - Coulomb's law - electric field intensity - field due to different types of charges - electric flux density - Gauss's law and application - divergence and divergence

theorem -electric potential - potential field due to different types of charges - potential gradient.

Unit 2: ELECTROSTATICS APPLICATIONS

Current and current density - continuity of current - conductor properties and boundary conditions - the nature of dielectric materials - boundary conditions for perfect dielectric materials -capacitance - different types of capacitances - energy density in electric field - Poisson's and Laplace's equations.

Unit 3: MAGNETOSTATICS

Magnetic field - magnetic flux - magnetic flux density –curl- Stoke's theorem - Biot-savart law and application - Ampere's circuital law and application - scalar and vector magnetic potentials - force on a moving charge, differential current element, torque on a closed circuit - inductance - nature of magnetic materials - magnetization and permeability - magnetic boundary conditions.

Unit 4: MAXWELLS EQUATIONS AND ELECTROMAGNETIC WAVES

Faraday's laws- Faraday's law - Lenz's law - Maxwell's equations in differential and integral forms - displacement current - Electromagnetic wave equations - wave parameters - velocity, intrinsic impedance, propagation constant - waves in free space, lossy and lossless dielectric, conductors - skin depth - Poynting theorem.

Unit 5: FIELD MODELLING AND COMPUTATION

Problem formulation - boundary condition - solutions Analytical methods - variables separable methods - conformal transformation - method of images - numerical methods - finite difference method - finite element method - charge simulation method.

Text Book(s):

1. Mathew N. O. Sadiku, 'Principles of Electromagnetics', 4thEdition ,Oxford University Press Inc. First India edition, 2009.

Reference(s):

1. William H. Hayt and John A. Buck, 'Engineering Electromagnetics', Tata McGraw Hill 8th Revised edition, 2011.
2. Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, 2010.
3. Joseph. A.Edminister, 'Schaum's Outline of Electromagnetics, Third Edition (Schaum's Outline Series), Tata McGraw Hill, 2010

EEE18R202ELECTRICAL MACHINES I

EEE18R202 ELECTRICAL MACHINES I	***L***	***T***	***P***	***C***
	3	***0***	***0***	***3***
Pre-requisite: Nil	**Course Category:** Programme Core – Theory			

Course Objective(s):

To give the students a fair knowledge on working of transformers & various types of DC machines.

To expose the students for testing methodologies of DC machines and transformers.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Develop the equivalent circuit of the given transformer and analyze its performance.
CO2: Analyze the basic concept of rotating machines.
CO3: Analyze the performance characteristics of self and separately excited DC generators.
CO4: Analyze the operation, starting methods and speed control of DC Motors.
CO5: Apply the testing procedures of electrical machines as per the standard practice.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S	S			S								S	M	
CO2	S			S									S	S	
CO3	S	M		S	S								S	S	
CO4	S			S	S								S	S	
CO5	S	S		M								S	S	M	

Course Topics:

Unit 1: TRANSFORMERS

Construction - working principle - EMF equation - Elementary theory of ideal transformer - Transformation ratio - Transformer with losses but no magnetic leakage - Transformer on no load and on load - Equivalent circuit – Regulation - Efficiency - All day efficiency - Auto transformer - Condition for maximum efficiency - Parallel operation of single phase transformer - Three phase transformer connections.

Unit 2: BASIC CONCEPTS OF ROTATING MACHINES

Principles of electromechanical energy conversion - Single and multiple excited systems - MMF of distributed AC windings - Rotating magnetic field - generated voltage - Torque in round rotor machine.

Unit 3: DC GENERATORS

Construction - Principle and operation - EMF equation – Types - Characteristics - Armature windings - Single, double layer windings - Losses in a DC generator - Condition for maximum efficiency - Armature reaction - Demagnetizing and cross magnetizing conductors - Commutation - Parallel operation of generators - Load sharing.

Unit 4: DC MOTORS

Working principle – Types - EMF equation – Torque equation - Characteristics - Significance of the back EMF - Losses and efficiency - Power stages- Speed control of DC motor - Necessity of starter - three point and four point starters.

Unit 5: TESTING OF DC MACHINES AND TRANSFORMERS

DC machines: Brake test - Swinburne's test - Hopkinson's test - Retardation test - Field test Transformer: Open and short circuit tests - Load test - Polarity test - Sumpner's test.

Text Book(s):

1. D. P. Kothari And I. J. Nagrath, Electric Machines, Tata McGraw Hill Education Pvt. Ltd., New Delhi,: 4thEdition, 2010.

Reference(s):

1. P. C. Sen, Principles of Electric Machines and Power Electronics, Wiley, 3rd Edition, 2013.
2. Fitzgerald A.E., Charles Kingsley, Stephen.D.Umans, Electric Machinery, Tata McGraw Hill Publishing Company Ltd, 2003.
3. Gupta,J.B., Theory and Performance of Electrical Machines,S.K.Kataria and Sons 2002.
4. Theraja ,B.L., Theraja, A.K.,A text book on Electrical technology, Volume-II, S.Chand Company & Ltd.,2005.

ECE18R276 ANALOG ELECTRONICS

ECE18R276 ANALOG ELECTRONICS	*L*	*T*	*P*	*C*
	3	*0*	*2*	*4*
Pre-requisite: Nil	**Course Category:** Integrated Course			

Course Objective(s):

The course intends to provide an overview of the principles, operation and application of the analog building blocks like diodes, BJT, FET etc for performing various functions. This course relies on elementary treatment and qualitative analysis and makes use of simple models and equation to illustrate the concepts involved. To provide an overview of amplifiers, feedback amplifiers and oscillators. To gain the knowledge on existing on future analog circuits.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understand the characteristics and applications of diode.
CO2: Analyze the characteristics and various configurations of BJT
CO3: Analyze the characteristics and various configurations of FET
CO4: Understand the functioning & characteristics of OP-AMP

CO5: Design of OP-AMP based amplifiers and oscillators

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	S												S		
CO2	S	S											S		
CO3	S	S											S		
CO4	S	S	S	S				M					S	S	M
CO5	S	S	S	M				S				M	S	M	S

Course Topics:

UNIT 1: DIODE CIRCUITS

P-N junction diode, I-V characteristics of a diode; half-wave and full-wave Rectifiers, clamping and clipping circuits Zener diodes and its applications- L, C, LC filters- Regulated Power Supply – Switch Mode Power supply

UNIT 2: BJT CIRCUITS

Structure and I-V characteristics and configurations of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits**.**

UNIT 3: MOSFET CIRCUITS

MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, transconductance, high frequency equivalent circuit.

UNIT 4: DIFFERENTIAL, MULTI-STAGE AND OPERATIONAL AMPLIFIERS

Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal

structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)- **Idealized analysis of op-amp circuits.**

UNIT 5: LINEAR AND NON LINIER APPLICATIONS OF OP-AMP

Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift). Analog to Digital Conversio , Zero Crossing Detector , Square-wave and triangular-wave generators

List of Experiments:

1. Characteristics of PN junction diode and Zener diode
2. Transistor biasing Methods.
3. Input and Output characteristics of Transistor
4. Transistor as amplifier.
5. FET characteristics and evaluation of its parameters.
6. MOSFET characteristics.
7. FET biasing methods.
8. BJT and FET as a switch.
9. Class B complementary symmetry power amplifier
10. Half and full wave rectifiers.
11. Phase shift oscillator using BJT/FET.
12. RC coupled amplifier - frequency response.
13. Halfwave Rectifier, Full Wave rectifier, Clipper & Clampers
14. Multivibrators
15. Mini project

Text Book(s):

1. Jacob. Millman, Christos C.Halkias and Sathyabrata Jit, "Electronic Devices and Circuits", Tata McGraw Hill Publishing Limited, New Delhi, 2010.
2. David A. Bell., "Electronic Devices and Circuits" Oxford University Press., 5th Edition, 2008

Reference Books:

1. Robert Boylestad and Luis Nashelaky"Electronic Devices and Circuit Theory" 11thEdision, Pearson publishers.
2. S. Sedra and K. C. Smith, "Microelectronic Circuits", New York, Oxford UniversityPress, 1998.
3. J. V. Wait, L. P. Huelsman and G. A. Korn, "Introduction to Operational Amplifier theory and applications", McGraw Hill U. S., 1992.

4. J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education, 1988.
5. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1989.
6. P. R. Gray, R. G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 2001.

EEE18R281 ELECTRICAL MACHINES LABORATORY I

EEE18R281 ELECTRICAL MACHINES LABORATORY I	*L*	*T*	*P*	*C*
	0	*0*	*3*	*2*
Co-requisite:EEE18R201	**Course Category:** Programme Core – Laboratory			

Course Objective(s):

1. The ability to conduct the testing and experimental procedure on different types of electrical machines.
2. The capability to analyse the operation of machines under different loading conditions.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Acquire the knowledge, experimental procedure in static and rotating DC machines.

CO2: Improve the ability of observation and mathematical manipulation of experiments in electrical machines.

CO3: Apply the knowledge of experiment skills of electrical machines for solving the electrical problems in industries.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	S			S	S								**S**	**S**	
CO2				S	S				S	M				**S**	**S**
CO3				S	S	S	M		S	S	M	S		**S**	**M**

Course Topics:

1. Open circuit and load characteristics of DC separately and shunt generator
2. Open circuit and load characteristics of DC self excited shunt generator
3. Load characteristics of differential DC compound generator
4. Load characteristics of DC shunt motor
5. Load characteristics of DC series motor
6. Speed control of DC shunt motor
7. Swinburne's test

8. Load test on single-phase transformer
9. Load test on three phase transformer
10. Open circuit and short circuit tests on single phase transformer
11. Sumpner's test on transformers
12. Separation of no-load losses in single phase transformer
13. Parallel operation of single phase transformers.
14. Performance characteristics of DC series motor using MATLAB/SIMULINK.
15. Performance characteristics of DC shunt motor using MATLAB/SIMULINK.

EEE18R251 CONTROL SYSTEMS

EEE18R251 CONTROL SYSTEMS	***L***	***T***	***P***	***C***
	3	***0***	***1***	***3.5***
Pre-requisite:MAT18R206	**Course Category:** Programme Core – Theory with Practice			

Course Objective(s):

To understand the use of transfer function models for analysis physical systems and introduce the control system components.

To provide adequate knowledge in the time response of systems and steady state error analysis.

To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of systems.

To introduce stability analysis and design of compensators

To introduce state variable representation of physical systems and study the effect of state feedback

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Model the electric, mechanical and electromechanical systems and evaluate their performances
CO2: Determine the time and frequency responses of I and II order systems
CO3: Analyze the stability of the system using Time domain and frequency domain methods
CO4: Design the compensators using Bode plot and root locus techniques to stabilize control systems
CO5: Solve the state equation by transformation methods.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S	S	M	S								M	S	M	
CO2	S	S	S	S					S			M	S	S	
CO3	S	S	S	S					S			M	S	S	M
CO4	S	S	S	S					S				S	S	S
CO5	S	S	S	M									S		

Course Topics:

Unit 1: SYSTEM MODELLING **12 Hours**

Open loop and closed loop systems - mechanical systems - translational, rotational - electrical systems - force voltage and force current analogy - - mathematical representation - transfer functions - block diagram, signal flow graph - basic components of control systems - potentiometer - synchros - tachogenerator - servo motor AC, DC.

Practical: Performance analysis of open and closed loop systems of DC and AC motor.

Unit 2: TIME DOMAIN ANALYSIS **12 Hours**

Time response - step response of first order and second order systems - time domain specification - type and order of a system - steady state error - static error and generalized error coefficient – concepts of stability - Routh Hurwitz stability - P, PI and PID controllers

Practical: Time response

Unit 3: FREQUENCY DOMAIN ANALYSIS **12 Hours**

Frequency domain specifications of second order systems - analysis and stability using Bode plots, Polar plot, Nichols chart -, Use of Nichol's Chart in Control System Analysis- Nyquist stability criterion

Practical: frequency response analysis

Unit 4: ROOT LOCUS AND COMPENSATOR **12 Hours**

Root locus concept - rules for constructing root loci - root contours - design of lag, lead and lag lead compensators using Bode plots

Practical: Compensator design

Unit 5: STATE SPACE ANALYSIS **12 Hours**

Concepts of state - state variable and state models - state equation - state transition matrix - Transfer function from State Variable Representation- solution of state equation by classical and laplace transformation method - Concepts of Controllability and Observability.

Text Book(s)

1. M. Gopal, 'Control Systems, Principles and Design', 5th Edition, Tata McGraw Hill, New Delhi, 2015
2. Norman N.Nise' Control System Engineering', 7th Edition , Wiley Publication
3. S.K.Bhattacharya, Control System Engineering, 4th Edition, Pearson, 2013.
4. Dhanesh. N. Manik, Control System, Cengage Learning, 2014.

Reference(s):

1. Arthur, G.O.Mutambara, Design and Analysis of Control; Systems, CRC Press, 2013.
2. Richard C. Dorf and Robert H. Bishop, " Modern Control Systems", Pearson Prentice Hall, 2012.
3. Benjamin C. Kuo, Automatic Control systems, 7th Edition, PHI, 2010.
4. K. Ogata, 'Modern Control Engineering', 5th edition, PHI, 2012.
5. S.N.Sivanandam, S.N.Deepa, Control System Engineering using Mat Lab, 2nd Edition, Vikas Publishing, 2012.
6. S.Palani, Anoop. K.Jairath, Automatic Control Systems including Mat Lab, Vijay Nicole/ Mcgraw Hill Education, 2013.

EEE18R203ELECTRICAL MACHINES II

EEE18R203ELECTRICAL MACHINES II	*L*	*T*	*P*	*C*
	3	*0*	*0*	*3*
Pre-requisite:EEE18R202	**Course Category:** Programme Core – Theory			

Course Objective(s):

To learn the operation of synchronous machines and their characteristics.

To learn the use of equivalent circuit and circle diagram for Induction motor.

To learn the performance of special machines and their applications.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Analyze the performance of alternator based on voltage regulation methodologies and describe the parallel operation of alternators through capability curves.

CO2: Describe the performance of synchronous motor based on effect of increased load and changing excitation.

CO3: Analyze the starting and running conditions of three phase induction motor & determine the induction motor parameters through equivalent circuit and circle diagram.

CO4: Apply the knowledge of three phase induction motor, analyze the selection of starters & speed control techniques for the practical applications.

CO5: Describe the operation & performance characteristics of single phase induction motor and special machines.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S	S		S	M								S	S	
CO2	S	S		S									S	M	
CO3	S	S	M	S	S	M							S	S	
CO4	S	M		M									S	M	
CO5	S					M							S	M	

Course Topics:

Unit 1: SYNCHRONOUS GENERATOR **12 Hours**

Construction - Working principle - EMF equation - Armature windings - Synchronous reactance - Armature reaction – Voltage regulation - EMF, MMF, ZPF, ASA methods - Synchronizing to infinite bus bars - Operating characteristics - Capability curves - Two reaction theory - Parallel operation of synchronous generators.

Unit 2: SYNCHRONOUS MOTOR **12 Hours**

Principle of operation - Methods of starting - Power developed by a synchronous motor - Synchronous motor with different excitations - Effect of increased load with constant excitation - Effect of changing excitation constant load - Torque equation - V curve and inverted V curve - Hunting – Synchronous phase modifier - PF correction.

Unit 3: THREE PHASE INDUCTION MOTOR **12 Hours**

Constructional details - Principle of operation - Torque-slip characteristics - Starting torque - Condition for maximum starting torque - Rotor EMF & reactance under running conditions -Torque under running condition - Condition for maximum torque under running condition - Relation between torque and slip - Losses and efficiency - Power stages in an induction motor - No load and blocked rotor test - Equivalent circuit - Circle diagram - Power balance equation - Maximum power output - Induction generator.

Unit 4: STARTING AND SPEED CONTROL OF INDUCTION MOTOR 12 Hours

Need for starter - Types of starters - Starting methods of three phase induction motor - Cogging & crawling - Speed control of three phase induction motor - Double cage rotor.

Unit 5: SINGLE PHASE INDUCTION MOTORS AND SPECIAL

MACHINES **12Hours**

Single phase induction motor: Construction - Double field revolving theory - Split phase induction motor - Capacitor start induction run motor - Capacitor start capacitor run motor - Equivalent circuit (without and with core loss) - Shaded pole induction motor-Special machines: Universal motor - Stepper motor - Linear induction motor - Reluctance motor - Repulsion motor - hysteresis motor - AC series motor.

Text Book(s):

1. D. P. Kothari And I. J. Nagrath, Electric Machines, Tata McGraw Hill Education Pvt. Ltd., New Delhi,: 4thEdition, 2010.

Reference(s):

1. Fitzgerald, A.E., et.al, "Electric Machinery", Tata McGraw Hill publishing Company Ltd, 2005.
2. Gupta, J.B., "Theory and Performance of Electrical Machines", S.K.Kataria and Sons, 2005.
3. Say, M.G., "Alternating Current Machines", ELBS & Pitman, London, 5th edition, 1992.
4. Theraja,B.L., Theraja,A.K., "A text book on Electrical technology", Volume-II, S. Chand company & Ltd. 2009.

EEE18R271 MEASUREMENTS AND INSTRUMENTATION

EEE18R271 MEASUREMENTS**AND** INSTRUMENTATION	***L***	***T***	***P***	***C***
	3	***0***	***2***	***4***
Pre-requisite: Nil	**Course Category:** Programme Core – Integrated Theory and Laboratory			

Course Objective(s):

To introduce the basic concepts related to the operation of Electrical and Electronic Measuring Instruments to measure various electrical quantities and to study about the transducers.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understand the fundamental Characteristics of an instrument.
CO2: Analyze instruments adopted for measurement of current, voltage,power and energy
CO3: To study different methods available for measurement of active, passive elements and various signal conditioning devices.
CO4: Analyze the problems in various electrical parameter measurements.
CO5: Study and analyze the storage of digital signal and analyzers.

Mapping of Course Outcome(s):

CO /	**PSO**

PSO	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S												S		
CO2	S	S	S										S		
CO3	S	M		S									S	S	
CO4	S	S	M										S		
CO5	M	M										L	M		

Course Topics:

Unit 1: FUNDAMENTALS AND CHARACTERISTICS OF INSTRUMENTS

Functional elements of an instrument - static and dynamic characteristics - analog indicating instruments, hall effect instruments - rms, average and peak reading instruments- errors - systematic and random errors, error analysis, errors in measurement - statistical evaluation of measurement data - standards and calibration

Unit 2: MEASURING INSTRUMENTS

Permanent Magnet Moving Coil instrument (PMMC) - Moving Iron instruments – electrodynamic instruments - instrument transformer - current transformer, potential transformer - measurement of power – electrodynamic, ferrodynamic - measurement of energy - induction type - watt-hour meters - maximum demand indicators - polyphase energy meters - power factor meters - frequency meters - synchroscopes - electronic voltmeters - differential voltmeters - electronic multimeter

Unit 3: BRIDGES AND SIGNAL CONDITIONING DEVICES

Measurement of resistance - Wheatstone bridge, Kelvin‟s bridge, measurement of self inductance - Hay‟s, Anderson‟s, Owen‟s bridges- measurement of capacitance - Schering bridge - components of signal conditioning devices - current to voltage and voltage to current converter - buffer amplifier - differential amplifier - instrumentation amplifier - digital to analog converters - analog to digital converters - components of data acquisition systems.

Unit 4: TRANSDUCERS

Classification of transducers - selection of transducers - resistive, capacitive and inductive transducers - piezoelectric, optical and digital transducers - pH electrodes - transducers for measurements – measurement of displacement, temperature, level flows, pressure, velocity, acceleration, torque, speed, viscosity and moisture

Unit 5: DIGITAL MEASURING INSTRUMENTS

Digital Voltmeters and Multi meters – Microprocessor based DMM with auto ranging and self-diagnostic features- Digital Energy meter –Frequency, Period, time interval and Pulse Width measurement.

LIST OF EXPERIMENTS

1. AC bridges – Anderson and Schering bridge using LABVIEW
2. DC bridges- Wheatstone and Kelvin double bridge using LABVIEW
3. Instrumentation amplifiers.
4. Calibration of single–phase and three - phase energy meter.
5. Measurement of three phase real, reactive and apparent power and power factor using electronic tri-vector meter.
6. Measurement of power factor of an inductive load and its improvement by static capacitor.
7. Measurement of displacement using LVDT
8. Measurement of pressure

Text Book(s):

1. Sawhney, A.K., A Course in Electrical & Electronic Measurements & Instrumentation, DhanpatRai and Co, 2004.
2. Albert D.Helfrick., William D.Cooper, Modern Electronic Instrumentation & measurement techniques, Prentice Hall of India 2003.

References(s):

1. Bouwens, J., Digital Instrumentation, Tata McGraw Hill, 2002.
2. Kalsi, H.S., Electronic Instrumentation, Tata McGraw Hill, 2004.
3. Doebelin, E.O., Measurement Systems - Application and Design, Tata McGraw Hill publishing company, 2005.
4. David.A.Bell, "Electronic Instrumentation and Measurements", 2nd edition, Oxford University Press, 2007.

EEE18R252 DIGITAL ELECTRONICS

EEE18R252 DIGITAL ELECTRONICS	*L*	*T*	*P*	*C*
	3	*0*	*1*	*3.5*
Pre-requisite: Nil	**Course Category:** Programme Core – Theory with Practical			

Course Objective(s):

Introduce the concept of digital and binary systems

Be able to design and analyze combinational logic circuits.

Be able to design and analyze sequential logic circuits.

Understand the basic software tools for the design and implementation of digital circuits and systems.

Reinforce theory and techniques taught in the classroom through experiments and projects in the laboratory.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understand the philosophy of number systems and codes.
CO2: Solve the logic functions using different simplification techniques

CO3: Design combinational logic circuits using logic gates.
CO4: Design Sequential circuits using Flip Flop
CO5: Summarize the function, characteristics and structure of different memory systems and programmable logic devices

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S												S		
CO2	S	S		S									S	S	
CO3	S	M	S	S	M				M				S	S	M
CO4	S	S	S	S	S				S				S	S	S
CO5	S												S		

Course Topics:

Unit 1: NUMBER SYSTEMS & BOOLEAN ALGEBRA

Review of binary, octal, hexadecimal number systems - representation of signed numbers - floating point number representation - BCD -ASCII-EBCDIC - excess 3 codes - gray code -error detecting, correcting codes - Boolean Algebra- postulates and theorems of Boolean Algebra - canonical forms - simplification of logic functions using karnaugh map and Quine Mcclausky method.

Unit 2: COMBINATIONAL LOGIC DESIGN

Digital Logic families - Logic gates - implementation of combinational logic functions - encoders & decoders - multiplexers & demultiplexers - code converters - comparator - half adder, full adder - parallel adder - binary adder - parity generator/checker - implementation of logical functions using multiplexers.

Unit 3: SEQUENTIAL CIRCUITS

Flip flops - SR, D, JK and T - analysis and design of synchronous sequential circuits - state diagram, state reduction and state assignment - counters - modulus counters, shift register, Johnson counter , ring counter – Design of Asynchronous sequential circuits.

Unit 4: MEMORIES & PROGRAMMABLE LOGIC DEVICE

ROM, PROM, EPROM, Semi custom design - introduction to PLD‟s - PAL - PLA - architecture of PLD‟s - PAL 22V10, PLS 100/101 - implementation of digital functions- FPGA

Unit 5: VHSIC HARDWARE DESCRIPTION LANGUAGE (VHDL)

RTL Design - combinational logic - Types - Operators - Packages - Sequential Circuit - Sub programs - Test Benches. (Examples: adders, counters, flip flops, FSM, multiplexers / Demultiplexers)

LIST OF EXPERIMENTS

1. To check the operation of OR gate according to the OR's truth table, using the IC 74LS32
2. To check the operation of AND gate according to the AND's truth table, using the IC 74LS08
3. To check the operation of NOT gate according to the NOT's truth table, using the IC 74LS04
4. To check the operation of NOR gate according to the NOR's truth table, using the IC 74LS02
5. To check the operation of NAND gate according to the NAND's truth table, using the IC 74LS00
6. To check the operation of XOR gate according to the XOR's truth table, using the IC 74LS86
7. Design the BCD-to-seven-segment decoder circuit.
8. Verifying the operation of multiplexer by using IC74LS04,IC 74LS08andIC74LS32.
9. Verifying the operation of shift register by using flip flops.
10. To check the operation of two stage binary ripple up counter
11. To perform the operation of Half adder and full adder circuit using VHDL
12. To perform the operation of multiplexers / Demultiplexers and full adder circuit using VHDL

Text Book(s):

1. Morris Mano, M., Digital Design, Prentice Hall of India (P) Ltd., New Delhi, 2016.

Reference(s):

1. Tocci, R.J., Digital Systems - Principles & Applications, Prentice Hall of India, 2002.
2. Fletcher, W.I., An Engineering Approach to Digital Design, Prentice Hall of India, 1994.
3. Floyd, Digital Fundamentals, Prentice Hall of India, 2003.

EEE18R282 ELECTRICAL MACHINES LABORATORY II

EEE18R282 ELECTRICAL MACHINES LABORATORY II	*L*	*T*	*P*	*C*
	0	*0*	*3*	*2*
Co-requisite:EEE18R203	**Course Category:** Programme Core – Laboratory			

Course Objective(s):

To expose the students to the operation of synchronous machines and induction motors and give them experimental skills.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Acquire the knowledge, experimental procedure in synchronous and induction machines.

CO2: Improve the ability of observation and mathematical manipulation of experiments in AC dynamic machines.

CO3: Analyze the performance & characteristics of rotating AC machines based on conduction of experiments and Apply the knowledge of experiment skills of AC machines for solving the electrical problems in industries.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	M			S	S				S				**M**	**S**	**S**
CO2				S	S	M			S	S	S			**S**	**S**
CO3				S	S	S		M	S		S	S		**S**	**M**

Course Topics:

1. Regulation of three phase alternator using EMF method.
2. Regulation of three phase alternator using MMF method.
3. Regulation of three phase alternator using ZPF method.
4. Regulation of three phase alternator using ASA method.
5. Load test on alternator.
6. Parallel operation of two alternators.
7. V and inverted V curves of three phase synchronous motor.
8. Load test on three-phase squirrel cage induction motor.
9. Equivalent circuit for three phase induction motor.
10. Circle diagram for three phase induction motor.
11. Load test on three phase slip ring induction motor
12. Load test on single-phase induction motor.
13. Load test on three phase induction generators

EEE18R301 POWER ELECTRONICS

EEE18R301 POWER ELECTRONICS	*L*	*T*	*P*	*C*
	3	*0*	*0*	*3*
Pre-requisite:ECE18R276	**Course Category:** Programme Core – Theory			

Course Objective(s):

The main objective of the course is to provide an understanding of the operation and characteristics of the power electronic devices. On completion of the course the students will be able to design and analyze the power electronic circuits like rectifier, chopper, inverter and AC-AC converter for various applications.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Describe the construction, working and Characteristics of various Power Semiconductor Devices.
CO2: Analyze the performance characteristics of various types of phase controlled converter.
CO3: Design and analyze the DC-DC converter.
CO4: Describe the operation of inverter and analyze its performance.
CO5: Design and analyze the performance of AC/ AC converter.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S												S		
CO2	S	M	S										S		
CO3	S	S	S	S									S	S	
CO4	S	S	L	S									S	S	
CO5	S	M	S									M	S		

Course Topics:

Unit 1: POWER SEMI-CONDUCTOR DEVICES

Structure, operation and characteristics of Diode, SCR, power transistor, MOSFET and IGBT – Firing circuit for Thyristor- Voltage and Current commutation of Thyristor – Gate Drive Circuit for MOSFET and IGBT - protection schemes and switching losses.

Unit 2: PHASE–CONTROLLED CONVERTERS

2- pulse, 3-pulse, 6-pulse and dual converters- inverter operation of fully controlled converter – effect of source inductance – distortion and displacement factor, Power factor – ripple factor .

Unit 3: CHOPPERS

Step-down and step-up choppers – time ratio and current limit control – switching mode regulators – buck and boost converter – multiphase choppers – chopper control of DC motors.

Unit 4: INVERTERS

Classification of inverters – single phase, three phase (both 120 and 180 degree mode) inverters– series inverter – parallel inverter –voltage control of single phase, three phase inverters – current source inverters, harmonic reduction in inverters, Multilevel inverter, Inverter fed induction motor drive.

Unit 5: AC TO AC CONVERTERS

Single phase AC regulators – sequence control of AC regulators –three phase AC regulators – single phase to single phase cycloconverter – three phasecycloconverter – control circuit output voltage equation.

Text Book(s):

1. Muhammad H. Rashid., Power Electronics: Circuits, Devices and Applications, Prentice Hall of India, Pearson education, 4th edition, 2013
2. P.S.Bimbhra, Power Electronics, Khanna Publishers,5th edition,2012.

Reference(s):

1. Singh, M.D., Power Electronics, Tata McGraw Hill publications, 2nd Edition, 2008.
2. Ramamoorthy ,M., An Introduction to thyristor and their application, Affiliated East west press (P) Ltd, 2nd Edition, 1991
3. Ned Mohan.,et.al., Power Electronics: Converters, Applications and Design, John Wiley and sons, 3rd edition, 2003

EE18R381POWER ELECTRONICS LABORATORY

EEE18R381POWER ELECTRONICS LABORATORY		*L*	*T*	*P*	*C*
		0	*0*	*2*	*1*
Co-requisite:EEE18R301	**Course Category:** Programme Core –Laboratory				

Course Objective(s):

The main objective of the course is to provide an understanding of the operation and characteristicsof the power electronic devices.On completion of the course the students will be able to demonstrate and analyze the performance of power Electronic circuits like rectifier, chopper, inverter and AC-AC converter.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Apply the knowledge of power electronic devices and converters.
CO2: Demonstrate the performance of Converters and power semiconductor devices.
CO3: Analyze the performance of converters and power electronic devices.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1			M						M	L		S	M	S	M
CO2				S	S				S	S	S			S	S
CO3				S	S				S	S	S			S	S

Course Topics:

1. Characteristics of MOSFET, SCR and IGBT
2. Single phase half and fully controlled converters
3. Three phase half controlled converters
4. Three phase fully controlled converters
5. Simulation of DC-DC Converter
6. Simulation of inverter
7. Single phase IGBT based PWM inverters
8. Step up and step down MOSFET based choppers.
9. Resonant dc-dc converters.
10. Single phase AC voltage controller
11. Three phase AC voltage controller
12. Single phase cyclo converters.
13. Closed loop control of converter fed drive.

Additional Experiments

14. PWM Motor Control with forward, reverse and Break Operation

EEE18R302TRANSMISSION AND DISTRIBUTION

EEE18R302TRANSMISSION AND DISTRIBUTION	*L*	*T*	*P*	*C*
	3	*0*	*0*	*3*
Pre-requisite: Nil	**Course Category:** Programme Core – Theory			

Course Objective(s):

To develop basic knowledge in Electrical Transmission and Distribution
To learn the substation operation and maintenance of Substations

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To Understand the various transmission and distribution systems.
CO2: To develop the mathematical model of different types of transmission system
CO3: To determine the performance of transmission lines under various conditions
CO4: To understand the role of insulators and its characteristics.
CO5: To understand the functioning of substations and to evaluate the performance of distribution systems

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S					M							S	M	
CO2	S	S	S	M									S	M	
CO3	S	S		S		M						S	S	S	
CO4	S	S		M		S	M						S	M	M
CO5	S	M		S		S	M						S	S	M

Course Topics:

Unit 1BASICS OF TRANSMISSION AND DISTRIBUTION

Structure of electric power system – types of transmission systems – AC systems, DC systems – requirements of good distribution system – types of distribution system – Extra High Voltage AC (EHVAC) Transmission – need, advantages, limitations – High Voltage Direct Current Transmission (HVDC) – classifications, advantages, limitations – comparison of EHVAC and HVDC transmission –Introduction to Flexible AC Transmission System (FACTS).

Unit 2 TRANSMISSION LINE PARAMETERS

Parameters of single and three phase transmission lines with single and double circuits – resistance, inductance and capacitance of solid, stranded and bundled conductors – symmetrical and unsymmetrical spacing and transposition – application of self and mutual GMD – skin and proximity effect – interference with neighboring communication circuits

Unit 3 MODELLING AND PERFORMANCE OF TRANSMISSION LINES

Classification of lines – short line, medium line and long line – equivalent circuits, attenuation constant, phase constant, surge impedance transmission efficiency and voltage regulation – real and reactive power flow in lines – power angle diagram – surge impedance loading, load ability limits based on thermal loading, angle and voltage stability considerations – compensation in transmission lines, Ferranti effect and corona loss – sag and tension calculation , sag template , stringing chart – effect of atmospheric conditions on transmission lines – vibration of conductors and dampers.

Unit 4 INSULATORS AND CABLES

Properties of an insulator – insulator materials – types of insulators – insulator string – voltage distribution, string efficiency, methods of increasing string efficiency –testing of insulators – cables – comparison of underground and overhead cables– construction, types, insulating materials, dielectric stress, grading, thermal characteristics.

Unit 5 SUBSTATION, GROUNDING SYSTEM AND DISTRIBUTION SYSTEM

Types of substations – bus-bar arrangements – substation bus schemes – single bus scheme, double bus with double breaker, double bus with single breaker, main and transfer bus, ring bus, breaker – half with two main buses, double bus-bar with bypass isolators, resistance of grounding systems – resistance of driven rods, resistance of grounding point electrode, grounding grids – design principles of substation grounding system – neutral grounding. Radial and ring-main distributors – interconnectors – AC distribution –AC distributor with concentrated load – three-phase, four-wire distribution system – sub-mains – stepped and tapered mains, Distribution Automation

Text Book(s)

1. Singh, S.N., Electric Power Generation, Transmission and Distribution, Prentice Hall of India (P) Ltd, New Delhi, 2006.
2. Gupta, B.R., Power System Analysis and Design, S.ChandPubliactions, New Delhi, 2005.

Reference Book(s)

1. Hadi Saadat., Power System Analysis, Tata McGraw Hill Publishing Company, 2005.
2. Luces M.Fualkenberry., Walter Coffer., Electrical Power Distribution and Transmission, Pearson education, 1996.
3. V.K. Mehta, Principles of Power System, Chand(S.) & Co Ltd, India, 2005

EEE18R371 MICROPROCESSOR AND MICROCONTROLLER

EEE18R371MICROPROCESSOR AND MICROCONTROLLER	***L***	***T***	***P***	***C***
	3	***0***	***2***	***4***
Pre-requisite: EEE18R252	**Course Category:** Programme Core – Integrated Theory and Laboratory			

Course Objective(s):

To develop an in-depth understanding of the operation of microprocessors and microcontrollers, machine language programming & interfacing techniques. Developing of assembly level programs and providing the basics of the processors

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Describe fundamental of Microprocessor and Microcontrollers
CO2: Illustrate the architecture and analyze the instruction sets, programming of 8-bit microprocessor 8085.
CO3: Study the different peripheral devices and their interfacing to 8085
CO4: Illustrate the architecture of 8051 microcontroller
CO5: Study the interrupt and timers of 8051 microcontroller and design the microcontroller based control circuit for electrical and electronics applications.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1			S	S					-			S	S	S	
CO2			S	S	S				S			M	S	S	S
CO3			S	S					S				S	S	S
CO4			S	S	S								S	S	
CO5			S	S	S					L			S	S	

Course Topics:

Unit 1: FUNDAMENTALS OF MICROPROCESSORS AND MICROCONTROLLER:

Fundamentals of Microprocessor Architecture. 8-bitMicroprocessor and Microcontroller architecture, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers. Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems. Overview of the 8051 family.

Unit 2: 8085 MICROPROCESSOR

8085 architecture - Instruction set - Addressing modes- Timing diagram - Assembly Language Programming - Counters time delays – Interrupts - Memory Interfacing - Interfacing I/O devices.

Unit 3: MICROPROCESSOR INTERFACING TECHNIQUES

Interfacing serial I/O (8201) – Parallel I/O (8255) – RS232, SPI, I2C, Introduction and interfacing to protocols like Blue-tooth and Zig-bee. Keyboard and display controller (8279) - ADC/DAC interfacing – 8257 programmable DMA controller – 8259A programmable interrupt controller.

Unit 4: 8051 MICROCONTROLLER

8051 microcontroller hardware – I/O Pins, Ports and circuits – external memory, 8051 Instruction set – Addressing Modes – – counters and timers – serial data input and output – interrupts – Interfacing to external memory and 8255.

Unit 5: 8051 PROGRAMMING AND APPLICATIONS

Assembly Language Programming – I/O Port Programming – Timer and counter Programming – Serial Communication – Interrupt Programming – 8051 Interfacing, LED, ADL, Sensors – Stepper Motor - keyboard and DAC,C language programs. Assemblers and compilers. Programming and debugging tools**.**

LIST OF EXPERIMENTS

1. Simple arithmetic operations
2. ADC and DAC interfacing
3. Arithmetic operation with 8051 micro controller execution.
4. Sine wave and Square wave generation
5. ADC and DAC interfacing
6. Stepper motor control
7. Servomotor control
8. Traffic light control
9. Seven segment display
10. Basic programming using keil

Additional Experiments

1. Simple Digital Voltmeter using 8051.
2. Digital lock using AT89C2051 with LCD and keypad assembly.
3. Data acquisition system using 8051.
4. Temperature controlled Fan.
5. Microcontroller based caller ID.
6. Bio medical monitoring system.
7. Auto Control of 3-phase Induction Motor.

