FACULTY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRICAL ENGINEERING
B.E., ELECTRICAL ENGINEERING
REVISED REGULATIONS & SYLLABI
(Students Admitted From the Academic Year 2018-2019)

Vision

Empowering the community of students of Electrical and Electronics Engineering with very high morals, values, ethics, skills and technical knowledge through a rich curriculum blending the equal proportions of theoretical and hands-on experience by a process of transformation via hard-work and perseverance, with a view to serving the society in the role of socially responsible engineers so as to look after the needs of the nation and to elevate the standard of living of the people by incorporating innovation and sustained research.

Mission

To attract the students to pursue not only the under graduation, but also up to the research level, with the exquisite infrastructure, learned faculties, state-of-the-art laboratories etc., from the Indian and International diasporas.

To foster the global standards in learning, teaching and research that owes to an overall development of the department, faculties and students within the university and from across the globe as well.

To enhance the calibre of students to be the most sought for, by the industrial and research entities.

To enable for a diversified and challenging career that is ensued by the highest degree of professionalism, entrepreneurship, managerial and administrative expertise.

PROGRAMME EDUCATIONAL OBJECTIVES

The core objectives of the B.E. programme in Electrical and Electronics Engineering are intended towards;

PEO-1

Enriching the technicalities of domain-specific-knowledge and moulding the fraternity of students to be the best bet for industry, research and academia.

PEO-2

Creating awareness and keen-interest in updating and exploiting the prevailing cutting-edge technologies unto the best possible extent, so as to address any complex, non-linear, real-time engineering issues.

PEO-3

Enabling to redress the problems of the chosen field of engineering with 4Es – ethical, economical, efficient and environmental concerns.

PEO-4

Paving foundation for developing multifaceted skills on the road to leadership, entrepreneurship, professionalism, interpersonal, critical thinking, problem solving, decision making, communication / presentation and innovation / imagination.

PROGRAMME OUTCOMES

PO-1

Identification, Analysis and Formulation of Real-time Engineering Problems and Ability to devise Innovative Methodologies for their Effective and Efficient Tackling.

PO-2

Application of Technical, Mathematical, Reasoning and Logical skills to Design and Implement Novel Systems, with a view to enhance the Standard of Living of the Society.

PO-3

Evaluation and Validation upon the State-of-the-art Solution Strategies employed in Various Spheres of Electrical and Electronics Engineering.

PO-4

Indulging in and Valuing the Ethical Principles, Eco-friendliness, Societal-benefits and Socio-economic concerns.

PO-5

To emulate in the Research pertaining to the Fundamental and Advanced Areas of Power Systems, Power Electronics, Digital Electronics, Microprocessors/ Microcontrollers etc.

PO-6

Capability to excel in Multi-disciplinary Specializations and Research in bridging the gap between the Conventional and Modern Modalities / Requirements.

PO-7

Abiding by the Regulations, Norms, Standards and Rules that have been put forth by the Pioneers and Organizations of the E.E.E. Society.

PO-8

Exhibition of Skills that look after Team-playing Virtues and Nurturing Leadership Qualities, especially while working in tandem with Fellow Engineers for Social Goodness.

PO-9

Curiosity in developing Managerial and Administrative capabilities that aims for the betterment of Professionals and Professionalism.

PO-10

Ability to engage in self-education to enable competence globally.

PO-11

Interact with engineering community and with society at large, regarding intricate engineering activities of technical perspectives and emerge as an efficient motivator.

PO-12

Appreciate the need for life-long learning independently in the broadest contest of technological challenges.

Mapping of PEO Vs PO				
	PEO 1	PEO 2	PEO 3	PEO 4
PO 1	✓	✓		
PO 2	✓	✓		✓
PO 3	✓	✓	✓	
PO 4			✓	✓
PO 5	✓			
PO 6	✓	✓		
PO 7		✓	✓	
PO 8				✓
PO 9				✓
PO 10	✓			✓
PO 11				✓
PO 12		✓		

COURSES OF STUDY AND SCHEME OF EXAMINATIONS (REGULATION -2019)

SEMESTER I									
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
ETBS101	BS-I	Physics	3	1	0	25	75	100	4
ETBS102	BS-II	Mathematics – I	3	1	0	25	75	100	4
ETES103	ES-I	Basic Electrical Engineering	3	1	0	25	75	100	4
ETBP104	BSP-I	Physics Laboratory	0	0	3	40	60	100	1.5
ETSP105	ESP-I	Electrical Engineering Laboratory	0	0	2	40	60	100	1
ETSP106	ESP-II	Engineering Workshop/ Manufacturing Practices	1	0	4	40	60	100	3
						Total Credits			17.5

SEMESTER II									
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
ETHS201	HS-I	English	2	0	0	25	75	100	2
ETBS202	BS-III	Chemistry	3	1	0	25	75	100	4
ETES203	ES-II	Programming for Problem Solving	3	0	0	25	75	100	3
ETBS204	BS-IV	Mathematics – II	3	1	0	25	75	100	4
ETHP205	HSP-I	Communication Skills and Language Laboratory	0	0	2	40	60	100	1
ETBP206	BSP-II	Chemistry Laboratory	0	0	3	40	60	100	1.5
ETSP207	ESP-III	Computer Programming	0	0	4	40	60	100	2

		Lab							
ETSP208	ESP-IV	Engineering Graphics and Drafting	1	0	4	40	60	100	3
						Total Credits			20.5
Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming III Semester.									

COURSES OF STUDY AND SCHEME OF EXAMINATIONS (REGULATION -2019)

SEMESTER III									
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
ETBS301	BS-V	Engineering Mathematics -III	3	1	-	25	75	100	4
ETES302	ES-III	Environmental Studies	3	-	-	25	75	100	3
ETES303	ES-IV	Engineering Mechanics	3	-	-	25	75	100	3
EEES304	ES-V	Fluid Mechanics and Hydraulic Machinery	2			25	75	100	2
EEPC305	PC-I	Electrical Circuit Analysis	3	-	-	25	75	100	3
EEPC306	PC-II	Analog Electronics	3	1		25	75	100	4
EESP307	ESP-V	Hydraulic Lab	-	-	3	40	60	100	1.5
EECP308	PCP-I	Electrical Circuits Lab	-	-	3	40	60	100	1.5
EECP309	PCP-II	Analog Electronics Lab	-	-	3	40	60	100	1.5
ETIT310	IT-I	Internship Inter/ Intra Institutional Activities*	***Four weeks during the summer vacation at the end of II Semester***				100	100	4.0
For the Lateral entry students total credit for III Semester is 23.5 as they are exempted from internship during summer vacation of II semester.			Total Credits						27.5

SEMESTER IV									
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
*EEBS401	BS-VI	Probability, Random Process and Numerical Methods	3	-	-	25	75	100	3
EEES402	ES-VI	Data Structures & C++ Programming	2	-	-	25	75	100	2
EEPC403	PC-III	Electrical Machines	3	-	-	25	75	100	3
EEPC404	PC-IV	Digital Electronics	3	-	-	25	75	100	3

EEPC405	PC-V	Electrical Measurements & Instruments	3	-	-	25	75	100	3
EEPC406	PC-VI	Electromagnetic Fields	3	-	-	25	75	100	3
EECP407	PCP-III	Electrical Machines Lab	-	-	3	40	60	100	1.5
EECP408	PCP-IV	Digital Electronics Lab	-	-	3	40	60	100	1.5
EECP409	PCP-V	Electrical Measurements Lab	-	-	3	40	60	100	1.5
						Total Credits			21.5
Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming V Semester.									

COURSES OF STUDY AND SCHEME OF EXAMINATIONS (REGULATION -2019)

SEMESTER V									
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
EEPC501	PC-VII	Microprocessorand Microcontroller	3	-	-	25	75	100	3
EEPC502	PC-VIII	Power Electronics	3	-	-	25	75	100	3
EEPC503	PC-IX	Control Systems	3	-	-	25	75	100	3
EEPC504	PC-X	Power Systems-I	3			25	75	100	3
EEPE505	PE-I	Professional Elective I	3	-	-	25	75	100	3
EEPE506	PE-II	Professional Elective II	3	-		25	75	100	3
EECP507	PCP-VI	Microprocessorand Microcontroller Lab	-	-	3	40	60	100	1.5
EECP508	PCP-VII	Power Electronics Lab	-	-	3	40	60	100	1.5
EECP509	PCP-VIII	Control Systems Lab	-	-	3	40	60	100	1.5
ETIT510	IT-II	Industrial Training / Rural Internship/Innovation / Entrepreneurship	***Four weeks during the summer vacation at the end of IV Semester***				100	100	4.0
						Total Credits			26.5

SEMESTER VI									
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
EEPC601	PC-XI	Power Systems-II	3	-	-	25	75	100	3
EEPC602	PC-XII	Embedded Systems	3	-	-	25	75	100	3
EEPE603	PE-III	Professional Elective - III	3	-	-	25	75	100	3
EEPE604	PE-IV	Professional Elective - IV	3	-	-	25	75	100	3
EEPE605	PE-V	Professional Elective -V	3	-	-	25	75	100	3
#YYOE606	OE-I	Open Elective - I	3	-	-	25	75	100	3
EECP607	PCP-IX	Power Systems Lab	-	-	3	40	60	100	1.5
EECP608	PCP-X	Embedded System Lab	-	-	3	40	60	100	1.5
						Total Credits			21.0
Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming VII Semester.									

SEMESTER VII									
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
ETHS701	HS-II	Engineering Ethics	2	-	-	25	75	100	2
EEPC702	PC-XIII	Industrial Electrical Systems	3	-	-	25	75	100	3
EEPE703	PE-VI	Professional Elective-VI	3	-	-	25	75	100	3
EEPE704	PE-VII	Professional Elective-VII	3	-	-	25	75	100	3
YYOE705	OE-II	Open Elective - II	3	-	-	25	75	100	3
EECP706	PCP-XI	Electrical Estimation and Drawing Lab	-	-	3	40	60	100	1.5
ETIT707	IT-III	Industrial Training / Rural Internship/Innovation / Entrepreneurship	***Four weeks during the summer vacation at the end of VI Semester***				100	100	4.0
						Total Credits			19.5

SEMESTER VIII									
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
EEOE801	OE-III	Open Elective – III (from the same department)	3	-	-	25	75	100	3
EEOE802	OE-IV	Open Elective – IV (from the samedepartment)	3	-	-	25	75	100	3
EEPV803	PV-I	Project Work and Viva-Voce	-	PR 10	S 2	40	60	100	6
									12

L	No. of Lecture	TR	No. of for Discussion on Industrial Training
T	No. of Tutorial	S	No. of Seminar on Industrial Training / Project
P	No. of Practical	PR	No. of for Discussion on Project work
CA	Continuous Assessment Marks	FE	Final Examination Marks
Credits	Credit points allotted to that course	Total	Total Marks

PROFESSIONAL ELECTIVES

EEPESCN-Electrical Machine Design
EEPESCN-Electrical Energy Conservation and Auditing
EEPESCN-Electrical Drives
EEPESCN-Electrical and Hybrid Vehicles
EEPESCN-Wind and Solar Energy Systems
EEPESCN-Digital Signal Processing
EEPESCN-Control Systems Design
EEPESCN-Computer Architecture
EEPESCN-Power System Protection
EEPESCN-High Voltage Transmission Systems
EEPESCN- Computer Aided Power System Analysis
EEPESCN-Communication Engineering
EEPESCN- VLSI Design
EEPESCN-Micro Electro Mechanical Systems

OPEN ELECTIVES

EEOESCN- Electrical Safety Engineering
EEOESCN- Generation of Electrical Energy
EEOESCN- Electrical Materials
EEOESCN-Soft Computing Tools for Electrical Engineering
EEOESCN- Biomedical Engineering
EEOESCN- Utilization of Electrical Energy

HONOURS COURSES

EEHESCN - Power System Dynamics and Control
EEHESCN - Restructured Power Systems
EEHESCN - Flexible AC Transmission System
EEHESCN - Power Quality Studies
EEHESCN - High Voltage Engineering
EEHESCN - Digital Control Systems

MINOR ENGINEERING COURSES

EEMISCN –Analog Electronics
EEMISCN –Digital Electronics
EEMISCN –Electrical Measurements & Instruments
EEMISCN –Microprocessor and Microcontroller
EEMISCN –Control System
EEMISCN – Industrial Electrical systems

		L	T	P	C
ETBS301	ENGINEERING MATHEMATICS - III	3	1	0	4

Course Objectives

- To train the students in partial differential equations, Fourier series, Boundary value problems, Fourier transform and Z-transform which can serve as basic tools for specialized studies in engineering.

Unit – I: Partial Differential Equations

Formation of partial differential equations by eliminating arbitrary constants and arbitrary functions - Solution of standard type of first order partial differential equations - Lagrange's linear equation - Linear partial differential equations of second order with constant coefficients.

Unit – II: Fourier series

Dirichlet's conditions - General Fourier series - Odd and Even functions - Half range sine series - Half range cosine series - Complex form of Fourier series – Parseval's identity.

Unit – III: Boundary Value Problems

Solutions of one dimensional wave equation – One dimensional heat equation (without derivation) – Fourier series solutions in Cartesian co-ordinates.

Unit – IV :Fourier Transform

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem - Parseval's identity

Unit – V : Z – Transform and Difference Equations

Z – transform – Elementary properties – Inverse Z – transform - Convolution theorem – Solution of difference equations using Z – transform.

Text Books

1. Kandasamy,P., Thilagavathy,K. and Gunavathy,K., Engineering Mathematics,6th ed., (Vol-I & II) S.Chand& Co Ltd. 2006, New Delhi.
2. Ventakataraman,M.K., 2003. Engineering Mathematics-The National Publishing Co., Chennai.

References

1. Veerarajan, T., Engineering Mathematics, 3rd edition, 2005, Tata McGraw Hill Pub.
2. Singaravelu, A., Engineering Mathematics, Meenakshi Publications, Chennai,2004.

Course Outcomes

At the end of this course, students will demonstrate the ability to

1. Acquire basic understanding of the most common partial differential equations.
2. Understand Fourier series,
3. Ability to solve some boundary value problems.
4. Fourier transform and Z-transform analysis.
5. To know about the transform and Differential equation.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓									
CO2			✓									
CO3	✓			✓								
CO4	✓			✓								
CO5										✓		

ETES302	ENVIRONMENTAL STUDIES	L	T	P	C
		3	0	0	3

Course Objectives

- To realize the importance of environment for engineering students.
- To understand the basics of ecosystems.
- To discuss various aspects of bio diversity and its conservation.
- To make aware the student about global environmental pollution problems and natural disasters.
- To give the ideas about advance technologies of engineering that will be useful to protect environment.

Unit–I: Multidisciplinary Nature of Environmental Studies

Definition, scope and importance - Need for public awareness. Natural resources and associated problems - Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources:

Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies- Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.- Role of an individual in conservation of natural resources.- Equitable use of resources for sustainable lifestyles.

Unit–II: Ecosystems

Concept of an ecosystem - Structure and function of an ecosystem - Producers, consumers and decomposers - Energy flow in the ecosystem -Ecological succession - Food chains, food webs and ecological - pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem - Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit–III : Biodiversity and its Conservation

Introduction – Definition: genetic, species and ecosystem diversity - Bio geographical classification of India - Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, National and local levels - India as a mega-diversity nation - Hot-spots of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - Endangered and endemic species of India - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit–IV: Environmental Pollution

Definition - Cause, effects and control measures of Air pollution - Water pollution - Soil pollution - Marine pollution- Noise pollution - Thermal pollution - Nuclear hazards- Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - Disaster management: floods, earthquake, cyclone and landslides. Sustainable development - Urban problems related to energy - Water conservation, rain water harvesting, and watershed management - Resettlement and rehabilitation of people; its problems and concerns. - Environmental ethics: Issues and possible solutions - Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.

Wasteland reclamation - Consumerism and waste products - Environment Protection Act - Air (Prevention and Control of Pollution) Act - Water (Prevention and control of Pollution) Act - Wildlife Protection Act - Forest Conservation Act - Issues involved in enforcement of environmental legislation.

Unit–V: Human Population and the Environment

Population growth, variation among nations - Population explosion – Family Welfare Programme - Environment and human health - Human Rights - Value Education - HIV/AIDS - Women and Child Welfare - Role of Information Technology in Environment and human health -Case Studies.

Field Work

Visit to a local area to document environmental assets –river / forest / grassland / hill / mountain-Visit to a local polluted site – Urban/Rural/Industrial/Agricultural - Study of common plants, insects, birds - Study of simple ecosystems-pond, river, hill slopes, etc. (Field work equal to 5 lecture)

Text Books

1. Agarwal, K.C., 2001. Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. BharuchaErach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net (R).