Text Book(s):

1. Gaonkar, R.S., Microprocessor Architecture Programming and Application, Wiley Eastern Ltd., New Delhi, 2005.
2. M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, “The8051Microcontroller and Embedded Systems: Using Assembly and C”,Pearson Education, 2007.

Reference(s):

1. Hall, D.V., Microprocessor and Interfacing Programming and Hardware, Tata McGraw Hill Publishing Company, 2nd edition, 2012.
2. YuCheng Liu & Glenn A Gibson, Microcomputer System, 8086/8088 Family, 2nd edition, Prentice Hall of India, 2005.
3. Rafiquzzaman M., Microprocessor Theory and Application – Intel and Motorola, Prentice Hall of India, 2007.

EEE18R401 POWER SYSTEM PROTECTION

EEE18R401 POWER SYSTEM PROTECTION	*L*	*T*	*P*	*C*
	3	*0*	*0*	*3*
Pre-requisite: Nil	**Course Category:** Programme Core – Theory			

Course Objective(s):

To learn various faults in power systems

To learn about various protection schemes of electrical power Systems.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To understand the requirement of protective relays and circuit breakers in power system.

CO2: To explain the working of different type of circuit breakers.

CO3: To analyze the functioning of various protective systems.

CO4: To design the protective system for the given power system components.

CO5: To Explain the working of static relays.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S												S		
CO2	S												S		
CO3	S	M	S	S									S		
CO4	S	S	S	S									S	M	
CO5	S												S		

Course Topics:

Unit 1: PROTECTIVE RELAYS

Principles and need for protective schemes – nature and causes of faults – types of faults – essential qualities of protection – zones of protection – primary and back up protection – relay classification – principle types of electromagnetic relays – theory of induction disc relay – relay design – relay construction – general equation for electromagnetic relays – over current relays – directional relays – distance relays – differential relays

Unit 2: CIRCUIT BREAKERS

Physics of arc phenomena – maintenance of the arc – losses – arc interruption theories – circuit breaker rating – characteristics of restriking voltage – current chopping – types of circuit breakers – air break CB, Air blast CB, Oil CB, Vacuum CB,SF6 CB – basic steps for design of circuit breaker

Unit 3: POWER SYSTEM APPARATUS PROTECTION

Over current, distance, pilot feeder, protection schemes – transformer protection – generator protection – motor protection – bus zone protection – auto reclosing – methods of testing protective gear – current transformer tests – potential transformer tests.

Unit 4: OVER VOLTAGE PROTECTION

Causes of over voltages – lightning – switching – insulation failure and arcing grounds – methods of protection – ground wires, Peterson coils, surge absorbers and diverters – location of protective apparatus – insulation coordination – neutral earthing

Unit 5: STATIC RELAYS

Basis for static relay development – classification – components of static relays – elements of a static relay – over current relay – differential protection – static distance relay – microprocessor based relays – concepts of digital relaying.

Text Book(s):

1. Sunil S.Rao., Switchgear Protection and Power system, Khanna Publishers, New Delhi, 13th Edition, 1999.
2. Ravindranath B., Chander, N., Power Systems Protection and Switch Gear, Wiley Eastern (P) Ltd., Second Edition, 2011.

Reference(s):

1. Badri Ram., Vishwakarma, D.N., Power system protection and switchgear, Tata Mc Graw Hill publishing company Ltd., Second Edition , 2011.
2. Uppal, S.L., Electrical Power, Khanna Publishers, New Delhi, 2004.
3. V.K. Metha, Principles of power system, chand (s) & Co. Hd Ltd. Revised Edition

EEE18R471 POWER SYSTEM

EEE18R471POWER SYSTEM	***L***	***T***	***P***	***C***
	3	***1***	***2***	***5***
Pre-requisite:EEE18R151	**Course Category:** Programme Core – Integrated Course			

Course Objective(s):

To have an overview of power system.
To model power-frequency dynamics and to design power-frequency controller.
To model reactive power-voltage interaction and the control actions to be implemented for maintaining the voltage profile against varying system load.
To study the economic operation of power system.
To teach about application for real time operation and control of power systems**.**

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To form Y_{bus} and Z_{bus} matrices for power system networks and to solve the power flow problem using numerical methods.
CO2: To analyze the fault using Z_{bus} matrix and To apply symmetrical component techniques for unsymmetrical fault analysis
CO3: To develop the swing equation and analyze the stability of synchronous machine.
CO4: To understand the methods to control voltage, frequency and power flow.
CO5: To solve the economic dispatch problem using mathematical programming techniques.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S												S		
CO2	S	S			S								S	S	
CO3	S	S	M	M		M							S	M	
CO4	S	M	S	S									S	S	
CO5	S				S	S						S	S	S	

Course Topics:

Unit 1: Load Flow Analysis

Bus Admittance and impedance matrix formation-Importance of power flow analysis– power flow problem – classification of buses – development of power flow model in Gauss-seidel power flow – numerical problems – computation of transmission line flows, losses and slack bus power – Newton-Raphson (N-R) method (polar form)– flowchart – numerical problems – development of Fast Decoupled Power Flow (FDPF) model, flowchart, numerical problems – comparison of the three methods of load flow.

Unit 2 Fault Analysis

Need for fault analysis – common approximations made in fault analysis – symmetrical short circuits – Thevenin's equivalent circuit and its applications – short circuit capacity – circuit breaker selections – fault analysis using Z bus matrix- Unsymmetrical short circuits – short circuit analysis – symmetrical components method – derivation of fault current – LG, LL, LLG short circuits – development of interconnection of sequence networks for LG, LL and LLG faults.

Unit 3 Stability Analysis

Importance of stability analysis – classification of power system stability – single Machine Infinite Bus (SMIB) system – development of swing equation – synchronous machine representation by classical model – power – angle equation– equal area criterion – determination of critical clearing angle and time – algorithm for numerical solution of swing equation using modified Euler method – plotting of swing curves.

Unit 4 Economic Dispatch

Incremental cost curve – co-ordination equations – without loss and with loss – solution by direct method and λ-iteration method – hydrothermal coordination

Unit 5 Real and Reactive Power Control

Fundamentals of speed governing mechanism and modeling – speed-load characteristics – load sharing between two synchronous machines in parallel – concept of control area – LFC control of a single-area system – static and dynamic analysis of uncontrolled and controlled cases- multi-area systems – modelling of two-area system, static analysis and dynamic analysis of two area system-Excitation system – modeling, static and dynamic analysis – stability compensation; generation and absorption of reactive power

List of Experiments:

1. Introduction to MATLAB and ETAP
2. Ybus Formation Using Singular Transformation Method
3. Z_{BUS} formation using bus building algorithm
4. Gaussian Elimination method
5. Load flow solution using Gauss – Seidal method
6. Load flow solution using Newton – Raphson method
7. Load flow solution using Fast Decoupled load flow method
8. Solution of economic dispatch control
9. Symmetrical fault analysis
10. Transient stability analysis
11. Automatic Generation control
12. Relay Coordination Using MIPOWER

Text Book(s):

1. Olle. I. Elgerd., Electric Energy Systems Theory – An Introduction, Tata McGraw Hill Publishing Company Ltd, New Delhi, Revised edition, 2006.
2. Allen.J.Wood and Bruce F.Wollenberg., Power Generation, Operation and Control, John Wiley and Sons, Inc., 2004.
3. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.
4. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012.

Reference(s):

1. Kothari ,D.P., and Nagrath., I.J., Modern Power System Analysis, Tata McGraw Hill Pulishing Company Limited, New Delhi, 3rd edition, 2005.

B) COMMUNITY SERVICE PROJECT

EEE18R399 COMMUNITY SERVICE PROJECT

ECE18R399 COMMUNITY SERVICE PROJECT	*L*	*T*	*P*	*C*
	0	*0*	*3*	*3*
Course Category: Project				

Course Objective(s):

The emphasis of this course is to enable third level engineering students to participate in an interdisciplinary team effort to apply engineering principles to solve open-ended problems that will have some significant societal impact

Course Outcome(s):

After completing this course, the student will be able to:

CO1 : Acquire experience the worth of helping public and giving back to the society

CO2 : Develop Strong ties between students and society so as to give it a sustainable nature.

CO3 : Gain skill to equip themselves with diverse and rich leadership experience and Design the experiments and make power point presentation with results and challenges.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1				S		S	S		S					S	S
CO2	S			S	M	S	S	M	S	S		S	S	S	S
CO3				S	S	S	S	S	S	S		M		S	S

C) PROJECT WORK

EEE18R499 PROJECT WORK

EEE18R499 PROJECT WORK	*Credits*			
	L	*T*	*P*	*Total*
	0	*0*	*26*	*10*
Course Category: core Project				

Course Objective(s):

The emphasis of this course is to enable bachelor engineering students to apply electrical and electronics principles to solve open-ended problems that will belongs to real time.

Strategy:

The student works on the topic approved by the project coordinator and Head of the department under the guidance of a faculty member. Student's progress is continuously monitoring by reviews conducted by the department as per the department rubrics. The students will be evaluated based on the report, publication and viva vice examination by examiner.

Course Outcomes:

After Successful completion of course, the students will be able,

CO1	:	Apply the engineering knowledge and identify the project based on practical applications in electrical and electronics engineering components.
CO2	:	Design hardware circuits / software for problems.
CO3	:	Implement and demonstrate the projects for real time applications or products developed in electrical and electronics applications.

V ELECTIVE COURSES

A) PROFESSIONAL ELECTIVE

STREAM-I (ENERGY SYSTEM)

EEE18R317 HIGH VOLTAGE ENGINEERING

EEE18R317 HIGH VOLTAGE ENGINEERING	*L*	*T*	*P*	*C*
	3	*0*	*0*	*3*
Pre-requisite: EEE18R302	**Course Category:** Major Elective - Theory			

Course Objective(s):

Students get knowledge in various types of Generation and Measurements of High Voltage AC, DC and Impulse waves along with testing methods of High Voltage Equipment.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Analyze the various breakdown mechanisms in solids, liquids and gases.
CO2: Understand the principle of generation of high voltage and high current.

CO3: Understand the principles of measurement of impulse voltages and overvoltage protection.
CO4: Analyze the transformer winding behavior under transient and switching surge conditions.
CO5: Test the various power system apparatus.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S			S									S	S	
CO2	S												S		
CO3	S		S	S									S	S	
CO4	S		S	M									S		
CO5	S		S	S									S	S	S

Course Topics:

Unit 1: CONDUCTION AND BREAKDOWN IN GASES, LIQUIDS AND SOLIDS

Gases: Collision processes – Ionization processes – Townsend's current growth equation – Secondary processes – Townsend's criterion for breakdown – Determination of Coefficients of α and γ – Breakdown in electronegative gases – Streamer theory - Paschen's law - Breakdown in non-uniform fields and corona discharges.Liquid dielectric: Pure and commercial liquids – Conduction and breakdown of pure liquid – Conduction and breakdown of commercial liquid – Testing of insulating oils.Solid dielectric: Intrinsic breakdown – Electromechanical breakdown – Thermal breakdown – Breakdown of solid dielectrics in practice – Breakdown in composite dielectrics.

Unit 2: GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS

Generation of High DC voltages: Half and full-wave rectifier circuits – Voltage doubler circuit – Voltage multiplier circuit – Vande Graaff Generator – Electrostatic generators.

Generation of High AC voltages: Cascade transformers – Resonant transformers – Generation of High-frequency ac high voltages using Tesla coil. Generation of Impulse voltages: Impulse waveshape – Circuits for producing impulse waves – Marx circuit – Generation of switching surges. Generation of impulse currents: Circuit for producing impulse current waves – Generation of rectangular current pulses.

Unit3: **MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS**

Measurement of High DC voltages: High ohmic resistance with microammeter – Resistance potential dividers – Generating voltmeters – Measurement of ripple voltage in DC systems – Measurement of ripple with CRO. Measurement of High AC and impulse voltages: Series impedance voltmeter – Series capacitance voltmeter – Capacitance potential divider – Capacitance voltage transformer – Electrostatic voltmeter – Peak reading AC voltmeters – Spark gap measurement – Potential dividers for impulse voltage measurements. Measurement of High DC current: DC current transformer – Hall Generator. Measurement of High-power frequency AC current: CT with electro-optical signal converter for EHV systems – Cathode ray oscillographs for impulse voltage and current measurements.

Unit 4: OVERVOLTAGE PHENOMENON IN ELECTRICAL

POWER SYSTEM

Natural causes for overvoltages – Lightning phenomenon – Mechanism of lightning strokes – Parameters and characteristics of lightning strokes – Mathematical model of lightning. Switching surges: Characteristics – Power frequency overvoltages in power systems – Control of overvoltages due to switching – Protection of transmission lines against overvoltages.

Unit 5: HIGH VOLTAGE TESTING AND INSULATION COORDINATION

High voltage testing: Testing of Insulators and bushings – Testing of isolators and circuit breakers – Testing of cables – Testing of transformers – Testing of surge arresters. Insulation Coordination: Principles – Surge arrester – Insulation coordination in EHV and UHV systems.

Text Book(s):

1. Naidu,M.S., Kamaraju,V., High Voltage Engineering, McGraw Hill Education (India) Private Limited, New Delhi, 2013.
2. Wadhwa,C.L., High Voltage Engineering, New Age International (P) Limited, New Delhi, 2007.

Reference(s):

1. A. Haddad, D.F.Warne, Advances in High Voltage Engineering Technology & Engineering, Institution of Engineering and Technology, 2004.
2. Kuffel,E., ZaenglW.S., High Voltage Engineering Fundamentals , Pergamon press, Oxford, London, 2002.
3. Subir Ray, An Introduction to High Voltage Engineering, PHI Learning Pvt. Ltd., 2004.
4. Simmi P. Burman, Nikita Gupta, High Voltage Engineering, S.K. Kataria& Sons; 2013

EEE18R318 ELECTRIC ENERGY GENERATION, UTILISATION AND CONSERVATION

EEE18R318 ELECTRIC ENERGY GENERATION, UTILISATION AND CONSERVATION	*L*	*T*	*P*	*C*
	3	*0*	*0*	*3*
Pre-requisite: Nil	**Course Category:** Major Elective – Theory			

Course Objective(s):

To introduce the basic concepts of generation, utilization and conservation of electrical energy.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Describe the basic principles & technologies of various renewable and non-renewable energy resource based power generation.
CO2: Apply the energy management and energy audit techniques for a given system and measure the cost analysis.
CO3: Design the lighting, heating, and welding system for domestic, commercial and industrial application standards.
CO4: Analyze the behavior& control of electric traction system.
CO5: Describe the selection of electrical drives based on the industrial applications.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	S	M											S		
CO2	S	S					S					L	S		S
CO3	S	S	S			S		S				S	S	S	S
CO4	S	S	S	S			M						S	S	M
CO5	S	M	S	S		S		S					S	S	S

Course Topics:

Unit 1: GENERATION

Generation of electrical power by conventional methods – brief review – generation from tidal, wind, MHD, geothermal and solar sources – concept of distributed generation – effect on system operation.

Unit 2: CONSERVATION

Economics of generation – definitions – load curves – number and size of UNITs – cost of electrical energy – tariff – need for electrical energy conservation – methods – energy efficient equipment – energy management – energy auditing – economics of power factor improvement – design for improvement of power factor using power capacitors – power quality – effect on conservation.

Unit3: ILLUMINATION, HEATING AND WELDING

Nature of radiation – definition – laws of photometry – lighting calculations – design of illumination systems – residential, industrial, commercial, health care, sports and administrative complexes, street lighting – types of lamps – energy efficient lamps – Methods of heating, requirement of heating material – design of heating element – furnaces – welding generator – welding transformer and its characteristics

Unit 4: ELECTRIC TRACTION

Requirements of an ideal traction system – supply systems – mechanics of train movement – traction motors and control – multiple UNITs – braking – current collection systems – recent trends in electric traction.

Unit 5: DRIVES AND THEIR INDUSTRIAL APPLICATIONS

Motor selection and related factors – loads – types – characteristics – steady state and transient characteristics – load equalization – Industrial applications – modern methods of speed control of industrial drives.

Text Book(s):

1. Wadhwa, C.L., Generation, Distribution and Utilization of Electrical Energy, New Academic Science, 2011
2. Openshaw Taylor, E., Utilization of Electrical Energy, Orient Longman (P) Ltd, 2003.

Reference(s):

1. Partab, H., Art and Science of Utilization of Electrical Energy, Dhanpat Rai and Co, New Delhi, 2004.
2. Gupta, B.R., Generation of Electrical Energy, Eurasia Publishing House (P) Ltd, New Delhi, 2003.
3. Gupta, J.B., Utilization of Electric Power and Electric Traction, S.K.Kataria and Sons, 2002.

EEE18R304 SPECIAL ELECTRICAL MACHINES

EEE18R304 SPECIAL ELECTRICAL MACHINES	*L*	*T*	*P*	*C*
	3	*0*	*0*	*3*
Pre-requisite:EEE18R203	**Course Category:** Major Elective – Theory			

Course Objective(s):

To expose the students to the construction, principle of operation and performance of special electrical machines.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understand the features of synchronous reluctance motor.
CO2: Know the operational features of stepping motor.
CO3: Know the control strategy of switched reluctance motor.
CO4: Know the operational features of PMBLDC.
CO5: Know the operational features of Permanent magnet synchronous machine.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S	S											S		
CO2	S	S		S							S		S	S	
CO3	S	S		M									S	M	
CO4	S	S									S		S		
CO5	S	S											S		

Course Topics:

Unit1: SYNCHRONOUS RELUCTANCE MOTORS 9 Hours

Construction – Types – Axial and radial air gap motors – Operating principle – Phasor diagram – Characteristics – Vernier motor – Applications.

Unit2: STEPPING MOTORS 9 Hours

Construction – Principle of operation – Variable reluctance stepper motor – Permanent magnet stepper motor - Hybrid motor – Single and multi stack configurations – Theory of torque predictions – Linear and non-linear analysis – Characteristics – Driver circuits – Open and closed loop controls of stepper motor - Applications.

Unit 3: SWITCHED RELUCTANCE MOTORS 9 Hours

Construction – Principle of operation – Torque equation – characteristics – power converter circuits – Current controllers – Rotor position sensors – Control of switched reluctance motor - Microprocessor based control – Applications

Unit 4: PERMANENT MAGNET BRUSHLESS DC MOTORS 9 Hours

Construction - Principle of operation – Mechanical and Electronic commutations – Square wave and sine wave PMBLDC motors – Types of PMBLDC motor – Control of PMBLDC motor – Microprocessor based control – Applications.

Unit 5: PERMANENT MAGNET SYNCHRONOUS MOTORS 9 Hours

Construction - Principle of operation – EMF and torque equations – Phasor diagram – Vector Control – Self control – Sensorless control – Microprocessor based control - Applications.

Text Book(s):

1. E.G. Janardanan, Special Electrical Machines, PHI, 2014.
2. J.Gnanavadivel, Dr.S.Muralidharan,. J.Karthikeyan, Principles of Special Electrical Machines, Anuradha Publications.
3. K. Venkataratnam, Special Electrical Machines, CRC Press, 2008.

Reference(s):

1. D. P. Kothari And I. J. Nagrath, Electric Machines, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 4thEdition, 2010.
2. Theodore Wildi, Electrical Machines Drives, Pearson Education, 2013.
3. Kenjo, T., Stepping Motors and Their Microprocessor Controls, Clarendon Press London, 1984.
4. Kenjo,T., Nagamori,S., Permanent Magnet and Brushless DC Motors, Clarendon Press, London, 1988.
5. Miller, T.J.E., Brushless Permanent Magnet and Reluctance Motor Drives, Clarendon Press, Oxford, 1989.
6. Aearnley P., Stepping Motors – A Guide to Motor Theory and Practice, Peter Perengrinus, London, 1982.

EEE18R426 ELECTRICAL AND HYBRID VEHICLES

EEE18R426 ELECTRICAL AND HYBRID VEHICLES	*L*	*T*	*P*	*C*
	3	*0*	*0*	*3*
Pre-requisite:EEE18R203	**Course Category:** Major Elective – Theory			

Course Objective(s):

To expose the students to the construction, principle of operation and performance of special electrical machines.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understand the functional concepts of vehicles.
CO2: Describe the performance of hybrid electric vehicles.
CO3: Study of Electric trains.
CO4: Understand the different possible ways of energy storage.
CO5: Understand the various strategies in energy storage system.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S	S											S		
CO2	S	S													
CO3	S	S													
CO4	S	S													
CO5	S	S											S		

Unit 1 INTRODUCTION **9 Hours**

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.

Unit 2 HYBRID ELECTRIC VEHICLES **9Hours**

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains onenergy supplies.

Unit 3 ELECTRIC TRAINS **9 Hours**

Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

Unit 4 ENERGY STORAGE **9 Hours**

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric

Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage andits analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power

electronics, selecting the energy storage technology, Communications, supporting subsystems.

Unit 5 ENERGY MANAGEMENT STRATEGIES 9 Hours

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric

Vehicle (BEV).

Text Books

1. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and

Applications with Practical Perspectives", John Wiley & Sons, 2011.

2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management

Strategies", Springer, 2015.

Reference Books

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel

Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.

2. T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016.

EEE18R316DESIGN OF ELECTRICAL APPARATUS

EEE18R316DESIGN OF ELECTRICAL APPARATUS	***L***	***T***	***P***	***C***
	3	***0***	***0***	***3***
Pre-requisite: EEE18R203	**Course Category:** Programme Core – Theory with Practice			

Course Objective(s):

To develop knowledge on principles of design of static and rotating electrical machines. Also students must able to understand the concept of magnetic circuits and fundamental concepts of design of main dimensions & cooling systems of static and rotating machine.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Describe the concepts of magnetic circuit in static and rotating electrical machines
CO2: Design the field poles, field winding, armature core and armature windings of DC machines
CO3: Design the transformer core, windings and cooling tubes for core and shell type transformers.
CO4: Design the stator core, squirrel cage rotor and slip ring rotor of three phase induction motor.
CO5: Design the main dimensions of three phase salient pole and turbo alternators.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S	S											S		
CO2	S	S	S										S		
CO3	S	S	S			S		M					S	S	M
CO4	S	S	S			S							S	S	
CO5	S	S	S			M							S	M	

Course Topics:

Unit 1: MAGNETIC CIRCUITS AND ITS CALCULATIONS 12 Hours

Concept of magnetic circuit – MMF calculation for various types of electrical machines – real and apparent flux density of rotating machines – leakage reactance calculation for rotating machines – thermal rating –continuous, short time and intermittent short time rating of electrical machines.

Unit 2: DESIGN OF DC MACHINES 12 Hours

Constructional details, output equation, main dimensions, choice of specific loadings, choice of number of poles – armature design – armature winding design- design of field poles and field coil, design of commutator and brushes.

Unit 3: DESIGN OF TRANSFORMERS 12 Hours

Constructional details of core and shell type transformers – output rating of single phase and three phase transformers – design of core, yoke and windings for core and shell type transformers– design of tank and cooling tubes of transformers.

Unit 4: DESIGN OF THREE PHASE INDUCTION MOTORS 12 Hours

Three phase Squirrel cage and slip ring motors – constructional details, output equation, main dimensions, choice of specific loadings – stator core and winding design, squirrel cage rotor design- design of rotor bar and end ring and slip ring rotor design-rotor winding design.

Unit 5: DESIGN OF SYNCHRONOUS MACHINES **12 Hours**

Alternators – constructional details of cylindrical pole and salient pole alternators, output equation, choice of specific loadings, main dimensions, short circuit ratio – design of stator and rotor of cylindrical pole and salient pole machines, design of field coil.

Text Book(s):

1. Sawhney, A.K., A Course in Electrical Machine Design, DhanpatRai and Sons, New Delhi, 2006.
2. Sen,S.K., Principles of Electrical Machine Design with Computer Programmes, Oxford and IBH Publishing Co.(P) Ltd., New Delhi, 2004.

Reference(s):

1. Agarwal, R.K., Principles of Electrical Machine Design, S.K.Kataria and Sons, Delhi, 2002.
2. Mittle, V.N., and Mittle, A., Design of Electrical Machines, Standard Publications and Distributors, Delhi, 2002.
3. Balbir Singh, Electrical Machine Design, Brite Students Publications.

EEE18R320 POWER SYSTEM TRANSIENTS

EEE18R320 POWER SYSTEM TRANSIENTS	***L***	***T***	***P***	***C***
	3	***0***	***0***	***3***
Prerequisite: EEE18R471	**Course Category:** Major– Elective			

Course Objective(s):

The topics of the course impart knowledge on basic concepts related to generation of switching transients, Laplace transform methods for handling transients, impacts of voltage transients due to switching and principles of propagation of voltage and current waves along power lines.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To explain the causes of transients and their effects on power system.
CO2: To demonstrate the basic concepts of switching surges in a system
CO3: To Illustrate the impact of voltage transients due to various switching surges
CO4: To develop the theoretical aspects of travelling waves.
CO5: To estimate the transient voltages in integrated power system.

Mapping of Course Outcome(s):

CO / PSO	**PSO**														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	S												S		
CO2	S	S											S		

CO3	S	S											S		
CO4	S	S	S	S				M					S	S	M
CO5	S	S	S	M				S				M	S	M	S

Course Topics:

Unit1: INTRODUCTION ABOUT ELECTRICAL TRANSIENTS 9 Hours

Review and importance of the study of transients – Physical Interpretation of Transients-Circuit characteristics causes for transients. Sources of electrical transients-basic mathematical concepts for transient analysis. RL circuit transient with sine wave excitation - double frequency transients – Different types of power system transients - effect of transients on power systems – role of the study of transients in system planning.

Unit2: BASIC CONCEPTS OF SWITCHING TRANSIENTS 9 Hours

Basic simulation of switching –Closing and opening of a switch-Recovery voltage in circuit breaker-Current chopping in dc systems and ac systems-compound transients-switching surges in capacitive circuits-switching surges in distributed constant systems.

Unit3: TRANSFORMS OF SWITCHING TRANSIENTS 9 Hours

Basic transforms of the RLC circuit transients- equivalent circuit for interrupting the resistor current - load switching and equivalent circuit - waveforms for transient voltage across the load and the switch - normal and abnormal switching transients. Current suppression - effective equivalent circuit. Capacitance switching - effect of source regulation - capacitance switching with a restrike, with multiple restrikes Illustration for multiple restriking transients - ferro resonance

Unit4: WAVE PROPAGATION 9 Hours

Wave equation-velocity of travelling waves-Relation between the voltage and current waves-Line of finite length: Point of discontinuity-Examples of line terminations-Line terminated by surge impedance-open circuited line-short circuited line- Line terminated by complex impedance- -Multiple reflections –Lattice diagram-Examples of Multiple reflections.

Unit5: TRANSIENTS IN INTEGRATED POWER SYSTEM 9 Hours

The short line and kilometric fault - distribution of voltages in a power system -Line dropping and load rejection - voltage transients on closing and reclosing lines - over voltage induced by faults - switching surges on integrated system-Qualitative application of EMTP for transient computation.

Text Book(s):

1. Allan Green wood," Electrical Transients in power systems", Wiley Inter science, New York,3rd Edition, 2012.

Reference(s):

1. PribindraChowdhuri, "Electromagnetic transients in power systems", Pearson Education Limited, 2004
2. Begamudre R.D., "Extra High Voltage AC Transmission Engineering", Wiley Eastern Limited, 2003
3. Mazen Abdel-Salam, Hussein Anis, "High Voltage Engineering", Marcel Dekker, Inc, 2010.
4. Wadhwa C.L., "Power Systems Engineering", New Age International, Fourth Edition 2006.
5. Harold A. Peterson, 'Transients in Power Systems', John Wiley and sons, 1966

EEE18R404DIGITAL PROTECTION

EEE18R404DIGITAL PROTECTION	*L*	*T*	*P*	*C*
	3	*0*	*0*	*3*
Pre-requisite: EEE18R401	**Course Category:** Major Elective – Theory			

Course Objective(s):

- Introduction to static relay, static over current relay.
- Brief description of static differential relay schemes single phase and three phase schemes.
- Introduction to static differential protection of generator and transformer.
- Different types of Circuit Breaker and their applications.
- Introduction to digital over current, transformer differential and transmission line distance protection.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To explain the working of numerical relay.
CO2: To discuss the different types of protection methods for transmission lines.
CO3: To explain the different types of faults and protection methods for synchronous generators.
CO4: To discuss the different types of faults and protective schemes for power transformers.
CO5: To understand the concept of relay coordination for distance and overcurrent relay

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	M	M	S										M		
CO2	S				S								S	S	
CO3															
CO4					S									S	
CO5	S			S	S								S	S	

Course Topics:

Unit 1: NUMERICAL PROTECTION **9 Hours**

Introduction – block diagram of numerical relay– sampling theorem, correlation with a reference wave–least error squared (LES) technique–digital filtering, numerical over current protection.

Unit 2: DIGITAL PROTECTION OF TRANSMISSION LINE **9 Hours**

Introduction–protection scheme of transmission line–distance relays, traveling wave relays– digital protection scheme based upon fundamental signal, hardware design, software design– digital protection of EHV/UHV transmission line based upon travelling wave phenomenon, new relaying scheme using amplitude comparison.

Unit 3: DIGITAL PROTECTION OF SYNCHRONOUS GENERATOR AND POWER TRANSFORMER **9 Hours**

Introduction–faults in synchronous generator, protection schemes for synchronous generator, digital protection of synchronous generator. – Faults in a transformer, schemes used for transformer protection–digital protection of transformer.

Unit 4: DISTANCE AND OVER CURRENT RELAY SETTING AND CO-ORDINATION **9 Hours**

Directional instantaneous IDMT over current relay, directional multizone distance relay– distance relay setting–co-ordination of distance relays, co-ordination of over current relays, computer graphics display–man-machine interface subsystem, integrated operation of national power system, application of computer graphics.

Unit 5: PC APPLICATIONS IN SHORT CIRCUIT STUDIES FOR DESIGNING RELAYING SCHEME **9 Hours**

Types of faults– assumptions, development of algorithm for S.C. studies–PC based integrated software for S.C. studies, transformation to component quantities, S.C. studies of multiphase systems. Ultra high speed protective relays for high voltage long transmission line.

Text Book(s):

1. Digital Protection, L. P. Singh, New Age International PvtLimited Publishers, New Delhi, 2nd Edition.
2. Digital Relay / Numerical relays – T.S.M. Rao, Tata Mc Graw Hill, New Delhi. 2005

Reference(s):

1. Fundamentals of Power System Protection, Paithankar&Bhide Prentice Hall of India Pvt. Ltd., New Delhi. 2004
2. Protective Relaying for Power System II, Stanley Horowitz IEEE press , New York Transmission Network Protection, Paithankar (Marcel & Dekker, New York).

EEE18R406 RENEWABLE ENERGY SOURCES

EEE18R406 RENEWABLE ENERGY SOURCES	*L*	*T*	*P*	*C*
	3	*0*	*0*	*3*
Pre-requisite: Nil	**Course Category:** Major Elective – Theory			

Course Objective(s):

To understand the basic principle of solar PV system and WECS characteristics.

To understand the concept of hybrid Renewable energy system for standalone power system and grid connected system.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To gain the knowledge about the renewable energy scenario in India and its features
CO2: To understand the concept of Photovoltaic cell and its performance characteristics
CO3: To understand the concept of Photovoltaic system designfor standalone and grid connectedsystem.
CO4: To understand the concept of WECS and its types and performance characteristics.
CO5: To understand the concept of fuel cell and hybrid renewable energy system.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S						S						S		S
CO2	S	S	M	S		S			S	M		M	S	S	M
CO3	S	M		M		M						S	M	M	

CO4	S	S			S								S	S	
CO5	M		S	S		S	S	M					S	S	S

Course Topics:

Unit1: INTRODUCTION **9 Hours**

Classification of energy sources-Features of Renewable energy- Renewable energy scenario in India–Solar Energy: Sun and Earth-Basic Characteristics of solar radiation-angle of sunrays on solar collector-Estimating Solar Radiation Empirically

Unit2: SOLAR PHOTOVOLTAICS **9 Hours**

Equivalent circuit of PV Cell- Photovoltaic cell-characteristics: PV and I-V curve of cell-Impact of Temperature and Insolation of I-V characteristics-Shading Impacts on I-V characteristics-Bypass diode-Blocking diode- Boost converter based Maximum power point tracking (MPPT)-MPPT algorithms: P&O and Incremental conductance algorithm

Unit3: PHOTOVOLTAIC SYSTEM DESIGN **9 Hours**

PV systems classification- Stand-alone PV system configurations-Design of PV-powered DC pump-Design of stand-alone system with battery and AC or DC load-Hybrid PV systems – Grid connected solar photovoltaic system – Grid integration issues.

Unit4: WIND ENERGY **9 Hours**

Origin of Winds: Global and Local Winds- Aerodynamics of Wind turbine-Derivation of Betz's limit- Power available in wind-Classification of wind turbine: Horizontal Axis wind turbine and Vertical axis wind turbine- Aerodynamic Efficiency-Tip Speed-Tip Speed Ratio-Solidity-Blade Count-Power curve of wind turbine - Configurations of wind energy conversion systems: Type A, Type B, Type C and Type D Configurations-Grid Integration.

Unit5: FUEL CELL AND HYBRID RENEWABLE ENERGY SYSTEMS

9 Hours

Fuel cell – principle of working of phosphoric acid Fuel cell –VI Characteristics of Fuel cell-Introduction to Hybrid Renewable Energy System - Need for Hybrid Systems-Range and type of Hybrid systems- Quantitative study of Diesel-PV and Wind- PV system

Text Book(s):

1. Chetan Singh Solanki, "Solar Photovoltaics: Fundamentals, Technologies and Applications", PHI Learning Private Limited, 2012.
2. Twidell, J.W. and Weir, A., "Renewable Energy Sources", EFN Spon Ltd., 2005.
3. B.H.Khan, "Non-Conventional energy resources", McGraw-Hill Education,2nd Edition,2009.
4. Sukhatme S P, Nayak J K, "Solar Energy: Principles of Solar Thermal Collection and Storage", McGraw Hill, 2008.

Reference(s):

1. Kothari D. P &Singal K. C &Ranjan, Rakesh, "Renewable Energy Sources and Emerging Technologies", PHI Learning Private Limited, New Delhi, 2013.
2. Tasneem Abbasi & Abbasi Sa, "Renewable Energy Sources", PHI Learning Private Limited, New Delhi, 2013.
3. Gilbert M. Masters, "Renewable and Efficient Electric Power Systems", Second Edition, John Wiley & Sons, 2013.
4. Rashid .M. H "power electronics Hand book", Academic press, 2001

EEE18R330 ELECTRICAL SYSTEM DESIGN

EEE18R330 ELECTRICAL SYSTEM DESIGN	*Credits*			
	L	***T***	***P***	***Total***
	3	***0***	***0***	***3***
Prerequisite: NIL	**Course Category:** Professional Elective – Theory			

Course Objective(s):

Knowledge of electrical engineering drawing, IE rules, different types of electrical Installation their design considerations equips the students with the capability to design and prepare working of different Installation projects.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To understand the basic of wiring accessories and types of wiring systems
CO2: To gain the knowledge about Estimating and Costing of electrical wiring
CO3: To gain the knowledge for estimating and constructing the domestic wiring.
CO4: To understand the cost of equipments and estimation of wiring used in industry
CO5: To do the plan for overhead underground lines.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S	S			S								S	M	
CO2	S			S									S	S	
CO3	S	M		S	S								S	S	
CO4	S			S	S								S	S	

CO5	S	S		M								S	S	M	

Course Topics:

Unit 1: WIRING MATERIALS AND ACCESSORIES 9 Hours

Need of electrical symbols - List of symbols for electrical equipments and accessories used in electrical works – IE rules - General specifications and different types of wires – Cables – Switches - Distribution board - Switch board – Boxes - Batten and its accessories - Conduit and its accessories - Lamp holders - Socket out lets - Plug ceiling roses - Fuse and energy meter used in domestic and power wiring installations- Type of wiring diagrams - Wiring diagrams (multiple and single line representation)

Unit 2: ESTIMATING AND COSTING PRINCIPLES 9 Hours

Purpose of estimating and costing - Essentials of estimating and costing-market survey - Price list and net prices - Preparation of list of materials - Calculation of material and labour cost – Contingencies - Overhead charges - Profit and total cost.

Unit 3: ESTIMATION OF DOMESTIC WIRING CIRCUITS 9 Hours

Description of various domestic wiring systems - calculation of No. of points (light, fan, socket outlet) - Calculation of total load including domestic power - Determination of no. of circuits - Size of wires and cables - Switches and main switch - Distribution board and switch board - Batten conduit and other wiring accessories - Need of earthing as per IE rules.