References

1. Brunner, R.C., 1989. Hazardous Waste Incineration, McGraw Hill Inc. 480p.
2. Clark, R.S., Marine Pollution, Clanderson Press Oxford (TB).
3. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T., 2001. Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p.
4. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
5. Down to Earth, Centre for Science and Environment (R).
6. Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute Oxford Univ. Press. 473p.
7. Hawkins, R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R).
8. Heywood, V.H.&Waston, R.T., 1995. Global Biodiversity Assessment. Cambridge Univ. Press 1140p.
9. Jadhav, H.&Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284 p.
10. Mckinney, M.L. & School, R.M., 1996. Environmental Science systems & Solutions, Web enhanced edition. 639p.
11. Mhaskar A.K., Matter Hazardous, Techno-Science Publication (TB).
12. Miller, T.G. Jr., Environmental Science, Wadsworth Publishing Co. (TB).
13. Odum, E.P., 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p.
14. Rao M N. &Datta, A.K., 1987. Waste Water treatment. Oxford & IBH Publ. Co. Pvt. Ltd. 345p.
15. Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut.
16. Survey of the Environment, The Hindu (M).
17. Townsend, C., Harper J., and Michael Begon, Essentials of Ecology, Blackwell Science (TB).
18. Trivedi, R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards, Vol I and II, Enviro Media (R).
19. Trivedi, R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (TB).
20. Wanger, K.D., 1998. Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p.

Course Outcomes

At the end of this course, students will demonstrate the ability to

1. Understand the importance of environment.
2. Analyze the importance of environment in engineering.
3. Apply their own ideas and demonstrate advanced technologies that will be useful to protect environment.
4. Employ awareness among the society about environmental problems and natural disasters.
5. Practice according to the present and future environmental issues.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				✓								
CO2		✓										
CO3				✓								
CO4				✓								
CO5		✓										✓

ETES303	ENGINEERING MECHANICS	L	T	P	C
		3	0	0	3

Course Objectives

- To introduce the fundamentals of forces and their effects with their governing laws.
- To understand the definitions of particle, body forces and their equilibrium conditions.
- To discuss about geo material properties of different types of surfaces of solids.
- To analyze the dynamics of particles and Newton's law of motion.
- To understand and predict the forces and its related motions.

Unit–I: Statics of Particles

Introduction-Units and Dimensions-Laws of Mechanics-Lami's Theorem-Parallelogram, Triangular and Polygon Law of Forces-Classification of Forces - Vectorial Representation of Forces-Coplanar Forces-Resolution of Forces.

Equilibrium of Particle-Vector representation of Space Force-Equilibrium of Particle in Space-Equivalent System of Forces-Principle of Transmissibility.

Unit–II: Equilibrium of Rigid Bodies

Free Body Diagram-Types of Supports- Types of loads- Types of beams-Action and Reaction of Forces- -Moments and Couples-Moment of a Force-Vectorial Representation of Moments and Couples.

Varignon's Theorem- Stable Equilibrium-Single Equivalent Force-Equilibrium of Rigid Bodies in Two Dimensions and Three Dimensions.

Unit–III: Geometrical Properties of Surfaces and Solids

Centroid and Centre of Gravity-Determination of Centroid of Sections of Different Geometry- Centre of Gravity of a Body-Area Moment of Inertia-Parallel Axis Theorem-Perpendicular Axis Theorem-Determination of Moment of Inertias of Rectangular, Triangular, Circular and Semi-circular- Moment of Inertias of structural Steel Sections of Standard and Composite Sections.

Polar Moment of Inertia-Radius of Gyration-Principal Moment of Inertia-Mass Moment of Inertia- Determination of Mass Moment of Inertia of a Thin Rectangular Plate, Thin Circular Disc, Solid Cylinder, Prism, Sphere and Cone from first principles.

Unit–IV: Dynamics of Particles

Introduction-Kinematics and Kinetics-Displacements, Velocity and Acceleration-Equations of Motion-Types of Motion-Rectilinear Motion-Relative Motion-Curvilinear Motion-Projectiles.

Newton's Laws of Motion-Linear Momentum-Impulse and Momentum - D'Alembert's Principle-Dynamic Equilibrium- Work Energy Equations-Law of Conservation of Energy-Principle of Work and Energy.

Unit–V : Friction and Elements of Rigid Body Dynamics

Friction Force-Laws of Sliding Friction-Equilibrium Analysis of simple systems with Sliding Friction-Wedge Friction.

Rolling Resistance-Translation and Rotation of Rigid Bodies-Velocity and Acceleration-General Plane Motion of Simple Rigid Bodies such as Cylinder, Disc/Wheel and Sphere.

Text Books

1. Beer, F.P., and Johnson, R., (2004).***Vector Mechanics for Engineers (Statics)***, McGraw Hill Book Company, New Delhi.
2. Palanichamy, M.S. and Nagan, S., (2010).***Engineering Mechanics (Statics and Dynamics)***, Tata McGraw Hill Publishing Company, Ltd., New Delhi.

References

1. Natesan,S.C., (2002). Engineering Mechanics (Statics and Dynamics), First Edition, Umesh Publications, New Delhi.
2. S.S.BhavikattiandK.G.Rajasekarappa,(1999).Engineering Mechanics, New Agent International (P) Ltd.
3. Sadhu Sing, (2000).***Engineering Mechanics,*** Oxford & IBH Publishing Co., New Delhi.
4. Irving H. Shames, (2006).***Engineering Mechanics,*** prentice Hall of India Ltd., New Delhi.
5. Hibbeller, R.C. and Ashok Gupta, (2010).***Engineering Mechanics: Statics and Dynamics,*** Edition, Pearson Education.

Course Outcomes

At the end of this course, students will demonstrate the ability to

1. Understand the forces and its related laws of mechanics in static and dynamic conditions.
2. Analyze the forces and its motions on particles, rigid bodies and structures.
3. Solve the moment of inertia of any section and masses for the structural members.
4. To study about Dynamics of particles.
5. Understand the elements of rigid body dynamics.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓										
CO2	✓											
CO3		✓										
CO4	✓					✓						
CO5		✓										

ETES304	FLUID MECHANICS AND HYDRAULICS MACHINERY	L	T	P	C
		2	0	0	2

Course Objectives

- To understand the physical properties of fluids, fluid pressure and its measurement.
- To derive the equation of conservation of mass and its application.
- To solve problems of fluid kinematics and dynamics specifically flow through pipes and open channel flow.
- To use important concepts of continuity equation, Bernoulli's equation and apply the same to problems.
- To study the performance of Turbines, Radial flow, Reaction turbines and governing of turbines.
- To study the characteristics of Centrifugal pumps and reciprocating pumps.

Unit–I: Properties of Fluids, Fluid Pressure and its Measurement

Mass density, specific weight, specific volume, specific gravity, viscosity - Newton's law of viscosity - compressibility - surface tension and capillarity - real and ideal fluids.

Pressure - atmospheric and vacuum pressures - measurement of pressure by manometers and pressure gauges - total pressure and center of pressure – Buoyancy - metacentre - simple problems.

Unit–II :Dynamics of Fluid Flow

Kinematics of flow - types of fluid flow - continuity equation - Euler's equation of motion - Bernoulli's equation - practical applications - venturimeter, orificemeter and pitot tube. Simple treatment of orifices, mouthpieces, notches and weirs.

Flow through pipes - loss of energy due to friction - minor energy losses - hydraulic gradient and total energy line - flow through pipes in series - Flow through parallel pipes - power transmission through pipes - flow through nozzles.

Unit–III: Flow in Open Channels

Classification of flow in channels - Chezy's and Manning's formulae - most economical Rectangular, Trapezoidal and Circular sections of channel.-Non-uniform flow through open channels - specific energy and specific energy curve - critical depth - critical velocity - critical, supercritical and subcritical flows - alternate depths.

Unit–IV: Impact of Jet and Turbines

Impact of jets - force exerted by a fluid on stationary and moving flat plates held in various positions - force exerted on curved plates - concept of velocity triangles.

Turbines: General layout of a hydroelectric power plant - Classification of turbines - velocity triangles for turbines - work done and efficiency, specific speed - Impulse turbine- Pelton Wheel – Reaction turbine - Francis turbine - simple problems - selection of turbines.

Unit–V: Pumps

Centrifugal pumps - main parts - work done - definitions of heads and efficiencies -multistage pumps - specific speed - priming - cavitations'.

Reciprocating pumps - main parts - working principle – slip - indicator diagrams - effects of acceleration and friction on indicator diagrams - maximum speed of a reciprocating pump - study of air vessels.

Text Books

1. P.N. Modi& Dr. S.M. Seth, "Hydraulics and Fluid Mechanics Including Hydraulics Machines", 20th Edition, Standard Book House, New Delhi; 2015.
2. R.K. Bansal, "A Text Book of Fluid Mechanics and Hydraulic Machines" Laxmi Publications (P) Ltd, Madras; 2011.
3. JagdishLal, "Fluid Mechanics and Hydraulics with Computer Applications", Metropolitan Book Company, 9th Edition, New Delhi; 2014.

References

1. K.L. Kumar, "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd. 8th Edition, New Delhi, 2014.
2. V.P. Vasandani, "Theory and Design of Hydraulic Machines including Basic Fluid Mechanics", Khanna Publishers, 11th Edition, New Delhi, 2016.

Course Outcomes

At the end of this course, students will demonstrate the ability to

1. Apply the basic knowledge of fluid mechanics in finding fluid properties, performance parameters of hydraulic turbines and pumps.
2. Understand various dynamics of fluid flow.
3. Use fluid dynamics for study of flow through pipes and flow in open channels.
4. Present hydraulic design for the construction of efficient hydraulic turbines and pumps.
5. Get through knowledge of different kinds of pumps.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓										
CO2	✓											
CO3		✓			✓							
CO4	✓											
CO5		✓										✓

EEPC305	ELECTRICAL CIRCUIT ANALYSIS	L	T	P	C
		3	0	0	3

Course Objectives

- To study of different network theorems, node and mesh analysis, duality.
- To impart knowledge on solving circuits using first and second order differential equation.
- To obtain the transient response of circuits.
- To introduce the analysis of single and three phase AC circuits.
- To analyze the electrical circuit using Laplace transforms and frequency response.
- To analyze Two Port Network for the calculation of impedance parameters

Unit - I: Network Theorems

Super position theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem.Analysis with dependent current and voltage sources. Node and Mesh Analysis.Concept of duality and dual networks.

Unit - II: Solution of First and Second order networks

Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

Unit - III: Sinusoidal steady state analysis

Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

Unit - IV: Electrical Circuit Analysis Using Laplace Transforms

Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances

Unit - V: Two Port Network and Network Functions

Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

Text Books

1. S. Salivahanan and S. Pravin Kumar, Circuit Theory, Vikas Publishing, 2014.
2. Sudhakar, A. and Shyam Mohan, S.P., Circuits and Network Analysis and Synthesis, Tata McGraw Hill Publishing Company Limited, New Delhi, Fourth Edition, 2010.

References

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall,2006.
2. D. Roy Choudhury, "Networks and Systems", New Age International Publications,1998.
3. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.
4. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education,2004.
5. K. V. V. Murthy and M. S. Kamath, "Basic Circuit Analysis", Jaico Publishers,1999.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Apply network theorems for the analysis of electrical circuits.
2. Obtain the transient and steady-state response of electrical circuits.
3. Analyze circuits in the sinusoidal steady-state (single-phase and three-phase).
4. Get knowledge of analyzing electrical circuit using Laplace transforms.
5. To understand two port network and met function.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓										
CO2			✓									
CO3			✓									
CO4			✓		✓							✓
CO5		✓										

EEPC306	ANALOG ELECTRONICS	L	T	P	C
		3	1	0	4

Course Objectives

- To provide sound knowledge at the fundamentals of electronic circuits
- To analyze the BJT circuits and its characteristics
- Introduction to MOSFET and small signal models
- To study multi-stage and operational amplifier
- To study the application Linear and nonlinear applications of op-amp circuits

Unit - I: Diode circuits

P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

Unit - II: BJT circuits

Structure and I-V characteristics 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 - III: 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, trans-conductance, high frequency equivalent circuit.

Unit - IV: 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 band width product)

Unit - V: Linear applications of op-amp

Idealized analysis of op-amp circuits. 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 Conversion. Zero Crossing Detector, Square-wave and triangular-wave generators.

Text Books

1. S. Salivahanan and N. Suresh Kumar, “Electronic Devices and Circuits” Tata McGraw Hill Education, Third Edition, 2012.
2. V.K. Mehta, Rohit Mehta, “Principles of Electronics”, S.Chand Publications, 2005.

References

1. A. S. Sedra and K. C. Smith, “Microelectronic Circuits”, New York, Oxford University Press,1998.
2. J. V. Wait, L. P. HuelsmanandG. A. Korn, “Introduction to Operational Amplifier theory and applications”, McGraw Hill U. S.,1992.
3. J. Millman and A. Grabel, “Microelectronics”, McGraw Hill Education,1988.
4. P. Horowitz and W. Hill, “The Art of Electronics”, Cambridge University Press,1989.
5. P.R. Gray, R.G. Meyer and S. Lewis, “Analysis and Design of Analog Integrated Circuits”, John Wiley & Sons,2001.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the characteristics of transistors.
2. Design and analyze various rectifier and amplifier circuits.
3. Design sinusoidal and non-sinusoidal oscillators.
4. Understand the functioning of OP-AMP and design OP-AMP based circuits.
5. Get knowledge about linear applications of OP-AMP.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			✓		✓							
CO2			✓		✓							
CO3			✓		✓							
CO4			✓		✓							
CO5	✓											

EESP307	HYDRAULICS LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives

- To understand the properties of fluids and fluid statics, methods for determination of co-efficient of discharge are to be explained and computed practically.
- To study of the characteristic features of pumps and turbines using experiments.
- To understand the significance and role of such utilities in their further course of study.

List of Experiments

1. Determination of Co-efficient of discharge of Mouth Piece
2. Determination of Co-efficient of discharge of Venturi meter
3. Determination of Co-efficient of Head loss due to Sudden Change in Section
4. Determination of Co-efficient of Head loss due to Friction in Pipe
5. Determination of Co-efficient of discharge of Rectangular Notch
6. Determination of Co-efficient of Impact of Jet on Vanes
7. Study of Performance characteristics of Elmo Pump (Centrifugal Pump)
8. Study of Performance characteristics of Sump Pump (Centrifugal Pump)
9. Study of Performance characteristics of Submersible Pump (Centrifugal Pump)
10. Study of Performance characteristics of Gould's Pump (Reciprocating Pump)
11. Study of Performance characteristics of Pelton Turbine (Constant Speed method)
12. Study of Performance characteristics of Francis Turbine (Constant Head method)
13. Determination of Metacentric Height of a floating vessel (Demo Only)
14. Study on Flow through Open Channel (Demo Only)

Course Outcomes

At the end of this course, students will demonstrate the ability to

1. Determine the properties of fluids, pressure and their measurements.
2. Measure flow in pipes and determine frictional losses.

3. Compute forces on immersed plane and curved plates applying continuity equation and energy equation in solving problems on flow through conduits.
4. Develop Characteristics of pumps and turbines.
5. Develop Characteristics of turbines.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓				✓						
CO2	✓	✓				✓						
CO3	✓	✓				✓						
CO4	✓	✓				✓						
CO5	✓	✓				✓						

EECP308	ELECTRICAL CIRCUITS LAB	L	T	P	C
		0	0	3	1.5

Course Objectives

- To solve circuits by applying theorems.
- To illustrate the concepts of RL and RC circuits.
- To gain knowledge about resonance circuits

List of Experiments

1. Verification of Thevenin's theorem
2. Verification of Norton's theorem.
3. Verification of Super position theorem
4. Verification of Maximum power transfer theorem.
5. Verification of Reciprocity Theorem
6. Study of Series and parallel RL circuits
7. Study of Series and parallel RC circuits
8. Study of Series and parallel RLC circuits
9. Wave shaping circuits
10. Series resonance circuits
11. Parallel resonance circuits

Course Outcomes

At the end of this course, students will demonstrate the ability to

1. Basic Knowledge about theorems.
2. Analyze RL, RC and RLC series circuits.
3. Analyze RL, RC and RLC parallel circuits.
4. Understand different wave shaping circuits.
5. Ability to design resonance circuit.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓									
CO2	✓	✓	✓									
CO3	✓	✓	✓									
CO4			✓			✓						
CO5		✓										

EECP309	ANALOG ELECTRONICS LAB	L	T	P	C
		0	0	3	1.5

Course Objectives

- To understand basic electronic components and its applications
- To understand the basic functions of operational amplifier.
- To illustrate the application of operational amplifier.

List of Experiments

1. Characteristics of Junction diode, Characteristics of Zener diode and Zener diode as a voltage regulator.
2. Half wave and full wave rectifiers with capacitor filter.
3. Characteristics of Transistors.
4. Characteristics of Field Effect Transistor.
5. Wave shaping circuits
6. Zero crossing detector and Schmitt trigger using OP-AMP
7. Precision Rectifiers
8. R.C Phase Shift Oscillator using OP-AMP
9. Voltage to Current Converter and Current to Voltage Converter
10. Instrumentation Amplifier
11. Design of Low Pass Filters/High Pass Filters.
12. Analog to Digital Converter.

Course Outcomes

At the end of this course, students will demonstrate the ability to

1. Learn the application and characteristics of basic electronic devices.
2. Understand the characteristics oftransistors.
3. Design and analyze various rectifier and amplifiercircuits.
4. Understand the functioning of OP-AMP and design OP-AMP basedcircuits
5. Understand the circuit connections and testing points

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓			✓							
CO2		✓			✓							
CO3		✓			✓							
CO4	✓											
CO5	✓						✓					

EEBS401	PROBABILITY, RANDOM PROCESS AND NUMERICAL METHODS	L	T	P	C
		3	0	0	3

Course Objectives

- Be exposed to probability, random processes, and statistical methods designed to contribute to the process of making scientific judgments in the face of uncertainty and variation.
- To develop the skills of the students in numerical mathematics using method of finite difference interpolation.
- To find numerical solution of algebraic and transcendental equations.
- To find the numerical solution of ordinary and partial differential equations.

Unit–I: Probability and Random Variables

Definition – Types of random variables - probability distribution function - probability density function – expectation and moments – moment generating functions –joint probability distribution -marginal probability distribution function – joint probability density function – marginal probability density function – conditional probability density function.

Unit–II: Random Processes

Classification of random processes – methods of description of a random process – special classes of random processes – Average values of random process - stationary –Autocorrelation function and its properties - cross correlation function and its properties.

Unit–III: Test of Significance

Hypothesis, testing – Large sampling tests – small sampling test based on t, F and chi-square distributions – interval estimates of mean, standard deviation and proportion.

Unit–IV: Interpolation, Numerical Differentiation and Integration

Interpolation: Gregory Newton forward and backward interpolation formula; Stirling's central difference formula; Lagrange's interpolation formula for unequal interval. Numerical differentiation: Using Newton's forward and backward interpolation formula. Numerical integration: Trapezoidal rule, Simpson's one-third and three-eight rules.

Unit–V: Solution of Algebraic, Transcendental and Ordinary Differential Equations

Solution of algebraic and transcendental equations: Bolzano's bisection method, Regula-falsi method, Newton – Raphson method.

Solution of simultaneous algebraic equation: Gauss elimination method, Crout's method, Gauss – Seidel iteration method.

Solution of ordinary differential equations: Taylor series method, Runge–Kutta fourth order method, Milne's - Predictor corrector method.

Text Books

1. Kandasamy, P., Thilagavathy, K., and Gunavathy, K., Probability and Random Processes, S.Chand& Co. Ltd. 2006, New Delhi.
2. Veerarajan, T., Probability theory and Random Process, Tata McGraw Hill Co., Ltd., New Delhi, 2005.
3. Venkataraman, M.K., Numerical methods in Science and Engineering, National Publishing Co., Chennai - 2003.

References

1. Lipschutz, S., and Schiller, J., Schaums " s Outlines – Introduction to Probability and Statistics, McGraw Hill, New Delhi, 1998.
2. Kandasamy, P., Thilagavathy, K. and Gunavathy, K., Numerical Methods, S.Chand& Co. Ltd., New Delhi, 2004.

Course Outcomes

At the end of this course, students will demonstrate the ability to

1. Acquire skills in handling situations involving random variables, random processes.
2. Ability to solve problems for engineers in using numerical methods.
3. Acquire skills in solving algebraic transcendental equations.
4. Able to obtain solution of ordinary and partial differential equations.
5. Acquire knowledge on different numerical methods.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											✓
CO2	✓					✓						
CO3	✓											
CO4	✓					✓						
CO5	✓											

EEES402	DATA STRUCTURES AND C++ PROGRAMMING	L	T	P	C
		2	0	0	2

Course Objectives

- To introduce the concepts of linear data structure.
- To understand the different methods of nonlinear data structure representations.
- To introduce object oriented programming concepts.
- To study objects and classes.
- To important knowledge on different operations in C++.

Unit–I: Linear Data Structures

Introduction to data structures, Primitive and non-primitive data structures, Arrays In C -types, Structures in C, Stack-implementation, operations, Queues-operations-Lists-Linked list-types, Applications.

Unit–II: Non Linear Data Structures

Tree - Binary tree-representation - Tree traversal techniques- Graph-representation, traversal-Sorting- Selection Sorting, Insertion sorting, Merge sorting, Radix sorting, Searching -techniques -Hashing.

Unit–III: Object Oriented Programming

Object Oriented Programming concepts- Objects- classes – methods and message passing, encapsulation, abstraction, inheritance, polymorphism and dynamic binding-characteristics of OOPS-benefits of object orientation. Introduction to C++ and data types-Operators in C++.

Unit–IV: Objects and Classes

Objects and class -defining a class –defining member functions-Private and public member function–accessing class members, creating objects, object as function arguments- Array fundamentals - array within a class - array of objects. Constructors and destructors- Function overloading- Inline function - Virtual function.

Unit–V: Operations

Operator overloading – over loading unary, binary and relational operators-type conversion, Inheritance- derived class and base class-visibility mode-public, private and protected–various forms of in heritance. Address and pointers-Files and streams.

Text Books

1. John R.Hubbard, "Programming with C++", Tata McGraw Hill, New Delhi, 1988.
2. Jean - Paul Tremblay and Paul Sorenson, "An Introduction to Data Structures with Applications", Tata McGraw Hill, 1988.
3. E. Balagurusamy, “Object Oriented Programming with C++”, 6th Edition, Tata McGraw Hill, 2014.

References

1. R.F.Gilberg, B.A.Forouzan, "Data Structures", Second Edition, Thomson India Edition, 2005.
2. Sahni, "Data Structures Using C++", Tata McGrawHill, 2006.

Course Outcomes

At the end of this course, students will demonstrate the ability to

1. Understand basic data structures such as arrays, linked lists, stacks and queues.
2. Apply algorithm for solving problems like sorting, searching, insertion and deletion of data.
3. Able to use object oriented programming language like C++ and associated libraries to develop object oriented programs.
4. Describe the procedural and object oriented paradigm with concepts of streams, classes, functions, data and objects.
5. Able to get knowledge about C++ programming.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											✓
CO2		✓										
CO3			✓									
CO4		✓										
CO5			✓									

EEPC403	ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

Course Objectives

- To learn about construction, principle of operation, characteristics and testing of DC machine.
- To have a sound knowledge about transforms.
- To familiarize the students with the constructions, operating principle, speed control of three phase induction motors.
- To provide basic knowledge about the single phase induction motor.
- To illustrate the different testing techniques available and obtain their characteristics.
- To important knowledge on various aspects of synchronous machines.

Unit–I: D.C. Machines

Laws of Electromagnetism–Construction of DC Machines– DC Generator-EMF Equation–Methods of excitation–Types–Armature reaction– Commutation– Characteristics-DC Motor-Principle of operation–Types–Back EMF–Torque equation–Characteristics– Swinburne's test, Hopkinson's test –Starting and Speed control of D.C shunt and series motors.

Unit–II: Transformers

Constructional details – Principle of operation – Bucholtz relay, conservator and breather -EMF equation – Transformation ratio – Transformer on No-load and load – leakage reactance- phasor diagram - Equivalent circuit–Load test- Open circuit and Short circuit test– Voltage regulation - Parallel operation of single-phase transformer- Sumpner's test -Pseudo load test on three phase transformer – separation of core losses – Scott connection-No-load and on-load tap changing transformer- auto transformer- comparison of auto transformer with two winding transformer,

Unit–III: Three Phase Induction Motors

Constructionalfeatures,cageandslipringrotors,principleofoperation,synchronous rotation of gap flux, phasor diagram, equivalent circuit, expression fortorque, torque-slipcharacteristic-conditionfor maximum torque and maximum power- load test- no-load and blocked-rotor tests-Pre-determination of motor performance on the basis of circle diagram- starting of slip-ring and cage motors- Speed control of induction motors- Variation of supply voltage-rotor resistance control.

Unit–IV: Single Phase Induction Motors

Double field revolving theory, cross field theory. Torque slip characteristic and its interpretation, split phase starting, resistance start, resistance start and run, capacitance start, capacitance start and run, typical performance characteristics, determination of constants of equivalent circuit, computation of performance from equivalent circuit.

Unit–V: Synchronous Machines

Constructional features of round rotor type and salient pole type machines, EMF equation, rotating magnetic field, armature reaction- synchronous reactance, phasor diagram-performance characteristics, predetermination of voltage regulationbysynchronousimpedance,ampereturnandpotiermethods-
Paralleloperation- Principle of operation of synchronous motor on infinite bus bars, phasor diagram, V curves and inverted V curves, hunting and its suppression-starting methods - Permanent magnet synchronous motors – Principle of operation and characteristics.

Text Books:

1. Nagrath, I.J. and Kothari, D.P., Electric Machines, Tata McGraw Hill Publishing Company Ltd, Fourth Edition, Fifth Reprint 2012.
2. Er. Rajput, R.K., Electrical Machines, Lakshmi Publications, New Delhi, First Edition 1992.
3. A.K.Theraja & B.L.Theraja, A Text Book of Electrical Technology, Vol.2, S. Chand Publishing, 2014.

References

1. A.E. Fitzgerald, Charles KingselyJr, Stephen D.Umans, Electric Machinery, McGraw Hill Books Company, Seventh Edition, 2013.
2. P.S. Bhimbhra, Electrical Machinery, Khanna Publishers, Seventh Edition, 2013.
3. SamarajitGhosh, Electrical Machines, Pearson Education, Second Edition, 2012.

Course Outcomes

At the end of this course, students will demonstrate the ability to

1. Understand the construction, working principles & operations of all types of machines.
2. Predict the performance of electrical machines from their equivalent circuit models.
3. Select suitable machine to meet specific application requirement.
4. Validate the theoretical concepts by conducting experiments in practical sessions.
5. Study the different testing techniques available to assess the performance of machine.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓						✓					
CO2		✓										
CO3		✓										
CO4			✓									
CO5						✓						

EEPC404	DIGITAL ELECTRONICS	L	T	P	C
		3	0	0	3

Course Objectives

- To review the fundamental concepts relating to Number systems, codes and Boolean algebra function of logic gates and to explain the working and the characteristics of Logic families and Logic packages.
- To bring out the implementation of Boolean function using logic gates, simplification of Boolean Expression using K-map and implementation of various combinational circuits.
- To illustrate the function of various types of flip-flops and counters with the help of circuit diagram, truth table, state equation and timing diagram.
- To study about operation of A/D and D/A converters.
- To study the classification of semiconductor memories and programmable logic devices.

Unit - I: Fundamentals of Digital Systems and logic families

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

Unit - II: Combinational Digital Circuits

Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De- Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

Unit - III: Sequential circuits and systems

A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T and D- types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

Unit - IV: A/D and D/A Converters

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter lCs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltagetofrequencyandvoltagetotimeconversion,specificationsofA/Dconverters, example of A/D converter ICs.

Unit - V: Semiconductor memories and Programmable logic devices.

Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array(FPGA).

Text Books

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education,2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India,2016

References

1. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India,2016.
2. R. Anandh Digital Electronics – Kendra publishing house
3. Donald P. Leach, Albert Paul Malvino, GoutanSaha, "Digital Principles and Applications" Seventh Edition, 2010

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand working of logic families and logic gates.
2. Design and implement Combinational and Sequential logic circuits.
3. Understand the process of Analog to Digital conversion and Digital to Analog conversion.
4. Be able to use PLDs to implement the given logical problem.
5. Able to design digital circuits for consumer application

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓									✓
CO2		✓			✓							
CO3	✓		✓									
CO4		✓			✓							
CO5		✓			✓							

405	ELECTRICAL MEASUREMENTS & INSTRUMENTS	L	T	P	C
		3	0	0	3

Course Objectives

- To introduce the basic functional elements of instrumentation
- To discuss different methods of power and energy measurement.
- To explain various resistance and impedance measurement methods
- To study various storage and display devices
- To study various recorders, transducers and the data acquisition systems

Unit–I :Measurement of Voltage and Current

Units and standards-Dimensional analysis - D'Arsonval Galvanometer-Principle, construction, operation and comparison of moving coil, moving iron meters, dynamometer, induction type - Extension of range and calibration of voltmeter and ammeter – Errors and compensation.

Unit–II :Measurement of Power and Energy

Measurement of power in single phase and three phase circuits – Moving coil -DC potentiometer-Dynamometer type wattmeter - LPF wattmeter - compensated wattmeter, hall Effect wattmeter, thermal type wattmeter - Errors and compensation. Measurement of energy in single phase and three phase circuits - Induction type energy meter - Errors and compensation - Calibration.

Unit–III : Resistance and Impedance Measurements

Measurement of low, medium & high resistance – Ammeter, voltmeter method – Wheatstone bridge –A.C bridges – Measurement of inductance, capacitance – Q of coil – Maxwell Bridge – Wein's bridge – Schering bridge – Anderson bridge- Kelvin double bridge – Series and shunt type ohmmeter – High resistance measurement, Earth resistance measurement.

Unit–IV :Storage and Display Devices

Sampling- CRO dual trace and dual beam oscilloscope- applications-Digital storage oscilloscope and applications - XY Mode - Phase measurement using oscilloscope –Null balance method- Phase shift to pulse conversion method Magnetic disk and tape, digital plotters and printers- CRT display- digital CRO-LED-LCD.

Unit–V :Recorders, Transducers and Data Acquisition Systems

Recorders - XY recorders. Strip chart recorder – XY plotters-UV recorders-magnetic tape recording - FM digital recording –interference and screening-component impurities – electrostatic and electromagnetic interference-practical aspects of interference reduction. Classification of transducers- Selection of transducers- Elements of data acquisition system- A/D, D/A converters - Smart sensors.

Text Books

1. A.K. Sawhney, A Course in Electrical & Electronic Measurements & Instrumentation, DhanpatRai and Co, New Delhi, 2010.
2. E.W. Golding &F.C.Widdis, 'Electrical Measurements & Measuring Instruments', A.H.Wheeler& Co, 2001.

References

1. J.B.Gupta, 'A Course in Electronic and Electrical Measurements and Instrumentation', S.K.Kataria& Sons, Delhi, 2003.
2. S.K.Singh, 'Industrial Instrumentation and Control', Tata McGraw Hill, 2nd edn., 2002.
3. R.B. Northrop, Introduction to Instrumentation and Measurements, Taylor & Francis, New Delhi, 2008.
4. M.M.S. Anand, Electronics Instruments and Instrumentation Technology, Prentice Hall India, New Delhi, 2009.
5. J.J. Carr, Elements of Electronic Instrumentation and Measurement, Pearson Education India, New Delhi, 2011.
6. Martin U. Reissland, 'Electrical Measurement – Fundamental Concepts and Applications', New Age International (P) Ltd., 2001.
7. BouwensA.J.,"Digital Instrumentation", Tata McGraw Hill Publishing Co. Ltd., New Delhi -1997.

Course Outcomes

At the end of this course, students will demonstrate the ability to

1. Ability to understand basic principle of measuring instruments.
2. Understand the concept of measurement of power and energy in single and three phase circuits.
3. Knowledge on the measurement of resistance and impedance.
4. Acquire knowledge of display instruments, amplifier measurements and CRO
5. Distinguish recorders, transducers, data acquisition systems and display devices,frequency and period measurements.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			✓									
CO2			✓									
CO3			✓									
CO4					✓							
CO5					✓							✓

EEPC406	ELECTROMAGNETIC FIELDS	L	T	P	C
		3	0	0	3

Course Objectives

- To look back mathematical tools like vector calculus for investigating the physics of electric and magnetic fields.
- To understand the concepts of electrostatics, electro field due to various charge distribution, electric potential, energy density.
- To study Electro static boundary conditions, capacitors of various geometries.
- To impart knowledge on the concepts of magneto statics, magnetic flux density, scalar and vector potential and their applications.
- To understand Faraday's laws, time varying fields, magnetic boundary conditions and Maxwell's equations.

Unit - I: Review of Vector Calculus

Vector algebra-addition, subtraction, scalar and vector multiplications, three orthogonal coordinate systems (rectangular, cylindrical and spherical),Conversion of a vector from one coordinate system to another.Vector calculus-vector operator-del, gradient, divergence and curl.

Unit - II: Static Electric Field

Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference. Electric dipole, Electrostatic Energy and Energy density.

Unit - III: Conductors, Dielectrics and Capacitance

Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations.