Unit 4: ESTIMATION OF POWER WIRING 9 Hours

IE rules for power wiring - Calculation of current for single and three phase motors - Determination of sizes of cables, conductors distribution board, main switches and starters for power circuits - Cost of equipments and accessories and schedule of materials - Estimation and cost of material and work for motors upto 20 H.P., pump sets and small workshops.

Unit 5: ESTIMATION OF OVERHEAD AND UNDERGROUND DISTRIBUTION LINES 9 Hours

IE rules for overhead and underground lines - Main components of overhead lines-line supports - Cross-arm – Clamps - Conductors and stay sets - Lightening arrestors - Danger plates -Ant climbing devices - Bird guards - Jumpers - Concreting of poles - Earthing of transmission line - Formation of lines - Specification of materials for O.H. lines - Cost of material and work for overhead and underground lines upto 11 KV.

Textbook(s):

1. Uppal S.L, “Electrical Wiring - Estimating and Costing”, Khanna Publishers, Sixth edition 2011.
2. Giridharan M.K., “Electrical Systems Design”, I.K. International Publishing House, New Delhi, 2011.

Reference(s):

1. Gupta J.B., “A Course in Electrical Installation Estimating and Costing”, S. K. Kataria& Sons, Ninth Edition, 2012.
2. Raina K.B., Bhattacharya S.K., “Electrical Design Estimating and Costing” New Age International Pvt. Ltd., 2005.

EEE18R331 ELECTRICAL HAZRDS AND PROTECTION

EEE18R331 ELECTRICAL HAZRDS AND PROTECTION	*Credits*			
	L	*T*	*P*	*Total*
	3	0	0	3
Pre-requisite: Nil	**Course Category:** Professional Elective - Theory			

Course Objective(s):

To provide a comprehensive exposure to electrical hazards, various grounding techniques, safety procedures and various electrical maintenance techniques.

Course Outcome(s):

After completing this course, the student will be able to:

CO1 : Describe electrical hazards and safety equipment.

CO2 : Analyze and apply various grounding and bonding techniques.

CO3 : Select appropriate safety method for low, medium and high voltage equipment.

CO4 : Participate in a safety team.

CO5 : Carry out proper maintenance of electrical equipment by understanding various standards.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	M												M		
CO2	S	M	S	M									S	M	
CO3	S	M	S	M	M								S	M	
CO4	S	M	S	M								M	S	M	
CO5	M	L	M										M		

Course Topics:

UNIT I: HAZARDS OF ELECTRICAL SYSTEMS 9 Hours

Primary and secondary hazards-arc, blast, shocks-causes and effects-safety equipment-flash and thermal protection, head and eye protection-rubber insulating

equipment, hot sticks, insulated tools, barriers and signs, safety tags, locking devices-voltage measuring instruments-proximity and contact testers-safety electrical one line diagram-electrician's safety kit.

UNIT II: GROUNDING SYSTEMS 9 Hours

General requirements for grounding and bonding-definitions-grounding of electrical equipment-bonding of electrically conducting materials and other equipment-connection of grounding and bonding equipment-system grounding-purpose of system grounding-grounding electrode system-grounding conductor connection to electrodes-use of grounded circuit conductor for grounding equipment-grounding of low voltage and high voltage systems

UNIT III: PROTECTION SYSTEM 9 Hours

The six step safety methods-pre job briefings -hot-work decision tree-safe switching of power system-lockout-tag out-flash hazard calculation and approach distances-calculating the required level of arc protection-safety equipment , procedure for low, medium and high voltage systems-the one minute safety audit

UNIT IV: SAFETY 9 Hours

Electrical safety programmestructure, development-company safety team-safety policy-programme implementation-employee electrical safety teams-safety meetings-safety audit-accident prevention-first aid-rescue techniques-accident investigation

UNIT V: ELECTRICAL SYSTEM MAINTENANCE 9 Hours

Safety related case for electrical maintenance-reliability cantered maintenance (RCM) -eight step maintenance programme-frequency of maintenance-maintenance requirement for specific equipment and location-regulatory bodies-national electrical safety code-standard for electrical safety in work place-occupational safety and health administration standards, Indian Electricity Acts related to Electrical Safety.

Text Book(s):

1. Rao .S," Electrical Safety Fire Safety Engineering and Safety Management", Khanna Publications, 2nd Edition, 2012.

2. Fordham Cooper, W., "Electrical Safety Engineering" Butterworth and Company, London, 1986.

Reference(s):

1. Indian Electricity Act and Rules, Government of India.
2. Power Engineers – Handbook of TNEB, Chennai, 1989.
3. Martin Glov, 'Electrostatic Hazards in powder handling', Research Studies Pvt. Ltd., England, 1988.
4. MassimA.G.Mitolo, 'Electrical safety of Low voltage systems', Mc Graw Hill, 2009.
5. John Cadick et al., 'Electrical safety Handbook', Third Edition, Mc Graw Hill, 2006.

EEE18R402 ENERGY CONSERVATION PRACTICES

EEE18R402 ENERGY CONSERVATION PRACTICES	*Credits*			
	L	*T*	*P*	*Total*
	3	*0*	*0*	*3*
Pre-requisite: NIL	**Course Category:** Professional Elective – Theory			

Course Objective(s):

To acquire knowledge about the basics of energy conservation practices in major electric utilities.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To have knowledge of energy conservation practices.
CO2: To appreciate conservation measures in electrical systems.
CO3: To realize energy consumption and energy saving potentials.
CO4: To have knowledge on electrical conservation in major utilities.
CO5: To understand the techniques of conservation methods.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S			S									S	S	
CO2	S												S		
CO3	S		S	S									S	S	
CO4	S		S	M									S		
CO5	S		S	S									S	S	S

Course Topics:

Unit 1: INTRODUCTION **9 Hours**

Energy Conservation: Introduction, Indian Energy Conservation Act, Rules for Efficient Energy Conservation, Identification of Energy Conservation opportunities, Energy Conservation Schemes and Measures, Energy flow networks, Critical assessment of energy use, Optimizing Energy Inputs and Energy Balance.

Unit 2: ELECTRICAL SYSTEMS **9 Hours**

Components of electrical systems, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Energy efficient lighting - Terminology - Cosine law of luminance - Types of lamps - Characteristics - Design of illumination systems Steps for lighting energy conservation

Unit 3: ENERGY CONSERVATION PRINCIPLES **9 Hours**

Energy scenario - Principles of energy conservation - Resource availability - Energy savings - Current energy consumption in India - Roles and responsibilities of energy managers in industries. Environmental aspects associated with energy utilization – Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers, Instruments for energy auditing.

Unit 4: ENERGY CONSERVATION IN MAJOR UTILITIES **9 Hours**

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets

Unit 5: ELECTRICAL ENERGY CONSERVATION **9 Hours**

Potential areas for electrical energy conservation in various industries - Conservation methods - Energy management opportunities in electrical heating, lighting system - Cable selection - Energy efficient motors - Factors involved in determination of motor efficiency -, Adjustable AC drives - Variable speed drives - Energy efficiency in electrical system.

Text Book(s):

1. Energy Manager Training Manual (4 Volumes) available at www.energymanager training.com, a website administered by Bureau of

Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.

Reference(s):

1. Witte. L.C., P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" Hemisphere Publ, Washington, 1988.
2. Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford, 1981.
3. Dryden. I.G.C., "The Efficient Use of Energy" Butterworths, London, 1982
4. Turner.W.C., "Energy Management Hand book", Wiley, New York, 1982.
5. Murphy. W.R. and G. Mc KAY, "Energy Management", Butterworths, London 1987.
6. Energy Management and good lighting practice: Fuel Efficiency Booklet 12 / EEO

STREAM-II (POWER ELECTRONICS)

EEE18R324 Linear Integrated Circuits

EEE18R324 Linear Integrated Circuits	*L*	*T*	*P*	*C*
	3	*0*	*0*	*3*
Pre-requisite:ECE18R276	**Course Category:** Major Elective – Theory			

Course Objective(s):

1. Investigate the building blocks of a basic op-amp, determine op-amp parameters and design basic amplifier circuit applications using op-amps
2. Discuss, investigate and design various types of capacitor coupled op-amp circuits.
3. Explain the stability issues of op-amp circuits assess op-amp frequency response and design circuits to realize frequency compensation.
4. Discuss and design various op-amp applications such as voltage /current sources, instrumentation amplifier, precision rectifier, limiting circuits etc.
5. Explain the operation and design of signal generating circuits, V to I and I to V converters, oscillator circuits using op-amp.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understand the IC fabrication techniques
CO2: Develop the various circuits using OP Amp for the given application
CO3: Design and analyze the characteristics of integrated circuit.
CO4: Design and analyze the performance of filter and timer circuits.
CO5: Understand the basic concept of signal converters and regulators.

Mapping of Course Outcome(s):

CO /	PSO

PSO	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO6	M												M		
CO7	S	M	S	M									S	M	
CO8	S	M	S	M	M								S	M	
CO9	S	M	S	M								M	S	M	
CO10	M	L	M										M		

Course Topics:

Unit 1: INTEGRATED CIRCUIT TECHNOLOGY 9 Hours

Monolithic integrated circuit technology – planar process – bipolar junction transistor fabrication – fabrication of FET's – CMOS Technology – monolithic diodes – metal – semiconductor contact – integrated circuit resistors – integrated circuit capacitors – integrated circuit packaging – characteristics of integrated circuit components – microelectronic circuit layout.

Unit 2: CHARACTERISTICS AND APPLICATIONS OF OP–AMP 9 Hours

DC Characteristics of ideal op-amp, pin configuration of 741 op-amp, bias, offsets, drift, bandwidth, A.C characteristics – slew rate, frequency compensation. Applications – inverting and non-inverting amplifiers, inverting and non-inverting summers, difference amplifier, differentiator and integrator, log and antilog amplifiers, multiplier and divider.

Unit 3: COMPARATORS AND SIGNAL GENERATORS 9 Hours

Comparators – regenerative comparators, input output characteristics. Signal generators – astable multivibrator, monostable multivibrator, triangular wave generators, RC-phase shift oscillator, Wein bridge oscillator

Unit 4: ACTIVE FILTERS, TIMERS AND MULTIPLIERS 9 Hours

Filters – low pass, high pass, band pass and band reject, Butterworth, Chebychev filters, first and second order filters – switched capacitor filters – 555 timer functional diagram, monostable and astableoper ation – multiplier – application.

Unit 5: ADC, DAC, PLL AND REGULATORS 9 Hours

PLL – basic block diagram, operation, capture range and lock range – simple applications of PLL – AM detection, FM detection and FSK demodulation, ADC and DAC – weighted resistor DAC, R-2R and inverted R-2R DAC, monolithic DAC, Flash ADC, counter type ADC, successive approximation ADC, dual slope ADC, and conversion times of typical ADC – voltage regulator –variable voltage regulator –op amp regulator, IC voltage regulator, IC 723 general purpose regulator, Switching regulator. Switched mode power supply regulator.

Text Book(s)

1. Ramakant A. Gayakward., Op–amps and Linear Integrated Circuits, Pearson Education, 4th edition, 2005
2. Roy Choudhary, D., SheilB.Jani., Linear Integrated Circuits, New Age International, 2nd edition,2003.

Reference Book(s)

1. Robert F.Coughlin., Fredrick F.Driscoll, Op–amp and Linear ICs, Pearson Education, 6th edition, 2005.

2. Franco., Design with Operational Amplifier and Analog Integrated Circuits, Tata McGraw Hill publishing company, 2005.

EEE18R319ELECTRICAL DRIVES

EEE18R319ELECTRICAL DRIVES	*L*	*T*	*P*	*C*
	3	*0*	*0*	*3*
Pre-requisite:EEE18R203 & EEE18R301	**Course Category:** Programme Core – Theory			

Course Objective(s):

To describe the characteristics of Electric Drive systems and their role in various applications and also learn solid state speed control methods of DC and AC motor drives using power electronics.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To understand steady state operation and transient dynamics of a motor load system.

CO2: To study and analyze the operation of the converter/chopper fed dc drive, both qualitatively and quantitatively.

CO3: To study and understand the operation and performance of AC motor drives.

CO4: To analyze and design the current controllers for a closed loop solid state DC motor drive

CO5: To analyze and design the speed controllers for a closed loop solid state DC motor drive

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S												S		
CO2	S	S	L										S		
CO3	S	S	S										S		
CO4	S	S	S										S		
CO5	S	M		M									S	M	

Course Topics:

Unit 1: DRIVE CHARACTERISTICS 9 Hours

Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, starting & stopping – typical load torque characteristics Selection of motor.

Unit 2: CONVERTER / CHOPPER FED DC MOTOR DRIVE 9 Hours

Steady state analysis of the single and three phase converter fed separately excited DC motor drive–continuous and discontinuous conduction– Time ratio and current limit control – 4 quadrant operation of converter / chopper fed drive.

Unit 3: INDUCTION MOTOR DRIVES **9 Hours**

Stator voltage control–energy efficient drive–v/f control–constant air gap flux–field weakening mode– voltage / current fed inverter – closed loop control.

Unit 4: SYNCHRONOUS MOTOR DRIVES **9 Hours**

V/f control and self-control of synchronous motor: Margin angle control and power factor control –Permanent magnet synchronous motor.

Unit 5: DESIGN OF CONTROLLERS FOR DRIVES **9 Hours**

Transfer function for DC motor / load and converter – closed loop control with Current and speed feedback–armature voltage control and field weakening mode – Design of controllers; current controller and speed controller.

Text Book(s):

1. Dubey G.K., "Fundamentals of Electrical Drives", Narosa Publishing House, Second Edition ,2016
2. BimalK.Bose. Modern Power Electronics and AC Drives, Pearson Education, 2016.
3. Krishnan R., " Electric Motor & Drives: Modelling, Analysis and Control", Pearson Education, 2015

Reference(s):

1. John Hindmarsh and Alasdain Renfrew, "Electrical Machines and Drives System," Elsevier 2012.
2. ShaahinFelizadeh, "Electric Machines and Drives", CRC Press(Taylor and Francis Group), 2013.
3. S.K.Pillai, A First course on Electrical Drives, New Age International Publishers, Third Edition, 2013.
4. S. Sivanagaraju, M. Balasubba Reddy, A. Mallikarjuna Prasad "Power semiconductor drives" PHI, 5th printing, 2013.
5. N.K.De., P.K.SEN"Electric drives" PHI, 2012.
6. Vedam Subramanyam, "Thyristor control of Electrical Drives", Tata McGraw Hill, Eighteenth Reprint 2008.

EEE18R305 POWER QUALITY

EEE18R305 POWER QUALITY	*L*	*T*	*P*	*C*
	3	*0*	*0*	*3*
Pre-requisite:EEE18R301	**Course Category:** Major Elective – Theory			

Course Objective(s):

To study the production of voltages sags, over voltages and harmonics and methods of control. To study the various methods of power quality monitoring

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To understand the concepts of voltage imbalance, transients and variation.
CO2: To understand the concepts of sags and interruptions
CO3: To know the concepts of harmonics
CO4: To understand the sources, mitigation and effects of harmonics
CO5: To know the concepts of power quality issues

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S		M				M						S		M
CO2	S						M						S		M
CO3	S		S										S		
CO4	S			S		M	S						M	S	S
CO5							S								S

Course Topics:

Unit1: INTRODUCTION **9 Hours**

Terms and definitions: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation, Power acceptability curves – Computer Business Equipment Manufacturers Associations (CBEMA) curve.

Unit2: VOLTAGE SAGS AND INTERRUPTIONS **9 Hours**

Sources of sags and interruptions –Estimation of sag magnitude in radial systems: Influence of fault distance, Transformer, area of cross section of Conductor-Estimation of Motor Starting Sags-Voltage Tolerance Ranges for different equipment-Area of Vulnerability Equipment-sensitivity on voltage sag on different equipment-Mitigation of voltage sag at End User Level: Active series compensators - Custom power devices.

Unit3: HARMONICS **9 Hours**

Harmonics and its types-Harmonics versus Transients- Harmonic indices: THD, TDD and Related Problems- Power Systems Quantities under Non-sinusoidal Condition: Sinusoidal Voltage Source Supplying Non-linear Load Current Non-sinusoidal Voltage Source Supplying Non-linear Loads-Distortion Power-True Power

Unit4: SOURCES, EFFECTS AND MITIGATION OF HARMONICS **9 Hours**

Harmonic sources from commercial and industrial loads – Effect of Harmonics on Transformer, AC motors, Capacitor banks, Protective Devices, Energy and demand

Metering-Devices for controlling Harmonic Distortion: In-line Reactor, Zigzag Transformers, Passive filters, Active Filters-Harmonic Standards on Harmonics

Unit5: POWER QUALITY BENCH MARKING AND MONITORING 9 Hours
Benchmarking Process-RMS Voltage Variation Indices: SARFI, SMARFI, STARFI-Power Quality Contracts-Power Quality Insurance-Monitoring considerations

Text Book(s):

1. Roger.C.Dugan, Mark.F.McGranagham, Surya Santoso, H.WayneBeaty, "Electrical Power Systems Quality", McGraw Hill Publishing Company Ltd, New Delhi, Third Edition, 2013.
2. Math H.J.Bollen, "Understanding Power Quality Problems-Voltage Sag & Interruptions", (New York: IEEE press, 2000).
3. Arindam Ghosh, "Power Quality Enhancement Using Custom Power Devices", Springer International Edition, 2002

Reference(s):

1. C.Sankaran, "Power Quality", CRC press, 2002.
2. J.Arrilaga, N.R.Watson, S.Chen, " Power System Quality Assessment", John Wiley & Sons, 2000

EEE18R408 HIGH VOLTAGE DIRECT CURRENT TRANSMISSION

EEE18R408 HIGH VOLTAGE DIRECT CURRENT TRANSMISSION	***L***	***T***	***P***	***C***
	3	***0***	***0***	***3***
Pre-requisite:EEE18R301	**Course Category:** Major Elective – Theory			

Course Objective(s):

To understand the concept, planning of DC power transmission and comparison with AC power transmission. To analyze HVDC converters, harmonics and design of filters. To study about compounding and regulation. To learn about HVDC cables and simulation tools

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To know the concepts of high voltage dc power transmission
CO2: To analyze the characteristics of HVDC converters
CO3: To understand the control characteristics of HVDC system
CO4: To understand the concepts of harmonics and filters
CO5: To apply the modeling and simulation in HVDC system

Mapping of Course Outcome(s):

CO / PSO	**PSO**														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	S												M		

CO2	M	S		S									S	S	
CO3															
CO4	S	S	S	M				M					S	L	M
CO5	S	M	S	S				M					S	S	M

Course Topics:

Unit 1: INTRODUCTION TO HVDC SYSTEM **9 Hours**

Introduction of DC Power transmission technology – Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system –Ground Electrodes for HVDC systems-Planning for HVDC transmission – Modern trends in DC transmission.

Unit 2: ANALYSIS OF HVDC CONVERTERS **9 Hours**

Pulse number – Choice of converter configuration –Analysis of Graetz bridge circuit with and without overlap – Converter bridge characteristics – Characteristics of a twelve pulse converter – Detailed analysis of Line commutated converters.

Unit 3: HVDC SYSTEM CONTROL **9 Hours**

Principles of DC link control– Converter Control Characteristics(CIA,CEA and CC control) –Power Reversal in a DC link- VDCOL-Control Hierarchy - Firing Angle control: IPC & EPC – Tap Changer Control - Starting and Stopping of HVDC link.

Unit 4: HARMONICS AND FILTERS **9 Hours**

Introduction – Generation of harmonics – Characteristics and Non-Characteristics harmonics – Definition of Wave Distortion or Ripple - Harmonics Filters – Types – Effect of Network Impedance on Filtering - Design of AC filters – Types of AC filters – Single Tuned Passive filters – Minimum Cost Tuned Filters – Design of High Pass Damped Filter- Design of DC filters – PLC/RI noise filters.

Unit 5: MODELLING AND SIMULATION OF HVDC SYSTEMS **9 Hours**

Simulation: Introduction to system simulation – Philosophy and tools – HVDC Simulator– Parity Simulator – Digital Dynamic Simulation - Modeling of HVDC systems for digital dynamic simulation - Graph Theoretic Analysis – Transient Simulation of DC and AC networks.

Textbook(s):

1. Kundur P., “Power System Stability and Control”, McGraw-Hill, 1993.

2. Kimbark E.W., “Direct Current Transmission” John Wiley & Sons.

3. Padiyar K.R., , “HVDC Power Transmission Systems”, New Age International (P) Ltd., New Delhi, 2009.

4. Rakosh Das Begamudre, “Extra High Voltage AC Transimission Engineering”, Third Edition New Age International (P) Limited, Publishers. 2009

Reference(s):

1. J.Arrillaga, “High Voltage Direct Current Transmission”, Peter Pregrinus, London 1983.

2. Erich Uhlmann, “Power Transmission by Direct Current”, BS Publications, 2004.

3. Sood V.K., “HVDC and FACTS controllers – Applications of Static Converters in Power System”, Kluwer Academic Publisher,April 2004.

4. Kakshaish S., Kamaraju V., “HVDC Transmission”, McGraw-Hill Publishers, 2012.

5. Sunil.Rao S., “EHV AC and HVDC Transmission Engineering and Practice,” Khanna Publishers, New Delhi, 2004.

6. Chakrabarti.A, M.L.Soni, P.V.Gupta,U.S.Bhatnagar,“PowerSystem Engineering”, Dhanpat Rai & Co., 2010.

EEE18R409 FLEXIBLE AC TRANSMISSION SYSTEMS

EEE18R409 FLEXIBLE AC TRANSMISSION SYSTEMS	***L***	***T***	***P***	***C***
	3	***0***	***0***	***3***
Pre-requisite:EEE18R301	**Course Category:** Major Elective – Theory			

Course Objective(s):

To understand the concept of flexible AC transmission and the associated problems.
To review the static devices for series and shunt control.
To study the operation of controllers for enhancing the transmission capability.
To provide knowledge on FACTS controllers

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To know the basic concepts of FACTS controllers
CO2: To analyze the various compensation of static shunt compensators
CO3: To analyze the various compensation of static series compensators
CO4: To understand the various concepts of converter based compensators
CO5: To analyze the installation and coordination of FACTS controller

Mapping of Course Outcome(s):

CO / PSO	**PSO**														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**

CO1	S												M		
CO2	M	S		S									S	S	
CO3															
CO4	S	S	S	M				M					S	L	M
CO5	S	M	S	S				M					S	S	M

Course Topics:

Unit 1: GENERAL SYSTEM CONSIDERATION AND BASICS OF FACTS CONCEPTS **9 Hours**

Active & Reactive Power flow between Two synchronous sources in AC Systems - Constraints of maximum transmission line loading – Relative importance of controllable parameters. Compensation - Uncompensated line, shunt compensation. Series compensation, Effect of compensation on power transfer capacity. Definition and types of FACTS controllers - Benefits of FACTS Technology

Unit 2: VARIABLE IMPEDANCE BASED STATIC SHUNT COMPENSATORS **9 Hours**

Objectives of shunt compensation – Variable Impedance type static VAR generators: Operation, control and characteristics of TCR, TSR, TSC, FC-TCR and TSC-TCR-Functional control scheme for the FC-TCR and TSCTCR type static VAR generator

Unit 3: VARIABLE IMPEDANCE BASED STATIC SERIES COMPENSATION **9 Hours**

Objectives of series compensation– Need for Variable-Series Compensation-Variable impedance type series compensator: Operation, control, characteristics and control schemes of TSSC and TCSC

Unit 4: CONVERTER BASED COMPENSATORS STATCOM: **9 Hours**

Operation and VI Characteristics-Control Scheme for STATCOM- Comparison between SVC and STATCOM- SSSC – Capability, control range and VA rating-Control Scheme for SSSC- Features of SSSC-UPFC: Basic operating principle- IPFC : Basic operating principle

Unit 5: INSTALLATION OF FACTS CONTROLLERS & CO-ORDINATION ASPECTS **9 Hours**

Introduction , planning aspects, operational aspects and results of Slatt's TCSC, Sullivan's STATCOM Introduction to Co-ordination of FACTS controllers-Controller Interactions-Different interaction between FACTS controllers: Steady state interactions, electro mechanical interaction, Small signal interaction, SSR interaction, High frequency interaction

Textbook(s):

1. N.G. Hingorani& L. Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems" IEEE Press, 2001.
2. R. Mohan Mathur, Rajiv K. Varma, "Thyristor-Based FACTS Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, 2002

Reference(s):

1. John A.T., "Flexible AC Transmission System", Institution of Electrical and Electronic Engineers (IEEE), 1999
2. Padiyar K.R., "FACTS Controllers in Power Transmission and Distribution", New Age International, First Edition, Reprint 2013.
3. Enrique Acha, Claudio R.Fuerte, Esquivel, HygoAmbriz, Perez & Cesar Angeles – Camacho, "FACTS – Modeling and Simulators in Power Networks",Johnwiley& sons, 2004.

EEE18R410 MEMS

EEE18R410 MEMS	*L*	*T*	*P*	*C*
	3	*0*	*0*	*3*
Pre-requisite:EEE18R276	**Course Category:** Major Elective – Theory			

Course Objective(s):

To gain the rudiments in the materials, sensors and the fabrication of Micro Electro Mechanical Systems (MEMS).To gain the basic principles of system issues and to know about the optical and RF MEMS.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To understand the concepts of Microsystems
CO2: To know the basic fundamentals of sensors in MEMS
CO3: To understand the operation of actuators in MEMS
CO4: To understand the concepts of circuit and system issues
CO5: To study the basics of optical and RF MEMS

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S		M										L		
CO2	L		M	L									L	M	
CO3	L			L									L	L	
CO4			L	L	M			L					L	L	L
CO5	L		L										L		

Course Topics:

Unit 1: INTRODUCTION TO MEMS **9 Hours**

MEMS and Microsystems, Miniaturization, Typical products, Micro Sensors, Micro actuation, MEMS with micro actuators, MEMS materials, Micro Fabrication.

Unit 2: SENSORS **9 Hours**

Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors – Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph – Applications

Unit 3: ACTUATORS **9 Hours**

Magnetic Actuators – Micro magnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys. Piezo resistive sensors & materials – Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

Unit 4: CIRCUIT AND SYSTEM ISSUES **9 Hours**

Electronic interfaces, Feedback systems, Noise, Circuit and system issues, Case studies –Capacitive accelerometer, Piezo-electric pressure sensor, Thermal sensors, radiation sensors, mechanical sensors, biochemical sensors.

Unit 5: INTRODUCTION TO OPTICAL AND RF MEMS **9 Hours**

Optical MEMS, Lenses and mirrors, Actuators for active optical MEMS, Digital Micro mirror devices, RF MEMS –Capacitive RF MEMS switch, Performance issues.

Textbook(s):

1. Chang Liu,"Foundations of MEMS", 2nd Edition, Pearson Prentice Hall, 2012

2. Stephen D. Senturia, "Microsystem Design ", Springer Publications, 2013.

3. James J.Allen, “Micro Electro Mechanical System Design’, CRC Press published in 2005.

Reference(s):

1. NadimMaluf, “An introduction to Micro electro mechanical system design”, Artech House, 2000.

2. Mohamed Gad-el-Hak, editor, “The MEMS Handbook”, CRC press Baco Raton, 2001.

3. Tai Ran Hsu, “MEMS & Micro systems Design and Manufacture” Tata McGraw Hill, New Delhi, 2002

EEE18R329 AUTO ELECTRICAL AND ELECTRONICS SYSTEMS

EEE18R329 AUTO ELECTRICAL AND ELECTRONICS SYSTEMS	*Credits*			
	L	*T*	*P*	*Total*
	3	0	0	3
Pre-requisite: Nil	**Course Category:** Professional Elective - Theory			

Course Objective(s):

The objective of this course is to prepare students for entry-level employment. By the end of this course the student, should have a thorough grasp of basic electrical laws. The student should understand and be able to diagnose problems with basic electrical systems and components.

Course Outcome(s):

After completing this course, the student will be able to:

CO1 : To understand the basic need of electrical and electronic system in vehicle

CO2 : To know the concepts and working of battery system

CO3 : To gain the concept of charging system

CO4 : To understand the types of ignition system

CO5 : To understand the concepts of electrical equipment and electronics accessories

Course Topics:

Unit 1: INTRODUCTION TO ELECTRICAL AND ELECTRONICS SYSTEM

9 Hours

Storage, Distribution systems & Generation of electric energy, Lighting system, 12 Volt &24 volt systems. Insulation and earth (negative and positive earthing) system, types of cables used, colour codes, cable connectors, wiring, fuse system, circuit breakers, Relays, Switches. Layout and Wiring diagram for 2, 3 and 4 wheeler vehicles, Buses and Commercial vehicles.

Unit 2: BATTERY MANAGEMENT SYSTEM 9 Hours

Various Types of Automotive batteries. Principles, Construction & working of lead acid battery, dry battery & Alkaline battery. Designations & Rating of Batteries. Performance tests: Battery Capacity, Efficiency, Gravimetric test and efficiency. Battery failures. Recharging: Electronic circuits, battery charging current, charging methodology & precautions.

Unit 3: CHARGING SYSTEM 9 Hours

Need. Charging circuit, Types of charging system: D.C. dynamo, AC dynamo, flywheel magneto charging system and Alternator (more emphasis on Alternators). Charging system controlling & regulator system: Relay/cut-out, voltage and current regulator, compensated voltage and current regulator, electronic regulator, regulator characteristics. Drive for charging system.

Unit 4: IGNITION SYSTEM 9 Hours

Requirements. Types of Ignition systems: Ballast Resistance, Ignition coil characteristics, Cam angle & contact angle gap, spark advance mechanism, spark plug, ignition timing, multi-cylinder distributor, Distributor (contact breaker ignition system), limitations of coil ignition system, electronic ignition systems. Voltage and current required for Spark. Spark Plug, characteristics, material, types.

Unit 5: AUTO ELECTRICAL EQUIPMENTS 9 Hours

Windscreen wipers, windscreen washers, power windows, doors locks, Rear wind shield glass heating system. Rear view mirror Adjusting, Day light regulating system. Central Locking system. Convertible Mechanism. Sensors: Instrument Cluster panel, fuel gauges, oil temperature gauge, warning light sensors, coolant temperature gauge, speedometer, Odometer, tachometer, trip meter, oil level indicator, parking brake indictor, direction indicators.

Text Book(s):

1. Automobile Electrical and Electronics Author : A. L. StatiniPublisher : Delmar Publications
2. Automotive Electrical EquipmentsAuthor: P. L. Kohli Publisher: Tata McGraw Hill Pub. Co. Ltd.
3. Automobile Electrical & Electronic Systems Author : Tom Denton Publisher : Allied Publishers Pvt. ltd
4. Automobile Electrical & Electronic EquipmentsAuthor : Young, GriffithePublisher : The English Language Book Co

STREAM-III(CONTROLAND AUTOMATION)

EEE18R306CONTROL SYSTEM DESIGN

EEE18R306CONTROL SYSTEM DESIGN				
	L	***T***	***P***	***Total***
	3	***0***	***0***	***3***
Pre-requisite:EEE18R251	**Course Category:** Major Elective – Theory			

Course Objective(s):

To impart knowledge on performance specification, limitations and structure of controllers

To impart knowledge on design of controllers using root-locus and frequency domain techniques

To introduce the techniques of extending the theory on continuous systems to discrete time systems

To introduce design in discrete state space systems

To introduce the linear quadratic regulator and estimation in the presence of noise

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understand the fundamental control system design specifications
CO2: Analyze the lead, lag, lead-lag compensators in frequency domain
CO3: Use system observability and controllability concepts
CO4: Design classical controllers based on Bode plots and root locus techniques
CO5: Design the Kalman filter and use it in diverse engineering disciplines

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S	S	S	S	S								S		
CO2	S	S	S	S	S								S	S	

CO3	S	S	M	S	S							M	S	M	
CO4	S	S	S	S	M								S	S	
CO5	S	S	S										S		

Course Topics:

Unit 1:INTRODUCTION TO DESIGN **9Hours**

System performance and specification – P,PI, PD and PID controllers – characteristics – design – tuning – manual and automatic – robust control system design.

Unit 2: FREQUENCY DOMAIN DESIGN **9 Hours**

Realization of compensators – design of lead, lag, lead-lag compensators – design using Bode plots – polar plots – Nichol‟s chart – MIMIO design – feedback compensation

Unit 3: STATE VARIABLE DESIGN **9 Hours**

Design by state feedback – output feedback – MIMO pole assignment technique – design of state and output regulators – design of reduced and full order observer – parameter optimization – Hα control.

Unit 4: STATE ESTIMATION TECHNIQUES **9 Hours**

Introduction – state observers, asymmetric observers, frequency domain interpretation – linear quadratic regulator (LQR) – statistical descriptions of noise, Kalman filter, stability margins.

Unit 5: CASE STUDIES **9 Hours**

Inverted pendulum – robo arm control – RADAR tracking control – satellite attitude control – process control.

Textbook(s):

1. Friedland.B., Control System Design, Tata McGraw Hill 2016.
2. Anderson, B.D.O., Moore, J.B., Optimal Control – LQ Methods, Prentice Hall of India, New Delhi, 2011.
3. Doyle, J.C., Francis, B.A., Tannenbaum, A.R., Feedback Control Theory, Maxwell Macmilan International, 2012.
4. Benjamin C. Kuo “Digital control systems”, Oxford University Press, 2014

Reference(s):

1. Gopal, M., Control system Principles and Design, Tata McGraw Hill, New Delhi, 2014.
2. Goodwin, G.C., et al., Control system Design, Pearson education, 2013.
3. M. Gopal “Modern control system Theory” New Age International, 2015.
4. Arthur G. O. Mutambara, “Design and Analysis of Control Systems”, CRC Press, Indian reprint 2011.
5. G. F. Franklin, J. D. Powell and A. E. Naeini “Feedback Control of Dynamic Systems”, PHI (Pearson), 2012.

6. Graham C. Goodwin, Stefan F. Graebe and Mario E. Salgado "Control systemDesign", PHI (Pearson), 2013.
7. Loan D. Landau, Gianluca Zito," Digital Control Systems, Design, Identification and Implementation", Springer, 2016.

EEE18R307 NETWORK ANALYSIS AND SYNTHESIS

EEE18R307 NETWORK ANALYSIS AND SYNTHESIS	Credits			
	L	T	P	Total
	3	0	0	3
Pre-requisite:EEE18R151& MAT18R206	**Course Category:** Major Elective - Theory			

Course Objective(s):

To make the students capable of analyzing any given electrical network.

To make the students to learn synthesis of an electrical network for a given impedance/ Admittance function.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understand and apply the concept of stability in active network
CO2: Analyze the frequency domain of RLC network
CO3: Analyze the two port network
CO4: Apply the concept of foster and cauer forms of realization in network synthesis
CO5: Design the various classifications of filter

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S	S	S	S								L	S		
CO2	S	S	S	S								M	S	M	
CO3	S	S	S	S									S	M	
CO4	S	S	S	M	S								S	S	
CO5	S	S	S	S									S	S	

Course Topics:

Unit 1:INTRODUCTION TO NETWORK ANALYSIS 9 Hours

Network elements – one port and two port networks – driving point immittance – transfer function – necessary conditions for driving point function and transfer function – poles and zeros – significance of poles and zeros – restriction and the

location of pole and zeros – time domain behavior from pole zero plot – stability criterion for active network – solved problems.

Unit 2:FREQUENCY DOMAIN ANALYSIS **9 Hours**

Admittance-Loci of RLC network-Frequency- RLC networks-Frequency response from pole –zero –Bode plots.

Unit 3: TWO–PORT NETWORKSTWO–PORT NETWORKS **9 Hours**

Two port network – open circuit impedance (Z)parameters – short circuit admittance(Y) parameters – transmission (ABCD) parameters – inverse transmission (A'B'C'D')parameters – hybrid (h) parameters – inverse hybrid(g)parameters – inter relationship of different parameters – inter connection of two port networks– T and representation – terminated two port networks – lattice networks – image parameters.

Unit 4: NETWORK SYNTHESIS **9 Hours**

Network reliability – Hurwitz polynomials – positive real functions – properties of RC, RL & LC networks – Foster and Cauer forms of realization (Synthesis of RL and RC Network) – transmission zeroes – synthesis of transfer functions.

Unit 5: FILTERS DEISGN **9 Hours**

Filters-Classification of filters –Characteristics of ideal filters –Image impedance – constant K low pass, high pass and band pass filter-M derived low pass, high pass and band pass filter

Text Book(s):

1. Franklin F. Kuo., Network Analysis and Synthesis,Wiley India Pvt Ltd, 2nd Edition 2010.
2. Louis Weinberg., Network Analysis and Synthesis, Tata McGraw Hill Book Company Inc., Revised Version, 1975.
3. Vanvalkenburg., Network Analysis, Pearson India; 3 edition (2015)
4. S.P Ghosh , A.K Chakrabarthy, Network analysis and synthesis, McGraw Hill Education (28 August 2009)
5. Ravish R. Singh, Network Analysis and Synthesis , McGraw Hill Education (1 July 2013)

Reference(s):

1. SomeshwarC.Gupta., et. al., Circuit Analysis with computer applications to problem– sovling, Wiley–Eastern Ltd., 2001.
2. Vasudev K. Aartre, Network Theory and Filter Design,New Age International Private Limited (1 January 2014).
3. Electrical networks , Ravi R Singh , Tata McGraw-Hill, 2009.
4. K.M. Soni, Network Analysis and Synthesis, S K Kataria and Sons, 2013

EEE18R328 SMART GRID

EEE18R328 SMART GRID	Credits			
	L	*T*	*P*	*Total*
	3	*0*	*0*	*3*
Pre-requisite:EEE18R302	**Course Category:** Major Elective - Theory			

Course Objectives

The main objective of this course is to present concepts and topics that are relevant to smart grid technologies like Advanced metering infrastructure, Wide area monitoring system, Communication network etc, to facilitate implementation in the electrical system and to explore research opportunities in this area.