Unit - IV: Static Magnetic Fields

Biot - Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors.

Unit - V : Time Varying Fields and Maxwell's Equations

Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations. Force on a moving charge, Force on a differential current element, Force between differential current elements, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances, Derivation of Wave Equation, Uniform Plane Waves, Poynting theorem.

Text Books

1. W. Hayt, "Engineering Electromagnetics", McGraw Hill Education,2012.
2. A. Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2009.

References

1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication,2014.
2. A. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India,2012.
3. G.W. Carter, "The electromagnetic field in its engineering aspects", Longmans,1954.
4. W.J. Duffin, "Electricity and Magnetism", McGraw Hill Publication,1980.
5. W.J. Duffin, "Advanced Electricity and Magnetism", McGraw Hill,1968.
6. E.G. Cullwick, "The Fundamentals of Electromagnetism", Cambridge University Press,1966.
7. B. D. Popovic, "Introductory Engineering Electromagnetics", Addison-Wesley Educational Publishers, International Edition, 1971.
8. Electromagnetic waves, Shevgaonkar, McGraw Hill.

Course Outcomes:

At the end of the course, students will demonstrate the ability

1. To understand the basic laws of electromagnetism.
2. To obtain the electric and magnetic fields for simple configurations under static conditions.
3. To analyze time varying electric and magnetic fields.
4. To understand Maxwell's equation in different forms and different media.
5. To understand the propagation of EM waves.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2	✓											
CO3			✓									✓
CO4			✓									
CO5	✓											

EECP407	ELECTRICAL MACHINES LAB	L	T	P	C
		0	0	3	1.5

Course Objectives

- To familiarize the students with the functioning of different types of DC, AC machines,
- To illustrate the different testing techniques available for DC, AC machines and transformer and obtain their characteristics practically.
- To make the students understand the concept of predetermination of voltage regulator of alternator by various method.

List of Experiments

1. Open Circuit Characteristics of DC Shunt Generator
2. Internal & External Characteristics of DC Shunt &Compound Generators
3. Swinburne's Test
4. Open Circuit & Short Circuit Tests on Single Phase Transformer
5. Separation of Losses in Single Phase Transformer
6. Pseudo load test on Three Phase Transformer
7. Load test on 3 phase slip ring induction generator
8. Load test on 3 phase slip ring induction motor
9. Predetermination of equivalent circuit of 1 phase induction motor
10. Predetermination of voltage regulation of 3 phase alternator using
11. EMF method b. MMF method c. ZPF method
    d) V and inverted V curves of synchronous motor
12. Synchronization and parallel operation of two 3 phase alternators

Course Outcomes

At the end of the course, students will demonstrate the ability

1. Understand the construction, working principles & operations of DC machines and transformers, Induction motors and Synchronous machines.
2. Predict the performance of electrical machines from their equivalent circuit models.
3. Validate the theoretical concepts by conducting experiments in practical sessions.
4. Distinguish the various categories of electrical machines.
5. Study the different testing techniques available to assess the performance of machine.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2		✓										
CO3		✓										
CO4			✓									
CO5					✓							

EECP408	DIGITAL ELECTRONICS LAB	L	T	P	C
		0	0	3	1.5

Course Objectives

- To understand the basic code conversion and Karnaugh Map reduction
- To illustrate the design of Combinational and Sequential logic circuits.
- To design different counters.

List of Experiments

1. Verification of basic gates and logic circuit using universal building blocks.
2. Karnaugh Map reduction
3. Parity generator and checker circuits
4. Multiplexer and De multiplexer
5. a. Design of Half adder and full adder circuits
6. b. Full adder circuit using Multiplexer
7. Decimal to BCD converter.
8. BCD to seven segment display.
9. Design of Modulo UP Counters
10. Design of Modulo DOWN Counters
11. Design of digital to analog circuits
12. Design of Non-Sequential Counter
13. Design of Sequence Generator

Course Outcomes

At the end of the course, students will demonstrate the ability

1. Understand the basic code conversion and Karnaugh mapping technique
2. Acquire the operating theory of combinational and sequential circuits.
3. Explore the use of digital logic in integrated circuit applications.
4. Acquire the design capability of digital circuits
5. Able to design various counters

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓			✓							
CO2		✓			✓							
CO3		✓			✓							
CO4						✓						
CO5	✓											

EECP409	ELECTRICAL MEASUREMENTS LAB	L	T	P	C
		0	0	3	1.5

Course Objectives:

- To Design understand the principle of DC and ACbridges.
- To illustrate the calibration of various instruments.
- To learn about various measurement methods and fault detection.

List of Experiments

1. Measurement of Inductance using
   a)Anderson's bridge
   b) Hay's bridge
2. Measurement of Resistance using
   a) Kelvin's double bridge
   b) Wheatstone bridge
3. Measurement of Capacitance using
   a) Schering bridge
   b) Desauty bridge
4. Two Wattmeter Method of Power Measurement.
5. Determination of B-H loop in a transformer core using CRO
6. Calibration of ammeter, voltmeter and wattmeter using DC potentiometer
7. Calibration of single-phase Energy meter
8. Calibration of Three phase Energy meter
9. Measurement of ABCD constants in a short transmission lines
10. Cable fault detection
11. Measurement of Induction using three ammeter, three voltmeter method
12. Reactive power measurement.

Course Outcomes

At the end of the course, students will demonstrate the ability

1. Develop skills to find error in any meters.
2. Acquire knowledge in the detection of faults.
3. Concept of the bridge balancing method to determine R,L and C.
4. Understanding the principle of calibration.
5. Able to identify the cable faults

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			✓									
CO2			✓									
CO3					✓							
CO4		✓				✓						
CO5	✓											

EEPC501	MICROPROCESSOR AND MICROCONTROLLER	L	T	P	C
		3	0	0	3

Course Objectives

- To study the architecture,addressing modes and instructions setof 8085 microprocessors.
- To study the architecture,addressing modes and instructions set of 8051 microcontrollers.
- To gain knowledge about interrupt, I/O and communication interface
- To know about interfacing related to various applications.

Unit - I: Fundamentals of programmable device -8085

Fundamentals of Microprocessor Architecture - 8-bitMicroprocessor and Microcontroller architecture, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers. Architecture of 8085 microprocessor, memory organization, timing diagram and interrupts, interfacing of I/O devices.

Unit - II: 8051 Architecture

Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles.

Unit - III: Instruction Set and Programming

Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing.

8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs.

Unit - IV: Memory,I/O and communication Interfacing:

Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, timers, counters, memory devices, Synchronous and Asynchronous Communication. RS232, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee.

Unit - V: Interfacing and Control

LED,LCD and Keyboard interfacing, stepper motor interfacing, D.C motor interfacing, sensor interfacing, Introduction to 16-bit microcontroller - 8097

Text / References:

1. M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, “The8051Microcontroller and Embedded Systems: Using Assembly and C”, Pearson Education,2007.
2. K. J. Ayala, “8051 Microcontroller”, Delmar CengageLearning,2004.
3. R. Kamal, “Embedded System”, McGraw HillEducation,2009.

4. R. S. Gaonkar, “, Microprocessor Architecture: Programming and Applications with the 8085”, Penram International Publishing,1996
5. D.A. Patterson and J.H. Hennessy, "Computer Organization and Design: The Hardware/Software interface”, Morgan Kaufman Publishers, 2013.
6. D. V. Hall, “Microprocessors & Interfacing”, McGraw Hill Higher Education,1991.

Course Outcomes:

At the end of this course, students will acquire the ability to

1. Understand the fundamental of microprocessors.
2. Understand the structure of microcontroller.
3. Able to write the assembly language programs.
4. Interface the memory and peripheral devices.
5. Understand the microprocessor based automation system.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2		✓			✓							✓
CO3	✓											
CO4		✓										
CO5						✓		✓				

EEPC502	POWER ELECTRONICS	L	T	P	C
		3	0	0	3

Course Objectives

- To study different power switching devices and their characteristics.
- To introduce the basic theory of SCR and its practical application in the area power of electronics.
- To explain the operating principle of conversion circuits and analyze study state response.
- To illustrate the usage of single phase voltage source inverters.
- To impart knowledge on three-phase VSI and sinusoidal modulation.

Unit - I: Power switching devices

Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.

Unit - II: Thyristor rectifiers

Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R- load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.

Unit - III: DC-DC buck converter

Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of output voltage.Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

Unit - IV: Single-phase voltage source inverter

Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage

Unit - V: Three-phase voltage source inverter

Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation

Text/References:

1. M. H. Rashid, “Power electronics: circuits, devices, and applications”, Pearson Education India, 2009.
2. N. Mohan and T. M. Undeland, “Power Electronics: Converters, Applications and Design”, John Wiley & Sons,2007.
3. R. W. Erickson and D. Maksimovic, “Fundamentals of Power Electronics”, Springer Science & Business Media,2007.
4. L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India,2009.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand the details of switching devices.
2. Analyze use of thyristors in different types of rectifier circuits.
3. Analyze the operation of DC-DC buck and boost converters.
4. Analyze the operation of single phase voltage source inverters.
5. Obtain knowledge about three phase voltage source inverters.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓	✓									
CO2			✓									
CO3					✓							
CO4				✓	✓							
CO5	✓											✓

EEPC503	CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives

- To develop a mathematical model for physical systems – translational and rotational system block diagram reduction techniques for obtaining transfer function.
- To study time response analysis of various standard inputs for first order and second order systems.
- To study frequency response analysis and frequency domain specification by bode plot and polar plot.
- To analyze stability of system and design of controllers
- To study the concept of controllability and observability and state space analysis. (Obtaining state equation for physical, phase and canonical variable)

Unit - I: Introduction to control problem

Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems.Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.

Unit - II: Time Response Analysis

Standard test signals. Time response of first and second order systems for standard test inputs.Application of initial and final value theorem. Design specifications for second-order systems based on the time-response. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis.Root-Locus technique.Construction of Root-loci.

Unit - III: Frequency-response analysis

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

Unit - IV: Introduction to Controller Design

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems.Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design.Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs.Analog and Digital implementation of controllers.

Unit - V: State variable Analysis

Concepts of state variables.State space model.Diagonalization of State Matrix.Solution of state equations.Eigenvalues and Stability Analysis.Concept of controllability and observability.Pole-placement by state feedback.Discrete-time systems.Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.Performance Indices.Regulator problem, Tracking Problem.Nonlinear system–Basic concepts and analysis.

Text/References:

1. M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education,1997.
2. B. C. Kuo, "Automatic Control System", Prentice Hall,1995.
3. K. Ogata, "Modern Control Engineering", Prentice Hall,1991.
4. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International,2009
5. Ambikapathy,"control systems ",khanna book publishing co.(p) ltd,Delhi.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the modeling of linear-time-invariant systems using transfer function and feedback control systems.
2. Gain knowledge about time response analysis and the use of Root – loci to determine stability of systems.
3. Understand the concept of frequency response analysis
4. Design simple feedback controllers.
5. Acquire knowledge about state variable analysis.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2			✓									
CO3		✓										✓
CO4			✓		✓							
CO5			✓									

EEPC504	POWER SYSTEMS-I	L	T	P	C
		3	0	0	3

Course Objectives

- To develop expressions for the computation of transmission line parameters.
- To improve the voltage profile of the transmission system by determining voltage regulation and efficiency.
- To analyze the voltage distribution in insulator strings and cable for improving voltage profile.
- To understand the operation of different types of distribution systems.

Unit–I : Determination of Line Parameters

Fundamentals of power systems: Single phase transmission - Three phase transmission - complex power - Load characteristics. Inductance of a single phase two wire line - Inductance of composite conductor lines - Inductance of three phase lines - Inductance of double circuit three phase lines - Bundled conductors - Skin effect and proximity effect.

Capacitance of a two-wire line - Capacitance of a three phase line with equilateral spacing - Capacitance of a three phase line with unsymmetrical spacing - Capacitance of a double circuit line - Effect of earth on transmission line capacitance.

Unit–II : Performance of Transmission Lines

Characteristics and performance of transmission lines : Representation of lines - Short lines - Medium length lines - Solution by nominal T and π methods - Calculation of sending and receiving end voltages and current - Regulation and efficiency of a transmission line - Long transmission line - Hyperbolic form of equations for long lines - ABCD constants - Ferranti effect - Tuned power lines - Equivalent circuit of a long line.

Voltage control: Methods of voltage control-shunt capacitors, series capacitors, tap changing transformers and booster transformers-Sending end and receiving end power circle diagrams.

Unit–III : Mechanical Characteristics of Transmission Lines

Mechanical characteristics of transmission lines: Sag in overhead lines - the catenary curve – calculation of sag with supports at different levels - Effects of wind and ice loading - Stringing chart-Sag template-Equivalent span - Stringing of conductors-vibration and vibration dampers.

Corona: Theory of formation – Factors affecting corona - Critical disruptive voltage - Visual critical voltage - Corona loss - Advantages and disadvantages of corona-Methods of reducing corona effect-Radio interference-Inductive interference between power and communication lines.

Unit–IV : Insulators

Overhead line insulators - Types of insulators-Potential distribution over a string of suspension insulators - Methods of equalizing potential - Causes of failure of insulators.

Underground cables-Types of cables-capacitance of single core cable-Grading of cables- Power factor and heating in cables-Capacitance of three core cable.

Unit–V : Distribution Systems

Feeders, distributors and service mains: D.C. distributors - Singly fed and doubly fed two wire and three wire systems, with concentrated and uniformly distributed loads. A.C. distributor - Single phase and three phase -Division of load between lines in parallel.

Effect of Working voltage on the size of feeders and distributors - Effect of system voltage on economy - Voltage drop and efficiency of transmission-Distribution systems: Types of distribution systems - Section and size of feeders - Primary and secondary distribution - Distribution substations - Qualitative Treatment of Rural distribution and Industrial distribution

Text Books

1. Wadhwa, C.L., "Electrical Power Systems", Wiley Eastern, 2015.
2. Nagrath, I.J. and Kothari, D.P., "Power System Engineering" Tata McGraw Hill Publishing Company Limited, New Delhi, 2015.

References

1. Soni, Gupta, Bhatnagar and Chakrabarthi, "A Text Book on Power system Engineering" DhanpatRai and Co; 1998.
2. Stevenson, W.D., "Elements of Power System Analysis", McGraw Hill, 1985.
3. Ashfaq Husain, "Electrical Power Systems", CBS Publications & Distributors, 2006.
4. V.K. Mehta and Rohit Mehta, "Principles of Power System", S.Chand Publishers, Fourth Revised Edition, 2008.

Course Outcomes

1. Understand the concepts of power systems
2. Able to determine the line parameters and analyze the performance of transmission lines
3. Acquire knowledge of mechanical characteristics of transmission lines
4. Analyze the concepts of distribution systems
5. Understand concept of insulation

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓		✓							
CO2			✓									
CO3					✓							
CO4		✓										
CO5	✓											

EECP507	MICROPROCESSOR AND MICROCONTROLLER LAB	L	T	P	C
		0	0	3	1.5

Course Objectives

- To understand practically the programmable devices.
- To have a sound knowledge about different categories of processors and controllers.
- To familiarize the students with the functioning of different peripheral interfacing.
- To illustrate the different processing capabilities of 8085, 8051 and 8097 practically.
- To expose the students to the programming facilities available in the lab.

List of Experiments

1. Study of 8085 Microprocessor
   a. Finding out the largest and smallest number
   b. Sorting an array

2. Multi byte Addition and Subtraction using 8085 Microprocessor
3. Study of 8255 PPI – I/O Mode and BSR Mode
4. Serial Data Communication using USART 8251 and Timer 8253
5. Study of 8051 Microcontroller
   a. Arithmetic Operations
   b. Code Conversion
6. Stepper Motor Control using 8051 Microcontroller
7. Seven Segment LED Display using 8051 Microcontroller
8. Study of Keyboard Display Interface 8279 using 8051 Microcontroller
9. Serial Data Communication Between Two 8051 Kits
10. Timer and Counter Programming in 8051 Microcontroller
11. Study of 8097 Microcontroller
    a. Arithmetic Operations
    b. Logical Operations
12. Applications of 8097 Microcontroller
    a. DAC
    b. ADC
    c. PWM Generation

Course **Outcomes**

At the end of this course, students will demonstrate the ability to

1. Understand the architecture and operations of microprocessors and microcontrollers.
2. Able to write programs for performing real world a task.
3. Validate the theoretical concepts by performing experiments in practical sessions.
4. Distinguish the various categories of programmable devices.
5. Study the different interfacing techniques available for 8085 and 8051.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					✓		✓					
CO2			✓	✓						✓		
CO3		✓	✓					✓				
CO4			✓									
CO5					✓		✓					

EECP508	POWER ELECTRONICS LAB	L	T	P	C
		0	0	3	1.5

Course Objectives

- To explain the characteristics of power electronic devices.
- To train the students about the operation and uses of power converter circuits.

List of Experiments

1. Switching characteristics of IGBT and MOSFET.
2. Performance evaluation of single phase semi and full converters with R load.
3. Extended firing angle control of single phase semi converter.
4. Performance evaluation of three phase semi and full converters.
5. Time ratio control of IGBT based single quadrant DC chopper.
6. Time ratio control of IGBT based two quadrant DC chopper.
7. Performance evaluation of series resonant converter.
8. Modulation index control of single phase bridge inverter.
9. PWM pulse generation for power switches.
10. Voltage regulation of three phase VSI using IPM module.
11. PSIM of AC-DC bridge converter.
12. PSIM of chopper

Course Outcomes

At the end of this course, students will demonstrate the ability to

1. Develop schemes for generation of firing pulses suitable for the power switches in converter circuits.
2. Formulate procedures for testing the operation of power converters.
3. Evaluate the performance of power converter circuits.
4. Experience the platform for simulation of power electronic circuits.
5. Acquire knowledge on characteristics of switching devices

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2		✓	✓									
CO3					✓							
CO4	✓											
CO5		✓										

EECP509	CONTROL SYSTEMS LAB	L	T	P	C
		0	0	3	1.5

Course Objectives:

To provide the students simple hands-on-experience in the basic aspects of various control scheme's implementation to various control system components.

List of Experiments

1. Potentiometer Error Detector
2. D.C Position Control System
3. D.C Speed Control System
4. PID Controller
5. Linear System Simulator

6. Temperature Control System
7. Compensation Design
8. Stepper Motor Study
9. Relay Control System
10. Digital Control System
11. Electronic PID Controller
12. AC Servo motor Position Controller
13. Phase plane Analysis of Nonlinear Control System
14. Computation of Steady State Error Caused by nonlinear systems elements

Course Outcomes

1. Able to use basic tools of designing various controllers.
2. Experience with various control schemes for electrical motors, process control equipments.
3. Develop skill to implement various compensating schemes for improved output response of various control system components.
4. Able to understand the non linear control system.
5. Acquire knowledge about digital control system.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓										
CO2	✓											
CO3		✓										
CO4	✓		✓									
CO5						✓						

EEPC601	POWER SYSTEMS – II	L	T	P	C
		3	0	0	3

Course Objectives

- To introduce the formation of bus impedance and bus admittance matrices.
- To introduce different techniques of dealing with sparse matrices for large scale power systems.
- To impart in-depth knowledge on different methods of power flow solutions.
- To perform short circuit fault analysis and understand the consequence of different type of faults.

Unit–I : Modelling of Power Systems Components

Representation of power system components : Single phase solution of balanced three phase networks - One line diagram - Impedance or reactance diagram - Per unit system - Per unit impedance diagram - Complex power - representation of loads.

Review of symmetrical components - Transformation of voltage, current and impedance (conventional and power invariant transformations) - Phase shift in star-delta transformers - Sequence impedance of transmission lines - Sequence impedance and sequence network of power system components (synchronous machines, loads and transformer banks) - Construction of sequence networks of a power system.

Unit–II : Bus Impedance and Admittance Matrices

Development of network matrix from graph theory - Primitive impedance and admittance matrices - Bus admittance and bus impedance matrices – Properties - Formation of bus admittance matrix by inspection and analytical methods.

Bus impedance matrix: Properties - Formation using building algorithm - addition of branch, link - removal of link, radial line - Parameter changes.

Unit–III : Power Flow Analysis

Sparsity - Different methods of storing sparse matrices - Triangular factorization of a sparse matrix and solution using the factors - Optimal ordering - Three typical schemes for optimal ordering - Implementation of the second method of Tinney and Walker.

Power flow analysis - Bus classification - Development of power flow model - Power flow problem - Solution using Gauss Seidel method and Newton Raphson method - Application of sparsity based programming in Newton Raphson method - Fast decoupled load flow- Comparison of the methods.

Unit–IV : Fault Analysis

Short circuit of a synchronous machine on no load and on load - Algorithm for symmetrical short circuit studies - Unsymmetrical fault analysis - Single line to ground fault, line to line fault, double line to ground fault (with and without fault impedances) using sequence bus impedance matrices - Phase shift due to star-delta transformers - Current limiting reactors - Fault computations for selection of circuit breakers.

Unit–V : Short Circuit Study Based on Bus Admittance Matrix

Phase and sequence admittance matrix representation for three phase, single line to ground, line to line and double line to ground faults (through fault impedances) - Computation of currents and voltages under faulted condition using phase and sequence fault admittance models - Sparsity based short circuit studies using factors of bus admittance matrix.

Text Books

1. Nagrath, I.J., Kothari. D.P., “Power System Engineering”, TMH, New Delhi; 2007.
2. Wadhwa, C.L., “Electric Power Systems”, Wiley Eastern, 2007

References

1. Pai, M.A., “Computer Techniques in Power System Analysis”, TMH, 2007.
2. Stagg and El-Abiad, “Computer Methods in Power System Analysis”, McGraw Hill International, Student Edition, 1968.
3. Stevenson, W.D., “Element of Power System Analysis”, McGraw Hill, 1975.
4. Ashfaq Husain, “Electrical Power Systems”, CBS Publishers & Distributors, 1992.

5. HaadiSaadat, “Power System Analysis”, Tata McGraw Hill Edition, 2002.
6. Gupta, B.R., “Power System Analysis and Design, Third Edition”, A.H. Wheeler and Co Ltd., New Delhi, 1998.
7. Singh, L.P., “Advanced Power System Analysis and Dynamics, Fourth Edition, New Age International (P) Limited, Publishers, New Delhi, 2006.

Course Outcomes

1. Ability to understand and analyze power system.
2. Ability to form power system matrices.
3. Ability to model power system components.
4. Apply load flow analysis to an Electrical power network and interpret the results of the analysis.
5. Analyze a network under symmetrical and unsymmetrical fault conditions and interpret the results.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2			✓							✓		
CO3			✓							✓		
CO4						✓						
CO5			✓							✓		

EEPC602	EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives

1. To provide knowledge of fundamental embedded systems, design paradigms and architectures.
2. To introduce students to PIC microcontrollers and its programming.
3. To study the interfacing capabilities of PIC and varies memories.
4. To impart knowledge on Arm Architecture and its programming.
5. To give an overview of operating system, resources, tasks.

Unit–I : Overview of Embedded Systems

Embedded system concept – Embedded hardware devices – Memory devices – memory management methods – timing and counting devices – watch dog timer – real time clock- in circuit emulator – target hardware- debugging-embedded processors.

Unit–II : PIC Microcontroller

Introduction to PIC microcontrollers - PIC 16C74A Architecture –Comparison of PIC with other CISC and RISC based systems- memory organization – addressing modes – instruction set – PIC programming in Assembly language.

Unit –III : Interfacing capabilities of PIC

I/O ports, I/O bit manipulation programming, timers / counters, Programming to generate delay and waveform generation, Interrupts- Data Conversion- A/D converter, I2C bus-UART-RAM & ROM Allocation–Flash and EEPROM memories.

Unit–IV : Arm Architecture and Programming

RISC Machine – Architectural Inheritance – Core & Architectures -Registers – Pipeline - Interrupts – ARM organization - ARM processor family – Co-processor - Instruction set – Thumb instruction set – ARM Assembly Language.

Unit–V : Operating System Overview

Introduction to OS – Function of OS – Defining an RTOS – Differences in Embedded Operating Systems – Introduction to Kernel – Resources – Shared Resources- Task – Multitasking- Task Management Functions – Scheduling and Scheduling Algorithms – Implementation of scheduling and rescheduling.

Text Books

1. R.S. Gaonkar, "Microprocessor Architecture Programming and Application", Penram International (P) Ltd., Mumbai, 5th edition, 2008.
2. Muhammad Ali Mazidi, Janice GillispieMazidi, "8051 Microcontroller and Embedded Systems", Second Edition, PHI, 2000.
3. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey 'PIC Microcontroller and Embedded Systems using Assembly Language", Pearson Prentice Hall, 2008.
4. Steve Furber, 'ARM System on Chip Architecture', 2nd Edition Addision Wesley, 2000.
5. Raymond J.A. Bhur, Donald L. Bailey, "An Introduction to Real Time Systems", PHI, 1999.

References

1. Dijasio, Wilmshurst, Ibrahim, John Morton, Martin P. Bates, Jack Smith, Smith, D.W., "PIC Microcontrollers", Newnes, Elsevier, 2008.
2. Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield 'ARM System Developer's Guide Designing and Optimizing System Software', Elsevier 2007.
3. Arnold, Berger, S., "Embedded System Design- An Introduction to Processes, Tools and Techniques, CMP Books- 2002.
4. Kenneth Ayala, "The 8051 Microcontroller", Thomson, 2005.
5. Shibu, K.V., "Introduction to Embedded Systems", Tata McGraw Hill, 2009.
6. Rajkamal, "Embedded System-Architecture, Programming, Design", TMH, 2011.
7. Peckol, "Embedded System Design", John Wiley & Sons, 2010.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the architecture and its programming aspects.
2. Distinguish between the general computing system and embedded system.
3. Design real time embedded systems using the concept of RTOS.
4. Acquire knowledge about architecture, registers, instruction set of arm processor.
5. Know about operating system function, resource and task management function.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2						✓						
CO3	✓											
CO4					✓							
CO5		✓			✓							

EECP607	POWER SYSTEMS LAB	L	T	P	C
		3	0	0	1.5

Course Objective:

- To have hands on experience on various system studies and different techniques adapted for power system planning, operation and control.

List of Experiments:

1. Modeling of transmission lines and computation of their parameters
2. Formation of bus admittance matrix
3. Formation of bus impedance matrix
4. DC load flow analysis
5. Solution to load flow problem using Gauss-Siedel method
6. Economic load dispatch without losses
7. Single area load frequency control
8. Power flow analysis of radial distribution systems
9. Solution to load flow problem using Newton- Raphson approach
10. Fast Decoupled method for the solution of load flow problem
11. Symmetrical Short circuit analysis
12. Unsymmetrical Short circuit analysis
13. Economic load dispatch with losses

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Familiar with analyzing the load flow problems.
2. Capable of analyzing load frequency problem.
3. Capable of performing short circuit studies.
4. Capable of performing transient stability studies.
5. Ability to perform economic load dispatch.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓					✓						
CO2			✓									
CO3			✓									
CO4		✓	✓									
CO5	✓			✓								

EECP608	EMBEDDED SYSTEMS LAB	L	T	P	C
		3	0	0	1.5

Course Objectives:

- To understand practically the programmable controllers.
- To have a sound knowledge about different applications performed by microcontrollers.
- To familiarize the students with the functioning of ARM7 processing system.
- To illustrate the various capabilities of 89C51 and PIC16F877 microcontrollers practically.
- To expose the students to the programming facilities available in the lab.

List of experiments:

1) Study of 89C51 Microcontroller
2) Application of 89C51 Microcontroller
   a. Frequency Measurement
   b. Boolean Operation
3) Stepper Motor Control Using 89C51 Microcontroller
4) Seven Segment LED Display Using 89C51 Microcontroller
5) Study of PIC Microcontroller 16F877
6) Application of PIC Microcontroller 16F877
   a. Seven Segment LED Display
   b. Analog to Digital Conversion
   c. PWM Generation
7) Real Time Clock Using PIC Microcontroller 16F877
8) I^2C Logic Based Character Display Using PIC Microcontroller 16F877
9) Study of ARM Processor LPC2148
10) Seven Segment LED Display Using ARM Processor LPC2148
11) ADC Using ARM Processor LPC 2148
12) Study of DSP Processor TMS320C50

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the architecture and operations of MICROCHIP microcontrollers.
2. Able to write programs in Embedded C for performing a task.
3. Validate the theoretical concepts by performing experiments in practical sessions.
4. Distinguish the various categories of programmable devices.
5. Acquire knowledge about different interfacing capabilities of 89C51, PIC and ARM7.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						✓	✓					
CO2			✓		✓					✓		
CO3	✓		✓					✓				
CO4			✓					✓				
CO5		✓			✓		✓					

ETHS701	ENGINEERING ETHICS	L	T	P	C
		2	0	0	2

Course Objectives:

- To understand the moral and ethical dimensions in engineering.
- To provide knowledge about research entries, codes and industrial standard.
- To analyze the safety and risk assessment, government regulators to reduce risk with practical case studies.
- To explain about collegiality and loyalty, discrimination between employee, professional and intellectual property rights.
- To know the ethics of business, environment and computer and various roles of engineers.

Unit–I

Senses of "Engineering 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- Uses of Ethical Theories.

Unit–II

Engineering as Experimentation- Engineers as Responsible Experimenters – Research Ethics – Codes of Ethics - Industrial Standards - A balanced outlook on law – The Challenger Case Study.

Unit–III

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis- Reducing Risk- The Government Regulators Approach to Risk-Chernobyl and Bhopal Case Studies.

Unit–IV

Collegiality and Loyalty - Respect for Authority - Collective Bargaining - Confidentiality - Conflicts of Interest - Occupational Crime - Professional rights - Employee Rights- Intellectual Property Rights (IPR)- Discrimination.

Unit–V

Multinational Corporations-Business Ethics- Environmental Ethics- Computer Ethics- Role in Technological Development – Weapons Development- Engineers as Managers - Consulting Engineers - Engineers as Expert Witness and Advisers – Honesty- Moral Leadership- Sample Code of Conduct.

Text Books

1. Govindarajan, M., Natarajan, S., Senthil Kumar, V.S., "Professional Ethics and Human Values", PHI Learning, New Delhi, 2013.
2. Mike Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New York, 2005.

References

1. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, Boston, 2013.
2. Charles D. Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 1999.
3. John R. Boatright, "Ethics and the Conduct of Business", Pearson Education, Chennai, 2003.
4. Edmund G. Seebauer and Robert L. Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Chennai, 2001.
5. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, Chennai, 2003.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the relationship between the engineering and the society.
2. Learn the importance of codes in engineering practice.
3. Acquire knowledge on the legal, moral and ethical aspects in engineering.
4. Understand the importance of abiding the regulations , norms and standards.
5. Learn about values of ethical principles and social concerns.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓										
CO2				✓								✓
CO3				✓			✓					
CO4							✓	✓				
CO5				✓				✓				

EEPC702	INDUSTRIAL ELECTRICAL SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

- To impart a wide knowledge about the components of LT system wiring components and their selection.
- To provide detects regarding residential and commercial working systems, guide lines for their installation .
- To learn about various industrial electrical system and their production schemes.
- To enable the student to acquire thorough knowledge about the automation of Industrial Electrical systems.
- To understand different types of illumination systems and its design.

Unit - I: Electrical System Components

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices.

Unit - II: Residential and Commercial Electrical Systems

Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices,Earthling system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

Unit - III: Industrial Electrical Systems

HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

Unit - IV: Industrial Electrical System and Automation

DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

Unit - V: Illumination Systems

Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, floodlighting.

TextBooks

1. S.L. Uppal and G.C. Garg, "Electrical Wiring, Estimating &Costing", Khanna publishers,2008.
2. K. B. Raina, "Electrical Design, Estimating & Costing", New age International,2007.

References

1. S. Singh and R. D. Singh, "Electrical estimating and costing", DhanpatRai and Co.,1997.
2. Web site for IS Standards.
3. H. Joshi, "Residential Commercial and Industrial Systems", McGraw Hill Education,2008.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD.
2. Understand various components of industrial electrical systems.
3. Analyze and select the proper size of various electrical system components.
4. Understand the design of illumination system.
5. Acquire knowledge about various automation system.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓				✓							
CO2							✓					
CO3					✓							
CO4	✓											
CO5	✓											✓

EECP706	ELECTRICAL ESTIMATION AND DRAWING LAB	L	T	P	C
		0	0	3	1.5

Course Objectives

1. To provide the students simple hands-on-experience in the basic aspects of electrical engineering diagrams using CADD.
2. Exercises in estimating the materials and cost of materials required for pump room, industry and house wiring.
3. To use of CADD tools, vice, line, poly line, circle, ellipse, arc, break, text, hatch, etc – Simple drawing exercises relevant to electrical engineering.

List of Experiments

1. Principles of estimation
2. Types of wiring system
3. Pump room wiring layout
4. Industrial wiring layout
5. Residential wiring layout

6. Substation layout
7. Office lighting
8. Symbols
9. Earthing
10. Insulators
11. Lamps
12. SF6 circuit breaker
13. Towers
14. Three phase four wire energy meter

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand basic tools of CADD.
2. Able to estimate of the materials required.
3. Able to draw various electrical components.
4. Acquire the designing wiring system.
5. Able to understand the design of lighting schemes.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						✓						
CO2	✓		✓									
CO3										✓		
CO4	✓	✓										
CO5	✓	✓										

EEST707	SEMINAR/ INDUSTRIAL TRAINING	L	TR	S	C
		0	1	2	2

Course Objectives:

- To work on a technical topic and acquire the ability of written and oral presentation
- To acquire the ability of writing technical papers for Conferences and Journals
- To train the students in the field work related the Power Systems and to have a practical knowledge in carrying out Power Systems field related works.
- To train and develop skills in solving problems during execution of certain works related to Power Systems.