Course Outcomes: After Successful completion of course, the participants will be able to

CO1: Acquire in-depth knowledge about the smart grids, which supports the clean energy technology of this era.

CO2: Understand the various communication technologies available for Smart Grid Systems.

CO3: Acquire in-depth knowledge about Advanced Metering infrastructures and associated communication networks

CO4: Understand the Concepts of Phasor measurement Unit and Wide Area Monitoring System.

CO5: Acquire in-depth knowledge regarding the grid integration of renewable energy system

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S	S	S	S								L	S		
CO2	S	S	S	S								M	S	M	
CO3	S	S	S	S									S	M	
CO4	S	S	S	M	S								S	S	
CO5	S	S	S	S									S	S	

Course Topics:

Unit 1 Introduction to Smart Grid

Introduction - Background and Definitions, Smart Grid Initiatives in various countries, Developments, Plan, Energy Independence and Security Act of 2007: Rationale for the Smart Grid, Today's Grid versus the Smart Grid, Representative Architecture of the smart grid. Functions of Smart Grid components, Framework and characteristics of Smart Transmission Grid, Impediments to Smart Grid, and Global policies in smart grid.

Unit 2 Communication Technologies for Smart Grid

Introduction-Smart grid communication network ,IEEE P2030 communication model ,Services supported in a Smart Grid communication network, Communications Technologies available for Smart Grids- IEEE 802 series, Mobile communications ,Multi-protocol label switching ,Power line communication, Comparison of communication Technologies, Smart Grid Communications Requirements- Security-System reliability-Scalability-Quality of Service, Smart grid communication standards

Unit 3 Advanced Metering Infrastructure

Introduction- Structure of the AMI System - Local Data Collecting - Data-Processing Center, Smart meter Communication Network - Communication through Concentrator,Communication through Concentrator and Gateway, Direct Communication, Protocols, Smart meters- Trends of the Smart Metering Systems, Considerations for a Smart Metering System, Smart Metering Applications, Development of Smart Metering Worldwide Challenges to be addressed, Case Study

Unit 4 Phasor Measurement Techniques

Historical overview- Phasor representation of sinusoids- Fourier series and Fourier transform- Sampled data and aliasing-DFT and Fourier series- DFT and phasor representation-Leakage phenomena, a generic PMU –introduction- The global positioning system- Hierarchy for phasor measurement systems- Communication options for PMUs, Functional requirements of PMUs and PDCs - The evolution of "Synchrophasor" standard, File structure of "Synchrophasor" standard, PDC files, Transient Response of Phasor Measurement Units, Wide Area measurement system (WAMS), Case Study

Unit 5 Grid integration

Sustainable Energy Options for the Smart Grid, Trends in Renewable Integration - issues and challenges, Fault Ride-Through (FRT) Operation, Impact on Protection Systems, Global Renewable Energy Shares, Case Study

Text Book(s):

1. James Momoh, "Smart Grid: Fundamentals of design and analysis", John Wiley & sons Inc, IEEE press 2012.
2. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihikookoyam"Smart Grid: Technologyand Applications", John Wiley sons inc, 2012.

Reference(s):

1. FereidoonP.Sioshansi, "Smart Grid: Integrating Renewable, Distributed & Efficient Energy", Academic Press, 2012

EEE18R303 SIGNALS AND SYSTEM

EEE18R303 SIGNALS AND SYSTEM	Credits			
	L	*T*	*P*	*Total*
	3	*0*	*0*	*3*
Pre-requisite:MAT18R206	**Course Category:** Programme Core – Theory			

Course Objective(s):

1. Students can understand continuous-time and discrete-time linear systems
2. Students can apply Fourier analysis to important problems in communication and signal processing

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Explain the functional concepts of signals and systems
CO2: Analyze the concepts of continuous and discrete time invariant systems
CO3: Study of the Fourier and Laplace applications in various signals and systems
CO4: Application of Z-Transforms.
CO5: Understand the sampling theorem and its implications.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S	S													
CO2	S	S													

CO3	S	S		M											
CO4	S	S		M											
CO5	S	S													

Course Topics:

Unit 1: INTRODUCTION **9 Hours**

Definitions of signals and a system, classification of signals, Continuous time signals (CT signals) - Discrete time signals (DT signals) - Step, Ramp, Pulse, Impulse, Sinusoidal, Exponential elementary signals viewed as interconnections of operations, basic operations on signals, properties of systems :linearity: additivity and homogeneity, shift-invariance, causality, stability, reliability.

Unit 2: ANALYSIS OF CONTINUOUS AND DISCRETE-TIME LTI SYSTEMS **9 Hours**

Impulse response and step response, convolution, input-output behavior with a periodic convergent input, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State-space Representation of systems. State-Space Analysis, Multi-input, multi-output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse

Unit 3: FOURIER AND LAPLACE TRANSFORMS **9 Hours**

Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behaviour

Unit 4: Z- TRANSFORMS **9 Hours**

The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, properties of ROC, properties of Z-transforms, inversion of Z-transform methods - power series and partial expansion, Transforms analysis of LTI systems, transfer function, stability and causality, unilateral Z-transform and its application to solve difference equations

Unit 5: SAMPLING AND RECONSTRUCTION **9 Hours**

The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction:ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems

Text Books

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, "Signals and systems", Prentice Hall India, 1997.

2. J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", Pearson, 2006.

3. H. P. Hsu, "Signals and systems", Schaum's series, McGraw Hill Education, 2010.

4. S. Haykin and B. V. Veen, "Signals and Systems", John Wiley and Sons, 2007.

Reference Books

1. A. V. Oppenheim and R. W. Schafer, "Discrete-Time Signal Processing", Prentice Hall, 2009.

2. M. J. Robert "Fundamentals of Signals and Systems", McGraw Hill Education, 2007.

3. B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2009

EEE18R323 DIGITAL SIGNAL PROCESSING

EEE18R323 DIGITAL SIGNAL PROCESSING	*Credits*			
	L	***T***	***P***	***Total***
	3	***0***	***0***	***3***
Pre-requisite:MAT18R206	**Course Category:** Major Elective – Theory			

Course Objective(s):

To understand the basic concepts and techniques for processing signals on a computer.

To get familiarized in methods of DSP, including digital filter design, transform-domain processing and Signal Processors.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Characterize discrete-time signals critically and visualize them in time domain
CO2: Design the IIR filters
CO3: Design the FIR filters
CO4: Understand the meaning and implications of the number systems and signals scaling

CO5: Understand sampling rate and its significance and problems related to computational complexity.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S												S		
CO2		S	S										S		
CO3		S	S										S		
CO4		M											M		
CO5	M												M		

Course Topics:

Unit 1: INTRODUCTION **9 Hours**

Basic elements of a digital signal processing system – advantages of digital over analog signal processing, applications of DSP, FFT algorithms – radix-2 FFT algorithms – decimation in time– decimation in frequency algorithms – applications of FFT algorithms.

Unit 2: IIR FILTERS **9 Hours**

Design of Butterworth filters, Chebyshev Type I and Type II filters, IIR filter design using bilinear transformation, impulse invariant transformation – frequency transformation in analog and digital domain

Unit 3: FIR FILTERS **9 Hours**

Design of linear phase FIR filters using rectangular, hamming, Kaiser Windows – design of linear phase FIR filters using frequency sampling techniques.

Unit 4: FINITE WORD LENGTH EFFECTS **9 Hours**

Number representations – fixed point and floating point numbers, quantization of fixed and floating point numbers, coefficient quantization, over flow error – truncation error – co-efficient quantization error, limit cycle oscillation – signal scaling.

Unit 5: MULTIRATE DSP **9 Hours**

Decimation by a factor D, interpolation by a factor I, filter design and implementation for sampling rate conversion, multistage implementation of sampling rate conversion – sampling rate conversion by an arbitrary factor – applications of multi-rate signal processing.

Text Book(s):

1.John G Proakis., DimtrisManolakis, G., Digital Signal Processing Principles, Algorithms and Application, Prentice Hall of India, 3rd Edition, 2000

2. Alan V Oppenheim, Alan S. Willsky with Hamid Nawab, “Signals & Systems”, Pearson Education, 2nd Edition, 2000

Reference(s):

1.S. Salivahana, A.Vallavaraj, Gnanapriya, “Digital Signal Processing”, McGraw-Hill, 2nd Edition, 2(

2. Simon Haykin and Barry Van Veen, "Signals & Systems", John Wiley and Sons, 2nd Edition, 2002
3. S.K.Mitra., Digital Signal Processing - A Computer based approach, Tata McGraw Hill, 3rd Edition, 2004

EEE18R414 SOFT COMPUTINGTECHNIQUES

EEE18R414 SOFT COMPUTINGTECHNIQUES	Credits			
	L	*T*	*P*	*Total*
	3	*0*	*0*	*3*
Pre-requisite:MAT18R101	**Course Category:** Major Elective - Theory			

Course Objective(s):

To expose the concepts of feed forward neural networks.

To provide adequate knowledge about feedback neural networks.

To teach about the concept of fuzziness involved in various systems.

To expose the ideas about genetic algorithm

To provide adequate knowledge about of FLC and NN toolbox.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To understand the basic concepts of soft computing techniques
CO2: To solve real world problems using neural network
CO3: To analyze the functioning of recurrent neural network
CO4: To apply genetic algorithm to solve the optimization problem
CO5: To develop fuzzy logic controller and ANN for the given system

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	M			M	S								M	M	
CO2		S	M	S	S				S				S	S	S
CO3	S	S		S	S								S	S	
CO4	S		S	S	S				S			M	S	S	M
CO5	S		S	S	S				S			M	S	S	S

Course Topics:

Unit 1:INTRODUCTION AND FEEDFORWARD NEURAL NETWORK

9 Hours

Introduction to soft computing -soft computing vs. hard computing-various types of soft computing techniques-applications of soft computing-Neuron-Nerve structure and synapse- Artificial Neuron and its model-activation functions-Neural network architecture-single layer and multilayer feed forward networks-McCullochPitts neuron model-perceptron model -Adaline and Madaline-multilayer perception model-back propagation learning algorithm- Implement back propagation learning algorithm using Matlab Toolbox.

Unit 2:RECURRENT NEURAL NETWORKS 9 Hours

Counter propagation network-architecture-functioning & characteristics of counter-Propagation network-Hopfield/ Recurrent network-configuration-stability constraints-associative memory- and characteristics-limitations and applications-Hopfield v/s Boltzman machine-Adaptive Resonance Theory-Architecture-classifications-Implementation and training-Associative Memory- Design of multilayer feed forward network using MATLAB Toolbox..

Unit 3:FUZZY LOGIC SYSTEM 9 Hours

Introduction to crisp sets and fuzzy sets-basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control-Fuzzification-inferencing and defuzzification- Fuzzy knowledge and rule bases-Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control-Fuzzy logic control for nonlinear time delay system- Development of Neuro fuzzy system using MATLAB tool box.

Unit 4: GENETIC ALGORITHM 9Hours

Basic concept of Genetic algorithm and detail algorithmic steps-adjustment of free Parameters-Solution of typical control problems using genetic algorithm-Concept on some other search techniques like tabu search and ant colony search techniques for solving optimization problems- Implementation of optimization problem using MATLAB Toolbox.

Unit 5:APPLICATIONS 9 Hours

GA application to power system optimization problem-Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab-Neural Network toolbox. Stability analysis of Neural Network interconnection systems-Implementation of fuzzy logic controller using Matlab fuzzy logic toolbox-Stability analysis of fuzzy control systems.

Text Book(s):

1. S.N. Sivanandam, S.N. Deepa, “Principles of Soft Computing” 2nd Edition, Wiley, 2011.

2. Fakhreddine O. Karray and Clarence De Silva, "Soft Computing & Intelligent System: Theory, Tools and Applications", First edition, Pearson Education, 2009.

Reference(s):

1. Laurene V. Fausett, Fundamentals of Neural Networks: Architectures, Algorithms And Applications, Pearson Education. 2004
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications" Wiley India., 2010.

EEE18R415 PLC AND INDUSTRIAL AUTOMATION

EEE18R415 PLC AND INDUSTRIAL AUTOMATION	*Credits*			
	L	*T*	*P*	*Total*
	3	*0*	*0*	*3*
Pre-requisite:EEE18R371	**Course Category:** Major Elective – Theory			

Course Objective(s):

The topics of the course impart knowledge on simple logic circuits used in industrial applications, various programming methods of PLC and applications in automation industries.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To understand the architecture of industrial automation
CO2: To understand the concepts PLC design
CO3: To analyze the various techniques using timers and counters
CO4: To understand the local variables and functional blocks
CO5: To apply and design the various application for industry

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1															
CO2	S		S		S	S				S	S		S	S	
CO3	S		S		S		M			S		S	S	S	M
CO4			S		S	S								S	
CO5	S		L		S		S				S		S	S	S

Course Topics:

Unit1: INDUSTRIAL AUTOMATION **9 Hours**

History of Automation – Architecture of Industrial Automation, Fixed Automation – Programmable Automation – Flexible Automation, Components of Industrial Automation – Sensors.

Unit 2: PROGRAMMABLE LOGIC CONTROLLERS 9 Hours

Evolution of PLC – Sequential and Programmable controllers – Architecture of PLC-PLC Hardware components: I/O modules, CPU, Memory-Programming devices-Memory allocation and Addressing.

Unit 3: PROGRAMMING PART - I 9 Hours

PLC Scan-Programming Methods: Ladder logic, Instruction list, Sequential function chart- NO/NC & RLO Concept – Bit Logic Instructions - Programming timers and counters using ladder logic- Program control instructions, math instructions, sequencer instructions

Unit 4: PROGRAMMING PART – II 9 Hours

Symbolic Name - Local Variables – Function and Function Blocks, Instance Data block, Shared Data Block– Single Instance and Multiple Instance – System Function and System Function Blocks.

Unit 5: INDUSTRIAL APPLICATIONS 9 Hours

Development of control logic for Planner machine-Skip hoist control-Automatic control of water pump-Air compressor-Conveyor system-Battery operated truck-bottle filling system

Text Book(s):

1. Frank Petruzella, “Programmable Logic Controllers”McGraw-Hill Education – Fourth Edition, 2010.

Reference(s):

1. W. Bolton, “Programmable Logic Controllers” Newnes, Sixth edition 2015.

2. BISWANATH PAUL, “Industrial Electronics and Control Including Programmable Logic Controller” Prentice-Hall of India Private Limited – Third Edition, 2014.

3. John W. Webb, Ronald A. Reis, “Programmable Logic Controllers: Principles and Applications” Prentice Hall, 2003.

4. Jon Stenerson, "Programmable Logic Controllers with ControlLogics, DELMAR Cengage Learning.

5. Simatic S7 – 1200 Programming Manual 6. Simatic St – 300 Programming Manual

EEE18R416 INTRODUCTION TO IOT

EEE18R416 INTRODUCTION TO IOT	***Credits***			
	L	***T***	***P***	***Total***
	3	***0***	***0***	***3***
Pre-requisite:EEE18R371	**Course Category:** Major Elective - Theory			

Course Objective(s):

The topics of the course impart knowledge on the concept of IoT, outline the global context of M2M and IoT, to provide an overview of IoT architecture, to learn to program Arduino microcontroller for IoT, to cover real-world implementation examples of IoT.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To identify the components of IoT devices and communication technologies.
CO2: To discriminate between M2M and IoT technologies.
CO3: To realize the significance of various IoT architectures.
CO4: To develop portable IOT applications using appropriate microcontroller.
CO5: Develop IoT applications for real-world situations.

Mapping of Course Outcome(s):

CO / PSO	**PSO**														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	M			M	S								M	M	
CO2		S	M	S	S				S				S	S	S
CO3	S	S		S	S								S	S	
CO4	S		S	S	S				S			M	S	S	M
CO5	S		S	S	S				S			M	S	S	S

Course Topics:

Unit1: INTRODUCTION TO IoT **9 Hours**

Definition and characteristics of IoT - Physical and logical design of IoT - IoT Enabling Technologies - IoT Levels & Deployment Templates - IoT Design Methodology - Components of Internet of Thing devices: Control UNITs – Sensors – Communication modules – Power Sources. Communication Technologies: RFID –

Bluetooth – ZigBee – Wi-Fi – RFlinks – Mobile Internet – Wired Communication. Safety – privacy – trust - security model

Unit2: M2M AND IoT **9 Hours**

Machine-to-Machine (M2M) communication – IoT – M2M towards IoT – Main characteristics of M2M and IoT – Global value chains – Ecosystem – M2M and IoT value chains – Main design principles and needed capabilities - An IoT architecture outline - Standardizations around M2M and IoT.

Unit3: IoT ARCHITECTURE **9 Hours**

European Telecommunications Standards Institute (ETSI) M2M – International Telecommunication Union-Telecommunication (ITU-T) IoT model – Internet Engineering Task Force (IETF) IoT model – Open Geospatial Consortium (OGC) architecture – IoT domain model – IoT information model – IoT functional model – Communication model.

Unit4: IoT PROGRAMMING **9 Hours**

Basics of sensors and actuators – Examples and working principles of sensors and actuators –Arduino/Equivalent Microcontroller platform – Programming for IOT – Reading from Sensors. Communication: Connecting microcontroller with Bluetooth and USB – Connection with the Internet using Ethernet.

Unit5: IoT APPLICATIONS **9 Hours**

Asset Management: Introduction - Expected benefits - e-Maintenance in the M2M Era - Hazardous goods management in the M2M Era. Industrial Automation: Service-oriented architecture-based device integration - SOCRADES: realizing the enterprise integrated Web of Things - IMC-AESOP: from the Web of Things to the Cloud of Things. Smart Grid: Smart metering - Smart house - Smart energy city. Smart cities: Need – Definition – Examples - Roles, actors, engagement - Transport and logistics-an IoT perspective.

Text Book(s):

1. ArshdeepBahga and Vijay Madisetti, “Internet of Things: A Hands-On Approach”, VPT Publisher, 2014.
2. CharalamposDoukas, “Building Internet of Things with the Arduino”, Create space, April 2002.
3.Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand and David Boyle, “From Machine-to-Machine to the Internet of Things Introduction to a New Age of Intelligence”, Academic Press, 2014.

Reference(s):

1. Jean-Philippe Vasseur and Adam Dunkels “Interconnecting Smart Objects with IP: The Next Internet”, Morgan Kaufmann Publishers, 2010.

EEE18R405 INTELLIGENT BUILDING ENERGY MANAGEMENT SYSTEMS

EEE18R405 INTELLIGENT BUILDING	***Credits***

ENERGY MANAGEMENT SYSTEMS	*L*	*T*	*P*	*Total*
	3	0	0	3
Pre-requisite: NIL	**Course Category:** Professional Elective - Theory			

Course Objective(s):

1. To manage the sub-systems within a building to ensure pleasant, controlled and safe environment
2. To control all or some of the following in a building: HVAC, CCTV, Access Control, Fire and Intruder Alarms, Lighting and Power Consumption

Course Outcome(s):

After completing this course, the student will be able to:

CO1 : Understand the basics of building automation and its design concepts

CO2 : Analyze electronics and electrical components and systems, and get familiarized with different tools of building automation

CO3 : Achieve networking in automation with necessary security systems

CO4 : Operate and program the PLC, SCADA and HMI for automation of buildings

CO5 : Understand the working concepts of alarms, panels & controls pertaining to building control and management

Course Topics:

UNIT I: BUILDING ENERGY MANAGEMENT SYSTEM 9 Hours

Basic criteria of designing – BMS – components, Design concepts - Energy management systems - MEP fundamentals - Components of building automation system - HVAC, electrical, lighting, security, fire-fighting, communication - Integrated approach in design, maintenance and management system - Current trend and innovation in building automation systems.

UNIT II: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

9 Hours

Electronic components - Network theory - Power electronics components - Familiarization of tools Multi-meter, Soldering, De-soldering - Selection of components - Single phase and three phase systems - Types of load & calculation - Measurement of current voltage, power - Types of motors - Basics of motors-dc motor, stepper, servo - Selection of servo motor and drives - Different types of earthing - Concept of two wire/ three wire controls.

UNIT III: NETWORK SECURITY SYSTEMS 9 Hours

Concept of LAN, WAN - Implementing of networks - Sharing of files, printers, scanners etc - Network protocols- TCP/IP, ETHERNET - MODBUS, CANBUS, PROFIBUS - Transmission techniques - CCTV – Installation - Selection of camera - Cabling and termination - Different types of cameras - Night vision systems.

UNIT IV: PLC, SCADA / HMI 9 Hours

Monitoring the process through sensors - NO/ NC concept - Data file handling - forcing I/O - Wiring and fault correction - Programming practices - SCADA and HMI packages - Role of SCADA and HMI in building automation – Programming - Configuring alarms - Real time project development.

UNIT V: ALARMS, PANELS & CONTROLS 9 Hours

Sensors-heat, smoke, PIR - Conventional fire alarm panels - Addressable fire alarm panels - Cabling and safety standards - Biometric Access Control - Video door phones - Lighting controls - Solar panels - Ups and generators - Surge & lightening protection systems - Automatic gates & barriers - Security Automation – Biometric access control – RFID, Finger print, Magnetic locks.

Text Book(s):

1. G. J. Levermore, “Building Energy Management Systems: Applications to Low-energy HVAC and Natural Ventilation Control”, Taylor & Francis, 2000
2. Shengwei Wang, “Intelligent Buildings and Building Automation”, Routledge, Technology & Engineering, 2009
3. Doug Oughton, Steve Hodkinson, “Faber & Kell's Heating & Air-conditioning of Buildings”, Routledge, Technology & Engineering, 2008

Reference(s):

1. Lal Jayamaha, “Energy-Efficient Building Systems: Green Strategies for Operation and Maintenance: Green Strategies for Operation and Maintenance”, McGraw Hill Professional, 2006.

EEE18R407 EMBEDDED COMPUTING SYSTEM DESIGN

	Credits			
EEE18R407 EMBEDDED COMPUTING SYSTEM DESIGN	***L***	***T***	***P***	***Total***
	3	**0**	**0**	**3**

Pre-requisite: Nil	**Course Category:** Professional Elective - Theory

Course Objective(s):

1. To optimize hardware designs of custom single-purpose processors.
2. To compare different approaches in optimizing general-purpose processors.
3. To introduce different peripheral interfaces to embedded systems.
4. To understand the design trade-offs made by different models of embedded systems.
5. To apply knowledge gained in software-hardware integration in team-based projects

Course Outcome(s):

After completing this course, the student will be able to:

CO1 : Design the embedded process for simple application

CO2 : Describe the processor and component interfacing

CO3 : Understand the network protocols

CO4 : Analyze the different scheduling algorithm

CO5 : Design simple product using system design technology

Course Topics:

Unit 1: **EMBEDDED SYSTEM ARCHITECTURE** 9 Hours

Embedded computers, characteristics of embedded computing applications - challenges in embedded computing system design - embedded system design process – requirements – specification - architectural design - designing hardware and software components - system integration - formalism for system design – structural description - behavioral description - design example: model train controller.

Unit 2: **EMBEDDED PROCESSOR AND COMPUTING PLATFORM**

9 Hours

ARM processor – processor and memory organization - data operations - flow of control - memory devices - input/output devices - component interfacing - designing with microprocessor development and debugging - design example: alarm clock - component interfacing using LPC1768 controller.

Unit 3: **NETWORKS** 9 Hours

Distributed embedded architecture – hardware and software architectures - networks for embedded systems – I2C, CAN Bus - SHARC link p ports - ethernet, myrinet, internet, network – based design – communication analysis - system performance analysis - hardware platform design - allocation and scheduling - design example: elevator Controller - I2C and CAN bus interfacing using LPC1768 controller.

Unit 4: **REAL-TIME CHARACTERISTICS** 9 Hours

Clock driven approach - weighted round robin approach - priority driven approach - dynamic versus static systems - effective release times and deadlines - optimality of the Earliest Deadline First (EDF) algorithm - challenges in validating timing constraints in priority driven systems - off-line versus on-line scheduling - Task Scheduling.

Unit 5: S**YSTEM DESIGN METHODOLOGIES** 9 Hours

Design methodologies - requirement analysis – specification - system analysis and architecture design - quality assurance - design example: telephone PBX – system architecture - ink jet printer – hardware design and software design - personal digital assistants - set-top boxes.

Text Book(s):

1. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Morgan Kaufman Publishers, 2016.
2. Jane.W.S. Liu Real–Time systems, Pearson Education Asia, 2004.

Reference(s):

1. C. M. Krishna and K. G. Shin, Real–Time Systems, McGraw–Hill, 2011.
2. Frank Vahid and Tony Givargi, Embedded System Design: A Unified Hardware/Software Introduction, s, John Wiley & Sons, 2011

OPEN ELECTIVE COURSES

EEE18R309 PRINCIPLES OF POWER SYSTEMS

EEE18R309 PRINCIPLES OF POWER SYSTEMS	***Credits***			
	L	***T***	***P***	***Total***
	3	**0**	**0**	**3**
Pre-requisite:EEE18R172 or EEE18R171	**Course Category:** Open Elective - Theory			

Course Objective(s):

The course provides the theoretical background required to model and analyze large power systems. This includes basic concepts of transmission lines, corona and interference, mechanical design and grounding.

Course Outcome(s):

After completing this course, the student will be able to:

CO1 : To understand the basic concepts of power system

CO2 : To know the basic concepts of overhead lines

CO3 : To acquire the knowledge about corona and interference

CO4 : To understand the mechanical design of transmission lines

CO5 : To gain knowledge on neutral grounding

Course Topics:

Unit 1: POWER SYSTEM COMPONENTS 9 Hours

Single line Diagram of Power system, Brief description of power system Elements: Synchronous machine, transformer, transmission line, bus bar, circuit breaker and isolator Supply System Different kinds of supply system and their comparison, choice of transmission voltage, Transmission Lines: Configurations, types of conductors, resistance of line, skin effect, Kelvin's law. Proximity effect

Unit 2: OVER HEAD TRANSMISSION LINES 9 Hours

Calculation of inductance and capacitance of single phase, three phase, single circuit and double circuit transmission lines-Representation and performance of short, medium and long transmission lines, Ferranti effect. Surge impedance loading

Unit 3: CORONA AND INTERFERENCE 9 Hours

Phenomenon of corona, corona formation, calculation of potential gradient, corona loss, factors affecting corona, methods of reducing corona and interference. Electrostatic and electromagnetic interference with communication lines. Overhead line Insulators: Type of insulators and their applications, potential distribution over a string of insulators, methods of equalizing the potential, string efficiency

Unit 4: MECHANICAL DESIGN OF TRANSMISSION LINE 9 Hours

Catenary curve, calculation of sag & tension, effects of wind and ice loading, sag template, vibration dampers. Insulated cables: Type of cables and their construction, dielectric stress, grading of cables, insulation resistance, capacitance of single phase and three phase cables, dielectric loss, heating of cables.

Unit 5: NEUTRAL GROUNDING 9 Hours

Necessity of neutral grounding, various methods of neutral grounding, earthing transformer, grounding practices. Electrical Design of Transmission Line: Design consideration of EHV transmission lines, choice of voltage, number of circuits, conductor configuration, insulation design, selection of ground wires.EHV AC and HVDC Transmission: Introduction to EHV AC and HVDC transmission lines.

Text Book(s):

5. W. D. Stevenson, "Element of Power System Analysis", McGraw Hill,
6. L. Wadhwa, "Electrical Power Systems" New age international Ltd. Third Edition
7. Asfaq Hussain, "'Power System", CBS Publishers and Distributors,
8. R. Gupta, "Power System Analysis and Design" Third Edition, S. Chand & Co.
9. M. V. Deshpande, "Electrical Power System Design" Tata Mc Graw Hill.

Reference(s):

1. Soni, Gupta & Bhatnagar, "A Course in Electrical Power", Dhanpat Rai & sons,
2. S. L. Uppal, "Electric Power", Khanna Publishers
3. S.N.Singh, "Electric Power Generation, Transmission& distribution." PHI Learning

EEE18R310SOLAR AND WIND ENERGYCONVERSIONS

EEE18R310SOLAR AND WIND ENERGY CONVERSIONS	***Credits***			
	L	***T***	***P***	***Total***
	3	**0**	**0**	**3**
Pre-requisite: Nil	**Course Category:** Open Elective - Theory			

Course Objective(s):

1. To understand and analyze the various renewable energy technologies.
2. To understand the nature of the solar and wind as an energy source.

3. To understand and evaluate different uses of solar energy, such as direct conversion to electricity (photovoltaic), different types of wind turbines.
4. To design and perform the financial estimations of a wind power system.

Course Outcome(s):

After completing this course, the student will be able to:

CO1 : Apply the knowledge in solar spectrum and solar radiation.

CO2 : Understand the basic concept of solar photovoltaic energy conversion and different types of solar PV plants.

CO3 : Apply the solar power Conversion techniques in the field of solar cars, air craft and space satellites.

CO4 : Understand the basic concept of wind energy conversion system.

CO5 : Analyze the various aspects related to Wind turbine generators.

Course Topics:

Unit 1:SOLAR SPECTRUM AND SOLAR RADIATION 9 Hours

World energy resources - Indian energy scenario - environmental aspects of energy utilization - renewable energy resources and their importance – global solar resources - solar spectrum – electromagnetic spectrum - basic laws of radiation - physics of the sun - energy balance of the earth - energy flux - solar constant for earth – green-houseeffect.Solar radiation on the earth surface – extra-terrestrial radiation characteristics - terrestrial radiation - solar isolation - spectral energy distribution of solar radiation- depletion of solar radiation – absorption – scattering - beam radiation - diffuse and global radiation - measurement of solar radiation

Unit 2: SOLAR ELECTRICAL ENERGY CONVERSION 9 Hours

Solar photovoltaic energy conversion - principles - physics and operation of solar cells - classification of solar PV systems - solar cell energy conversion efficiency - I-V characteristics - effect of variation of solar insulation and temperature – losses - solar PV power plants.

Unit 3:PV SYSTEM APPLICATIONS 9 Hours

Integrated photovoltaic UNITs – grid interacting central power stations – standalone devices for distributed power supply in remote and rural areas - solar cars – aircraft - space solar power satellites - socio-economic and environmental merits of photovoltaic systems

Unit 4:INTRODUCTION OF WIND ENERGY 9 Hours

Basics & power analysis - wind resource assessment - power conversion technologies and applications - wind power estimation techniques - principles of aerodynamics of wind turbine blade - various aspects of wind turbine design

Unit 5: WIND TURBINE GENERATORS **9** Hours

Induction machines - synchronous machine - constant V & F and variable V & F generations - reactive power compensation - site selection - concept of wind form & project cycle - cost economics & viability of wind farm.

Text Book(s):

1. Duffy and Buckman, Solar energy thermal process, John wiley and sons, 4th Edition. April 2013.
2. CulpA.W., Principles of Energy Conversion, Tata McGraw Hill Publication, New Delhi.
3. Solar Energy: Principles of Thermal Collection and Storage S. Sukhatme(Author), J Nayak (Author), Mcgraw Hill Education 2008.

Reference(s):

1. Rai, G.D., Non–conventional Energy Sources, Khanna Publishers, New Delhi, 2011.
2. Sathyajith Mathew, Wind energy–Fundamentals, Resource Analysis and Economics, Springer, 2006.
3. S. Sumathi (Author), L. Ashok Kumar (Author), P. Surekha (Author), Solar PV and Wind Energy Conversion Systems, Springer; 2015 edition (14 April 2015).
4. Energy Harvesting: Solar, Wind, and Ocean Energy Conversion Systems (Energy, Power Electronics, and Machines), AlirezaKhaligh (Author), Omer C. Onar (Author) CRC Press 2009.

EEE18R311 PRINCIPLES OF POWER ELECTRONICS

EEE18R311PRINCIPLES OF POWER ELECTRONICS	***Credits***			
	L	***T***	***P***	***Total***
	3	**0**	**0**	**3**
Pre-requisite: EEE18R171 or EEE18R172	**Course Category:** Open Elective - Theory			

Course Objective(s):

1. To get an overview of different types of power semi-conductor devices and their switching characteristics and to understand the operation, characteristics and performance parameters of controlled rectifiers.
2. To study the operation, switching techniques and basic topologies of DC-DC switching regulators.
3. To learn the different modulation techniques of pulse width modulated inverters and to understand the harmonic reduction methods.
4. To study the operation of AC voltage controller and Matrix converters.

Course Outcome(s):

After completing this course, the student will be able to:

CO1 : Describe the construction, working and Characteristics of various Power Semiconductor Devices.

CO2 : Analyze the performance characteristics of various types of phase controlled converter.

CO3 : Design and analyze the DC-DC converter.

CO4 : Describe the operation of inverter and analyze its performance.

CO5 : Design and analyze the performance of AC/ AC converter.

Course Topics:

Unit 1:POWER SEMI-CONDUCTOR DEVICES 9 Hours

Structure, operation and characteristics of SCR, TRIAC, Power transistor, MOSFET, IGBT and GTO- turn on and turn off characteristics

Unit 2:PHASE–CONTROLLED CONVERTERS 9 Hours

2- pulse, 3-pulse, 6-pulse and dual converters- inverter operation of fully controlled converter – effect of source inductance – distortion and displacement factor – ripple factor – triggering circuits.

Unit 3:CHOPPERS 9 Hours

Step-down and step-up choppers – time ratio and current limit control – switching mode regulators – buck, boost, buck-boost converter– chopper control of DC motors.

Unit 4:INVERTERS 9 Hours

Classification of inverters – single phase, three phase (both 120^0 mode and 180^0 mode) inverters– series inverter – parallel inverter –voltage control of single phase, three phase inverters – current source inverters, harmonic reduction in inverters.

Unit 5:AC TO AC CONVERTERS 9 Hours

Single phase AC regulators – sequence control of AC regulators –three phase AC regulators – single phase to single phase cycloconverter – three phase half wave cycloconverter

Text Book(s):

1. Muhammad H. Rashid., Power Electronics: Circuits, Devices and Applications, Prentice Hall of India, Pearson education, 4th edition, 2013
2. Bhimbra.P. S. Power Electronics", Khanna publishers, Fifth edition
3. Sen .P C, "Power Electronics", Tata Mc Graw Hill Education, Twelfth edition
4. Singh. M.D., Power Electronics, Tata McGraw Hill publications, 2nd Edition, 2008.

Reference(s):

1. Ramamoorthy ,M., An Introduction to thyristor and their application, Affiliated East west press (P) Ltd, 2nd Edition, 1991
2. Ned Mohan, Power Electronics: Converters, Applications and Design, John Wiley and sons, 3rd edition, 2003
3. PowerTransmission: The HVDC Options, Wiley-Blackwell,2007
4. Joseph Vithayathil, "Power Electronics", Mc Graw Hill series in Electrical and Computer Engineering, USA., 1995.
5. Dubey.G.K, Doradia.S.R, Joshi, A. and Sinha.R.M, "Thyristorised Power Controllers", Wiley Eastern Limited, 1986.
6. Lander.W, "Power Electronics", McGraw Hill and Company, Third Edition, 1993.
7. Loganathan Umanand, "Power Electronics", Wiley India Pvt. Limited, 2009.

EEE18R312 ELECTRICAL MACHINES

EEE18R312ELECTRICAL MACHINES	***Credits***			
	L	***T***	***P***	***Total***
	3	**0**	**0**	3
Pre-requisite: EEE18R171 or EEE18R172	**Course Category:** Open Elective - Theory			

Course Objective(s):

To understand the basic principle of operation of static and rotating electrical machines and also to analyze the performance characteristics of electrical machines.

Course Outcome(s):

After completing this course, the student will be able to:

CO1 : To understand the concepts of electromagnetic induction and electro magnetism

CO2 : To understand the principle of operation of DC machines and to analyze its performance characteristics.

CO3 : To understand the principle of operation of transformer and to analyze its performance characteristics.

CO4 : To understand the principle of operation of synchronous machines and to analyze its performance characteristics.

CO5 : To understand the principle of operation of Induction machines and to analyze its performance characteristics.

Course Topics:

Unit 1: ELECTRO MAGNETIC INDUCTION & BASIC CONCEPTS IN ROTATING MACHINES 9 Hours

Introduction to magnetic circuits – Magnetically induced e.m.f and force – AC operation of magnetic circuits – Hysteresis and Eddy current losses. Energy in magnetic systems Field energy & mechanical force

Unit 2:D.C. MACHINES 9 Hours

Construction of D.C. Machines - Principle and theory of operation of D.C. generator - EMF equation- Characteristics of D.C. generators - Armature reaction – Commutation - Principle of operation of D.C.motor - Voltage equation - Torque equation - Types of D.C. motors and their characteristics – Starters -Speed control of D.C. motors - Applications.