The students will work for two periods per week guided by student counsellor. They will be asked to present a seminar of not less than fifteen minutes and not more than thirty minutes on any technical topic of student's choice and to engage in discussion with audience. They will defend their presentation. A brief copy of

their presentation should also be submitted. Evaluation will be done by the student counsellor based on the technical presentation and the report and also on the interaction shown during the seminar.

The students individually undergo a training program in reputed concerns in the field of Power Systems during the summer vacation (at the end of second semester for full – time / fourth semester for part – time) for a minimum stipulated period of four weeks. At the end of the training, the student has to submit a detailed report on the training he/she had, within ten days from the commencement of the third semester for Full-time / fifth semester for part-time. The students will be evaluated, by a team of staff members nominated by Head of the Department, through a viva-voce examination.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. The students will be getting the training to face the audience and to interact with the audience with confidence.
2. To tackle any problem during group discussion in the corporate interviews.
3. The students can face the challenges in the field with confidence.
4. The students will be benefited by the training with managing the situation that arises during the execution of works related to Power Systems.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓		✓				✓			
CO2	✓	✓	✓		✓		✓	✓	✓			
CO3								✓	✓			
CO4	✓		✓									

EEPV803	PROJECT WORK AND VIVA-VOCE	L	PR	S	C
		0	8	4	10

Course Objectives:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.

Method of Evaluation:

- The students in a group of 3 to 4 works on a topic approved by the Head of the Department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor.
- The progress of the project is evaluated based on a minimum of three reviews. The review committee will be constituted by the Head of the Department.

- A project report is required at the end of the semester.
- The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.
2. Carrying out any experimental works.
3. Understand the modeling, analysis and design.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓			✓			✓			
CO2	✓	✓	✓			✓			✓	✓		
CO3	✓	✓	✓			✓			✓	✓		

PROFFESSIONAL ELECTIVES

EEPESCN	ELECTRICAL MACHINE DESIGN	L	T	P	C
		3	0	0	3

Course Objectives:

- To provide sound knowledge about constructional details and design of various electrical machines.
- To provide knowledge about constructional details of transformers.
- To study about mmf calculation and thermal rating of various types of electrical machines.
- To learn about the various materials used in electrical machines, heating and cooling of electrical machines.
- To learn to design electrical machines using software.

Unit - I: Introduction

Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

Unit - II: Transformers

Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.

Unit - III: Induction Motors

Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of polyphase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.

Unit - IV: Synchronous Machines

Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.

Unit - V: Computer aided Design (CAD):

Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based machine design. Introduction to complex structures of modern machines-PMSMs, BLDCs, SRM and claw-pole machines.

Text / References:

1. A. K. Sawhney, "A Course in Electrical Machine Design", DhanpatRai and Sons,1970.
2. M.G. Say, "Theory & Performance & Design of A.C. Machines", ELBSLondon.
3. S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBH Publishing,2006.
4. K. L. Narang, "A Text Book of Electrical Engineering Drawings", SatyaPrakashan,1969.
5. A. Shanmugasundaram, G. Gangadharan and R. Palani, "Electrical Machine Design Data Book", New Age International,1979.
6. K. M. V. Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications,2008.
7. Electrical machines and equipment design exercise examples using Ansoft's Maxwell 2D machine designpackage.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the construction and performance characteristics of electrical machines.
2. Under the construction and performance characteristics of transforms.
3. Understand the various factors which influence the design: electrical, magnetic and thermal loading of electrical machines
4. Understand the principles of electrical machine design and carry out a basic design of an ac machine.
5. Use software tools to do design calculations.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2			✓									
CO3	✓											
CO4		✓			✓							
CO5		✓										

EEPESCN	ELECTRICAL ENERGY CONSERVATION AND AUDITING	L	T	P	C
		3	0	0	3

Course Objectives:

- To enable the students to get knowledge about the Electrical energy Scenario.
- To introduce various forms of energy and its Basic.
- To inculcate the students on feasibility of Energy management and Auditing.
- To impart a thorough knowledge about Energy efficiency in Industrial systems
- To Familiarize the students about Energy efficient technologies in Electrical systems.

Unit - I: Energy Scenario

Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

Unit - II: Basics of Energy and its various forms

Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.

Unit - III: Energy Efficiency in Electrical Systems

Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors . Compressed Air System: Types of air compressors, compressor efficiency, compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types,

performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities, assessment of cooling towers.

Unit - IV: Energy Efficient Technologies in Electrical Systems

Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.

Unit - V: Energy Management & Audit

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 & energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

Text/References

1. S. C. Tripathy, "Utilization of Electrical Energy and Conservation", McGraw Hill,1991.
2. Success stories of Energy Conservation by BEE, New Delhi(www.bee-india.org)
3. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)
4. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the current energy scenario and importance of energy conservation.
2. Understand various forms of energy.
3. Understand the concepts of energy management.
4. Understand the methods of improving energy efficiency in different electrical systems.
5. Understand the concepts of different energy efficient devices.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓				✓							
CO2			✓									
CO3		✓										
CO4	✓	✓										
CO5	✓											

EEPESCN	ELECTRICAL DRIVES	L	T	P	C
		3	0	0	3

Course Objectives

- To enable the students to acquire a thorough knowledge about the electrical drives, techniques for controlling the drives and their applications in industries.
- To impart a wide knowledge about the modern electric drives and its latest developments and also its industrial applications.

Unit–I : Performance of Electric Drives

Electric Drives – Types of electric drives - Characteristics of Electric Drives - Advantages of electric drives - speed torque characteristics of various types of loads and drive motors - Joint speed torque characteristics - Selection of power rating for drive motors based on thermal limits, overload capacity and load variation factors.

Unit–II : Phase Controlled DC Drives

Solid state Drives : Introduction - comparison between solid state and conventional drives - open loop and closed loop speed control - DC motor transfer function - speed and current control loops - converter fed DC drives (using thyristors) - single, two and four quadrant operations - Reversible drives - Armature and field current reversal - Dynamic and regenerative braking.

Unit–III : Chopper Controlled DC Drives (Using Devices other than Thyristors)

Principles of chopper operation - chopper configuration - chopper fed D.C. motors, analysis and performance characteristics - Dynamic and regenerative braking of chopper controlled drives - regenerative reversals.

Unit–IV : Induction Motor Drives (Using Devices other than Thyristors)

Speed control of three phase induction motor - stator voltage and frequency control – V/F control - Rotor control - static control of rotor resistance using DC chopper - slip power recovery scheme – Static Kramer and Scherbius drives.

Unit–V : Synchronous Motor and Special Machine Drives

Speed control of synchronous motors - modes of operation - Adjustable frequency operation - controlled current operation - voltage source inverter and current source inverter fed synchronous motor drive - PWM inverter fed synchronous motor drives – cyclo converter fed synchronous motor drives Special Machines Drives (qualitative treatment) – Principle of operation, Torque speed characteristics of Switched reluctance, Brush less DC and Permanent Magnet Synchronous Motor drives.

Text Books

1. Dubey, G.K., “Fundamentals of Electrical Drives”, Narosa Publishing House, New Delhi, 2004.
2. P.C. Sen., “Thyristor DC Drives”, John Wiley and Sons, New York, 1981.
3. Bimal K. Bose, “Modern Power Electronics and AC Drives”, Pearson Education Asia 2003.

References

1. Pillai, S.K., "A First course on Electric Drives", Wiley Eastern Ltd, Bombay, 1988.
2. VedamSubramanayan, "Electric Drives - Concepts and Applications", Tata McGraw Hill Publishing Company Limited, New Delhi, 2007.
3. Murphy, J.M.D. and Turnbull, F.G., "Power Electronic Control of A.C. Motors", Pergamon Press, Oxford.
4. Miller, T.J.E., "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1989.
5. Gopal K. Dubey, "Power Semi Conductor Controlled Drives", Prentice Hall New Jersey, 1989.

Course Outcomes

1. Acquire knowledge about various electric drives with their characteristics that are used in the industries.
2. Able to choose a particular motor to suit a particular application.
3. Learn about the modern electric drives, its latest developments and their industrial applications.
4. Understand the operation and control of synchronous and induction motor drives.
5. Understand the operation of chopper fed drive.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2			✓									
CO3			✓			✓			✓			
CO4	✓											
CO5	✓											

EEPESCN	ELECTRICAL AND HYBRID VEHICLES	L	T	P	C
		3	0	0	3

Course Objectives:

- To understand the fundamental concepts, principles, analysis and design of hybrid and electric vehicles.
- To understand deeper into various aspects of hybrid and electric drive train such as their configuration, types of electric machines used, energy storage device etc.
- To understand the various types of energy storage method in hybrid and electric drive
- To understand the energy management strategies and implementation in hybrid and electric drive
- To understand the design of hybrid electric vehicle and battery electric vehicle.

Unit - I: Introduction

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

Unit-II: Hybrid Vehicles

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 on energy supplies.

Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive- train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Unit - III: Electric Trains

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 - IV: Energy Storage

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its 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 electricmachine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

Unit - V: Energy Management Strategies

Energy Management Strategies: 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 / References

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.
3. 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.
4. T. Denton, “Electric and Hybrid Vehicles”, Routledge,2016.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the models to describe hybrid vehicles and their performance.
2. Understand the different possible ways of energy storage.
3. Under various topologies of electric drive and its control.
4. Understand the different strategies related to energy storage systems.
5. Knowledge about different energy management strategies.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2		✓	✓									
CO3				✓	✓							
CO4				✓								
CO5				✓			✓					✓

EEPESCN	WIND AND SOLAR ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

- To study the wind speed statistics and probability distributions
- To understand various wind generator topologies
- To estimate the solar energy availability
- To study the power electronics convertors and MPPT
- To analyze the hybrid and isolated operation of solar PV and wind systems

Unit - I: Physics of Wind Power:

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

Unit - II: Wind Generator Topologies:

Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent-Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.

Unit - III: Solar Resources:

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

Unit - IV: Solar Photovoltaic:

Technologies-Amorphous, mono crystalline, polycrystalline; V-I characteristics of a PV cell, PV Unit, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.

Unit - V: Network Integration Issues:

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems. Solar thermal power generation: central receivers, solar pond

Text / References

1. T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd.,2005.
2. G. M. Masters, "Renewable and Efficient Electric Power Systems", John Wiley and Sons,2004.
3. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill,1984.
4. H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd.,2006.
5. G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications,2004.
6. J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley & Sons,1991.

Course Outcomes

At the end of this course, students will demonstrate the ability to

1. Understand the energy scenario and the consequent growth of the power generation from renewable energy sources.
2. Understand the basic physics of wind and solar power generation.
3. Understand the power electronic interfaces for wind and solar generation.
4. Understand solar photo voltage power generation.
5. Understand the issues related to the grid-integration of solar and wind energy systems.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				✓								✓
CO2			✓		✓							
CO3		✓		✓								
CO4	✓	✓										
CO5		✓										

EEPESCN	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

Course Objectives:

- To represent the discrete system using different equations
- To study Z and inverse Z transforms
- To understand DFT and FFT
- To design FIR filters & IIR filters
- To Study the application of Digital signal processing

Unit - I: Discrete-time signals and systems

Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signalsaliasing; Sampling theorem and Nyquistrate.

Unit - II: Z-transform

Z-Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using Z-transform, Properties of Z-transform for causal signals, Interpretation of stability in Z-domain, Inverse Z- transforms.

Unit - III: Discrete Fourier Transform

Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.

Unit - IV:Designof Digital filters

Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low-pass, Band-pass, Band-stop and High- pass filters.Effect of finite register length in FIR filter design.Parametric and non-parametric spectral estimation. Introduction to multi-rate signal processing.

Unit–V : Digital Signal Processors

Generic DSP Architecture – Architecture of TMS 320 F 2407 and TEXAS 5416 processor – memory and I/O Organization – CPU –Program control – Addressing modes – Assembly Language Instructions – On chip peripherals – Clock, watch dog and real time Interrupt, event manager units – Interface units – Simple Programs.

Text/Reference Books

1. S. K. Mitra, "Digital Signal Processing: A computer based approach", McGraw Hill,2011.
2. A.V. Oppenheim and R. W. Schafer, "Discrete Time Signal Processing", Prentice Hall,1989.
3. J. G. Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, Algorithms And Applications", Prentice Hall,1997.
4. L. R. Rabiner and B. Gold, "Theory and Application of Digital Signal Processing", Prentice Hall,1992.
5. J. R. Johnson, "Introduction to Digital Signal Processing", Prentice Hall,1992.
6. D. J. DeFatta, J. G. Lucas andW. S. Hodgkiss, "Digital Signal Processing", John Wiley & Sons,1988.
7. Venkatramani, B. and Bhaskar,M., "Digital Signal Processors", TMH, 2002.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Represent signals mathematically in continuous and discrete-time, and in the frequency domain.
2. Analyze discrete-time systems using z-transform.
3. Understand the Discrete-Fourier Transform (DFT) and the FFT algorithms.
4. Design digital filters for various applications.
5. Apply digital signal processing for the analysis of real-life signals.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓										
CO2	✓											
CO3			✓									
CO4	✓	✓										
CO5		✓								✓		

EEPESCN	CONTROL SYSTEMS DESIGN	L	T	P	C
		3	0	0	3

Course Objectives:

- To study the effect of gain on transient and steady state response
- To understand the concept of different compensators in time domain
- To analyze a steady state and transient response with compensator in frequency domain
- To study the different controllers for first, second & third order systems
- To understand controllability & observability

Unit - I: Design Specifications

Introduction to design problem and philosophy.Introduction to time domain and frequency domain design specification and its physical relevance.Effect of gain on transient and steady state response.Effect of addition of pole on system performance.Effect of addition of zero on system response.

Unit - II: Design of Classical Control System in the time domain

Introduction to compensator.Design of Lag, lead lag-lead compensator in time domain. Feedback and Feed forward compensator design. Feedback compensation.Realization of compensators.

Unit - III: Design of Classical Control System in frequency domain

Compensator design in frequency domain to improve steady state and transient response. Feedback and Feed forward compensator design using bode diagram.

Unit - IV: Design of PID controllers

Design of P, PI, PD and PID controllers in time domain and frequency domain for first, second and third order systems. Control loop with auxiliary feedback – Feed forward control.

Unit - V: Control System Design in state space

Review of state space representation. Concept of controllability & observability, effect of pole zero cancellation on the controllability & observability of the system, pole placement design through state feedback. Ackerman's Formula for feedback gain design. Design of Observer. Reduced order observer. Separation Principle.Various types of non-linearities Singular points.

Text / Reference Books :

1. N. Nise, "Control system Engineering", John Wiley,2000.
2. I. J. Nagrath and M. Gopal, "Control system engineering", Wiley,2000.
3. M. Gopal, "Digital Control Engineering", Wiley Eastern,1988.

4. Ogata, “Modern Control Engineering”, Prentice Hall,2010.
5. B. C. Kuo, “Automatic Control system”, Prentice Hall,1995.
6. J. J. D’AzzoandC. H. Houpis, “Linear control system analysis and design (conventional and modern)”, McGraw Hill, 1995.
7. R.T.Stefani and G.H.Hostetter, “Design of feedback Control Systems”, Saunders College Pub, 1994.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand various design specifications.
2. Design classical control system in time domain
3. Design classical control system in frequency domain .
4. Design controllers to satisfy the desired design specifications using simple controller structures (P, PI, PID, compensators).
5. Design controllers using the state-space approach.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓	✓				✓						
CO3		✓				✓						
CO4						✓						
CO5	✓					✓						

EEPESCN	COMPUTER ARCHITECTURE	L	T	P	C
		3	0	0	3

Course Objectives:

- To introduce the computer organization and Memory organization
- To study about Input – output Organization
- To impact knowledge about 16 and 32 (bit) microprocessors
- To illustrate Pipelining
- To study Different Architectures

Unit - I: Introduction to computer organization

Architecture and function of general computer system, CISC Vs RISC, Data types, Integer Arithmetic - Multiplication, Division, Fixed and Floating point representation and arithmetic, Control unit operation, Hardware implementation of CPU with Micro instruction, microprogramming, System buses, Multi-bus organization. System memory, Cache memory - types and organization, Virtual memory and its implementation, Memory management unit, Magnetic Hard disks, Optical Disks.

Unit - II: Input – output Organization

Accessing I/O devices, Direct Memory Access and DMA controller, Interrupts and Interrupt Controllers, Arbitration, Multilevel Bus Architecture, Interface circuits - Parallel and serial port. Features of PCI and PCI Express bus.

Unit - III: 16 bit and 32bitmicroprocessors

80x86 Architecture, IA – 32 and IA – 64, Programming model, Concurrent operation of EU and BIU, Real mode addressing, Segmentation, Addressing modes of 80x86, Instruction set of 80x86, I/O addressing in80x86.

Unit - IV: Pipelining

Introduction to pipelining, Instruction level pipelining (ILP), compiler techniques for ILP, Data hazards, Dynamic scheduling, Dependability, Branch cost, Branch Prediction, Influence on instruction set.

Unit - V: Different Architectures

VLIW Architecture, DSP Architecture, SoC architecture, MIPS Processor and programming.

Text/Refence Books

1. V. Carl, G. Zvonko and S. G. Zaky, "Computer organization", McGraw Hill,1978.
2. B. Brey and C. R. Sarma, "The Intel microprocessors", Pearson Education,2000.
3. J. L. Hennessy and D. A. Patterson, "Computer Architecture A Quantitative Approach", Morgan Kauffman, 2011.
4. W. Stallings, "Computer organization", PHI,1987.
5. P. Barry and P. Crowley, "Modern Embedded Computing", Morgan Kaufmann,2012.
6. N. Mathivanan, "Microprocessors, PC Hardware and Interfacing", Prentice Hall,2004.
7. Y. C. Lieu and G. A. Gibson, "Microcomputer Systems: The 8086/8088 Family", Prentice Hall India,1986.
8. J. Uffenbeck, "The 8086/8088 Design, Programming, Interfacing", Prentice Hall,1987.
9. B. Govindarajalu, "IBM PC and Clones", Tata McGraw Hill,1991.
10. P. Able, "8086 Assembly Language Programming", Prentice Hall India.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand architecture and function of computer system.
2. Understand various I/O interface.
3. Understand the concepts of microprocessors, their principles and practices.
4. Write efficient programs in assembly language of the 8086 family of microprocessors.
5. Introduce different architecture like VLIW, DSP, SOC.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓			✓							
CO2		✓			✓							
CO3	✓		✓	✓								
CO4		✓			✓							
CO5			✓									

EEPESCN	POWER SYSTEM PROTECTION	L	T	P	C
		3	0	0	3

Course Objectives:

- To impart knowledge on different components of protection system.
- To discuss different types of faults, overcurrent protection and relay coordination
- To explain various equipment protection schemes.
- To study computer aided protection schemes.
- To understand various system protection and application of wide area measurement system.

Unit–I : Protective Relaying Schemes

Functional characteristics of a protective relay - operating principles of relays - over current relays - instantaneous and time over current relays - definite time and inverse time characteristics -Direct over current relay - Directional over current relay - universal torque equation - performance characteristics of distance relays - differential relays - under frequency and over frequency relays - translay scheme - HRC fuses for relays.

Unit–II: Circuit Breakers

Circuit breakers - Arc in oil - Arc interruption – Current chopping - Bulk oil and minimum oil circuit breaker - Air circuit breakers - Air blast circuit breakers - Vacuum circuit breakers - SF6 circuit breakers -Rating of circuit breakers - Testing of circuit breakers - Auto reclosure. HVDC circuit breakers - Energy consideration in breaking - HVDC system - commutating principle - control of di/dt and dv/dt - surge suppression - main circuit breakers for HVDC switching.

Unit–III: Protection Schemes

Feeder protection - distance protection - alternator protection - short circuit protection of stator windings by percentage differential relays - protection against turn to turn faults in stator winding - field ground fault protection - protection of stator windings by overvoltage relays - protection against stator open circuits, loss of synchronism, loss of excitation, rotor overheating - protection of transformers - typical schemes- motor protection- Bus bar protection schemes.

Unit–IV: Digital Protection

Computer aided protection, Fourier analysis and estimation of Phasors from DFT. Sampling, aliasing issues.Digital protection techniques - Introduction - advantages – algorithms - microprocessor based protection schemes.

Unit - V: System Protection

System Protection Schemes. Under-frequency, under- voltage and df/dt relays, Out-of-step protection, CT/PT modeling and standards, Simulation of transients using Electro-Magnetic Transients (EMT) programs, Synchro-phasors, Phasor Measurement Units and Wide-Area Measurement Systems (WAMS).Application of WAMS for improving protection systems.

Text/References

1. Sunil S.Rao, "Protection and Switchgear", Khanna Publishers, New Delhi, 2006.
2. Rabindaranath, B., Chander, M., "Protective System Protection and Switchgear", New age International, New Delhi, 1997.
3. Wadhwa, C.L., "Electrical Power Systems", New Age International, New Delhi,2005.
4. J. L. Blackburn, "Protective Relaying: Principles and Applications", Marcel Dekker, New York, 1987.
5. Y. G.Paithankar and S. R. Bhide, "Fundamentals of power system protection", Prentice Hall, India,2010.
6. A. G. Phadke and J. S. Thorp, "Computer Relaying for Power Systems", John Wiley & Sons, 1988.
7. A. G. Phadke and J. S. Thorp, "Synchronized Phasor Measurements and their Applications", Springer,2008.
8. D. Reimert, "Protective Relaying for Power Generation Systems", Taylor and Francis,2006.
9. MadhavaRao. T.S., "Power System Protection - Static Relays with Microprocessor Applications", Tata McGraw Hill Publishing Co., New Delhi, 2007.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the different components of a protection system.
2. Understand the operation of circuit breakers.
3. Understand the protection schemes for different power system components.
4. Understand the basic principles of digital protection.
5. Understand system protection schemes, and the use of wide-area measurements.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			✓									
CO2		✓										
CO3	✓											
CO4		✓			✓							
CO5			✓									

EEPESCN	HIGH VOLTAGE TRANSMISSION SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives

- To study HVAC and HVDC for overhead and underground transmission systems and factors governing the choice of them.
- To learn about the properties of bundle conductors for reducing the corona effects.
- To introduce the problems of EHVAC transmission at power frequency.
- To introduce modern developments in HVDC transmission and FACTS.
- To learn about the overvoltage problem in extra high voltage system.

Unit–I : Introduction to EHVAC and HVDC Transmission

EHVAC and HVDC transmission -Comparison between HVAC and HVDC overhead and underground transmission scheme - Standard transmission voltages - Factors concerning choice of HVAC and HVDC transmission - Block diagram of HVAC and HVDC transmission schemes.

Unit–II : Corona

Properties of bundled conductors - Inductance and capacitance of EHV line - Surface voltage gradient on single, double, and more than three conductor bundles -Corona effects - Power loss - Increase in radius of conductors - Charge-voltage diagram - Qualitative study of corona pulses, their generation and properties.

Unit–III : EHVAC Transmission

Problems of EHVAC transmission at power frequency - Generalised constants - Power circle diagram and its use - Voltage control using compensators - High phase order transmission.

Unit–IV : DC Transmission

Review of rectification and inversion process -Constant current and constant extinction angle modes of operations - Analysis of DC transmission systems - Harmonics on AC and DC sides and filters for their suppression - Multiterminal DC transmission systems -Parallel operation of AC and DC transmission - Modern developments in HVDC transmission/Introduction to FACTS.

Unit–V : Overvoltage in EHV Systems

Origin and types - Ferro resonance overvoltage - switching surges, reduction of switching surges on EHV systems. Introduction to EHV cable transmission, electrical characteristics of EHV cables, properties of cable insulation materials. EHV insulators - characteristics and pollution performance -Protection of HVAC and HVDC systems.

Text Books

1. Rakosh Das Begamudre "Extra High Voltage AC Transmission Engineering", New Age International Publishers, Reprint 2014.
2. K. R. Padiyar"HVDC Power Transmission Systems: Technology and System Interactions", New Age International, 1990.

Reference

1. Rao. S, "EHV_AC and HVDC Transmission & Distribution Engg.- 3rd edition",Khanna Publication-2007.

Course Outcomes

1. Understand the factors governing the choice of HVAC and HVDC for overhead and underground transmission system.
2. Learn properties of bundled conductors.
3. Analyze the DC transmission system in case of harmonics and as well as multi terminal DC transmission system.
4. Knowledge about the EHV cables and insulating materials.
5. Learn about protection of HVAC and HVDC systems.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		
CO2					✓							
CO3	✓	✓										
CO4							✓					
CO5					✓					✓		

EEPESCN	COMPUTER AIDED POWER SYSTEM ANALYSIS	L	T	P	C
		3	0	0	3

Course Objectives

- To study the economic operation of power system.
- To learn optimal power flow and unit commitment.
- To illustrate different numerical integration methods in transient stability analysis.
- To model power-frequency dynamics and to design load-frequency controller.
- To examine the concept of transient stability in the power system.

Unit–I : Economic Load Dispatch

System constraints - Economic dispatch neglecting losses - Optimum load dispatch including transmission losses - Exact transmission loss formula - Modified co-ordination equations – hydro-thermal scheduling

Unit–II : Optimal Load Flow

Reactive Power Control for Loss Minimization- Gradient Method for Optimal Load Flow- Non - Linear Programming- Lagrange Function for Optimal Load Flow- Computational Procedures- Conditions for Optimal Load Flow- Implementation of optimal conditions.

Unit–III : Unit Commitment

Cost Function Formulation- Constraints for Plant Commitment Schedules- Priority - List Method- Dynamic Programming- Unit Commitment by Dynamic Programming.

Unit–IV : Load Frequency Control

Necessity of maintaining frequency constant- Load Frequency Control (Single Area Case)-Turbine Speed Governing System-Model of Speed Governing System-Turbine Model-Generator-Load Model-Block Diagram model of LFC-Steady State Analysis-Dynamic Response-Control Area Concept-Proportional plus Integral Control-Optimal Control-State variable model of single area and two-area power systems

Unit–V : Transient Stability Studies

Transient stability - Power angle curve and swing equation of single machine connected to infinite bus - Equal area criterion - Numerical solution of swing equation of single-machine system by point by point method - Factors affecting transient stability - Multi machine transient stability - solution techniques using modified Euler and RungeKutta methods

Text Books

1. Murty. PSR., "Power System Operation and Control", CRC Press, 2011.
2. Nagrath, I.J. and Kothari, D.P., "Power System Engineering", Tata McGraw Hill, Delhi, 2007.

Reference Books

1. Wadhwa, C.L., "Electrical Power Systems", New Age, 2010.
2. Elgerd, O.I., "Electric Energy Systems Theory - An Introduction", TMH, 2006.
3. Allen J. Wood, Bruce F. Wollenberg and Gerald B. Sheble, "Power Generation, Operation, and Control, Wiley Publications, Third Edition, 2013.
4. HaadiSaadat, "Power System Analysis" PSA publishing, 2011.
5. M.A. Pai, "Computer Techniques in Power System Analysis", Tata McGraw Hill Publishing Company, New Delhi, 2003.

Course Outcomes

1. Able to understand and analyze power system operation, stability and control.
2. Gain knowledge in economic load dispatch, load frequency control and transient stability studies that are useful for day-today operation of power system.
3. Study the concept of optimal load flow and unit commitment.
4. Gain knowledge from contemporary issues.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓	✓				✓			
CO2	✓	✓	✓	✓	✓		✓			✓		
CO3	✓	✓	✓	✓	✓							
CO4	✓	✓				✓	✓	✓		✓		

EEPESCN	COMMUNICATION ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives

- To give an exposure of different types of analog modulation techniques and their significances in communication systems.
- To familiarize the students about angle modulation techniques in communication systems.
- To introduce pulse modulation techniques
- To introduce the concepts of Pulse Code Modulation techniques and multiple access techniques used in communication systems for enhancing the number of users.
- To focus on various media for digital communication and future data communication.

Unit–I: Linear Modulation / Demodulation

Need for modulation – Amplitudemodulation - Power spectrum - Power relation – Differenttypes of modulation - Double sideband suppressed carrier (DSB/SC), Single sideband suppressed carrier (SSB) and Vestigial sideband (VSB) generation.AMtransmitters - Block diagram - Amplitude demodulation -Detection of DSB, SSB signals - Receiver characteristics - Super heterodyne reception - Automatic volume control.

Unit–II: Angle Modulation

Principleoffrequencyandphasemodulation- Generation of FM and PMsignals-Directand indirect methods - FM transmitters-Blockdiagram – Pre-emphasis circuit -Frequency demodulation –DetectionofFM and PM signals – Automaticfrequencycontrol - De-emphasis circuit.

Unit–III: Pulse Modulation

Analoganddigitalcommunicationsystemsandtechniques:Pulse modulation systems - Sampling theorem-Pulseamplitudemodulation –Channelbandwidth-Detectionof PAM signals - Cross talk in PAM signals-Pulsetimemodulation - Generation of PDMandPPM-Conversionof PDM to PPM - Detection of PTMsignals-Cross talk in PTM signals.

Unit–IV: Pulse Code Modulation Systems

Quantization - Compounding –Pulsecodemodulation - Sampling and digitizing - Aliasing-Sampleand hold circuit – Practicalimplementationofsampling and digitizing - Equalization - Multiplexing-Frequency Division Multiplexing (FDM)and Time Division Multiplexing (TDM) - Data communications – Serialsynchronous,asynchronouscommunicationprotocol-Hardware USARTS – SoftwareUSART.

Unit–V: Wireless Communication Systems

Evolution of generations (1G, 2G, 2.5, 3G, 4G and beyond 4G), - GSM and CDMA systems-cellular structure-frequency reuse-Handoff-Bluetooth and UWB network-Wi-Fi and Wi-Max. (Quantitative treatment only)

Text Books

1. Herbert Taub, Donald L. Schiling&GautamSaha "Principles of Communication Systems",TataMcGrawHill Education Pvt. Ltd., Third Edition, 2008.
2. Bernard Davis & George Kennedy, "Electronic Communication Systems", Tata McGrawHill Education Pvt. Ltd., Fifth Edition, 2011.

Reference Books

1. K.N. HariBhat& Ganesh Rao, "Analog Communications", Pearson Publications, 2nd Edition, 2008.
2. Anokh Singh, "Principles of Communication Engineering", 6th Reprint, S.Chand& Company Ltd., 2006.
3. Sanjay Sharma, "Analog and Digital Communication", S.K. Kataria and Sons Publications, 2013.
4. Bernard Sklar&Pabitra Kumar Ray, "Digital Communications - Fundamentals and Applications", Pearson Publications, Second Edition, 2010.

Course Outcomes

At the end of this course, students will demonstrate the ability to

1. Provide idea about modulation and demodulation techniques employed in communication systems.
2. Understand angle modulation technique in communication system
3. Understand pulse modulation technique and its conversion
4. Explain the concepts of pulse modulation systems and multiple access techniques used in communication field applications.
5. Understand the various broadband communication systems and recent advancements in communication systems.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2		✓										
CO3		✓										
CO4						✓						
CO5	✓	✓				✓						✓

EEPESCN	VLSI DESIGN	L	T	P	C
		3	0	0	3

Course Objectives:

- To provide an understanding of VLSI Design process and to bring both system and circuit view on design together.
- To familiarize the MOS circuit realization of the various building blocks that is common toany microprocessor or digital VLSI circuit..
- To learn transistor level CMOS logic design and to understand NMOS and CMOSfabrication process.

- To impart knowledge about designing digital circuits like adders and multipliers.
- To study programming technologies and architectures of FPGAs and understand theconcepts of modeling a digital system using VHDL.

Unit–I : VLSI Design Concepts

Evolution of VLSI – VLSI design flow--Design domains Behavioral, Structural and Physical design – Concept of Regularity, Modularity and Locality-Layout styles: Full custom - Semi custom approaches.MOS structure- MOS current equation – channel length modulation-Body effect –MOSFET capacitance-CMOS Logic Design: Static characteristics of CMOS Inverter, Dynamic behavior of CMOS inverter-static and dynamic power dissipation in CMOS – Basic and Complex gates realization in CMOS-Transistor sizing-Sheet resistance and area capacitance of layers-Wiring capacitance-Driving large capacitive loads.

Unit–II : VLSI Fabrication Techniques

An overview of wafer fabrication, Wafer Processing – Oxidation – Patterning – Diffusion – Ion Implantation – Deposition – Silicon gate NMOS process – CMOS processes – N-well, P-well- Twin tub, Silicon on insulator – CMOS process enhancements – Interconnects, Circuit elements-CMOS latch up.Design Rules-Need for Design Rules-CMOS lambda based design Rules-Stick diagram and layout for CMOS inverter.

Unit–III : Analog VLSI

Introduction to analog VLSI - Analog circuit building blocks – Switches- active resistors - Current sources and sinks - Current mirrors/amplifiers –Voltage and Current References-- CMOS inverting amplifiers - CMOS Differential Amplifiers - CMOS Two stage op-amp - Modulators and Multipliers-Switched capacitor filter.