Unit 3: TRANSFORMERS 9 Hours

Principle,Theory of ideal transformer - EMF equation - Construction details of shell and core typetransformers - Tests on transformers - Equivalent circuit - Phasor diagram - Regulation and efficiency of auto transformer - Introduction to three - phase transformer connections.

Unit 4: SYNCHRONOUS MACHINES 9 Hours

Principle of alternators: - Construction details, Equation of induced EMF and Vector diagram – Synchronous motor:- Starting methods, Torque, V curves, Speed control and Hunting.

Unit 5: INDUCTION MACHINES 9 Hours

Induction motor - Construction and principle of operation, Classification of induction motor, Torque equation, Condition for maximum torque, Equivalent Circuit, Starting methods and Speed control ofinduction motors.

Text Book(s):

1. Nagrath, I.J., and Kothari, D.P., "Electrical Machines", Tata McGraw - Hill, 1997.
2. Fitzgerald A.E, Kingsley C., Umans, S. and Umans S.D., "Electric Machinery", McGraw- Hill,Singapore, 2000.

Reference(s):

1. Theraja, B.L., "A Text book of Electrical Technology", Vol.II, S.C Chand and Co., New Delhi, 2007.
2. Del Toro, V., "Electrical Engineering Fundamentals", Prentice Hall of India, New Delhi, 1995.

EEE18R313 AUTO ELECTRICAL SYSTEM

EEE18R313AUTO ELECTRICAL SYSTEM	***Credits***			
	L	***T***	***P***	***Total***
	3	**0**	**0**	**3**
Pre-requisite: Nil	**Course Category:** Open Elective - Theory			

Course Objective(s):

The objective of this course is to prepare students for entry-level employment. By the end of this course the student, should have a thorough grasp of basic electrical laws. The student should understand and be able to diagnose problems with basic electrical systems and components.

Course Outcome(s):

After completing this course, the student will be able to:

CO1 : To understand the basic need of electrical and electronic system in vehicle

CO2 : To know the concepts and working of battery system

CO3 : To gain the concept of charging system

CO4 : To understand the types of ignition system

CO5 : To understand the concepts of electrical equipment and electronics accessories

Course Topics:

Unit 1:AUTOMOBILE ELECTRICAL SYSTEMS AND ELECTRONICS SYSTEM

9 Hours

Storage, Distribution systems & Generation of electric energy, Lighting system, 12 Volt &24 volt systems. Insulation and earth (negative and positive earthing) system, types of cables used, colour codes, cable connectors, wiring, fuse system, circuit breakers, Relays, Switches. Layout and Wiring diagram for 2, 3 and 4 wheeler vehicles, Buses and Commercial vehicles.

Unit 2:BATTERY SYSTEM 9 Hours

Various Types of Automotive batteries. Principles, Construction & working of lead acid battery, dry battery & Alkaline battery. Designations & Rating of Batteries. Performance tests: Battery Capacity, Efficiency, Gravimetric test and efficiency. Battery failures. Recharging: Electronic circuits, battery charging current, charging methodology & precautions.

Unit 3:CHARGING SYSTEM 9 Hours

Need. Charging circuit, Types of charging system: D.C. dynamo, AC dynamo, flywheel magneto charging system and Alternator (more emphasis on Alternators). Charging system controlling & regulator system: Relay/cut-out, voltage and current regulator, compensated voltage and current regulator, electronic regulator, regulator characteristics. Drive for Charging system.

Unit 4:IGNITION SYSTEM 9 Hours

Requirements. Types of Ignition systems: Ballast Resistance, Ignition coil characteristics, Cam angle & contact angle gap, spark advance mechanism, spark plug, ignition timing, multi-cylinder distributor, Distributor (contact breaker ignition system), limitations of coil ignition system, electronic ignition systems. Voltage and current required for Spark. Spark Plug, characteristics, material, types, plug fouling.

Unit 5:ELECTRICAL EQUIPMENTS & ACCESSORIES 9 Hours

Windscreen wipers, windscreen washers, power windows, doors locks, Rear wind shield glass heating system. Rear view mirror Adjusting, Day light regulating system. Central Locking system. Convertible Mechanism.Sensors:Instrument Cluster panel, fuel gauges, oil temperature gauge, warning light sensors, coolant temperature gauge, speedometer, Odometer, tachometer, trip meter, oil level indicator, parking brake indictor, direction indicators.

Text Book(s):

10. Automobile Electrical and Electronics Author : A. L. StatiniPublisher : Delmar Publications
11. Automotive Electrical EquipmentsAuthor: P. L. Kohli Publisher : Tata McGraw Hill Pub. Co. Ltd.
12. Automobile Electrical & Electronic Systems Author : Tom Denton Publisher : Allied Publishers Pvt. ltd
13. Automobile Electrical & Electronic EquipmentsAuthor : Young, GriffithePublisher : The English Language Book Co

EEE18R314 SMART GRID TECHNOLOGY

EEE18R314SMART GRID TECHNOLOGY	*Credits*			
	L	***T***	***P***	***Total***
	3	**0**	**0**	**3**
Pre-requisite: Nil	**Course Category:** Open Elective - Theory			

Course Objective(s):

The topics of the course focus on various types of smart-grid devices that are used in the power industry. Emphasis is placed on the operation, installation and maintenance of smart-grid devices and systems.

Course Outcome(s):

After completing this course, the student will be able to:

CO1 : To know the importance of smart grid and to design the smart grid architecture.

CO2 : To understand the basic concepts of the power flow model ling through power grid and measurement technologies for wide area monitoring systems.

CO3 : To understand the working principle of smart meter and to design the policy and economic drives of the smart grid

CO4 : To learn and analyze the power quality conditioners for smart grid

CO5 : To understand the concepts of of web service and CLOUD computing to make smart grids smarter

Course Topics:

Unit 1:SMART GRID ARCHITECTURA DESIGNS 9 Hours

Introduction–Comparison of Power grid with Smart grid –power system enhancement – communication and standards-General View of the Smart Grid Market Drivers Stakeholder Roles and Function-Measures- Representative Architecture-Functions of Smart Grid Components-Wholesale energy market in smart grid-smart vehicles in smart grid.

Unit 2:SMART GRID COMMUNICATIONS AND MEASUREMENT TECHNOLOGY
9 Hours

Communication and Measurement - Monitoring, Phasor Measurement UNIT (PMU), Smart Meters,WideArea Monitoring systems(WAMS)-Elements of the power grid and measurement technologies: generation, transmission, distribution, and end user-Basic concepts of power-load models-load flow analysis -wide area monitoring system (WAMS)-advanced metering infrastructure (AMI)and phasor measurement UNITs (PMU).

Unit 3: **SMART METERS AND ADVANCED METERINGINFRASTRUCTURE**
9 Hours

Introduction to Smart Meters-Advanced Metering Infrastructure(AMI) drivers and benefits-AMI protocols-standards and initiatives-AMI needs in the smart grid-Policy and economic drives of the smart grid; environmental implications; sustainability issues; state of smart grid implementation.

Unit 4:POWER QUALITY MANAGEMENT IN SMART GRID 9 Hours

Power quality & EMC in Smart Grid- power quality issues of grid connected renewable energy sources-power quality conditioners for smart grid-web based power quality monitoring- power quality audit.

Unit 5:HIGH PERFORMANCE COMPUTING FORSMART GRIDAPPLICATIONS
9 Hours

ISDN–overview–interfaces and functions–layers and services–signallingSystem–broadband ISDN architecture and protocols-load flow state of the art: classical, extended formulations, and algorithms–load flow for smart grid design-contingencies studies for smart grid-basics of web serviceand CLOUD computing to make smart grids smarter -cyber security for smart grid.

Text Book(s):

1. James Momoh, "Smart Grid: Fundamentals of design and analysis", John Wiley & sons Inc, IEEE press 2012.
2. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihikookoyam"Smart Grid: Technologyand Applications", John Wiley sons inc, 2012.

Reference(s):

2. FereidoonP.Sioshansi, "Smart Grid: Integrating Renewable, Distributed & Efficient Energy", Academic Press, 2012

EEE18R315 ELECTRICAL WIRING ESTIMATION AND COSTING

EEE18R315 ELECTRICAL WIRING ESTIMATION AND COSTING	*Credits*			
	L	*T*	*P*	*Total*
	3	*0*	*0*	*3*
Prerequisite: Nil	**Course Category:** Open Elective – Theory			

Course Objective(s):

Knowledge of electrical engineering drawing, IE rules, different types of electrical Installation their design considerations equips the students with the capability to design and prepare working of different Installation projects.

Course Outcome(s):

After completing this course, the student will be able to:

CO6: To understand the basic of wiring accessories and types of wiring systems
CO7: To gain the knowledge about Estimating and Costing of electrical wiring

CO8: To gain the knowledge for estimating and constructing the domestic wiring.
CO9: To understand the cost of equipments and estimation of wiring used in industry
CO10: To do the plan for overhead underground lines.

Course Topics:

Unit 1: WIRING MATERIALS AND ACCESSORIES 9 Hours

Need of electrical symbols - List of symbols for electrical equipments and accessories used in electrical works – IE rules - General specifications and different types of wires – Cables – Switches - Distribution board - Switch board – Boxes - Batten and its accessories - Conduit and its accessories - Lamp holders - Socket out lets - Plug ceiling roses - Fuse and energy meter used in domestic and power wiring installations- Type of wiring diagrams - Wiring diagrams (multiple and single line representation)

Unit 2: PRINCIPLES OF ESTIMATING AND COSTING 9 Hours

Purpose of estimating and costing - Essentials of estimating and costing-market survey - Price list and net prices - Preparation of list of materials - Calculation of material and labour cost – Contingencies - Overhead charges - Profit and total cost.

Unit 3: ESTIMATION OF DOMESTIC WIRING CIRCUITS: 9 Hours

Description of various domestic wiring systems - calculation of No. of points (light, fan, socket outlet) - Calculation of total load including domestic power - Determination of no. of circuits - Size of wires and cables - Switches and main switch - Distribution board and switch board - Batten conduit and other wiring accessories - Need of earthing as per IE rules.

Unit 4: ESTIMATION OF POWER WIRING 9 Hours

IE rules for power wiring - Calculation of current for single and three phase motors - Determination of sizes of cables, conductors distribution board, main switches and starters for power circuits - Cost of equipments and accessories and schedule of materials - Estimation and cost of material and work for motors upto 20 H.P., pumpsets and small workshops.

Unit 5: ESTIMATION OF OVERHEAD AND UNDERGROUND DISTRIBUTION LINES 9 Hours

IE rules for overhead and underground lines - Main components of overhead lines-line supports - Cross-arm – Clamps - Conductors and stay sets - Lightening arrestors - Danger plates -Ant climbing devices - Bird guards - Jumpers - Concreting of poles - Earthing of transmission line - Formation of lines - Specification of materials for O.H. lines - Cost of material and work for overhead and underground lines upto 11 KV.

Textbook(s):

1. Uppal S.L, “Electrical Wiring - Estimating and Costing”, Khanna Publishers, Sixth edition 2011.
2. Giridharan M.K., “Electrical Systems Design”, I.K. International Publishing House, New Delhi, 2011.

Reference(s):

1. Gupta J.B., “A Course in Electrical Installation Estimating and Costing”, S. K. Kataria& Sons, Ninth Edition, 2012.
2. Raina K.B., Bhattacharya S.K., “Electrical Design Estimating and Costing” New Age International Pvt. Ltd., 2005.

EEE18R417 ELECTRICAL SAFETY

EEE18R417ELECTRICAL SAFETY	Credits			
	L	T	P	Total
	3	0	0	3
Pre-requisite: Nil	**Course Category:** Open Elective - Theory			

Course Objective(s):

To provide a comprehensive exposure to electrical hazards, various grounding techniques, safety procedures and various electrical maintenance techniques.

Course Outcome(s):

After completing this course, the student will be able to:

CO1 : Describe electrical hazards and safety equipment.

CO2 : Analyze and apply various grounding and bonding techniques.

CO3 : Select appropriate safety method for low, medium and high voltage equipment.

CO4 : Participate in a safety team.

CO5 : Carry out proper maintenance of electrical equipment by understanding various standards.

Course Topics:

UNIT I: ELECTRICAL HAZARDS 9 Hours

Primary and secondary hazards-arc, blast, shocks-causes and effects-safety equipment-flash and thermal protection, head and eye protection-rubber insulating equipment, hot sticks, insulated tools, barriers and signs, safety tags, locking devices-voltage measuring instruments-proximity and contact testers-safety electrical one line diagram-electrician's safety kit.

UNIT II: GROUNDING 9 Hours

General requirements for grounding and bonding-definitions-grounding of electrical equipment-bonding of electrically conducting materials and other equipment-connection of grounding and bonding equipment-system grounding-purpose of system grounding-grounding electrode system-grounding conductor connection to electrodes-use of grounded circuit conductor for grounding equipment-grounding of low voltage and high voltage systems

UNIT III: PROTECTION SYSTEM 9 Hours

The six step safety methods-pre job briefings -hot-work decision tree-safe switching of power system-lockout-tag out-flash hazard calculation and approach distances-calculating the required level of arc protection-safety equipment , procedure for low, medium and high voltage systems-the one minute safety audit

UNIT IV: SAFETY 9 Hours

Electrical safety programmestructure, development-company safety team-safety policy-programme implementation-employee electrical safety teams-safety meetings-safety audit-accident prevention-first aid-rescue techniques-accident investigation

UNIT V: ELECTRICAL MAINTENANCE 9Hours

Safety related case for electrical maintenance-reliability centered maintenance (RCM) -eight step maintenance programme-frequency of maintenance-maintenance requirement for specific equipment and location-regulatory bodies-national electrical safety code-standard for electrical safety in work place-occupational safety and health administration standards, Indian Electricity Acts related to Electrical Safety.

Text Book(s):

3. Rao .S," Electrical Safety Fire Safety Engineering and Safety Management", Khanna Publications, 2nd Edition, 2012.
4. Fordham Cooper, W., "Electrical Safety Engineering" Butterworth and Company, London, 1986.

Reference(s):

6. Indian Electricity Act and Rules, Government of India.
7. Power Engineers – Handbook of TNEB, Chennai, 1989.
8. Martin Glov, 'Electrostatic Hazards in powder handling', Research Studies Pvt. LTd., England, 1988.

9. MassimA.G.Mitolo, 'Electrical safety of Low voltage systems', Mc Graw Hill, 2009.
10. John Cadick et al., 'Electrical safety Handbook', Third Edition, Mc Graw Hill, 2006.

EEE18R418 POWER GENERATION SYSTEMS

EEE18R418POWER GENERATION SYSTEMS	*Credits*			
	L	*T*	*P*	*Total*
	3	0	0	3
Pre-requisite: Nil	**Course Category:** Open Elective - Theory			

Course Objective(s):

To understand the working of different types of power generation systems and to realize the necessity of operation of different types of power stations.

Course Outcome(s):

After completing this course, the student will be able to:

CO1 : To understand the various power UNITs and its load

CO2 : Determine the significance of various components of the steam power generation plants

CO3 : To understand the insights of hydro power station

CO4 : Understand the operations on nuclear power station and MHD power generation system.

CO5 : Correlate the importance of operation of the different renewable power generation systems

Course Topics:

UNIT I: INTRODUCTION 9 Hours

Prediction of Load: Definition of connected load, maximum load, maximum demand, demand factor, load factor, diversity factor, plant capacity factor, plant utilization factor, load duration curve, mass curve. Choice of Power station and UNITs: Types of power station, choice of type of generation, choice of size of generator UNITs and number of UNITs. Economic operation of power systems: Criteria for distribution of

load between UNITs of a plant and between plants, transmission loss as a function of plant generation, loss formula coefficients, brief aspects of load dispatching.

UNIT II: STEAM POWER STATION 9 Hours

Steam Power station: Main parts and working of a steam station, characteristics off steam turbines, characteristics of turbo alternators, steam station auxiliaries, steam station layout, super pressure steam stations.

UNIT III: HYDRO POWER STATIONS 9 Hours

Hydro power stations: Hydrology, hydrographs, flow duration curve, mass curve, types of dam, principle of working of a hydroelectric plant, tidal power plant, power to be developed, types of turbine and their characteristics, characteristics of generators, power station structure and layout.

UNIT IV: NUCLEAR AND MHD GENERATION 9 Hours

(A) Nuclear power stations: main parts of nuclear power station principle of nuclear energy, main parts of reactor, types of power reactor, location of nuclear power plant, layout of power station, reactor control, nuclear waste disposal.

(B) MHD generation: history of MHD generation, principle of MHD generation, MHD cycles and working fluids, open cycle MHD system, closed cycle MHD system, advantage of MHD generation.

UNIT V: RENEWABLE POWER GENERATION 9 Hours

New Energy Sources: Solar radiation, Solar energy collectors, Conversion of solar energy into electric energy, Solar hydrogen energy cycle, Wind mills, Tidal power generation schemes, Tidal barrage, Environmental aspects of new and old electric energy generation.

Text Book(s):

1. Generation of Electrical Energy by B.R. Gupta, S. Chand & Company Ltd, 2014, 5th Edition.
2. Carr, T.H., Electric Power Stations, Published by Chapman and Hall.

Reference(s):

1. Elements of Electric Power Station Design by M.V. Deshpande, PHI Learning Pvt. Ltd., 2010
2. A Course in Electrical Power by Soni Gupta Bhatnagar, Dhanpat Rai, 2015.
3. A Course in Electrical Power by J.B.Gupta, ‘, S.K.Kataria and sons, reprint 2010-2011

EEE18R419 SOFT COMPUTINGTECHNIQUES

EEE18R419SOFT COMPUTINGTECHNIQUES	***Credits***			
	L	***T***	***P***	***Total***
	3	**0**	**0**	**3**
Pre-requisite:-MATR101	**Course Category:** Open Elective - Theory			

Course Objective(s):

1. To expose the concepts of feed forward neural networks.
2. To provide adequate knowledge about feedback neural networks.
3. To teach about the concept of fuzziness involved in various systems.
4. To expose the ideas about genetic algorithm
5. To provide adequate knowledge about of FLC and NN toolbox.

Course Outcome(s):

After completing this course, the student will be able to:

CO1 : To understand the basic concepts of soft computing techniques

CO2 : To solve real world problems using neural network

CO3 : To analyze the functioning of recurrent neural network

CO4 : To apply genetic algorithm to solve the optimization problem

CO5 : To develop fuzzy logic controller for the given system

Course Topics:

Unit 1: **INTRODUCTION AND FEEDFORWARD NEURAL NETWORKS**

9 Hours

Introduction to soft computing -soft computing vs hard computing-various types of soft computing techniques-applications of soft computing-Neuron-Nerve structure and synapse- Artificial Neuron and its model-activation functions-Neural network architecture-single layer and multilayer feed forward networks-McCullochPitts neuron model-perceptron model -Adaline and Madaline-multilayer perception

model-back propagation learning algorithm- Implement back propagation learning algorithm using software.

Unit 2: **RECURRENT NEURAL NETWORKS** 9 Hours

Counter propagation network-architecture-functioning & characteristics of counter-Propagation network-Hopfield/ Recurrent network-configuration-stability constraints-associative memory- and characteristics-limitations and applications-Hopfield v/s Boltzmanmachine-Adaptive Resonance Theory-Architecture-classifications-Implementation and training-Associative Memory- Design of multilayer feed forward network using software.

Unit 3: **FUZZY LOGIC SYSTEM** 9 Hours

Introduction to crisp sets and fuzzy sets-basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control-Fuzzification-inferencing and defuzzification- Fuzzy knowledge and rule bases-Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control-Fuzzy logic control for nonlinear time delay system- Development of Neuro fuzzy system using software.

Unit 4: **GENETIC ALGORITHM** 9 Hours

Basic concept of Genetic algorithm and detail algorithmic steps-adjustment of free Parameters-Solution of typical control problems using genetic algorithm-Concept on some other search techniques like tabu search and ant colony search techniques for solving optimization problems- Implementation of optimization problem using software.

Unit 5: **APPLICATIONS** 9 Hours

GA application to power system optimization problem-Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab-Neural Network toolbox. Stability analysis of Neural Network interconnection systems-Implementation of fuzzy logic controller using Matlab fuzzy logic toolbox-Stability analysis of fuzzy control systems.

Text Book(s):

1. S.N. Sivanandam, S.N. Deepa, “Principles of Soft Computing” 2nd Edition, Wiley, 2011.

2. Fakhreddine O. Karray and Clarence De Silva, "Soft Computing & Intelligent System: Theory, Tools and Applications", First edition, Pearson Education, 2009.

Reference(s):

1. Laurene V. Fausett, Fundamentals of Neural Networks: Architectures, Algorithms and Applications, Pearson Education. 2004
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications" Wiley India. 2010.

EE18R420 INDUSTRIAL ELECTRONICS

EE18R420INDUSTRIAL ELECTRONICS	***Credits***			
	L	***T***	***P***	***Total***
	3	**0**	**0**	**3**
Pre-requisite:- NIL	**Course Category:** Open Elective - Theory			

Course Objective(s):

1. To get an overview of different types of power semiconductor devices and their switching characteristics.
2. To understand the operation, characteristics and performance parameters of controlled rectifiers.
3. To study the operation, switching techniques and basic topologies of DC-DC switching regulators.

Course Outcome(s):

After completing this course, the student will be able to:

CO1 : Illustrate the concept of power switches, components and systems.

CO2 : Design and analyze the Power Electronic Converters.

CO3 : Design the control of power electronic converters using different modulation techniques.

CO4 : Control the motor using power electronics converters.

CO5 : Illustrate the application of Industrial Electronics.

Course Topics:

UNIT I: POWER SWITCHES, COMPONENTS AND SYSTEMS 9 Hours

Principles and Methods of power electric conversion – Semiconductor power switches – Components and systems

UNITII: POWER ELECTRONICS CONVERTERS 9 Hours

AC/DC converters (Rectifiers) – DC/AC converters (Inverters) – AC/AC converters (Changers) – DC/DC converters (Choppers)

UNITIII: POWER ELECTRONICS CONTROLS 9 Hours

Phase modulation – Block modulation – Pulse width modulation – Space vector modulation

UNIT IV: MOTOR CONTROL 9 Hours

AC voltage controller – Zero voltage switches – Synchronous tap changer – DC motors phase control – Induction motor – DC series motor chopper control – Stepper motors – Servo – PLL control of DC motors

UNIT V: GENERAL APPLICATIONS 9 Hours

Capacitor charging applications – Power supplies – UPS – Automotive applications – Power electronics and clean energy – Introduction to Industrial Robots

Text Book(s):

1. Valery Vodovozov, Introduction to Power Electronics, free e-book at bookboon.com
2. Andrzej M. Trzynadlowski, Introduction to Modern Power Electronics, Wiley India, 2nd Edition, 2010
3. Biswanath Paul, Industrial Electronics and Control: Including Programmable Logic Controller, PHI, 2nd Edition, 2009

Reference(s):

1. P C Sen, Power Electronics, TMH, 2008.

EEE18R421 EVOLUTIONARY COMPUTATION TECHNIQUES

EEE18R421EVOLUTIONARY COMPUTATION TECHNIQUES	*Credits*			
	L	*T*	*P*	*Total*
	3	0	0	3
Pre-requisite:- MAT18R101	**Course Category:** Open Elective - Theory			

Course Objective(s):

To provide a broad introduction to the field of Genetic Algorithms and other fields of Evolutionary Computation and global optimization. To teach students how to apply these methods to solve problems in complex domains. The course is appropriate both for students preparing for research in Evolutionary Computation, as well as Science and Engineering students who want to apply Evolutionary Computation techniques to solve problems in their fields of study.

Course Outcome(s):

After completing this course, the student will be able to:

CO1 : To understand the working principle of evolutionary computation.

CO2 : To apply Genetic Algorithm to solve optimization problems.

CO3 : To recognize the powerfulness of EC Techniques and the ability to apply EC algorithms to solve optimization problem.

CO4 : To understand the principle of PSO and to solve optimization problems.

CO5 : To understand the principle of ACO and to solve optimization problems.

Course Topics:

UNIT I: EVOLUTIONARY COMPUTATION (EC): THE BACKGROUND

9 Hours

Outline of Evolutionary Algorithms (EA) – EA Terminologies – Robust adaptation and Machine Intelligence – Principles of Evolutionary Processes – Principles of Genetics – No-free Lunch theorem for EA – Advantages of EA over other approaches.

UNIT II: GENETIC ALGORITHM (GA) 9 Hours

Binary GA – genetic operators – Tournament, Proportionate and Ranking Selection – Single point, two-point and uniform crossover – Elitism – Real Parameter GA – Linear, naïve, blend and Simulated Binary Crossover – Random, Non-

uniform, Normally distributed and Polynomial Mutation – Constraint Handling Techniques in GA.

UNIT III: EVOLUTIONARY STRATEGIES (ES) & EVOLUTIONARY PROGRAMMING (EP) 9 Hours

Non-Re combinative ES – Re combinative ES – Self Adaptive ES – Connection between RGA and Self adaptive ES – Evolutionary Programming(EP) – EP and ES: Similarities and Differences – Genetic Programming (GP) – Population size and Dynamics – Convergence and Stopping Criteria – Exploration and Exploitation.

UNIT IV: PARTICLE SWARM OPTIMIZATION (PSO) 9 Hours

Concepts and formulation – Simulating the Social behavior – PSO algorithm – Topology – Parameter Selection and Improvements for Convergence – Maximum Velocity – Acceleration Constants - Constriction factor - Inertia weight – Advantages of PSO.

UNIT V: ANT COLONY OPTIMIZATION (ACO) 9 Hours

Ants' ForagingBehavior – Stigmergy – Double Bridge Experiment – Real Ants to Artificial Ants – Behavioral Differences – Properties of Artificial Ants – ACO Algorithms – Ant System - MAX–MIN Ant System – Ant Colony System (ACS) – Advances of ACO.

Text Book(s):

1. Kalyanmoy Deb, "Multi-Objective Optimization using Evolutionary Algorithms", 3rd Edition, John Wiley & Sons, 2008.
2. D.B.Fogel,"Evolutionary Computation", Prentice HallIndia publications, 2001.
3. Thomas Back, David BFogel and ZbigniewMichalewicz, "Evolutionary Computation 1 &2 : Basic/advanced Algorithms and Operators", Institute of Physics Publishing, 2000.
4. Marco Dorigo and Thomas Stutzle, "Ant Colony Optimization", MIT Press, 2004.
5. JurgenBranke, Kalyanmoy Deb, Kaisa Miettinen and Roman Slowinski (Eds.), "MultiObjective Optimization: Interactive and Evolutionary Approaches", Springer-Verlag, 2008.
6. S.N.Sivanandam and S.N.Deepa, "Introduction to Genetic Algorithms", Springer-Verlag, 2008.
7. Thomas Baeck, D.B.Fogel and Z.Michalewicz,"Handbookof Evolutionary Computation"aylor and Francis, 1997.

EEE18R422 ENERGY CONSERVATION AND MANAGEMENT

EEE18R422ENERGY CONSERVATION AND MANAGEMENT	*Credits*			
	L	*T*	*P*	*Total*
	3	0	0	3
Pre-requisite: Nil	**Course Category:** Open Elective - Theory			

Course Objective(s):

1. To impart basic knowledge to the students about current energy scenario, energy management, auditing and conservation.
2. To inculcate among the students systematic knowledge and skill about assessing the energy efficiency, energy auditing and energy management.

Course Outcome(s):

After completing this course, the student will be able to:

CO1 : To understand and analyze the energy data of industries

CO2 : To carryout energy basics and energy conservation techniques

CO3 : To conduct energy audit and suggest methodologies for energy savings

CO4 : To utilize the available resources in optimal ways and perform the financial estimations of energy performance

CO5 : To Know the energy monitoring and targeting techniques

Course Topics:

UNIT I: ENERGY SCENARIO 9 Hours

Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, Indian energy scenario, Sectorial energy consumption (domestic, industrial and other sectors), energy needs of growing economy, energy intensity, long term energy scenario, energy pricing, Energy security, energy conservation and its importance, energy strategy for the future, Energy Conservation Act 2001 and its features.

UNIT II: BASICS OF ENERGY ITS VARIOUS FORMS AND CONSERVATION
9 Hours

Electricity basics – Direct Current and Alternative Currents, electricity tariff, Thermal Basics-fuels, thermal energy contents of fuel, temperature and pressure, heat

capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity and heat transfer, analysis of existing buildings setting up an energy management programme and use management – electricity saving techniques

UNIT III: ENERGY MANAGEMENT & AUDIT 9 Hours

Definition, energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, Bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments and metering

UNIT IV: FINANCIAL MANAGEMENT 9 Hours

Investment-need, appraisal and criteria, financial analysis techniques simple payback period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity analysis; financing options, energy performance contracts and role of Energy Service Companies (ESCOs)

UNIT V: ENERGY MONITORING AND TARGETING 9 Hours

Defining monitoring & targeting, elements of monitoring & targeting, data and information-analysis, techniques – energy consumption, production, cumulative sum of differences (CUSUM).Energy Management Information Systems (EMIS).

Text Book(s):

1. Energy Engineering and Management Amlan Chakrabarti Prentice hall India 2011
2. Energy Management Principles, CB Smith, Pergamon Press, New York, 2007.
3. Bureau of energy efficiency, “General Aspects of Energy Management & Energy Audit”, old edition on2005& new edition on2011.

Reference(s):

1. Energy Management Hand Book. W. C. Turner. John Wiley and sons Handbook on Energy Efficiency, TERI, New Delhi, 2009
2. Energy Auditing and Conservation; Methods, Measurements, Management & Case Study, Hamies, Hemisphere Publishing, Washington, 1980.
3. Industrial Energy Management & Utilization, Write, Larry C Hemisphere Publishers, Washington, 1998.

EEE18R423EMBEDDED SYSTEM DESIGN

EEE18R423EMBEDDED SYSTEM DESIGN	***Credits***			
	L	***T***	***P***	***Total***
	3	**0**	**0**	**3**
Pre-requisite: EEE18R371	**Course Category:** Open Elective - Theory			

Course Objective(s):

1. To optimize hardware designs of custom single-purpose processors.
2. To compare different approaches in optimizing general-purpose processors.
3. To introduce different peripheral interfaces to embedded systems.
4. To understand the design tradeoffs made by different models of embedded systems.
5. To apply knowledge gained in software-hardware integration in team-based projects

Course Outcome(s):

After completing this course, the student will be able to:

CO1 : Design the embedded process for simple application

CO2 : Describe the processor and component interfacing

CO3 : Understand the network protocols

CO4 : Analyze the different scheduling algorithm

CO5 : Design simple product using system design technology

Course Topics:

Unit 1: **EMBEDDED ARCHITECTURE** 9 Hours

Embedded computers, characteristics of embedded computing applications - challenges in embedded computing system design - embedded system design process – requirements – specification - architectural design - designing hardware and software components - system integration - formalism for system design – structural description - behavioral description - design example: model train controller.

Unit 2: **EMBEDDED PROCESSOR AND COMPUTING PLATFORM**9 Hours

ARM processor – processor and memory organization - data operations - flow of control - memory devices - input/output devices - component interfacing - designing with microprocessor development and debugging - design example: alarm clock - component interfacing using LPC1768 controller.

Unit 3: **NETWORKS** 9 Hours

Distributed embedded architecture – hardware and software architectures - networks for embedded systems – I2C, CAN Bus - SHARC link p ports - ethernet, myrinet, internet, network – based design – communication analysis - system performance analysis - hardware platform design - allocation and scheduling - design example: elevator Controller - I2C and CAN bus interfacing using LPC1768 controller.

Unit 4: **REAL-TIME CHARACTERISTICS** 9 Hours

Clock driven approach - weighted round robin approach - priority driven approach - dynamic versus static systems - effective release times and deadlines - optimality of the Earliest Deadline First (EDF) algorithm - challenges in validating timing constraints in priority driven systems - off-line versus on-line scheduling - Task Scheduling.

Unit 5: S**YSTEM DESIGN TECHNIQUES** 9 Hours

Design methodologies - requirement analysis – specification - system analysis and architecture design - quality assurance - design example: telephone PBX – system architecture - ink jet printer – hardware design and software design - personal digital assistants - set-top boxes.

Text Book(s):

3. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Morgan Kaufman Publishers, 2016.
4. Jane.W.S. Liu Real–Time systems, Pearson Education Asia, 2004.

Reference(s):

3. C. M. Krishna and K. G. Shin, Real–Time Systems, McGraw–Hill, 2011.
4. Frank Vahid and Tony Givargi, Embedded System Design: A Unified Hardware/Software Introduction, s, John Wiley & Sons, 2011.

EEE18R424HYDRO POWER GENERATION

EEE18R424HYDRO POWER GENERATION	***Credits***			
	L	***T***	***P***	***Total***

	3	**0**	**0**	**3**
Pre-requisite: Nil	**Course Category:** Open Elective - Theory			

Course Objective(s):

To gain the basic knowledge for constructive structure and design of hydropower plant and able to analyze the load factor based on the electric load.

Course Outcome(s):

After completing this course, the student will be able to:

CO1 : Understand the basic knowledge about the hydropower plants.

CO2 : Understand the selection methodology for prime mover based on water level and find out the efficiency of pumped storage plant.

CO3 : Analyze the designing criteria of various types of penstock pipes.

CO4 : Understand the selection criteria for turbines and basic layout of power houses.

CO5 : Solve the capacity and diversity factors of hydro plant based on load.

Course Topics:

UNIT-I INTRODUCTION 9 Hours

Sources of energy - status of hydropower - Environmental aspects for selecting the sites and locations of hydro power stations - advantages of hydropower - place of hydropower in power system - Types of hydropower stations - classification of hydropower stations - run of river plants - general layout of run of river plants - storage and pondage

UNIT-II PRIME MOVER AND PUMP STORAGE PLANT 9 Hours

Selection of prime mover, speed and pressure regulation, methods of governing, starting and stopping of water turbines, operation of hydro turbines. Machine loading and frequency control, Maintenance of hydropower plants

Basic features of Hydropower plants - advantages of pumps storage plants - storage plants - types of pump storage plants - efficiency of pump storage plants.

UNIT-III WATER CONVEYANCE SYSTEM 9 Hours

Classifications of penstocks - design criteria of penstocks - anchor blocks - types of valves - water hammer - surges in power channels - Types of Surge shafts - surge analysis - design of surge shafts

UNIT-IV TURBINES AND POWER HOUSES 9 Hours

Types of turbines - criteria for selection - specifies speed of turbines - unit power - unit discharge - cavitations in turbines - design of draft tube

Types of power houses - lay out of power houses – ventilations - underground power houses -advantages.

UNIT-V ELECTRICAL LOAD ON HYDRO POWER 9 Hours

Load curves - load factor - capacity factors - utility factors - diversity factors - load on hydropower stations -load duration curves - firm power - secondary power - prediction of loads

Text Book(s):

1. K N Sharma& M MDandekar, Water Power Engineering,. Vikas Publishing, 2013
2. Mosonyi, Water Power Development Vol-I, New Chand & Bros.,

Reference(s):

1. Hydropower structures Volume III-By R S Varshney
2. Hydro Power Engineering By Dr Darde P N ,Vayu Education, Delhi

EEE18R425 BUILDING MANAGEMENT SYSTEMS

EEE18R425BUILDING MANAGEMENT SYSTEMS	***Credits***			
	L	***T***	***P***	***Total***
	3	**0**	**0**	**3**
Pre-requisite:- Nil	**Course Category:** Open Elective – Theory			

Course Objective(s):

1. To manage the sub-systems within a building to ensure pleasant, controlled and safe environment
2. To control all or some of the following in a building: HVAC, CCTV, Access Control, Fire and Intruder Alarms, Lighting and Power Consumption

Course Outcome(s):

After completing this course, the student will be able to:

CO1 : Understand the basics of building automation and its design concepts

CO2 : Analyze electronics and electrical components and systems, and get familiarized with different tools of building automation

CO3 : Achieve networking in automation with necessary security systems

CO4 : Operate and program the PLC, SCADA and HMI for automation of buildings

CO5 : Understand the working concepts of alarms, panels & controls pertaining to building control and management

Course Topics:

UNIT I: INTRODUCTION TO BUILDING MANAGEMENT SYSTEM 9 Hours

Basic criteria of designing – BMS – components, Design concepts - Energy management systems - MEP fundamentals - Components of building automation system - HVAC, electrical, lighting, security, fire-fighting, communication - Integrated approach in design, maintenance and management system - Current trend and innovation in building automation systems - Impact of Information Technology - Application of expert system in building automation - Stages in development of expert system, expert system application in architecture - Computerizing building management information.

UNIT II: BASIC ELECTRONICS AND ELECTRICAL ENGINEERING9 Hours

Electronic components - Network theory - Power electronics components - Familiarization of tools Multi-meter, Soldering, De-soldering - Selection of components - Single phase and three phase systems - Types of load & calculation - Measurement of current voltage, power - Types of motors - Basics of motors-dc motor, stepper, servo - Selection of servo motor and drives - Different types of earthing - Concept of two wire/ three wire controls.

UNIT III: NETWORKING AND SECURITY SYSTEMS 9 Hours

Concept of LAN, WAN - Implementing of networks - Sharing of files, printers, scanners etc - Network protocols- TCP/IP, ETHERNET - MODBUS, CANBUS, PROFIBUS - Transmission techniques - CCTV – Installation - Selection of camera - Cabling and termination - Different types of cameras - Night vision systems - DVR configuration - Intruder Alarms - GSM enabled control panel - PIR sensors - Vibration sensors - Gas leakage detectors - EM locks.

UNIT IV: PLC, SCADA / HMI 9 Hours

Monitoring the process through sensors - NO/ NC concept - Data file handling - forcing I/O - Wiring and fault correction - Programming practices - SCADA and HMI packages - Role of SCADA and HMI in building automation – Programming - Configuring alarms - Real time project development.

UNIT V: FIRE ALARMS, PANELS & CONTROLS 9 Hours

Sensors-heat, smoke, PIR - Conventional fire alarm panels - Addressable fire alarm panels - Cabling and safety standards - Biometric Access Control - Video door phones - Lighting controls - Solar panels - Ups and generators - Surge & lightening protection systems - Automatic gates & barriers - Security Automation – Biometric access control – RFID, Finger print, Magnetic locks.

Text Book(s):

4. G. J. Levermore, "Building Energy Management Systems: Applications to Low-energy HVAC and Natural Ventilation Control", Taylor & Francis, 2000
5. Shengwei Wang, "Intelligent Buildings and Building Automation", Routledge, Technology & Engineering, 2009
6. Doug Oughton, Steve Hodkinson, "Faber & Kell's Heating & Air-conditioning of Buildings", Routledge, Technology & Engineering, 2008

Reference(s):

1. Lal Jayamaha, "Energy-Efficient Building Systems : Green Strategies for Operation and Maintenance: Green Strategies for Operation and Maintenance", McGraw Hill Professional, 2006

OPEN ELECTIVES (BASIC SCIENCES AND MATHS)

OEE18R008	Photonics and Optoelectronic Devices	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, the students will be able to

CO-1: Know the fundamentals of fibre based optical devices

CO-2: Understand the basic of integrated optical devices

CO-3: Learn about the opto-electronic devices

CO-4: Understanding of nanostructured materials

CO-5: Understanding of quantum devices with applications

Unit – I: Optical Fibre based Devices 9 Hours

Introduction to optical Fibre; Fused single mode fibre directional coupler, Polished single mode fibre directional coupler; Fibrepolariser; Wavelength multiplexer and demultiplexer; Optical fibre switches and intensity modulators; Optical fibre phase modulator; Optical fibre frequency modulator; Optical fibre amplifiers

Unit – II: Integrated Optics based Devices 9 Hours

Optical directional coupler: directional coupler wavelength filter, polarisation splitting directional coupler; Polarisers: leaky mode polariser, metal clad polariser; Phase modulator; Optical switch; Acousto-optic devices : mode converter , tunable wavelength filter, Bragg type modulator , Bragg type deflector; Magneto-optic devices TE-TM mode converter, modulators and switches, Ti / $LiNbO_3$ based optical devices.

Unit – III: Optoelectronic Devices 9 Hours

Semiconductor Lasers: homojunction, heterojunction and surface emitting lasers, quantum well lasers; Modulation of lasers; Photodetectors: PIN, Avalanche photodiodes; Optoelectronic modulation and switching devices; Electro-optic Devices; Optoelectronic Integrated circuits; SiO_2 / Si based optoelectronic devices.

Unit – IV: Nanophotonics 9 Hours

Nanocomposites: Nanocomposite Waveguides, Random Lasers, Nanocomposites for optoelectronics-Basics of nano-photonics-Introduction to MEMS and NEMS-Working principles: as micro sensors-biosensors, chemical sensors and optical sensors.

MEMS/NEMS applications: Applications in automotive industry-health care-aerospace-industrial product-consumer products.

Unit – V: Quantum Devices 9 Hours

Low-dimensional structures: Quantum wells, Quantum wires, and Quantum dots; Density of states in low-dimensional structures; Resonant tunneling phenomena and applications in diodes and transistors; Applications of quantum devices: quantum well and quantum dot lasers, ultra-fast switching devices, high density memories, dc and rf squids, multi-state logic circuits, long wavelength detectors ; Quantum Computing (Qualitative)

Reference Books:

1. Joachim Piprek, Semiconductor optoelectronic devices, Academic press Hardbound, 2003

2. A.K. Ganguly, Optoelectronic devices and circuits, Narosa publication, 2007

3. Shun Lien Chuang, Physics of Optoelectronic Devices, Wiley-Interscience; 1st ed.,1995

4. Goure and I Verrier, Optical Fibre Devices, Taylor& Francis; 1st ed., 2001

5. Ray Tricker,Optoelectronics and Fiber Optic Technology,Newnes, 2002

6. K Krishna Reddy M Balakrishna Rao, Nanostructures & Quantum Devices, Campus Books International, 2007

7. RahmanFaiz, Nanostructures in Electronics and Photonics, Pan Stallion press (Year)

8. Guozhong Cao, Nano structures &nanomaterials: synthesis, properties & applications, Imperial College Press, 2004

9. Todd D. Steiner, Semiconductor nanostructures for optoelectronic application, Artech House, INC., 2004

10. Jia- Ming Liu, Photonic Devices, Cambrige University Press, 2005

OEE18R009	LASER TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, the students will be able to

CO-1: An ability to enhance the modern technological aspects in laser

CO-2: To correlate the basic concept of theoretical principles in laser

CO-3: An ability to improve the knowledge of various types of laser

CO-4: Enormous interest to study the various properties of laser.

CO-5: Knowledge of laser applications in various engineering fields

Unit - I: Absorption and Emission of Radiation 9 Hours

Concept of coherence – spatial and temporal - Conditions for Producing Laser - spontaneous and stimulated emission - Population Inversion-different methods- Einstein coefficients – negative absorption – Gain and Gain saturation - Saturation intensity - shape and width of spectral lines.

Unit - II: Threshold Condition and Resonators 9 Hours

Rate equations – optical excitation in three and four level lasers – standing waves in laser – cavity theory – dichroic filter – modes, diffraction theory of the Fabry – Perot interferometer – Types of resonators – stability diagram

Unit - III: Types of Lasers 9 Hours

Principle, construction, working-Gas lasers:He-Ne laser, , CO2 laser- Liquid lasers: dye lasers, solid state laser: Ruby laser, Nd-YAG laser-applications.

Unit - IV: Ultrafast Photonics and Laser Q Switching 9 Hours

Introduction to ultrashort pulse lasers and amplifiers – wavelength conversion – time-resolved experiments – applications of ultrashort pulses – Mode locking – second harmonic generation – theory and experiment – materials for optical second harmonic generation

Unit - V: Applications 9 Hours

Measurement of distance, velocity, rotation with lasers – laser in communications and computer technology– holography – industrial applications – cutting, drilling & welding – lasers in medicine – laser in research and development

Text Books:

1. Simon Hooker & Colin Webb “Laser Physics” Oxford Press, 2010.

2. William T. Silfvast "Laser Fundamentals" Cambridge University Press, Second Edition, 2008.

3. William S. C. Chang "Principles of Lasers and Optics" Cambridge University Press, 2007.

4.Yehoshua Y. Kalisky "The Physics and Engineering of Solid State Lasers" SPIE Press, 2006.

5. Mark Csele" Fundamentals of light sources and lasers" John Wiley and sons, New jersey 2004.

OEE18R006	Industrial Chemistry for Engineers	L	T	P	C
		3	0	0	3

CO1 To apply the knowledge of electrochemistry to understand the working mechanism of batteries and sensors.

CO2 To understand the process involved in refining of petroleum, cracking of crude oil and manufacturing of fuel gases and to analyze the flue gas.

CO3 To understand the process of adsorption and colloidal state of materials.

CO4 To understand the formulation of protective coatings and to know the process of manufacturing and cleansing action of soaps.

CO5 To know the constituents, composition and manufacturing process of cement, glass and ceramics.

Unit - I: Energy Storage Devices and Sensors 9 Hours

Batteries - primary and secondary cells. Primary cell - Dry cell, Mercury cell. Secondary cell - Lead acid battery, Lithium battery. Solar cells & fuel cells (H2-O2, PEFC and SOFC) - principle, construction, working and application. Electrochemical sensors - working, application and merits.

Unit - II: Fuels and Combustion 9 Hours

Petroleum: Origin, refining, cracking - thermal and catalytic, reforming – thermal and catalytic, knocking and octane number, synthetic petrol - Fischer-Tropsch and Bergius

method. Fuel Gases: Large scale production, storage, hazards and uses of LPG, coal gas, water gas, producer gas, and oil gas. Combustion (Problems). Mass analysis from volume analysis and vice versa. Analysis of flue gas (Orsat's apparatus).

Unit- III: Applications of Adsorption and Colloidal State 9 Hours

Adsorption: Classification of Adsorption – Adsorption of Gases on Solids – Adsorption from Solutions – Applications of Adsorption. Colloidal state: Types of colloidal solution –Preparation and purification of colloidal solutions – Characteristics of colloidal solution –Coagulation of sols – Origin of charge on colloids – Stability of colloids – Applications of Colloids – Protective colloids – Emulsions – Gels – Micelles.

Unit - IV: Organic Protective Coatings and Soaps 9 Hours

Paints & Varnishes: Requirements of a good paint. Primary constituents of paints, dispersion medium (solvent), binder, pigments, formulation of paints and varnishes.

Soaps: Classification of soap, manufacture of soaps by hot and cold process, cleansing action of soap and classification of detergents (anionic and cationic).

Unit - V: Siliceous Materials 9 Hours

Cement: Manufacture - Wet Process and Dry process, types, analysis of major constituents, setting of cement, reinforced concrete.

Glass: Composition and manufacture of glass .Types of glasses- optical glass, coloured glasses and lead glass.

Ceramics: Types- raw materials - white wares, manufacture and uses.

Reference Books:

1) Jain and Jain, Engineering Chemistry, 15th Edition, .Dhanpat Rai Publishing Company, New Delhi, 2005.

2) B.N. Chakrabarty, Industrial Chemistry, Oxford & IBH Publishing Co, New Delhi, 1981.
3) B.K. Sharma, Industrial Chemistry, 11th Edition, Goel Publishing House, Meerut, 2000.
4) P.P. Singh, T.M. Joesph, R.G. Dhavale, College Industrial Chemistry, 4th Edition, Himalaya Publishing House, Bombay, 1983.

OEE18R005	COMBINATORICS	L	T	P	C
		3	1	0	3

Course Objectives:

To enable the students to understand the concepts of permutation, combination and inclusion and exclusion principle.

Course outcomes:

Upon successful completion of this course, students will be able to

CO1. understand the rules of sum and product of permutations and combinations.

CO2. analyze the concepts of pigeonhole principle and its applications.

CO3. identify solutions by the technique of generating functions

CO4. understand the concepts of Pascal's triangle, the binomial Theorem and unimodality of binomial Coefficients.

CO5. understand the concepts of the principle of inclusion-exclusion and their applications.

Unit I - Permutations and Combinations 9 Hours

Four Basic Counting Principles, Permutations of sets, Combinations (Subsets) of Sets, Permutations of Multi-sets, Combinations of Multi-sets.

UnitII –The Pigeonhole Principle 9 Hours

Pigeonhole Principle: Simple Form, Pigeonhole Principle: Strong Form, A Theorem of Ramsey.

Unit III - Generating Permutations and Combinations 9 Hours

Generating Permutations, Inversions in Permutations, Generating Combinations, Generating r-Subsets.

Unit IV - The Binomial Coefficients 9 Hours

Pascal's Triangle, The Binomial Theorem, Unimodality of Binomial Coefficients, The Multinomial Theorem, Newton's Binomial Theorem.

Unit V - The Inclusion-Exclusion Principle and Applications 9 Hours

The Inclusion-Exclusion Principle, Combinations with Repetition, Derangements, Permutations with Forbidden Positions, Another Forbidden Position Problem.

Text Book:

1. Richard A. Brualdi, Introductory Combinatorics, Pearson Education, Inc, China machine press, Fifth Edition, 2009

References:

1. Miklos Bona, A walk through Combinatorics, (Second Edition), World Scientific Publ. Co., 2008.
2. C. L. Liu, Introduction to Combinatorial Mathematics, Mc Graw Hill Book Company, New York, 1968.

OEE18R003	Mathematical Biology	L	T	P	C
		3	1	0	3

Course Objective:

To enable the students to understand the concepts of models for single species, interacting populations and dynamics of marital interaction.

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Learn continuous population models for single species

CO2. Learn discrete population models for a single species

CO3. Understand models for interacting populations

CO4. Analyze the various competitive models..

CO5. Model the dynamics of marital interaction.

Unit-I: Continuous Population Models for Single Species 9 Hours

Continuous Growth Models, Insect Outbreak Model: Spruce Budworm, Delay Models. Linear Analysis of Delay Population Models: Periodic Solutions, Real Life Problems related to Growth Model.

Unit-II: Discrete Population Models for a Single Species 9 Hours

Introduction: Simple Models, Cob webbing: A Graphical Procedure of Solution, Discrete Logistic-Type Model: Chaos, Stability, Periodic Solutions. Discrete Delay Models, Tumor Cell Growth.

Unit-III: Models for Interacting Populations 9 Hours

Predator-Prey Models: Lotka-Volterra Systems, Complexity and Stability, Realistic Predator-Prey Models, Analysis of Predator-Prey Model with Limit Cycle, Periodic Behavior: Parameter Domains of Stability.

Unit-IV: Competitive Models 9 Hours

Competition Models: Competitive Exclusion Principle, Mutualism or Symbiosis, General Models and Cautionary Remarks, Threshold Phenomena, Discrete Growth Models for Interacting Populations, Predator- Prey Models : Detailed Analysis.

Unit-V: Modelling the Dynamics of Marital Interaction 9 Hours

Divorce Prediction and Marriage Repair Psychological Background and Data: Gottman and Levenson Methodology, Maital Typology and Modelling Motivation, Modelling Strategy and the Model Equations, Steady States and Stability.

Text Book:

1. J. D. Murray, Mathematical Biology: I. An Introduction, Third Edition, Springer-verlag Berlin Heidelberg, 2002.

Reference books:

1. R.M. Anderson and R. M. May, editors, Infectious Disease of Humans : Dynamics and Control. Oxford University Press, Oxford, 1991..
2. O. Diekmann and J. A. P. Heesterbeek. Mathematical Epidemiology of Infectious Diseases: Model Building, Analysis and Interpretation. John Weily, New York, 2000.

OEE18R004	MATHEMATICAL MODELLING	L	T	P	C
		3	1	0	3

Course Objective:

To make the students to be capable of doing simple mathematical modelling using differential equations and difference equations.

Course Outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand the mathematical modelling of ordinary differential equation of first order.

CO2: Know about the concepts of mathematical modelling in difference equations and Linear difference equations.

CO3: Know mathematical modelling through partial differential equation and study about the mass-balance equations.

CO4: Know the first and second methods of obtaining partial differential equation models.

CO5: Study about the mathematical modelling through delay differential and functional equations.

Unit I: Ordinary Differential Equations 9 Hours

Review of ODE and System of First Order ODE - Mathematical modelling in population dynamics-Epidemics through systems of ODE of first order - Mathematical modelling through systems of ordinary differential equations of the first order.

Unit II: Mathematical Modelling 9 Hours

Difference Equation and its solution - Mathematical modelling through difference equations - The need for mathematical modeling through difference equations some simple models-Basic theory of linear difference equations with constant coefficients.

Unit III: Partial Differential Equations 9 Hours

Review of PDE and solution of simple linear PDEs, Mathematical modelling through Partial differential equation -situation giving rise to Partial differential equation models-Mass-balance equations.

Unit IV: PDE Models 9 Hours

First method of getting Partial differential equation models-Momentum balance equations the second method of obtaining PDE models.

Unit V: Integral Equations 9 Hours

Integral Equations - Solution of Simple Integral Equations - Mathematical modelling through functional Integral , delay differential and differential difference equations.

Text Book:

1. J.N. Kapur, Mathematical modelling, New age international publishers, 2005 (Reprint).

Reference Book:

1. Frank R. Giordano, William P. Fox, Steven B. Horton , A First Course in Mathematical Modelling , Cengage Learning Publishers, 5th Edition, 2013.

HUMANITIES ELECTIVES

HSS18R001MANAGEMENT CONCEPTS AND TECHNIQUES

HSS18R001Management Concepts and Techniques	Credits			
	L	*T*	*P*	*Total*
	3	*0*	*0*	*3*
Course Category: Humanities Elective – Theory				

Course Objective(s):

This course addresses the definition of management, its characteristics, evolution and importance as well as the functions performed by manages-planning, organizing, directing and controlling. The course also intends to show students the applications of management functions in various enterprises such as marketing, finance, personnel, production, etc.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To Explain the historical backdrop and fundamentals of Management thoughts vital for understanding the conceptual frame work of Management as a discipline.
CO2: To Discuss about the various concepts of planning, Decision making and controlling to help solving managerial problems
CO3: To Understanding concepts of Ethics, Delegation, Coordination and Team work
CO4: To Study and understand the management concepts and styles in Global context
CO5: To develop an understanding about emerging concepts in management thought and philosophy

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1						M						L			
CO2							M	M	L	L					
CO3						L		H	H	M					
CO4						H	M			L					
CO5							H					H			

Course Topics:

Unit 1: DEVELOPMENT OF MANAGEMENT THOUGHTS **9 Hours**

Scientific Management Movement - Administrative Movement - Human Relations Movement -Decision Movement - Behavioural Science Movement - Systems Movement - Contingency Movement.

Unit 2:ESSENTIALS OF PLANNING **9 Hours**

Planning Objectives – Goals - Programmed Decisions and Unprogrammed Decisions; Decision – Making - Creativity in Decision - Making, Forecasting and Strategy to Formulation

Unit 3: EFFECTIVE ORGANISING **9 Hours**

Span of Control – Departmentation - Authority; Responsibility - Bureaucracy and Adhocracy; Group Dynamics

Unit 4: STAFFING AND DIRECTING **9 Hours**

Staffing: Manpower Planning – Recruitment Sources – Selection Procedure – Training Methods – Performance Evaluation Methods – Executive Development Programs - Directing: Communication Process and Barriers – Motivation Techniques – Financial and Non – Financial Motivation- Leadership Qualities and Styles

Unit 5: CONTROLLING AND RECENT CONCEPTS **9 Hours**

Controlling: Meaning and Process - Requisites of Effective Control - Control Techniques. Emerging Issues in Management: Japanese and American Management – Management by Objectives – Knowledge Management – Technology Management – Business Process Outsourcing- Social Responsibility and Business Ethics

Text Book(s):

1. Harold Koontz, Heinz Weihrich, Essentials of Management: An International, Innovation and Leadership Perspective, 10th Edition, McGraw Hill, 2016
2. Stephen P. Robbins, Mary A. Coulter, Management, 13th Edition, Pearson Education Limited, New Delhi, 2016

Reference(s):

1. C.B.Gupta, Management Theory and Practice, 19th Revised Edition, Sultan Chand and Sons.2017.
2. L.M.Prasad, Principles and Practices of Management, 9th Edition, Sultan Chand and Sons, 2015.
3. K.Aswathappa, Essentials of Business Environment: Text Cases and Exercises 12th, edition, Himalaya Publishing House, Mumbai, 2014.
4. Tripathi, Reddy, Principles of Management, 5th Edition, McGraw Hill, 2012

HSS18R002MARKETING MANAGEMENT

HSS18R002Marketing Management	*Credits*			
	L	***T***	***P***	***Total***
	3	***0***	***0***	***3***
Course Category: Humanities Elective – Theory				

Course Objective(s):

This course develops students understanding of how organizations match the requirements of consumers in competitive environments, and develop strategies to

create the competitive edge. It covers areas such as analysis, planning, implementation, and control, as well as the marketing mix, exportation, and the social aspects of marketing.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To Develop understanding of marketing concepts, philosophies and historical background.
CO2: To Develop understanding of marketing operations and complexities for students to apply in practical business situations.
CO3: To Understand concepts related to Segmentation, Targeting and Positioning, product attributes, and pricing strategies prevalent in domestic and international scenario.
CO4: To Study various tools and techniques of promoting the products in ethical manner.
CO5: To Understand emerging concepts of marketing in the emerging global markets

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1						M	L					L			
CO2							M	M	L	L					
CO3						L		H							
CO4						H	M	H	L	L					
CO5							H					H			

Course Topics:

Unit 1:MARKETING **9 Hours**

Meaning - concept - functions - marketing Planning and implementation marketing Programmes - Marketing environment – Market Segmentation and consumer behaviour – Influencing factors, Decision process –Marketing mix – Marketing department

Unit 2:PRODUCT **9 Hours**

Meaning - Product planning - policies - positioning - New product development Product life cycle – BCG Matrix - branding. Packing, labelling

Unit 3: PRICING **9 Hours**

Pricing objectives – Setting and modifying the price – Different pricing method Product line pricing and new product pricing

Unit 4:DISTRIBUTION **9 Hours**

Nature of Marketing channels - Types of Channel flows – Channel functions - Channel co-operation, conflict and competition - Direct Marketing Telemarketing, Internet shopping

Unit 5: PROMOTION **9 Hours**

Promotion Mix - Advertisement - Message - copy writing – Advertisement - budgeting - Measuring advertisement effectiveness - Media strategy - sales promotion - Personal selling steps, publicity and direct marketing

Text Book(s):

1. Philip.T. Khotler, Kevin Lane Keller, Marketing Management, 15th Edition, Pearson Education, New Delhi, 2016.
2. Ramaswamy.VS, Namakumari. S, Marketing Management – Global Perspective, Indian Context, McGraw Hill, 2013

Reference(s):

1. Rajan Saxena, Dorector, Jain S.P., Marketing Management, McGraw Hill, 2006.
2. K.S. Chandrasekar, Marketing Management, Text and Cases, McGraw hill 2013.
3. Tapan K. Panda, Marketing Management Text and Cases, 2nd Edition, Excel Books.2008

HSS18R003Organisational Psychology

HSS18R003Organisational Psychology	***Credits***			
	L	***T***	***P***	***Total***
	3	***0***	***0***	***3***
Course Category: Humanities Elective - Theory				

Course Objective(s):

This course aims to clarify the principles and basic concepts of organizational psychology. Including organizations and understanding its business design based on efficiency and quality of employee life. It also aims at enhancing the quality of life of employees. When organization's aspects are gauged in terms of psychological assessment, personnel decisions in line with training and development, organizational change and organizational health in specific the intrinsic problems are understood paving way towards standards that are high.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To learn basic concepts of industrial and organisational psychology

CO2: To illustrate different ways of achieving organisational effectiveness through individual behaviour.
CO3: To learn the concepts relating to individual behaviour to achieve group target and achieve leadership position in organisation.
CO4: To understand the organisational changes and means to evaluate based on nature of organisations.
CO5: To learn implications of changes aligning the interest of individual, group and organisation.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1						M		L	M						
CO2						L		L	M	M					
CO3						L		L	M	H					
CO4						L	L	L	L	L					
CO5						L	L	L				L			

Course Topics:

Unit 1: FOCUS AND PURPOSE **9 Hours**

OrganisationalBehaviour - Need and importance, nature and scope, framework

Unit 2: INDIVIDUAL BEHAVIOUR **9 Hours**

Personality – types – factors influencing personality – theories – learning – types of learners – learning theories – organizational Behaviour modification. Attitudes – characteristics –components – formation – measurement. Perceptions – importance – factors influencing perception – interpersonal perception

Unit 3: GROUP BEHAVIOUR **9 Hours**

Pricing objectives – Setting and modifying the price – Different pricing method Product line pricing and new product pricing

Unit 4: LEADERSHIP **9 Hours**

Leadership styles – theories – Qualities - leaders Vs managers – sources of power – power centres – power and Organisational Politics- Motivation

Unit 5:ORGANISATIONAL DEVELOPMENT **9 Hours**

Organizational development - Importance, characteristics, objectives, stability Vs change, proactive vs reaction change, the change process, resistance to change, managing change, team building - Organizational effectiveness, perspective,

effectiveness Vs efficiency, approaches, the time dimension, achieving organizational effectiveness

Text Book(s):

1. Stephen Probing and Timothy A. Judge, Organisational Behavior, Peason Education, 17th edition, 2017.
2. Fred Luthans, Organisational Behavior, McGraw Education, 12th Edition, 2010

Reference(s):

1. Aswathappa, Organisational Behavior, Himalaya Publishing House, 12th edition, 2016.
2. P.Subba Rao, Management and Organisational behavior: Text, Cases and Games, Himalaya Publishing House, 1st edition, 2010.
3. Mullins, Organisational Behavior, Pearson Education Limited, 9th edition, 2010.
4. L.M.Prasad, Organisational Behavior, 5th edition, Sultan Chand and Sons, New Delhi, 2014

HSS18R004Project Management

HSS18R004Project Management	***Credits***			
	L	***T***	***P***	***Total***
	3	***0***	***0***	***3***
Course Category: Humanities Elective - Theory				

Course Objective(s):

This course describes concepts relating to project management and enable students to evolve project objectives appropriately with relevance to business proposals. It covers the required dimensions relating to evaluation of project by testing the technical feasibility, financial viability, market acceptability and social desirability of projects. It gives an account on risk and profitability analysis that facilitates the making of the effective project proposal and guides learners in project planning, implementation and control. It also emancipates the scope of project management in undertaking foreign collaboration projects.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Familiarizes the concept of project and steps in project management.
CO2: Understand the basics stages involved in preparing business proposals.
CO3: Evaluate the technical feasibility, financial viability, market acceptability and social desirability of projects.
CO4: Enabled to analyze the Risk and profitability of the project proposals
CO5: Act effectively as project managers and as part of project teams

Mapping of Course Outcome(s):

CO /	**PSO**

PSO	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1							L		L	M	H	L			
CO2						L		L	H	H	L				
CO3						H		L	L	L	H				
CO4						L	L	L	L	L	H	L			
CO5						L		L	H	L	L	L			

Course Topics:

Unit 1: INTRODUCTION TO PROJECT MANAGEMENT 9 Hours

Projects - Project ideas and preliminary screening. Developments - Project planning to Project completion - Pre-investment phase, Investment phase, operational phase - Governmental Regulatory framework. Capital Budgeting

Unit 2: STAGES OF PROJECT MANAGEMENT 9 Hours

Opportunity studies - prefeasibility studies, functional studies or support studies, feasibility study expansion projects, data for feasibility study. Market and Technical Appraisal: Market and Demand analysis, Market Survey, Demand forecasting. Technical analysis- Materials and inputs, Choice of Technology, Product mix, Plant location, capacity, Machinery and equipment

Unit 3: APPRAISAL PROCESS 9 Hours

Concepts. Time value of money - Present and future value. Appraisal criteria - Urgency, Payback period, Rate of return, Debt service coverage ratio, Net present value, Benefit cost ratio, Internal rate of return, Annual capital charge, Investment appraisal in practice

Unit 4: RISK AND PROFITABILITY ANALYSIS 9 Hours

Risk analysis- Measures of risk, Sensitivity analysis, and Decision tree analysis. Means of financing, Term Loans, Financial Institutions. Cost of capital. Profitability - Cost of Production, Break-even analysis. Assessing the tax burden and financial projections

Unit 5: PROJECT PLANNING, IMPLEMENTATION AND CONTROL 9 Hours

Forms of Project Organization, Project Planning, Implementation, and Control - Network construction, CPM, PERT, Development of Project schedule, Crashing of Project Network. Introduction to Foreign collaboration projects - Governmental policy framework, Need for foreign technology, Royalty payments, Foreign investments and procedural aspects

Text Book(s):

1. Prasanna Chandra, Projects: Planning, Analysis, Selection, Financing, Implementation, 8th Edition, McGraw Hill, 2014.
2. M.R. Gopalan, Project Management Core Textbook, 2nd edition, Wiley India, 2015

Reference(s):

1. Harold Kerzne, Project Management - Best Practices: Achieving Global Excellence, 3edition, Wiley Publications, 2013
2. George Ritz, Sidney Levy, Project Management in Construction, Sixth Edition, Mc. Graw Hill Education, 2011.
3. Gary Heerkens, Project Management, 2ndEdition, Mc. Graw Hill, 2013
4. P.Gopalakrishnan and V.E.Rama Moorthy Text Book of Project Management,1st Edition, Macmillan India Ltd., New Delhi, 2014.
5. John M. Nicholas, Herman Steyn, Project Management for Engineering, Business and Technology, 5th Edition, Routledge, 2016

HSS18R005 Stress Management and Coping Strategies

HSS18R005 Stress Management and Coping Strategies	***Credits***			
	L	***T***	***P***	***Total***
	3	***0***	***0***	***3***
Course Category: Humanities Elective – Theory				

Course Objective(s):

Stress has become an integral part of every professional's life. Approaching the stress in the right manner has become imperative as it has become an unavoidable one. The stress and its effect over performance has also become notable in today's organization. To cope well and to sustain in market, for that the skills are required to understand and to overcome the same. This course helps in understanding the intricacies of stress and overcoming the stress through appropriate approaches.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: The students understand the responsibility of tackling stress
CO2: The students identify and modify the approaches of stress accordingly while dealing with team in workplace.
CO3: Those students who are prone to face high- pressure working conditions will be able to tackle stress appropriately without ignoring.
CO4: The students will implement a stress -free work environment.
CO5: The students will enrich their way of behaviour and personality and ensure professional working condition and balanced quality of life.

Mapping of Course Outcome(s):

CO / PO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1							L		L	M		L			

CO2						L		M	H	H					
CO3						M		L	L						
CO4						L	L	L	L	L		L			
CO5						L		L	H	L		L			

Course Topics:

Unit 1: UNDERSTANDING STRESS **9 Hours**

Meaning - Symptoms: Biological and Behavioural - Work Related Stress - Individual Stress – Reducing Stress – Burnout

Unit 2: COMMON STRESS FACTORS TIME **9 Hours**

Common Sources of Stress Biological, Personality and Environmental – Time Management – Techniques – Importance of planning the day – Time management schedule – Developing concentration – Organizing the Work Area - Prioritizing – Beginning at the start – Techniques for conquering procrastination – Sensible delegation – Taking the right breaks – Learning to say 'No'

Unit 3: CRISIS MANAGEMENT **9 Hours**

Implications – People issues – Structure issues, environmental issues, psychological fall outs – Learning to keep calm – Preventing interruptions – Controlling crisis – Importance of good communication – Taking advantage of crisis – Pushing new ideas – Empowerment

Unit 4: WORK PLACE HUMOUR **9 Hours**

Developing a sense of Humour – Learning to laugh, role of group cohesion and team spirit, using humour at work, reducing conflicts with humour. Coping Styles Defensive Behaviours and Problem-Solving

Unit 5: SELF DEVELOPMENT **9 Hours**

Improving Personality – Leading with Integrity, enhancing creativity – Effective Decision Making – Sensible Communication – The Listening Game – Managing Self - Meditation for Peace – Yoga for Life

Text Book(s):

1. D. Gordano and G. Everly., "Controlling Stress and Tension", 9th Edition, Prentice-Hall, 2013.
2. Greenberg Jerrold S., Comprehensive Stress Management, 14th Edition, McGraw Hill Education, 2017.

Reference(s):

1. Dr. P.K.Dutta, "Stress Management" Himalaya Publishing House, First Edition 2010.
2. Schafer, Stress Management, 4th Edition, Cengage Learning, Delhi, 2008
3. Wolfgang Linden, Stress Management, Sage Publication, 1st Edition 2005.
4. Daniel Girdano, Dorothy Dusek and George S. Everly, Controlling Stress and Tension, 8th Edition, Pearson Education, 2009.
5. Brian Luke Seaward, Essentials of managing Stress, 1st edition, Jones & Bartlett Publishers, 2013

HSS18R006 ECONOMICS FOR ENGINEERS

HSS18R006 Economics for Engineers	Credits			
	L	*T*	*P*	*Total*
	3	*0*	*0*	*3*
Course Category: Humanities Elective - Theory				

Course Objective(s):

This course introduces a broad range of economic concepts, theories and analytical techniques. It considers both microeconomics - the analysis of choices made by individual decision-making units (households and firms) - and macroeconomics - the analysis of the economy. Demand and market structure will be analysed at the firm level. Macroeconomic issues regarding National Income, Inflation, labour and money at an aggregate level will be modelled. The role of government policy to address microeconomic market failures and macroeconomic objectives will be examined.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Identify and learn economic concepts into market economies.
CO2: Understand the pricing methods, interpret the market factors to determine the price for products or services and to making decisions based on demand factors.
CO3: Understand the major characteristics of different market structures and the implications for the behaviour of the firm.
CO4: Measure living standards, inflation, and unemployment for use as economic indicators.
CO5: Understand the role of international trade,

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1											H				
CO2						L		L			M				
CO3						L	L		M	L	L				
CO4	H	H									L				
CO5	L							L	L						

Course Topics:

Unit 1: DEFINITION AND SCOPE OF ECONOMICS **9 Hours**

Meaning - Symptoms: Biological and Behavioural - Work Related Stress - Individual Stress – Reducing StressDefinitions by A. Smith, A. Marshal and L. Robbins, P.Samuels on and their critical examination - Nature and scope of Economics - Micro-economics in relation to other branches of Economics

Unit 2: PRICING AND LAW OF DEMAND **9 Hours**

Demand, Factors influencing demand, Elasticity of demand - price, income and cross, concepts and measurement - Break Even Analysis – Law of Demand - Price, income and substitution effects - Giffen goods- Pricing Methods.

Unit 3: MARKET STRUCTURE **9 Hours**

Definition of market. Concepts of product and factor markets. Different types of market: perfect competition, monopoly, imperfect competition, monopolistic, competition and oligopoly. Demand and Supply schedules. Price determination under perfect competition in long and short run. Price determination under monopoly. Discriminating monopoly

Unit 4: MACRO ECONOMICS **9 Hours**

Meaning, Macro-economic Policy and Its Objectives and Instruments - National Income and Social Accounting - Concepts, components, and measurement - Basic circular flow of income model, Unemployment, trade cycle, Inflation - causes, types, effects and control

Unit 5: COMMERCIAL AND CENTRAL BANKS **9 Hours**

Credit creation, monetary policy and tools - Balance of payments - Items in the balance of payments account, equilibrium in the balance of payments

Text Book(s):

1. Gupta, S.B., Monetary Economics, S. Chand & Co., New Delhi, 2nd Edition, 2009.
2. RuddarDatt and K.P.M. Sundharam, Indian Economy, 70th Edition, S. Chand & Company Ltd., New Delhi, 2013.

Reference(s):

1. D.N. Dewedi, Managerial Economics, 8th Edition, S. Chand & Company Ltd., New Delhi, 2005.
2. Gupta, G.S. Macroeconomics, Theory and Applications, 2nd edition, Tata McGraw-Hill publishing company Ltd., New Delhi, 2004.
3. Macroeconomic –Theory and policy, 3rd Edition, Tata McGraw-Hill publishing company Ltd., New Delhi, 2010.
4. Micro Economics, Mas Colell, 1st edition, Oxford Press, Delhi, 2012

HSS18R007 Human Resource Management and Labour Law

HSS18R007 Human Resource Management and Labour Law	***Credits***			
	L	***T***	***P***	***Total***
	3	***0***	***0***	***3***

Course Category: Humanities Elective – Theory

Course Objective(s):

This course aims at exploring key issues related to the management, performance, and development of human resources in the workplace. It places special emphasis on making decisions and developing plans that will enable managers to make the best possible use of their human resources, and covers areas such as: manpower planning, analysis and evaluation, recruitment and selection, wages and salaries, training and management development, performance appraisal, and industrial relations.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To provide the basic knowledge on developing the employment relations and knowledge to resolve the issues.
CO2: To design an appropriate and suitable role of HR specialist for implementing Human Resource Management policies.
CO3: To Manage the manpower to motivate and attract them to retain in the organization.
CO4: To Develop the responsibility of employer and legal system to manage the employment relations
CO5: To Provide more insights on the applicability of business law on various functional domains this in turn enhances a strong human relation

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1							L	L	M						
CO2									M	M					
CO3									H	H					
CO4						L		L	L						
CO5						L	L	L	H						

Course Topics:

Unit 1: FUNDAMENTALS OF HRM **9 Hours**

Human Resource Development Systems-HR environment in India-Functions and Operations of a Personnel Office - Emerging HR Trends - HR information system

Unit 2: HRM FUNCTIONS **9 Hours**

Job analysis and job design - HR planning – Recruitment - selection and induction-Staff Training and Development-Career planning and Development- Job Evaluation-Performance Appraisal and Potential Evaluation-Wage determination; salary structure-Wage policies and Regulations-Employee benefits and services.

Unit 3: MOTIVATING HUMAN RESOURCES **9 Hours**

Team and Team work - Collective Bargaining Employee Morale – Participative Management – Quality Circle – Empowerment –counselling and mentoring

Unit 4: MAINTENANCE OF WORKERS **9 Hours**

Compensation Management- Reward system – Labour relations –Employee Welfare, Safety and Health – Employee benefits and services – Promotion, Transfers and separation – Ethical issues in HR Management and International Human Resource Management - Legal Aspect of Labour

Unit 5: BUSINESS LAW **9 Hours**

Factories Act, 1948 - Industrial Dispute Act, 1947 – Industrial employment – Standing Orders Act, 1946 – Trade Union Act, 1926 - Workmen Compensation Act, 1923, Employees State Insurance Act, 1948, Employees Provident Fund and Miscellaneous Provision Act, 1952, Payment of Gratuity Act, 1972. Payment of Wages Act 1936, Minimum wages Act, 1948– Payment of Bonus Act, 1965.Tamil Nadu Shops and Establishments Act.

Text Book(s):

1. Decenzo and Robbins, Human Resource Management, Wiley, 12th edition, 2015.
2. Prasad L.M., Human Resource Management, Sultan Chand, 2014.

Reference(s):

1. BiswajeetPattanayak, Human Resource Management, 3rd edition, Eastern Economy Edition, New Delhi, 2010.
2. C.B. Gupta, Human Resource Management, 13th Edition, Sultan Chand
3. V.S.P. Rao, Human Resource Management, 3rd edition, Excel Books.
4. Frank B. Cross and Roger LeRoy Miller, The Legal Environment of Business Text and cases, 9th Edition, Cengage Learning, 2015

HSS18R008 Entrepreneurship Development

HSS18R008 Entrepreneurship Development	***Credits***			
	L	***T***	***P***	***Total***
	3	***0***	***0***	***3***
Course Category: Humanities Elective - Theory				

Course Objective(s):

This course focuses on the entrepreneurial process and the different kinds of entrepreneurial outcomes. Topics covered include opportunity identification through analysis of industry niches, skills needed to turn an opportunity into reality, business plans, launch decisions, and obtaining risk capital. This course deals with the problems and challenges facing the management of businesses in raising funds, marketing products and services, improving effectiveness and flexibility, and achieving growth.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: It provides more insights into the concept of entrepreneurship and which in turn leads to think creatively for new business opportunities to sustain individual as well as social goals.

CO2: It provides and promotes entrepreneurial spirit and provides a framework of successful business world with relation to agencies to promote employment opportunities.

CO3: It focuses on women entrepreneurship and promotes a successful business models and explains operational implementations for investment details.

CO4: It provides the role of government in promoting the entrepreneurship among the individuals and organizations as a whole

CO5: To Understand emerging concepts of marketing in the emerging global markets and provide more insights into project management and venture promotion

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1						H	L	L	M	L		L			
CO2						L		L	L						
CO3						M		M	M						
CO4								L	H	L					
CO5							H				L	H			

Course Topics:

Unit 1: BASICS **9 Hours**

Concepts of entrepreneur, entrepreneurship and entrepreneur - Characteristics and competencies of a successful entrepreneur - General functions of an entrepreneur - Type of entrepreneurs - Role of entrepreneur in economic development - Distinction between an entrepreneur and a manager - Entrepreneur and Intrapreneur

Unit 2: GROWTH OF ENTREPRENEURSHIP **9 Hours**

Emergence of entrepreneurship - Economic and non-economic factors for stimulating entrepreneurship development - Obstacles to entrepreneurship development in India - Growth of entrepreneurship in India.

Unit 3: WOMEN AND ENTREPRENEURSHIP **9 Hours**

Concept of women entrepreneurship - Reasons for growth of woman entrepreneurship - Problems faced by them and remedial measures

Unit 4:ROLE OF THE GOVERNMENT IN ENTREPRENEURSHIP DEVELOPMENT **9 Hours**

Concept and meaning of entrepreneurship development - Need for entrepreneurship development programmes (EDPs) - Objectives of EDPs - Organizations for EDPs in India; NIESBUD, SISI – their roles and activities.

Unit 5: VENTURE PROMOTION AND PROJECT FORMULATION **9 Hours**

Concept of projects classification of projects and project report - Project identification and selection - Constraints in project identification - Techniques of Project Identification, Significance – contents - formulation of project report - Need for Project Formulation - Elements of project Formulation

Text Book(s):

1. Michael H Morris, Corporate Entrepreneurship and Innovation in Corporations, 7th Edition, CENGAGE Learning, Delhi, 2010
2. Jerry Katz, Entrepreneurship Small Business, 5th edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2007

Reference(s):

1. Khanka S.S., Entrepreneurial Development, 1st edition, S. Chand and Company Limited, New Delhi, 2013.
2. Prasama Chandra, Projects: Planning, Analysis, Selection, Implementation and Reviews, 2nd edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1996.
3. Robert D. Hisrich, Entrepreneurship, 10th edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2017.

HSS18R009 Cost Analysis and Control

HSS18R009 Cost Analysis and Control	*Credits*			
	L	***T***	***P***	***Total***
	3	***0***	***0***	***3***
Course Category: Humanities Elective – Theory				

Course Objective(s):

This course in meant to exhibit the concepts on costing by describing its elements, types and cost sheet preparation. It also encompasses the analytical framework that can be applied in cost analysis like Marginal costing, CVP analysis, break even analysis, etc. enabling the students to make decisions on cost parameters. Students are enabled to apply techniques like standard costing, activity based costing, etc. to manage and control cost effectively.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understand the basics of Costing and preparation of Cost sheet.
CO2: Analyse the cost by applying tools like Marginal costing, CVP analysis and other applications.
CO3: Enabled to use Budgets for controlling cost in Manufacturing or Production Centres.
CO4: Defining cost standards and critically examining the application of Standard costing in a Production Centre.
CO5: Understanding the application of various strategic cost alternatives including Activity based costing.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1											H	L			
CO2											H	L			

CO3	L			L							M				
CO4									L		M				
CO5											M				

Course Topics:

Unit 1: BASICS OF COSTING **9 Hours**

Costing, Elements of costing, Types of cost, Preparation of cost sheet

Unit 2: COST ANALYSIS **9 Hours**

Marginal costing, Cost - volume – Profit analysis, Break-Even- Analysis, Break –Even - Chart, Applications.

Unit 3: CONTROL TECHNIQUES **9 Hours**

Budgeting and Budgetary control, Types of Budgets, Preparation of purchase Budget, Flexible budgets, Cash Budget, Sales Budget, Materials Budget, Master Budget, zero based Budgeting

Unit 4:STANDARD COSTING **9 Hours**

Types of Standards, Setting up of standards, Advantages and Criticism of Standard Costing –Control through variances.

Unit 5: ACTIVITY BASED COSTING **9 Hours**

Transfer Pricing, Target costing, Life Style Costing, Activity Based Costing (only theory)

Text Book(s):

1. K.Saxena& C.D. Vashist, Advanced Cost Accounting and Cost Systems, 2nd Edition, V.Sultan Chand & Sons Publishers. 2014
2. S.P. Jain & K. L. Narang, Advances Cost Accounting Kalyani Publishers, 1st Edition, 2017

Reference(s):

1. J. Blocher, K. H. Chen, G. Cokins and T. W. Lin., Cost Management: A Strategic Emphasis, Irwin/McGraw-Hill, 3d edition, 2008
2. Don R. Hansen, Maryanne M. Mowen, Cornerstones of Cost Management, 6th Edition, Cengage Learning, 2015
3. Roger Hussey, Audra Ong, Strategic Cost Analysis, Business Expert Press, 2012.

HSS18R010 Product Design and Development

HSS18R010 Product Design and Development	Credits			
	L	*T*	*P*	*Total*
	3	*0*	*0*	*3*
Course Category: Humanities Elective - Theory				

Course Objective(s):

This course aims to clarify the principles and basic concepts of Product Design and Development. Including organizations and understanding of its products. It also aims at enhancing the quality of products. Product Design means recognition of a new product need, information gathering and requirements setting up, unambitious-clear and complete specification list, study on the product's mechanical architecture, selection of materials and production processes and engineering the various components necessary to make the product work. Product Development means identification of market opportunity, creation of product to appeal to the identified market, and finally, testing, modifying and optimizing the product until it is ready for production.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To learn basic concepts related to design and development of New product
CO2: To understand the structured approach towards incorporating quality, safety, and reliability into design.
CO3: To learn the concepts relating to simulating product performance and manufacturing processes.
CO4: To understand the technologies related to computer aided group technology
CO5: To learn implications of changes related to Economic analysis.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1				L		L	M					L			
CO2				L		L	M					L			
CO3							M					L			
CO4							L	L				L			
CO5				L				M		L	L	L			

Course Topics:

Unit 1: NEW PRODUCT IDEA **9 Hours**

Definition – Design by Evolution and by Innovation - factors to be considered for product design – Production-Consumption cycle – The morphology of design – Primary design Phases and flowcharting. Role of Allowance, Process Capability, and Tolerance in Detailed Design and Assembly Product strategies, Market research – identifying customer needs – Analysis of product – locating ideas for new products,

Selecting the right product, creative thinking, curiosity, imagination and brain storming - product specification

Unit 2: NEW PRODUCT DESIGN **9 Hours**

Task - Structured approaches – clarification – search – external and internal – systematic exploration – conception, selection - methodology benefits. The value of appearance - principles and laws of appearance – incorporating quality, safety, and reliability into design. Man-machine considerations – Designing for ease of maintenance.

Unit 3: ROLE OF TECHNOLOGY IN DESIGNING **9 Hours**

Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing process – Needs for industrial design-impact – Industrial design process – Technology driven products - user driven products – assessing the quality of the product

Unit 4:METHODS AND PRINCIPLES OF DESIGNING **9 Hours**

Methodologies and tools - Design axioms - Design for assembly and evaluation - Minimum part assessment - Taguchi Method - Robustness assessment - Manufacturing process rules - Designer's tool kit - Computer aided group process rules - Designer's tool kit - Computer aided group technology - Failure Mode Effective Analysis – Design for minimum number of parts – Development of modular design – Minimising part variations – Design of parts to be multifunctional, multi-use, ease of fabrication – Pooka Yoka principles.

Unit 5: FEASIBILITY ANALYSIS **9 Hours**

Estimation of manufacturing cost – cost procedures – Value Engineering - reducing the component cost and assembly cost – minimizing the system complexity – Basics and Principals of prototyping – Economic Analysis: Break even analysis. Classes of exclusive rights – Patents – Combination versus aggregation – Novelty and Utility – Design patents – Paten disclosure – Patent application steps - Patent Office prosecution - Sales of patent rights - Trademarks – copy rights.

Text Book(s):

1. Karl. T.Ulrich, Steven D., Product Design and Development, McGraw Hill International, 6th Edition, 2016.
2. A.K.Chitale and R.C.Gupta, Product Design and Manufacturing, 3rd edition, Prentice Hall of India Private Limited, New Delhi, 2005

Reference(s):

1. Richard Crowson, Product Design and Factory Development, 2nd Edition, CRC Press, 2005.

2. Thomke, Stefan, and Ashok Nimgade. "IDEO Product Development." Boston, MA: Harvard Business School Case 9-600-143, June 22, 2000.
3. George E.Dieter, Linda C.Schmidt, "Engineering Design", McGraw-Hill Higher Education, 4th Edition, 2012.
4. Kevin Otto, Kristin Wood, "Product Design", Indian Reprint 2004, Pearson Education

HSS18R011 Business Process Reengineering

HSS18R011 Business Process Reengineering	Credits			
	L	*T*	*P*	*Total*
	3	*0*	*0*	*3*
Course Category: Humanities Elective - Theory				

Course Objective(s):

This course aims to clarify the principles and basic concepts of Business Process Engineering.

This course focuses on both quantitative and qualitative analytical skills and models essential to operations process design, management, and improvement in both service and manufacturing oriented companies. The main objective of the course is to prepare the student to play a significant role in the management of a world class company which serves satisfied customers through empowered employees, leading to increased revenues and decreased costs.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To learn the basic concepts related to Business Process Reengineering.
CO2: To understand the methodologies and tools used for Business Process Reengineering.
CO3: To learn the concepts relating to benefit/cost analysis and its impact on the business organizations.
CO4: To understand the need for assessment of business re-engineering and the factors contributing to its success.
CO5: To learn the best practices used in Business Process Reengineering with illustrations from corporate world.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1						L	L	M	L						
CO2						L	L	H	L						
CO3						L		L	L	L	M	L			
CO4	L						L	L							

CO5							M					H			

Course Topics:

Unit 1: BASIC CONCEPTS **9 Hours**

Introduction to BPR Definition; the paradigm shifts in production; the positioning concept; the re-engineering visions; the benefits of business re-engineering

Unit 2: METHODOLOGIES FOR BPR **9 Hours**

Methodologies and Tools for BPR, Process management; dynamic business re-engineering change framework; steps to reengineer the process.

Unit 3: MODELLING THE BUSINESS **9 Hours**

Methodologies and Tools for BPR, Process management; dynamic business re-engineering change framework; steps to reengineer the process

Unit 4:CHANGE MANAGEMENT **9 Hours**

Change Management, Planned changes in business re-engineering projects; challenges of business change; business change development. Success factors in re-engineering. The assessment of business re-engineering.

Unit 5: BEST PRACTICES IN BPR **9 Hours**

Best Practices in BPR, Case studies: Bell Atlantic, Nissan, Chrysler, Xerox, and Hewlett Packard etc.

Text Book(s):

1. Ali K. Kamrani, Maryam Azimi (2011). New Methods in Product Design: New Strategies in Reengineering (Engineering and Management Innovation). CRC Press. 1st ed.
2. Bassam Hussein (2008). PRISM: Process Reengineering Integrated Spiral Model. VDM Verlag Dr. Mueller e.K

Reference(s):

1. Harmon, P. (2007), Business Process Change: A Guide for Business Managers and BPM and Six Sigma Professionals, Elsevier/Morgan Kaufmann Publishers.
2. 2. R. Anupindi et al. (2006), Managing Business Process Flows: Principles of Operations Management, Pearson

HSS18R012 POLITICAL ECONOMY

HSS18R012 Political Economy	***Credits***			
	L	***T***	***P***	***Total***
	3	***0***	***0***	***3***

Course Category: Humanities Elective - Theory

Course Objective(s):

This course introduces the political economy of India. It examines the interplay of politics and economics. Some of the key themes to be explored are globalization, economic reform, poverty, redistribution, federalism, political protest, public goods delivery, gender, and ethnic politics. Although this class focuses specifically on India, many the themes discussed in this course are functions of institutions, rights, Party Systems and challenges.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Explain the key concepts of political economy analyse the significant developments in the political ideologies.

CO2: Describe the salient features of the constitution of India and its functions and interpret, integrate and critically analyse the fundamental rights duties and responsibilities.

CO3: Understand the Political party system their evolution and role in the economy

CO4: Understand the various ideological of Indian Political Thoughts

CO5: Have a deep understanding and appreciation of India undergoing major economic and social transformation

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1						L		H				L			
CO2						L		M	L	L	L				
CO3											L				
CO4	L						L								
CO5							L					L			

Course Topics:

Unit 1: BASICS OF POLITICAL ECONOMY **9 Hours**

Political Economy as a Method, perspectives, Politics as Reproduction of Social Relations, State and Social Opportunity, Politics of Rent Seeking -Evolution of State in India: Historical Roots of planning, Redistribution

Unit 2: INDIAN CONSTITUTION **9 Hours**

The Pre-amble- Fundamental rights and duties, Directive Principles- Offices of the President, Prime Minister, Cabinet Government, Chief Election Commissioner, and Governor – Parliamentary system and Procedures - The Judiciary system.

Unit 3: PARTY SYSTEM **9 Hours**

National and regional political parties, ideological and social bases of parties; patterns of coalition politics; Pressure groups, trends in electoral behaviour; changing socio- economic profile of Legislators.

Unit 4:INDIAN POLITICAL THOUGHT **9 Hours**

Political Ideologies: Liberalism, Socialism, Marxism, Fascism, Gandhism and Feminism - Dharamshastra, Arthashastra and Buddhist traditions; Sir Syed Ahmed Khan, Sri Aurobindo, M.K. Gandhi, B.R. Ambedkar, M.N. Roy.

Unit 5: CHALLENGES TO INDIAN DEMOCRACY **9 Hours**

Uneven Development of Regions in India – Communalism – Regionalism – Violence – Corruption – environmental degradation- illiteracy –***p***opulation

Text Book(s):

1. Charles Sackrey, Geoffrey Schneider, Janet Knoedler, Introduction to Political Economy, Dollars & Sense, 8th Edition, 2016.
2. Robert.S.Dimand, Review of Political Economy: An Introductory Text, 1st Edition, Routledge, 2008.

Reference(s):

1. Barry R. weingast and Donald A.Wittman, Handbook of Political Economy, 1st Edition, Oxford University Press, New York, 2006.
2. Ed. Sanjay Ruparelia; Sanjay Reddy; John Harriss& Stuart Corbridge, Understanding India's New Political Economy: A Great Transformation, Routledge 1st Edition 2011.
3. M.Laxmikanth, Indian Polity, 4th Edition, McGraw Hill Education, New Delhi,2017.
4. Niraja Gopal Jayal, Pratap Bhanu Mehra, The Oxford Companion to Politics in India: Student Edition, Oxford Press, 2011

HSS18R013 Professional Ethics

HSS18R013 Professional Ethics	***Credits***			
	L	***T***	***P***	***Total***
	3	***0***	***0***	***3***
Course Category: Humanities Elective – Theory				

Course Objective(s):

This subject will provide students with ability to understand and analyse managerial problems in industry so that they can use resources (capitals, materials, staffing, and machines) more effectively.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Identify the multiple ethical interests at stake in a real-world situation or practice
CO2: Assess their own ethical values and the social context of problems
CO3: Develop critical thinking skills and professional judgement and understand practical difficulties of bringing about change
CO4: demonstrate knowledge of ethical values in non-classroom activities, such as service learning, internships, and field work
CO5: Manage differing opinions on complex ethical scenarios. It's important for those confronted with ethical challenges to be able to hold multiple conflicting points of view, without necessarily adhering to any of them.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1						L		H	L	L					
CO2						H	L	H	L	L					
CO3				L			M					L			
CO4						M	M		M	M		L			
CO5								M		L					

Course Topics:

Unit 1: ENGINEERING ETHICS **9 Hours**

Functions of Being a Manager – Stock holder and stakeholder management – Ethical treatment of employees - ethical treatment of customers- supply chain management and other issues

Unit 2: ENGINEERING AS SOCIAL EXPERIMENTATION **9 Hours**

Senses of Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional ideals and virtues – Theories about right action – Self-interest – Customs and religion – Use of Ethical Theories.

Unit 3: ENGINEER RESPONSIBILITY FOR SAFETY **9 Hours**

Corporate social responsibility - Collegiality and loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Discrimination.

Unit 4:RESPONSIBILITY AND RIGHTS **9 Hours**

Moral imagination, stake holder theory and systems thinking - One approach to management decision – making Leadership.

Unit 5: GLOBAL ISSUES **9 Hours**

Multinational Corporations – Environmental Ethics – Computer Ethics – WeaponsDevelopment – Engineers as Managers – Consulting Engineers – Engineers as ExpertWitnesses and Advisors – Moral Leadership – Sample code of conduct

Text Book(s):

1. Mike Martin and Roland Schinzinger, Introduction to Engineering Ethics, 2nd Edition, McGraw Hill, 2010.
2. Charles D Fledderman, Engineering Ethics, Pearson, 2011.

Reference(s):

1. R.S.Nagarajan, Text book on Professional Ethics and Human Values, New Age International, 2007.
2. Gail Baura, Engineering Ethics- An Industrial Perspective, 1st Edition, Academic Press, 2006.
3. Charles e. Harris, Michael s. Pritchard and Michael J. Rabins Texas, Engineering Ethics- Conecpts and Cases, 4th Edition, Cengage Learning, 2009.
4. Charles BymsFleddermann, Engineering Ethics, Pearson, 2008.
5. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2013.
6. Dr.V.Jeyakumar, Professional Ethics in Engineering, Lakshmi Publication, Chennai, 2014

HSS18R014 Operations Research

HSS18R014 Operations Research	*Credits*			
	L	***T***	***P***	***Total***
	3	***0***	***0***	***3***
Course Category: Humanities Elective - Theory				

Course Objective(s):

It is essential for professionals in any field to understand the ethical problems and principles in their field. The general principles of professional ethics will be examined, as well as the distinctive problems. This course is presented in three parts: theory; case studies; and research and presentation. Theory includes ethics and philosophy of engineering.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Identify and develop operational research models from the verbal description of the real System.
CO2: Build and solve Transportation Models and Assignment Models
CO3: Use mathematical software to solve the proposed models.
CO4: Develop a report that describes the model and the solving technique, analyse theresults and propose recommendations in language understandable to the decision-making processes in Management Engineering.
CO5: Design new simple models, like: CPM, MSPT to improve decision –making and develop critical thinking and objective analysis of decision problems

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1			L					L							

CO2			M									L			
CO3			L							L					
CO4			L							L					
CO5			M				L			L	M	L			

Course Topics:

Unit 1: LINEAR PROGRAMMING BASICS 9 Hours

Introduction to applications of operations research in functional areas of management - Linear Programming - formulation, solution by graphical and simplex methods (Primal - Penalty, Two Phase), Special cases - Dual simplex method

Unit 2: TRANSPORTATION MODELS AND ASSIGNMENT MODELS 9 Hours

Transportation Models (Minimising and Maximising Cases) – Balanced and unbalanced cases – Initial Basic feasible solution by N-W Corner Rule, Least cost and Vogel's approximation methods - Check for optimality - Solution by MODI / Stepping Stone method - Cases of degeneracy - Transhipment Models - Assignment Models (Minimising and Maximising Cases) – Balanced and Unbalanced Cases - Solution by Hungarian and Branch and Bound Algorithms - Travelling Salesman problem - Crew Assignment Models.

Unit 3: INTEGER LINEAR PROGRAMMING AND GAME THEORY 9 Hours

Solution to pure and mixed integer programming problem by Branch and Bound and cutting plane algorithms - Game Theory - Two Person Zero sum games - Saddle point, Dominance Rule, graphical and LP solutions.

Unit 4:REPLACEMENT MODELS AND DECISION THEORY 9 Hours

Replacement Models-Individuals Replacement Models (With and without time value of money) – Group Replacement Models - Decision making under risk – Decision trees – Decision making under uncertainty.

Unit 5: PROJECT MANAGEMENT METHOD AND SIMULATION 9 Hours

PERT / CPM – Drawing the network, computation of processing time, floats and critical path. Resource levelling techniques - Application of simulation techniques for decision making

Text Book(s):

1. Kalavathy S, Operations Research, Vikas Publishing House, 4TH Edition, 2013.
2. Paneerselvam R., Operations Research, Prentice Hall of India, 2ND Edition, 2006.
3. Tulsian P.C, Vishal Pandey, Quantitative Techniques (Theory and Problems), Pearson Education, Asia, First Indian Reprint 2002.

Reference(s):

1. D.S.Hira, Problems in Operations Research, Kindle Edition, S.Chand, 2010.
2. Prem Kumar Gupta and D.S. Hira, Operations Research,S.Chand, 2016.
3. R.C.Mishra,Principles of Operations Research, 1st Edition, New Age International 2011.
4. Kanti Swarup, P.K.Gupta and Man Mohan, Operations Research, 15th Edition, Sultan Chand and Sons 2010

HSS18R015 TOTAL QUALITY MANAGEMENT

HSS18R015 Total Quality Management	*Credits*			
	L	***T***	***P***	***Total***
	3	***0***	***0***	***3***
Course Category: Humanities Elective – Theory				

Course Objective(s):

This subject provides students with the knowledge to understand the philosophy and core values of Total Quality Management (TQM). It helps to determine the voice of the customer and the impact of quality on economic performance and long-term business success of an organization; apply and evaluate best practices for the attainment of total quality. Students who complete this course will be able to critically appraise management techniques, choose appropriate statistical techniques for improving processes and write reports to management describing processes and recommending ways to improve them.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understand the role and nature of quality in evolving international economic conditions
CO2: Apply the Principles of Quality Management for real time problems.
CO3: the quality encounter process, including supporting facilities and customer requirements/characteristics
CO4: Classify quality measurement methods and continuous improvement process
CO5: Frame Management strategy methods, including identification, development, implementation and feedback processes

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1								L			M				

CO2						M	L					L			
CO3						L				L	L				
CO4										L					
CO5							L			M		M			

Course Topics:

Unit 1: INTRODUCTION TO QUALITY MANAGEMENT **9 Hours**

Definitions – TOM framework, benefits, awareness and obstacles - Quality – vision, mission and policy statements - Customer Focus – customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality

Unit 2: PRINCIPLES AND PHILOSOPHIES OF QUALITY MANAGEMENT 9 Hours

Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi, Shingeo and Walter Shewhart - Concepts of Quality circle, Japanese 5S principles and 8D methodology.

Unit 3: STATISTICAL PROCESS CONTROL AND PROCESS CAPABILITY 9 Hours

Meaning and significance of statistical process control (SPC) – construction of control charts for variables and attributed - Process capability – meaning, significance and measurement – Six sigma concepts of process capability - Reliability concepts – definitions, reliability in series and parallel, product life characteristics curve - Business process re-engineering (BPR) – principles, applications, reengineering process, benefits and limitations.

Unit 4: TOOLS AND TECHNIQUES FOR QUALITY MANAGEMENT 9 Hours

Quality functions development (QFD) – Benefits, Voice of customer, information organization, House of quality (HOQ), building a HOQ, QFD process. Failure mode effect analysis (FMEA) – requirements of reliability, failure rate, FMEA stages, design, process and documentation.

Unit 5: TAGUCHI TECHNIQUES **9 Hours**

Taguchi techniques – introduction, loss function, parameter and tolerance design, signal to noise ratio - Seven old (statistical) tools - Seven new management tools - Bench marking and POKA YOKE

Text Book(s):

1. Poornima M.Charantimath., Total quality management, Pearson Education, 2nd Edition, 2011.
2. Dale H.Besterfield et al, Total Quality Management, Perarson Education, Thrid edition, (First Indian Reprints 2004).

Reference(s):

1. Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, First Edition, 2002.
2. Jams R. Evans, Total Quality: Management, Organisation and strategy, 4th Edition, South- Western College, 2004.
3. Vincent K.Omachonu, Joel E.Ross, Principles of Total Quality, 3rd Edition, CRC Press, 2004.
4. S.Rajaram, M. Sivakumar, Total Quality Management, Wiley Publishers, 1st Edition,2008.

HSS18R016ADVANCED SOFT SKILLS

HSS18R016ADVANCED SOFT SKILLS	*L*	*T*	*P*	*C*
	3	*0*	*0*	*3*
Course Category: Humanities Elective – Theory				

UNIT I EFFECTIVE COMMUNICATION

Comprehending Ability, Business Vocabulary, Speed Reading, Non-Verbal Communication, Cross Cultural Communication, Meeting Management, Technology trend awareness

UNIT II QUANTITATIVE ABILITY

Time & Work, Time-Speed-Distance, Permutation &CombinationProbability, Geometry & Mensuration, Number Properties, Ratio & Proportion, Mixtures &Alligation, Percentages, Profit-Loss-Discount, Averages, Progression, Higher Mathematics

UNIT III LOGICAL ABILITY

Non-Verbal Reasoning, Deductive & Inductive Reasoning, Binary Logic, Number Series, Clocks, Calendars

UNIT IV VERBAL ABILITY

Reading Comprehension, Parajumbles, Critical Reasoning, Subject-Verb Agreement, Synonyms & Antonyms, GrammarReading Comprehension &LogicMiscellaneous Verbal questions

UNIT V DATA INTERPRETATION

Line Charts, Bar Charts, Pie Charts, Venn diagrams, Caselets, Data tables.

D) HONOURS' ELECTIVES

EEE18R321 ENERGY STORAGE SYSTEMS

EEE18R321 ENERGY STORAGE SYSTEMS	Credits			
	L	T	P	Total
	3	0	0	3
Prerequisite: Nil	**Course Category:** Honors - Elective			

Course Objective(s):

Understand the necessity and usage of different energy storage schemes for different purposes

Have a technological overview of various energy storage schemes

Understand the operational mechanisms of each energy storage system

Be able to characterize and analyze electrochemical energy storages

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Apply engineering fundamentals to design and implement alternate energy storage technologies
CO2: To understand the principles behind the hydrogen storage
CO3: To understand knowledge on various kinds of batteries
CO4: To acquire knowledge on battery charging and charge controller
CO5: To fabricate and investigate the performance of selected energy storage solutions (e.g. fuel cells)

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S												S		
CO2	S	S											S		
CO3	S	S											S		
CO4	S	S	S	S				M					S	S	M
CO5	S	S	S	M				S				M	S	M	S

Course Topics:

Unit1: ENERGY STORAGE METHODS **9 Hours**

Need for Energy storage-Different energy storage Methods- Mechanical energy storage: Pumped storage, Compressed air storage - Electromagnetic storage-Electrostatic storage-

Thermal energy storage: Sensible heat storage, Latent heat storage-Different methods of chemical Energy storage-Reversible Chemical Storage.

Unit2: HYDROGEN ENERGY STORAGE SYSTEMS 9 Hours

Block diagram of Hydrogen energy systems - Properties of Hydrogen - Extraction methods of Hydrogen: Thermochemical methods - Electrolysis of water-Thermolysis of water- Bio photolysis - Hydrogen storage techniques Delivery of Hydrogen-Conversion of Hydrogen - Applications-Safety Issues.

Unit3: ENERGY STORAGE USING BATTERIES 9 Hours

Batteries - Construction and working - Elements of electrochemical cell-operation of electrochemical cell Theoretical cell voltage and capacity-Losses in a cell-Battery classification-Constructions and working principle of Lead Acid battery-Nickel Cadmium batteries-Lithium-ion batteries-Battery parameters: Battery capacity, Battery Voltage, Depth of discharge-Battery life cycle-Discharge/charge rate, Self-discharge-Ragone Plots.

Unit4: BATTERY CHARGING AND CHARGE CONTROLLERS 9 Hours

Factors affecting battery performance: Battery voltage level, Battery Discharge current, Battery Temperature during discharge-Factors affecting Choice of a battery-Battery charging and discharging methods-Charge controllers for stand-alone PV system-Types of charge controllers for stand-alone PV system: Shunt type, Series type, DC-DC converter type, MPPT charge controller –Power stage and control scheme for battery charging using DC-DC converter-Flow chart for battery charging.

Unit5: FUEL CELL 9 Hours

Introduction-Advantages-Applications-Classification of fuel cells- Construction and working of Phosphoric Acid fuel cell-Alkaline Fuel cell-Polymer Electrolyte Membrane Fuel cell-Fuels for Fuel Cells-Efficiency of Fuel cell-VI characteristics of Fuel Cell-Power Electronics controller for fuel cell .

Text Book(s):

1. Ter-Gazarian, A.G.Energy Storage for Power Systems, 2nd Edition, IET Publications, 2011.
2. Khan B.H.,"Non-Conventional Energy Resources", Tata McGraw Hill Publication, 2nd Edition, 2009.
3. Chetan Singh Solanki., "Solar Photovoltaics: Fundamentals, Technologies and Applications", PHI Learning Private Limited, 2nd Edition, 2012.

Reference(s):

1.Robert A. Huggins, "Energy Storage", Springer Science & Business Media, 2010.

EEE18R326 ARTIFICIAL NEURAL NETWORKS

EEE18R326 ARTIFICIAL NEURAL NETWORKS	Credits			
	L	*T*	*P*	*Total*
	3	*0*	*0*	*3*
Pre-requisite:MAT18R101	**Course Category:** Major Elective – Theory			

Course Objective(s):

To survey of attractive applications of artificial neural networks.

To practical approach for using artificial neural networks in various technical, organizational and economic applications.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To understand the basic concepts of neural network
CO2: To understand the various methods of learning process
CO3: To analyze the algorithms of multilayer perceptron
CO4: To understand the concepts of self-organization maps and modelling
CO5: To design and analyze the neuro dynamic model

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S												S		
CO2	S	M	S										S		
CO3	S			S								M	S	S	
CO4	S	S	S		S				S	S			S	M	S
CO5	S	S	S		S				S	L		S	S	S	M

Course Topics:

Unit 1: INTRODUCTION: 9 Hours

Neural Network-Human Brain, Models Of A Neuron, Neural Networks Viewed As Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence And Neural Networks

Unit 2: LEARNING PROCESS 9 Hours

Learning Process 1–Error Correction learning, Memory based learning, Hebbian learning Process 2-Competitive, Boltzmann learning, Credit Assignment Problem, Memory, Adaption, Statistical nature of the learning process , SINGLE LAYER PERCEPTRONS – Adaptive filtering problem, Unconstrained Organization Techniques, Linear least square filters, least mean square algorithm, learning curves, Learning rate annealing techniques, perception –convergence theorem, Relation between perception and Bayes classifier for a Gaussian Environment

Unit 3: MULTILAYER PERCEPTRON 9 Hours

Back propagation algorithm XOR problem, Heuristics, Output representation and decision rule, Computer experiment, feature detection, BACK PROPAGATION -back propagation and differentiation, Hessian matrix, Generalization, Cross validation, Network pruning Techniques, Virtues and limitations of back propagation learning, Accelerated convergence, supervised learning.

Unit 4: SELF ORGANIZATION MAPS 9 Hours

Two basic feature mapping models, Self-organization map, SOM algorithm, properties of feature map, computer simulations, learning vector quantization, Adaptive patter classification, Hierarchal Vector quantilizer, contexmel Maps

Unit 5: NEURO DYNAMICS 9 Hours

Dynamical systems, stability of equilibrium states, attractors, neuro dynamical models, manipulation of attractors' as a recurrent network paradigm, Hopfield models

Text Book(s):

1. Neural networks A comprehensive foundations, Simon Hhaykin, Pearson Education 2ndEdition 2004

Reference(s):

1. Artificial neural networks -B.Vegnanarayana Prentice Halll of India P Ltd 2005
2. Neural networks in Computer intelligence, Li Min Fu TMH 2003
3. Neural networks James A Freeman David M S kapura Pearson Education 2005 B. Venkataramani and M Bhaskar – Digital Signal Processors – McGraw Hill – 2010 (2nd Edition)

EEE18R308 ADVANCED CONTROL THEORY

EEE18R308 ADVANCED CONTROL THEORY	*Credits*			
	L	***T***	***P***	***Total***
	3	***0***	***0***	***3***
Pre-requisite:EEE18R251	**Course Category:** Honors Elective – Theory			

Course Objective(s):

To gain knowledge in the field of the advanced methods of automatic control for real dynamic systems.

To learn the Various models, analysis and design using state variable techniques (e.g. robots) with parametric uncertainty and signal disturbances

To provide adequate knowledge in the Phase plane analysis, describing function analysis and stability analysis of linear and non-linear systems.

To give a basic knowledge in describing function analysis.

To analyze the stability of the systems using different techniques.

To study the design of optimal controller

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Design the Controllers & Compensators
CO2: Determine the time and frequency responses of I and II order systems for various inputs
CO3: Analyze the stability of the system using Time domain and frequency domain methods
CO4: Design the compensators using Bode plot and root locus techniques
CO5: Solve the state equation by transformation methods.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S	S	S	S	S								S		
CO2	S	S	S	S	S								S	S	
CO3	S	S	M	S	S							M	S	M	
CO4	S	S	S	S	M								S	S	
CO5	S	S	S										S		

Course Topics:

Unit 1: CONTROL SYSTEM DESIGN BY FREQUENCY RESPONSE APPROACH **9 Hours**

Control system design by frequency response approach- root locus method-lead, lag and lead lag compensation. PI,PD and PID controllers design procedures and examples.

Unit 2: STATE SPACE ANALYSIS 9 Hours

Concept of state , State Variable and State Model, State Space Representation,Solution of State Equation, State Transition Matrix, State models for linear and continuous timesystems – Solution of state and output equation, Canonical Forms – Controllable Canonical Form, Observable Canonical Form, Jordan Canonical Form.Controllability and Observability.Discritisation of continuous time state equations. Solution of state difference equation, controllability and Observability tests for continuous time systems &Digital Control Systems.

Unit 3: EIGEN VALUE AND EIGENVECTOR SENSITIVITIES IN LINEAR SYSTEM 9 Hours

Continuous time systems: Introduction, first-order Eigen value sensitivities, first order eigenvector - Sensitivities, second-order Eigen value sensitivities, second-order Eigenvector sensitivities. Mode-Controllability Matrix: Distinct Eigen-values, confluent Eigen-values associatedwith single Jordan block, confluent Eigen-values associated with number of distinct Jordanblocks, confluent Eigen-values associated with a number of non-distinct Jordan block.Mode –Controllability structure of multivariable linear systems

Unit 4: OBSERVABILITY MATRICES &PHASE PLANE ANALYSIS 9 Hours

Distinct Eigen-values, confluent Eigen-values, mode observability structure of multivariable linear systems: Introduction, Features of linear and non-linear systems: Common physical nonlinearities: Methods of linearisingnon-linear systems ,Concept of phase portraits Plane Analysis , – Phase plane analysis of linear and non-linear systems – basic concept,Singular points – Limit cycles construction of phase trajectories – Isocline and delta methods, Describing function – basic concept – derivation of describing functions – stability analysis by describing function method.

Unit 5:LYAPUNOV STABILITY ANALYSIS: 9 Hours

Stability of equilibrium state, asymptotic stability, graphical representation, Second method of Lyapunov, stability in the sense of Lyapunov, Lyapunov's first and second methods Stabilitydefinitions, Stability theorems, Lyapunov functions for linear and non-linear systems Lyapunov stability theorems, stability analysis of linear systems, nonlinear systems, construction of Lyapunov functions using Krasovskii method, variable gradient method Lyapunov stability analysis of linear time varying systems.Lyapunov stability Analysis-Basic concepts.

Text Book(s):

1. Advanced Control Systems B. N. Sarkar, PHI Learning Private Limited(2014).
2. Advanced Control Theory, Somanath Majhi, Cengage Learning,2017
3. Digital Control And State Variable Methods 5th Edition,M.Gopal, Tata Mcgraw –Hill (Sep-08)
4. Optimal Control Theory: An Introduction. Donald E. Kirk, Dover Publications (30-apr-06)
5. Digital Control Systems Second Edition, Benjamin C. Kuo , Oxford University Press (2017)

Reference(s):

1. M. Gopal, "Modern Control System Theory", Wiley Eastern Ltd., New Delhi,2017
2. G. J. Thaler, "Automatic Control Systems", Jaico Publishing House, 2013.
3. Modal Control theory and applications – Brian Porter & Roger Corssley.
4. K. Ogata, "Modern Control Engineering", 3 ed. Prentice Hall of India (P) Ltd.,New Delhi.
5. Dr. K.P. Mohandas, .Modern Control Engineering., revised edition, SanguinePublishers, Bangalore, 2006.

EEE18R322 MODERN OPTIMIZATION TECHNIQUES

EEE18R322 MODERN OPTIMIZATION TECHNIQUES	Credits			
	L	T	P	Total
	3	0	0	3
Pre requisite: MAT18R101	**Course Category:** Honors - Elective			

Course Objective(s):

To introduce the fundamental concepts of Optimization Techniques and the importance of solving it in real time situations.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To understand the fundamentals of optimization problems with various constraints
CO2: To gain the knowledge in evolutionary optimization techniques
CO3: To gain the knowledge in particle swarm optimization techniques
CO4: To gain the knowledge in advance optimization techniques
CO5: To gain the knowledge in multi objective optimization techniques

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S												S		
CO2	S	S											S		
CO3	S	S											S		
CO4	S	S	S	S				M					S	S	M
CO5	S	S	S	M				S				M	S	M	S

Course Topics:

Unit1: FUNDAMENTALS OF OPTIMIZATION 9 Hours

Definition-Classification of optimization problems-Unconstrained and Constrained optimization-Optimality conditions-Classical Optimization techniques (Linear and nonlinear programming, Quadratic programming, Mixed integer programming)-Intelligent Search methods (Optimization neural network, Evolutionary algorithms, Tabu search, Particle swarm optimization, Application of fuzzy set theory).

Unit2: EVOLUTIONARY COMPUTATION TECHNIQUES 9 Hours

Evolution in nature-Fundamentals of Evolutionary algorithms-Working Principles of Genetic Algorithm- Evolutionary Strategy and Evolutionary Programming-Genetic Operators-Selection, Crossover and Mutation-Issues in GA implementation- GA based Economic Dispatch solution-Fuzzy Economic Dispatch including losses- Tabu search algorithm for UNIT commitment problem-GA for UNIT commitment-GA based Optimal power flow- GA based state estimation.

Unit3: PARTICLE SWARM OPTIMIZATION 9 Hours

Fundamental principle-Velocity Updating-Advanced operators-Parameter selection- Hybrid approaches (Hybrid of GA and PSO, Hybrid of EP and PSO) -Binary, discrete and combinatorial PSO-Implementation issues Convergence issues- PSO based OPF problem and UNIT commitment-PSO for reactive power and voltage control-PSO for power system reliability and security.

Unit4: ADVANCED OPTIMIZATION METHODS 9 Hours

Simulated annealing algorithm-Tabu search algorithm-SA and TS for UNIT commitment-Ant colony optimization- Bacteria Foraging optimization.

Unit5: MULTI OBJECTIVE OPTIMIZATION 9 Hours

Concept of paretooptimality-Conventional approaches for MOOP-Multi objective GA-Fitness assignment-Sharing function-Economic Emission dispatch using MOGA-Multi objective PSO (Dynamic neighborhood PSO, Vector evaluated PSO) –Multi objective OPF problem.

Text Book(s):

1. D.P.Kothari and J.S.Dhillon,"Power System Optimization", 2nd Edition, PHI learning private limited, 2010.
2. Kalyanmoy Deb, "Multi objective optimization using Evolutionary Algorithms", John Wiley and Sons, 2008.
3. Kalyanmoy Deb, "Optimization for Engineering Design",Prentice hall of India first edition,1988.

Reference(s):

1. D.P.Kothari and J.S.Dhillon,"Power System Optimization", 2nd Edition, PHI learning private limited, 2010.

2. Kalyanmoy Deb, “Multi objective optimization using Evolutionary Algorithms”, John Wiley and Sons, 2008.
3. Kalyanmoy Deb, “Optimization for Engineering Design”,Prentice hall of India first edition,1988.
4. Carlos A.CoelloCoello, Gary B.Lamont, David A.VanVeldhuizen,“Evolutionary Algorithms for solving Multi Objective Problems”, 2 nd Edition, Springer, 2007.
5. Soliman, AbdelHady, MantawyAbdelAal Hassan, “Modern optimization techniques with applications in Electric Power Systems”, Springer, 2012

EEE18R325 DISTRIBUTED GENERATION AND MICRO GRID

EEE18R325 DISTRIBUTED GENERATION AND MICRO GRID	Credits			
	L	*T*	*P*	*Total*
	3	*0*	*0*	*3*
Pre requisite: Nil	**Course Category:** Honors– Elective			

COURSE OUTCOMES:

After successful completion of course, the students will be able,

CO1 - To understand the energy crises and its remedies

CO2 - To understand the principles and standards of Distributed generation

CO3 - To analyze the impact of DG with grid

CO4 - To understand the concept of microgrid

CO5 - To analyze the issues for power quality in microgrid

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	S												S		
CO2	S	S											S		
CO3	S	S											S		
CO4	S	S	S	S				M					S	S	M
CO5	S	S	S	M				S				M	S	M	S

Unit 1 INDRODUCTION

Conventional power generation: advantages and disadvantages, Energy crises, Non-conventional energy (NCE) resources: review of Solar PV, Wind Energy systems, Fuel Cells, micro-turbines, biomass, and tidal sources.

Unit 2 DISTRIBUTED GENERATION

Concept of distributed generations, topologies, selection of sources, regulatory standards/ framework, Standards for interconnecting Distributed resources to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Energy storage elements: Batteries, ultra-capacitors, flywheels. Captive power plants.

Unit 3 IMPACT OF GRID INTEGRATION

Requirements for grid interconnection, limits on operational parameters,: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues.

Unit 4 MICROGRIDS

Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids, communication infrastructure, modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques.

Unit 5 POWER QUALITY ISSUES IN MICROGRIDS

Modelling and Stability analysis of Microgrid, regulatory standards, Microgrid economics, smart microgrids.

REFERENCE BOOKS

1. AmirnaserYezdani, and Reza Iravani, “Voltage Source Converters in Power Systems: Modeling, Control and Applications”, IEEE John Wiley Publications, 2009.
2. DorinNeacsu, “Power Switching Converters: Medium and High Power”, CRC Press, Taylor & Francis, 2006.
3. Chetan Singh Solanki, “Solar Photo Voltaics”, PHI learning Pvt. Ltd., New Delhi, 2009.

TEXT BOOKS

1. J.F. Manwell, “Wind Energy Explained, theory design and applications,” J.G. McGowan Wiley publication, 2002.
2. D. D. Hall and R. P. Grover, “Biomass Regenerable Energy”, John Wiley, New York, 1987.

3. John Twidell and Tony Weir, “Renewable Energy Resources” Tyalor and Francis Publications, 2005.

EEE18R327 POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS

EEE18R327 POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	*Credits*			
	L	*T*	*P*	*Total*
	3	*0*	*0*	*3*
Pre-requisite:EEE18R301	**Course Category:** Honors Elective – Theory			

Course Objective(s):

To Provide knowledge about the stand alone and grid connected renewable energy systems and to analyze the various operating modes of wind electrical generators and solar energy systems. To develop maximum power point tracking algorithms.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To provide knowledge about the stand alone and grid connected renewable energy systems.

CO2: To equip with required skills to derive the criteria for the design of power converters for renewable energy applications

CO3: To analyze and comprehend the various operating modes of wind electrical generators and solar energy systems.

CO4: To design different power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy systems.

CO5: To develop maximum power point tracking algorithms

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S												S		
CO2			S				S					S	S	S	S
CO3	S		S	S	M	S	S					S	S	S	S
CO4	M	S				S	M						M		M
CO5	S		M	M	S	S	S					M	S	S	M

Course Topics:

Unit 1: INTRODUCTION 9 Hours

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems

Unit 2: ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION 9 Hours

Reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.

Unit 3: POWER CONVERTERS 9 Hours

Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizingWind: Three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters- Grid Interactive Inverters-matrix converters.

Unit 4: ANALYSIS OF WIND AND PV SYSTEMS 9 Hours

Standalone operation of fixed and variable speed wind energy conversion systems and solar System-Grid Connection Issues -Grid integrated PMSG, SCIG Based WECS, grid Integrated solar system

Unit 5: HYBRID RENEWABLE ENERGY SYSTEMS 9 Hours

Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV Maximum Power Point Tracking (MPPT).

Text Book(s):

1. S. N. Bhadra, D.Kastha, S.Banerjee, "Wind Electrical Systems", Oxford University Press,2005.
2. B.H.Khan Non-conventional Energy sources Tata McGraw-hill Publishing Company,New Delhi,2009.

Reference(s):

1. Rashid .M. H "power electronics Hand book", Academic press, 2001.
2. Ion Boldea, "Variable speed generators", Taylor & Francis group, 2006.
3. Rai. G.D, "Non conventional energy sources", Khanna publishes, 1993.
4. Andrzej M. Trzynnadlowski, 'Introduction to Modern Power Electronics', Second edition, wiley India Pvt. Ltd, 2012.

EEE18R431 POWER SYSTEM DYNAMICS

EEE18R431 POWER SYSTEM DYNAMICS	Credits			
	L	*T*	*P*	*Total*
	3	*0*	*0*	*3*
Prerequisite: EEE18R471	**Course Category:** Honors - Elective			

Course Objective(s):

The topics of the course impart knowledge on basic concepts related to power system dynamics, modeling of Synchronous machine and SSR analysis and the controllers to maintain stability in the power system.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To analyze dynamic modeling of a synchronous machine.
CO2: To develop the models for excitation and speed governing system.
CO3: To explain the fundamental concepts of stability of dynamic systems
CO4: To address the small signal stability problem in power systems
CO5: To understand the concepts of sub synchronous resonance

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	S												S		
CO2	S	S											S		
CO3	S	S											S		

CO4	S	S	S	S				M					S	S	M
CO5	S	S	S	M				S				M	S	M	S

Course Topics:

Unit1: INTRODUCTION **9 Hours**

Basics of system dynamics – numerical techniques – introduction to software packages to study the responses. Concept and importance of power system stability in the operation and design - distinction between transient and dynamic stability.

Unit2: SYNCHRONOUS MACHINE MODELLING **9 Hours**

Synchronous machine - flux linkage equations - Park's transformation - per UNIT conversion - normalizing the equations - equivalent circuit - current space model - flux linkage state space model. Sub-transient and transient inductances - time constants

Unit3: MACHINE CONTROLLERS **9 Hours**

Exciter and voltage regulators - function and types of excitation systems - typical excitation system configuration - block diagram and state space representation of IEEE type 1 excitation system - saturation function - stabilizing circuit. Function of speed governing systems.

Unit4: STEADY STATE STABILITY **9 Hours**

System response to small disturbances - linear model of the unregulated synchronous machine and its modes of oscillation - regulated synchronous machine - distribution of power impact – linearization of the load equation for the one machine problem – simplified linear model– dynamic performance measure

Unit5: SUB SYNCHRONOUS RESONANCE **9 Hours**

Problems at power frequency- Phenomenon of Sub Synchronous Resonance (SSR) – Problems associated with SSR-Induction Generator effect- Torsional interaction-Effects and Counter measures for Transient Torque Problem.

Text Book(s):

1. "Power system dynamics – Stability and control", K. R. Padiyar, BSP publications, 2008
2. R. Ramanujam, "Power System Dynamics, Analysis and Simulation", PHI Learning, New Delhi, January 2010.
3. P. Kundur, 'Power System Stability and Control', McGraw Hill Inc., USA, 1994.

Reference(s):

1. PribindraChowdhuri, "Electromagnetic transients in power systems", Research Studies Press Limited, 2004.

2. M.A.Pai and W.Sauer, 'Power System Dynamics and Stability', Pearson Education Asia, India, 2002.
3. James A.Momoh, Mohamed.E. EI-Hawary. "Electric Systems, Dynamics and stability with Artificial Intelligence Application", Marcel & Dekker Inc., 1999.

EEE18R432 POWER SYSTEM STABILITY

EEE18R432 POWER SYSTEM STABILITY	***Credits***			
	L	***T***	***P***	***Total***
	3	***0***	***0***	***3***
Prerequisite: EEE18R471	**Course Category:** Honors - Elective			

Course Objective(s):

The topics of the course impart knowledge on basic concepts related to power system stability and swing equation for determining stability, understanding transient stability and steady state stability in detail and methods to improve it and the types of excitation systems and voltage regulators and its effect on stability

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To deduce the swing equation
CO2: To apply the different approaches for solving swing equation
CO3: To evaluate critical clearing angle and clearing time and its effect on stability
CO4: To analyze the different types of excitation systems and automatic voltage regulators and their effect on stability
CO5: To estimate the Steady state stability limit.

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	S												S		
CO2	S	S											S		
CO3	S	S											S		
CO4	S	S	S	S				M					S	S	M
CO5	S	S	S	M				S				M	S	M	S

Course Topics:

Unit1: INTRODUCTION TO STABILITY OF ELECTRIC POWER SYSTEMS **9 Hours**

Concept and importance of stability to power system operation and design-Steady state, transient and dynamic stability-A simple two-machine stability problem-Bad effects of instability-General Background: Review on principles of Mechanics-Swing equation for a Synchronous Machine-Reduction of a power system to a single equivalent machine connected to infinite bus-Equivalent power angle curve of two finite machines-Stability of multi machine system.

Unit2: SWING EQUATION AND ITS SOLUTION **9 Hours**

Solution of swing equations by step-by-step method (I & II)- Runge–kutta and Modified Euler's methods-Digital computer in power system simulation

Unit3: TRANSIENT STABILITY **9 Hours**

Equal Area criterion-Determination of the maximum sudden increase of generator output-Application of equal area criterion to transient stability under sudden switching and fault conditions(single line to ground, double line to ground and three phase faults)-Determination of critical clearing angle-Fault clearing-Effect of enclosure towards stability(Single circuit and Double circuit line)- Pre-calculated swing curves-Effects of fault clearing time on transient stability limit-Techniques for improving transient stability.

Unit4: EXCITATION SYSTEMS AND AUTOMATIC VOLTAGE REGULATORS **9 Hours**

Definitions of excitation systems-Schemes of excitation-Quick response excitation-Types of excitation systems and automatic voltage regulators-Calculation of exciter response by Graphical integration and step by step methods-Effect of speed governing system, inertia and damping on steady state and transient stability.

Unit5: STEADY STATE STABILITY 9 Hours

Significance of steady state stability-Power limit of transmission system-Clarke's diagram two machine systems with and without losses-Power angle characteristics and steady state stability limit of cylindrical rotor and salient pole synchronous machines-Effect of inertia, damping and governor operation on stability-steady state stability with automatic voltage regulators on two finite machines and one machine connected to infinite bus with and without external reactance-Damping on steady state and transient stability.

Text Book(s):

1. S.S.Vadhera: Power System Analysis and Stability, Khanna publishers.2013
2. K.A.Gangadhar: Electric Power System Analysis, Stability and Protection, Khanna Publishers, 2009.
3. MadhavaRao: Power system Protection static relays with microprocessors applications, 2nd edition, TMH, 2001.

Reference(s):

1. Edward William Kimbark: Power System Stability Volume I – Elements of Stability calculations, IEEE Press, Wiley Interscience publishers, 1995
2. M.L.Soni, P.V.Gupta, U.S.Bhatnagar, A.Chakrabarti: A text book on Power System Engineering, Dhanpat Rai & Co,2009 Edition
3. I.J.Nagrath and D.P.Kothari: Power System Engineering, TMH, 1994.
4. B.R.Gupta: Power System Analysis and Design, S.Chand& Co.

EEE18R433 POWER SYSTEM RESTRUCTURING

EEE18R433 POWER SYSTEM RESTRUCTURING				Credits
	L	T	P	Total
	3	0	0	3
Prerequisite: EEE18R471	**Course Category:** Honors – Elective			

Course Objective(s):

To expose the flexibility of restructuring.

To Study about private sectors

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To elucidate the concept of Deregulation, different entities, market structures and bidding
CO2: To understand the transmission pricing issues and Ancillary services
CO3: To address the technical challenges in Restructuring
CO4: To know the concepts of ancillary services management
CO5: To understand the concepts of technical challenges and availability of tariff

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

CO1	S											S		
CO2	S	S										S		
CO3	S	S										S		
CO4	S	S	S	S				M				S	S	M
CO5	S	S	S	M				S			M	S	M	S

Course Topics:

Unit1: INTRODUCTION **9 Hours**

Introduction about deregulation – Structure of restructured electric utility – Different entities – Deregulation situation around the world (Qualitative treatment) – Benefits from competitive electricity market – After effects of deregulation. Role of Load Managers

Unit2: POWER SYSTEM OPERATION IN COMPETITIVE ENVIRONMENT **9 Hours**

Role of ISO – Comparison of two different market structures – Operational planning activities of ISO – ISO in bilateral markets – Operational planning activities of GENCO – GENCO in pool and bilateral markets – Market participation issues – Competitive bidding

Unit3: TRANSMISSION OPEN ACCESS AND PRICING ISSUES **9 Hours**

Power wheeling – Types of transmission services in open access – Cost components in transmission – Pricing of power transactions – Pricing mechanisms in various countries.

Unit4: ANCILLARY SERVICES MANAGEMENT **9 Hours**

General description of some ancillary services – Ancillary service management in various countries – Reactive power as an ancillary service – Synchronous generators as ancillary service providers

Unit5: TECHNICAL CHALLENGES AND AVAILABILITY BASED TARIFF **9 Hours**

Total Transfer Capability – Limitations - Margins – Available transfer capability (ATC) – Procedure - Methods to compute ATC – Static and Dynamic ATC –Concept of Congestion Management – Bid, Zonal and Node Congestion Principles - Generation Rescheduling. Availability based tariff – Necessity – Working Mechanism – Beneficiaries – Day Scheduling Process – Deviation from Schedule – Unscheduled Interchange Rate – 24*4 block – System Marginal Rate – Trading Surplus Generation – Applications

Text Book(s):

1. Kankar Bhattacharya, Math H.J. Bollen and Jaap E. Daalder, “Operation of Restructured Power Systems”, Kluwer Academic Publishers, First Edition, 2001.
2. Loi Lei Lai, “Power system Restructuring and Regulation”, John Wiley sons, 2001.

Reference(s):

1. Shahidehpour.M and Alomoush.M, “Restructuring Electrical Power Systems”, Marcel Decker Inc., 2001.
2. G.Zaccour, “Deregulation of Electric Utilities”, Kluwer Academic Publishers 1998.
3. M.Illic, F.Galiana and L.Fink, “Power Systems Restructuring: Engineering and Economics”, Kluwer Academic Publishers, 2000.

EEE18R434 COMPUTER RELAYING AND PHASOR

MEASUREMENT UNIT

EEE18R434 COMPUTER RELAYING AND PHASOR MEASUREMENT UNIT	***Credits***			
	L	***T***	***P***	***Total***
	3	***0***	***0***	***3***
Prerequisite: EEE18R401	**Course Category:** Honors – Elective			

Course Objective(s):

The goal of this course is to understand the operating principles of a computer relay s and wide area measurement systems. Learning about main classification of relay types, wide area measurement systems and their behavior, mathematical background for understanding relaying algorithms and also examining line relaying algorithms and protection of power system components. It will be discussed about several hardware related question-such as the computer hierarchy in the substation, subsystems of a computer relay and analog to digital converters as and system relaying and control.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To know the basic concepts of protection algorithm
CO2: To understand the basic elements of digital protection
CO3: To gain the knowledge in phasor measurement
CO4: To understand the applications of phasor measurement UNIT
CO5: To understand the concept of adaptive protection

Mapping of Course Outcome(s):

CO / PSO	**PSO**														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	S												S		
CO2	S	S											S		
CO3	S	S											S		
CO4	S	S	S	S				M					S	S	M
CO5	S	S	S	M				S				M	S	M	S

Course Topics:

Unit1: MATHEMATICAL BACKGROUND TO PROTECTION ALGORITHMS **9 Hours**

Finite difference technique-Numerical differentiation-Least Squares Method-Fourier analysis-Fourier analysis of analog signals-Fourier analysis of discrete signals-Walsh function analysis.

Unit2: BASIC ELEMENTS OF DIGITAL PROTECTION 9 Hours

Signal conditioning subsystem-Transducers-Surge protection circuits-Analog filtering-Analog multiplexers-Conversion subsystem-Sampling theorem-Signal aliasing error-Sample and hold circuit-Digital multiplexing-Digital-to-Analog Conversion-Analog-to-Digital Conversion-Processor-Data and Program memory-Digital relay hardware unit.

Unit3: PHASOR MEASUREMENT 9 Hours

Introduction-Phasor representation of sinusoids-Phasor Estimation of Nominal Frequency Signals-Formulas for updating phasors –Nonrecursiveupdates-Recursive updates-Frequency Estimation.

Unit4: PHASOR MEASUREMENT APPLICATIONS 9 Hours

State Estimation-History-Operator's load flow-Weighted least square -Linear weighted least squares; Nonlinear weighted least squares-Static state estimation-State estimation with Phasor measurements-linear state estimation.

Unit5: ADAPTIVE PROTECTION 9 Hours

Differential and distance protection of transmission lines-Adaptive out-of-step protection.

Text Book(s):

1. Arun G. Phadke, James S. Thorp, 'Computer Relaying for Power Systems', A John Wiley and Sons Ltd., Research Studies Press Limited, 2009.
2. A.G. Phadke, J.S. Thorp, 'Synchronized Phasor Measurements and Their Applications', Springer, 2008.

Reference(s):

1.Arun G Phadke James S Thorp, 'Computer Relaying for Power Systems, Wiley Publication, 2nd Edition, 2009.

EEE18R403 POWER SYSTEM OPTIMIZATION

EEE18R403 POWER SYSTEM OPTIMIZATION	*Credits*			
	L	***T***	***P***	***Total***
	3	***0***	***0***	***3***
Pre-requisite: EEE18R471	**Course Category:** Honors Elective – Theory			

Course Objective(s):

Introduction to power system optimization problems, importance, and linkages. Understanding solution techniques suitable for specific problems

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To apply well-known optimization techniques to power system problem.
CO2: To solve the economic dispatch and UNIT commitment problem using optimization techniques.
CO3: To analyze the hydro thermal scheduling problems
CO4: To solve the optimal power flow problem of electrical power systems
CO5: To understand the knowledge of maintenance scheduling of thermal plants

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	S	S											S		
CO2	S	S	S	M	S	S							S	S	
CO3	S	M	S	S	S	M							S	S	
CO4	S	S	S	S	M								S	S	
CO5	S					S	S					S	S	M	S

Course Topics:

Unit 1: OPTIMIZATION TECHNIQUES 9 Hours

Introduction, Statement of an optimization problem, design vector, design constraints, constraint surface, objective function, classification of optimization problem. Classical optimization Techniques, single variable optimization, multivariable optimization with equality constraints, Direct substitution method, constrained variation method, Lagrange Multiplier method, formulation of multivariable optimization, Kunh-Tucker conditions.

Unit 2: ECONOMIC DISPATCH AND UNIT COMMITMENT 9 Hours

Incremental cost curve – co-ordination equations with loss and without loss– solution by direct method and Iteration method – base point and participation factors method – two generator system, coordination equations, incremental losses and penalty factors-Constraints in UNIT commitment – spinning reserve, thermal UNIT constraints, other constraints – solution using priority list method, dynamic programming method – forward DP approach – Lagrangian relaxation method, adjusting

Unit 3: GENERATION SCHEDULING–THERMAL AND HYDROTHERMAL SYSTEM 9 Hours

Long range hydro scheduling – short range hydro scheduling – hydro electric plant models – scheduling problems – short term hydrothermal scheduling problem – solution using lamda iteration method – dynamic programming, pumped storage schemes.

Unit 4: OPTIMAL POWER FLOW 9 Hours

Solution of optimal power flow (OPF) – Gradient method, Newton‟s method, linear sensitivity analysis – LP methods with real power variables only – LP method with AC power flow variables and detailed cost functions – security constrained optimal power flow – interior point algorithm – bus incremental costs.

Unit 5: MAINTENANCE SCHEDULING 9 Hours

Factors considered in maintenance scheduling – generator UNITs, turbines, boilers– maintenance scheduling using mathematical programming.

Text Book(s):

1. Dhillon.J., Kothari.D.P., Power System Optimization, Prentice Hall India,2004.
2. Power System Optimization, Kothari D. P. (Author), Dhillon J. S. (Author), PHI; 2 edition(2010).

Reference(s):

1. Allen J.Wood., Bruce F Wollenberg, Power Generation, Operation and control, John Wiley and sons, Newyork, Third Edition, 2013.
2. Mahalanabis. A.K., et.al., Computer Aided Power System Analysis and Control, Tata McGraw Hill Publishing Co. Ltd., NewDelhi 1988.
3. Power System Engineering, D Kothari (Author), I Nagrath (Author), Mcgraw Hill Education (India) Private Limited; 2 Edition (9 July 2007).

EEE18R412 SCADA AND DCS

EEE18R412 SCADA AND DCS	Credits			
	L	*T*	*P*	*Total*
	3	*0*	*0*	*3*
Pre-requisite:EEE18R251	**Course Category:** Honors Elective - Theory			

Course Objective(s):

The topics of the course focus onbasic concepts of implementation of digital controllers for industrial process, components of SCADA and DCS, architecture of DCS and information about the programming languages and the interfaces used in DCS and computer controlled systems.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To understand the basics of digital controllers
CO2: To know the concepts of computer controlled systems
CO3: To understand the architecture of distributed control system
CO4: To know the basics of operator interfaces in DCS
CO5: To understand the applications of SCADA and DCS in industries

Mapping of Course Outcome(s):

CO / PSO	PSO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	M												M		
CO2	S		S										S		
CO3	S		S										S		
CO4	L				S								L	S	
CO5	S		S		S								S	S	

Course Topics:

Unit 1: INTRODUCTION TO DIGITAL CONTROLLERS 9 Hours

Introduction - Computer in process control - Data loggers, Data acquisition systems (DAS) – Data storage with time stampings - Direct Digital Control (DDC), Supervisory Digital Control (SCADA) - Controller software -Man machine interface- Management Information System.

Unit 2: COMPUTER CONTROLLED SYSTEMS AND COMPONENTS OF SCADA 9 Hours

Basic building blocks of Computer controlled systems – SCADA – Data Acquisition System – Supervisory Control – Direct digital Control. SCADA: - Hardware and software, Remote terminal UNITs, Master Station and Communication architectures.

Unit 3: DISTRIBUTED CONTROL SYSTEM 9 Hours

DCS – Various Architectures – Comparison – Local control unit – Process interfacing issues – Communication facilities.

Unit 4: INTERFACES IN DCS 9 Hours

Operator interfaces - Low level and high level operator interfaces – Displays - Engineering interfaces – Low level and high level engineering interfaces – Factors to be considered in selecting DCS.

Unit 5: APPLICATIONS OF SCADA & DCS IN INDUSTRIES 9 Hours

Applications of SCADA & DCS in Thermal power plant, Cement manufacturing Industries, Sugar Industries, paper manufacturing Industries and Water Treatment plant.

Text Book(s):

1. Krishna kant, "Computer based industrial control", PHI, second edition, 2010.
2. Michael P. Lukas, "Distributed Control System", Van Nostrand Reinhold Co., Canada, 1995.
3. David Bailey & Edwin Wright, "Practical SCADA for Industry", Elsevier 2003.

Reference(s):

1. Krishna Kant, "Digital control systems", ISTE learning materials centre, First edition 2001.

Clarke, G., Reynders, D. and Wright, E., "Practical Modern SCADA Protocols: "DNP3, 60870.5 and Related Systems", Newnes, 1st Edition, 2004.

EEE18R397 INTERNSHIP/INDUSTRY TRAINING	***Credits***			
	L	***T***	***P***	***Total***
	0	***0***	***0***	***2***

Objectives:

The main objective of Industrial Training/Internship is to expose the students to actual working environment and enhance their knowledge and skill from what they have learned in the university. This course enhances student's knowledge with good qualities of integrity, responsibility and self-confidence.

Strategy:

The students can choose nearby industries and get approval by department coordinator and placement officer. Students prepare a PPTs report after completing the work to satisfaction. The student will be evaluated based on the presentation, communication and the viva voce examination by examiners.

Course outcomes:

- Understand the basic working environment of industry and relevant to our courses.
- Apply the acquired skills to enrich the in-plant training/internship.
- Students can improve their presentation skills and communication skills and also improve their self-confidence.

Online Courses

Course Code & Name: EEEO004 - Demand Response and the Smart Grid

Investment in electrical infrastructure has struggled to keep up with increased demand. We have seen demand become so strong that it has triggered large network failures. Demand response programs provide a simple way for facility managers to get paid for reducing consumption and relieving load on the power grid when it is stressed. In effect they are returning capacity to the grid and being paid for that asset. This course will look at the issues involved, how Demand Response works, why it is beneficial, and what the Smart Grid is.

Course Code & Name: EEEO005 Energy Efficiency Fundamentals for Industrial Automation and Control Professionals

A selection of classes to familiarize industrial automation and control professionals with the concepts of energy efficiency and the opportunities for using their automation and control skills to implement active energy management solutions. This learning path begins with energy efficiency fundamentals, provides insight into how to evaluate the financial impact of an energy management solution and the opportunity for savings in an industrial environment, and familiarizes the professional with specific applications of automation and control where active energy management solutions have been shown to have a significant financial impact.

Course Code & Name: EEEO006 Semiconductor Devices and Circuits

Week 1: Introduction, Important components of transmission system, Insulation coordination, Design and selection of insulators for transmission/distribution

Week 2: Basics of Semiconductors: Concept of Mobility and Carrier concentration

Week 3: Basics of Semiconductors: Continuity Equation

Week 4: Metal-Semiconductor Junctions

Week5: p-n Junctions

Week 6: Introduction to Transistors - BJTs, JFETs and MESFETs

Week 7: Introduction to MOSFETs

Week 8: MOSFET Details 1: Scaling, Threshold Voltage

Week 9: MOSFETs Details 2: Leakage, Other Parasitic

Week 10: MOSFETs: Parameter Extraction via Experiments

Week 11: Circuit Design with MOSFETs - Impact of Device Physics on Circuits

Week 12: Advanced Topics - Flexible Electronics

Course Code & Name: EEEO003 Internet of things: Communication Technologies

Week 1: Introduction

Welcome to the Internet of Things! Before diving into this course give us a chance to let you know what it is all about! We will walk you through a module by module outline that will give you highlights on the interesting aspects of the course.

Terminology/Cheat Sheet (Beginner)

In this course, you will see a lot of new words and acronyms you might not be familiar with. If you feel comfortable with your knowledge of tech terminology, feel free to skip these lessons since they will not affect the overall integrity of the course. If you see something that you want to know a little more about, feel free to watch the video to gain insight on some basic concepts. We do expect you to know the majority of this material before going into the next module, we would recommend going through the lessons as a quick brush up.

Week 2 : VOIP in a Nutshell

This module will take a high level look at what VoIP is in a nutshell. Essentially, we would like to talk a little more in depth about the key terms you may have seen in module 1. We will also go over a great open source VoIP application called Linphone, and explain a variety of ways you can use this open source code to expand on a VoIP application we will be making later on in the course. We will take a look at SIP and look at some online resources that might help you to understand the inner working of VoIP.

Week 3: Codecs

In this module our esteemed Professor HarinathGarudadri will talk about coders and decoders (Codecs). This will allow us to make better use of the communications in the data plane .We want to look at the motivation behind using Codecs, the different ways to take advantage of redundancies when using codecs and finally the ability to take advantage of different receiver / transmitter combinations. If we are able to understand the way that information is sent and received over the data plane we can create and use the right codecs.

Week 4 : Make your own VoIP application

The main part of this module will focus on you making your very own VoIP application on the Android operating system. In order to do this, you might have to brush up on some of the materials in Course 2. You will be required to use Android Studio to push the application onto your board. You will need to know how to use Git, adb and possibly fastboot in order to accomplish this. We will provide you with the code for your application, but remember, the code we are giving you is only a template that can be used to build a bigger and better application with a wide variety of functions. Once we have built your application and pushed it to your board, we will sit together and brainstorm everything we have seen in the last few courses and take a look at what we are now capable of building in the IoT market.

One-Credit Courses

EEEX008-Real Time Monitoring and Control of Modern Power System

Module –I

Distribution System, Electric Generation Industry, Electric Power Grid, Electric System Reliability, Electric Utility, Electricity Congestion, Electricity Demand, Energy Efficiency, Electricity

Module –II

Renewable energy resources, solar energy, wind energy, hybrid energy, renewable energy integration and issues, distributed generation introduction and DER's.

Module –III

Carbon Credentials, Carbon Neutrality, Trading, Climatic Changes, Alternate Energy sources, Storage methodologies –Introduction to Smart Grid, AMR, AMI.

Module –IV

MDAM -Communication infrastructure (PLC, BPL, Copper Optical Fibre, Wireless ,Internet), HAN, MDMS -(Customer information System (CIS), Outage Management System (OMS), Enterprise Resource Planning(ERP), Geographic Information System (GIS), Transformer Load Management (TLM)).

Module –V

Real-time data collection, Cloud services, Data analytics, DSM, Cost analysis. Case study –I and Case Study –II

EEEX009 - DESIGN & INSTALLATION GUIDELINE ON LIGHTNING PROTECTION SYSTEM

& SURGE PROTECTION DEVICES

(BASED ON IS / IEC 62305, IEC 60364 Standards)

Module I :

I. Lightning Principles

II. Types of Lightning & Lightning Physics
III. Basic Do's and Don't's
IV. Calculating Step & Touch Potential
V. Significance of IS 62305 over IS 2309 standards
VI. Self-practice Exercise

Module II :

I. Basic components of Lightning Protection System
II. Design Guideline principle
III. Key Significant Aspects in Component Selection for Lightning Protection System
IV. Case Studies and learnings
V. Complex system design
VI. Calculation of Separation / Safety Distance
VII. Self-practice Exercise

Module III :

I. Lightning Protection application for Petrochemical Industries
II. Risk Assessment and Risk calculation
III. Software based Risk calculation &Output Analysis
IV. Structural Lightning Protection System
V. Soil resistivity measure and calculation
VI. Type A & Type B Earthing
VII. Self-practice Exercise

Module IV :

I. Surge Protection Devices
II. Voltage Protection Level and Inpulse Withstanding Capacity
III. Insulation co-ordination as per IEC 60364-5-553
IV. Working principle of Surge Protection Devices

Module V :

I. Selection and calculation of SPDs.
II. Self-practice Exercise

EEEX006 - Model Based Design for Power Electronics and Electrical Drives

Module I

Modeling of diode in simulation. Diode with R, R-L, R-C and R-L-C load with ac supply. Modelling of SCR, IGBT and Power Transistors in simulation.

Module II

Simulation and hardware model of gate/base drive circuits, simulation of snubber circuits for protection.

Module III

Introduction to electrical machine modeling: induction, DC, and synchronous machines,

Module IV

Simulation of basic electric drives, various types of drives applications and its control strategies, stability aspects.

Module V

Simulation of single phase uncontrolled and controlled (SCR) rectifiers, Simulation of converter fed dc motor drives, Simulation of chopper fed dc motor.

EEEX007 Thermal Power Plant Familiarization, Equipment Operation and Control

Module I

Various requisites for carrying out commissioning activities, Sequence of commissioning process for thermal power stations.

Module II

Safety considerations in commissioning, Concept of computer application and necessary data collection during the commissioning activities.

Module III

Commissioning of service system like auxiliaries power supply, water etc. Commissioning of electrical and C&I systems and its equipment's.

Module IV

Commissioning process of equips and systems connected with boiler, turbine, generator and their auxiliaries; Problems connected with commissioning activities and their ratification.

Module V

Acceptance test and commissioning reports.