Unit–IV : Digital VLSI

Logic design: Switch logic and Gate logic - Dynamic CMOS logic - Structured design examples: Simple combinational logic and Clocked sequential design. Sub-system design: Design of shifters, Design of Adders: Ripple carry adders, Carry select adder, carry save adder, Manchester carry –chain adder, Carry Look- ahead adder, Design of Multipliers: Serial, Parallel and pipelined multiplier arrays, Booth multiplier, Wallace tree multiplier.

Unit–V : Programmable ASCIS and VHDL

Architecture and Programming technologies of ROMs, EPROMs, PLA, PAL, Gate arrays, CPLD and FPGA – Xilinx FPGA's LCA , I/O block and interconnect – Programming technology. VHDL overview- Hardware modeling issues –VHDL code structure: Library declaration, Entities and Architectures –Data types- Operators-Concurrent and Sequential statements-Signals and Variables-Packages and Libraries - Introduction to behavioral, dataflow and structural modeling-simple VHDL code examples.

Text Books

1. Neil, H.E. Weste, David Money Harris, "CMOS VLSI Design": A Circuits and Systems Perspective, Pearson Education India, 3rd edition, 2012.
2. Wayne Wolf, "Modern VLSI Design", Ip-Based Design, Pearson Education India, 4th edition, 2009.

Reference Books

1. Deepak Garg, VLSI Design, S.K. Kataria& Sons; 1st edition, 2013.
2. R.Sakthivel, "VLSI Design", S.Chand& Company Ltd, 4th edition, 2008.
3. SaritaChauhan, "VLSI Design" S.K., Kataria& Sons; edition, 2012.
4. Sharat C. Prasad Kaushik Roy, "Low-Power CMOS VLSI Circuit Design", Wiley Publications, 2009.
5. AL.Visalatchi, B.Priya, S.Pravenaa, "Modern VLSI Design", Anuradha Publications, 1st edition, 2010.
6. Douglas. A. Puknell and Kamran Eshraghian, "Basic VLSI Design", PHI, 3rd Edition, 2005.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Provide comprehensive idea about the techniques of chip design using programmable devices.
2. Analyze VLSI systems, VHDL and MOS circuit realization of the various building blocks that is common to any microprocessor or digital VLSI circuit.
3. Design and analyze of analog circuit
4. Design and analyze digital circuits like multipliers, adders and understand the architecture and programming technologies of FPGA.
5. Model a simple digital system using VHDL.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2		✓			✓							
CO3		✓										
CO4	✓				✓							
CO5		✓										✓

EEPESCN	MICRO ELECTRO MECHANICAL SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

- To Provide Knowledge of Semiconductors and Solid Mechanics to Fabricate MEMS Devices.
- To Educate on the Rudiments of Micro Fabrication Techniques.
- To Introduce Various Sensors and Actuators
- To Introduce Different Materials used for MEMS
- To Educate on The Applications of MEMS to Disciplines Beyond Electrical and Mechanical Engineering.

Unit I: Introduction

Intrinsic Characteristics of MEMS – Energy Domains And Transducers- Sensors And Actuators – Introduction to Micro Fabrication – Silicon Based MEMS Processes – New Materials – Review of Electrical and Mechanical Concepts In MEMS – Semiconductor Devices – Stress And Strain Analysis – Flexural Beam Bending- Torsional Deflection.

Unit II : Sensors and Actuators

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 – Magnetic Actuators – Micromagnetic Components – Case Studies of MEMS in Magnetic Actuators- Actuation Using Shape Memory Alloys.

Unit III : Sensors and Actuators

Piezoresistive Sensors – Piezoresistive Sensor 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 IV : Micromachining

Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching Of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case Studies – Basic Surface Micro Machining Processes – Structural And Sacrificial Materials – Acceleration Of Sacrificial Etch – Striction And Antistriction Methods – LIGA Process – Assembly Of 3D MEMS – Foundry Process.

Unit V : Polymer and Optical MEMS

Polymers In MEMS– Polimide – SU-8 – Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon – Application To Acceleration, Pressure, Flow And Tactile Sensors- Optical MEMS – Lenses And Mirrors – Actuators For Active Optical MEMS.

Text Books:

1. Chang Liu, 'Foundations Of MEMS', Pearson Education Inc., 2012.
2. Stephen D Senturia, 'Microsystem Design', Springer Publication, 2000.
3. Tai Ran Hsu, "MEMS & Micro Systems Design And Manufacture" Tata McGraw Hill, New Delhi, 2002.

References:

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. Julian W. Gardner, Vijay K. Varadan, Osama O.Awadelkarim, Micro Sensors MEMS And Smart Devices, John Wiley & Son LTD, 2002.

4. James J.Allen, Micro Electro Mechanical System Design, CRC Press Publisher, 2005.
5. Thomas M.AdamsAnd Richard A.Layton, "Introduction MEMS, Fabrication And Application," Springer, 2010.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Ability to Understand the Operation of Micro Devices, Micro Systems And Their Applications.
2. Understand operation of different sensors and actuators
3. Ability to Design the Micro Devices, Micro Systems Using the MEMS Fabrication Process.
4. Ability to understand the application of MEMs
5. Ability to understand polymer and optical MEMs

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2		✓				✓						
CO3		✓				✓						✓
CO4		✓										
CO5		✓										

OPEN ELECTIVES

EEOESCN	ELECTRICAL SAFETY ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

- To impart knowledge about safety its requirements
- To impart knowledge on prevention of electrical shocks
- To create awareness about various Hazardous areas
- To create awareness about various first aid methods
- To study about safety management

Unit–I: Introduction

General Background-Objectives of safety and security measures-Hazards associated with electric current and voltage-principles of electrical safety-Approaches to Prevent Accidents- Fire Prevention and Fire Fighting-Objectives and scope of IE act and IE rules-General requirements for electrical safety as per IE rules

Unit–II: Electrical Shocks and their Prevention

Primary and Secondary Electric Shocks- Occurrence of Electric Shock-Shocks Due to Flashovers/Spark-overs- Lightning Strokes on Overhead Transmission Linesand Outdoor Substations - Safety Precautions in Small LV Installations, Residential Buildings, Shops -Safety Procedures in Electrical Plant Installation and description of Earthing System- Equipment Earthing - Substation Earthing.

Unit–III: First Aid

Introduction- Removal of Contact with Live Conductor- First Principles of Actions after Electric Shock - Artificial Respiration - Schafer's Prone Pressure Method- Silvester's Method- Nielson's Arm-lift Back-pressure Method- Mouth to Mouth Method- Use of Artificial Resuscitator- External Cardiac Massage- Cardiac Pulmonary Resuscitation-First aid treatment of Heat Exhaustion and heat stroke.

Unit–IV: Electrical Safety in Hazardous Areas

Introduction-Classification of Hazardous zones-causes of sparks and flashovers in electrical plants and machines-functional requirements of electrical equipment and installations for hazardous area/zones-classification of equipment/enclosure for hazardous locations.

Unit–V: Electrical Safety Management

Introduction-Principles of safety management-management's safety policy-safety organization-organization charts for construction phase of a project, maintenance mode of a plant and for safety department – safety auditing-training and supervision-annual reports - motivation to managers, supervisors and employees.

Text Books:

1. S.Rao and H.L.Saluja, "Electrical Safety, Fire Safety and Safety Management", Khanna Publishers, 2012.
2. W.F.Cooper, "Electrical Safety Engineering", Butterworth and Company, London, 1998.

References

1. J.Cadick, D.Neitzel and A.Winfield, "Electrical Safety HandBook", McGraw Hill Education, 2012.
2. J. Maxwell Adams, "Electrical Safety-A Guide to the Causes and Prevention of Electric Hazards", The Institution of Electric Engineers, 3rdReprint, 2009.
3. Martha J. Boss and Gayle Nicoll, "Electrical Safety - Systems, Sustainability and Stewardship", CRC Press, 2015.

Course Outcomes:

At end of this course, students will demonstrate the ability to

1. Learn about Electrical safety, IE act and IE rules
2. Acquire knowledge about preventing electrical shocks
3. Acquire knowledge about various first aid measures.
4. Familiarize with electrical safety in hazardous areas.
5. Get introduced to safety management.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓									
CO2			✓									
CO3	✓		✓									
CO4		✓			✓							
CO5	✓		✓									

EEOESCN	GENERATION OF ELECTRICAL ENERGY	L	T	P	C
		3	0	0	3

Course Objectives:

- To emphasize on power generation technology using conventional and non-conventional energy sources
- To create an understanding of conversion of various forms of energy to electrical energy.
- To highlight the operation and major components of electric generating plants.
- To highlight the operation and major components of hydro power plant
- To introduce to the basics of Tariff structure for energy production.

Unit – I: Thermal, Gas and Diesel Power Plants

Thermal Power Plant: Plant layout, Components of thermal power plant, Advantages and disadvantages, choice of site.

Gas Turbine Power Plants: Plant layout, advantages and disadvantages, Applications, Open cycle and closed cycle gas turbine power plant, combined cycle power plant, Comparison with steam power plants.

Diesel power plant: Plant Layout, advantages and disadvantages, Applications, Choice and characteristic of diesel engines, auxiliaries.

Unit – II: Hydro Power Plant

Advantages and disadvantages, choice of site, Classification, Schematic arrangement, constituents of hydro power plant, Hydro turbines, Economics of small hydro schemes, Pumped storage plants, types, Advantages.

Unit – III: Nuclear Power Plant

Location and size selection, Layout and components of Nuclear Power Plants, Nuclear reactors-types and applications, Safety measures for Nuclear Power plants-Radiation shielding, Radioactive and waste disposal

Unit- IV: Power from Renewable Energy

Principle, Construction, working and types of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas, Fuel Cell and Magneto-Hydro dynamic system.

Unit-V: Power Plant Economics and Tariffs

Factors affecting cost of generation, Selection of type of generation and generation equipment, Load curve, load duration curve, Effect of load on power plant design, tariffs, depreciation, causes and effects of low power factor and its improvement.

Text Books

1. B.R. Gupta , “Generation of Electrical Energy”, S.Chand and Co., 2010
2. 2. NagpalG.R. “Power Plant Engineering”, ***Khanna Publishers : 2007.***

References

1. Uppal S.L. “Electrical Power”, ***Khanna Publishers : 2007.***
2. Arora S.C. and Domakundwar S. “A Course in power plant engineering”***DhanpatRai& Co (P)Ltd., Delhi: 2005.***
3. Nag. P.K., "Power Plant Engineering", Tata McGraw – Hill., 2008.
4. Singhai D.K. “Fundamentals of Nuclear Power Engineering” ***KhannaPublishers : 2007.***

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Students can able to know different types of power plants, their functions and issues related to them.
2. Students can able to understand the significance of Hydro Energy and its economical benefits.
3. Students can able to understand the principle of operation and performance of various nuclear reactors and their impact on environment.
4. Students can able understand the importance of renewable energy sources as an alternative to energy crisis.
5. Students can learn the basics of Tariff structure for energy production.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓									
CO2			✓	✓								
CO3					✓							
CO4	✓											
CO5	✓				✓							

EEOESCN	ELECTRICAL MATERIALS	L	T	P	C
		3	0	0	3

Course Objectives:

- To introduce the basic concepts of conducting materials.
- To understand the properties of semiconducting, magnetic and dielectric materials.
- To study the properties and applications of optical materials.
- To learn the new materials used in communication engineering.

Unit–I: Conducting Materials

Classical free electron theory - electrical conductivity - drawbacks of classicaltheory - quantum free electron theory of metals and its importance - density of energy states - Fermi-Dirac statistics - calculation of Fermi energy and its importance - concept of hole – energy bands in solids (qualitative treatment only) - effective mass of electron - high resistivity materials, superconductors-properties and applications.

Unit–II: Semiconducting Materials

Elemental and compound semiconductors and their properties - carrier concentration intrinsic semiconductors - carrier concentration in n-type and p-type semiconductors - variation of Fermi level and carrier concentration with temperature - Hall effect – applications.

Unit–III: Magnetic and Dielectric Materials

Different types of magnetic materials and their properties - domain theory of ferromagnetism - Heisenberg criteria - Hysteresis energy product of a magnetic material - merits and their applications - magnetic recording materials-metallic glasses - Dielectrics - Fundamental definitions - different types of electric polarization - dielectric loss – properties and different types of insulating materials - active and passive dielectrics andtheir applications - Ferro electrics – Piezo-electrics .Unit–IV: Optical Materials

Optical properties of metals, insulators and semiconductors - phosphorescence and fluorescence - excitons, traps and colour centres and their importance - different phosphors used in CRO screens - liquid crystal as display material - Thermography and its applications - photoconductivity and photo conducting materials.

Unit–V: New Engineering Materials

Metallic glasses as transformer core materials - Nano phase materials - Shape memory alloys - Bio-materials - Non-linear materials – Second harmonic generation - Optical mixing - Optical phase conjugation - Solitons - Nuclear engineering materials - IC packaging material.

Text Books:

1. Arumugam, M., "Materials Science",***Anuradha Publications, 2010.***
2. Palanisamy, P.K., “Materials Science”, ***Scitech publications, 2003.***

References

1. Dekker, A.J., “Electrical Engineering Materials” ***Prentice Hall of India, 2006.***
2. Rajput, R.K., “Electrical Engineering Materials”, Laxmi Publications New Delhi, 1993.
3. Simon, S.M., "Physics ofSemiconductordevices",3rd Edition, ***WileyEastern, 2007.***
4. Van Vlack, L.H., "Material Science for Engineers", ***Addison Wesley, 2000.***

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the concept of conducting materials.
2. Realize the properties of semiconducting, magnetic, dielectric and optical materials.
3. Realize the properties of magnetic and dielectric materials
4. Know the importance of optical materials in electrical engineering field.
5. Introduce new engineering materials in electrical engineering.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓									
CO2	✓											
CO3	✓											
CO4				✓	✓							
CO5			✓		✓							

EEOESCN	SOFT COMPUTING TOOLS FOR ELECTRICAL ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

- To familiarize the students with the various architectures and learning algorithms of Artificial Neural Network.
- To make the students to understand the basis of classifying neural networks and suitability for different applications.
- To enable the students to acquire knowledge on Fuzzy logic and their operations
- To acquire the ability of designing Fuzzy logic controllers and Neuro Controllers.
- To introduce the concept of genetic algorithm and its operators.

Unit–I: Artificial Neural Networks

Motivation for the development of neural networks- biological neuralnetworks-artificial neural networks – Fundamental Concepts - weights – biasesand thresholds - common activation functions. McCulloch-Pitts neuron:Architecture, algorithm - Hebb Net- Architecture - algorithm - Perceptron –Architecture-algorithm- applications- Linear separability - Perceptron learningrule convergence theorem - Delta rule.

Unit – II: Neural Network Architecture And Algorithms

Back propagation Neural Net: Standard back propagation -architecture - algorithm - number of hidden layers - Discrete Hopfield neuralnet- architecture - algorithm – Competitive Neural Networks -Fixed-weightcompetitive nets – Kohonen self-organizing Maps – Adaptive ResonanceTheory- Basic architecture - Algorithm - Introduction to Neuro controllers - Application of ANN for Economic Load Dispatch problem.

Unit – III: Fuzzy Logic

Fuzzy sets - Properties of Classical and Fuzzy sets- Operations onFuzzy sets-Fuzzy relations- Linguistic variables - Linguistic Hedges- Fuzzystatements-Assignment statements- Conditional statements- unconditionalstatements- Fuzzy rule base- Canonical rule formation- Decomposition ofcompound rules.

Unit – IV: Fuzzy Logic Controller

Fuzzy logic controller: Functional diagram - Fuzzification -Membership value assignments using intuition - Membership functions-Defuzzification: Max-Membership principle - centroid method – weightedaverage method - Inference Engine – Knowledge Base -Rule base –Casestudies- Fuzzy logic controller for DC motor speed control.

Unit – V: Genetic Algorithm

Optimization – Traditional optimization methods – Concept of EvolutionaryAlgorithm – Genetic Algorithm – encoding and decoding of variables – GAoperators – reproductions – Cross over – mutation – fitness function – fitnessscaling.

Text Books

1. LawreneFaussett, "Fundamental of neural networks", ***Prentice Hall, 2004.***
2. Rajasekaran and VilyalakshmiPai G.A, “Neural Networks, Fuzzy Logic and Genetic Algorithms – Sysnthesis and Apllications”, Prentice Hall, 2015
3. David Goldberg. E,” Genetic algorithms in search optimization and machine learning,” Addison Wesley, Pearson Education, Asia, 2001.

References

1. Driankov.Hellendoornarow D.H Reinfrank M., "An introduction to Fuzzy Control”, ***Narosa Publishing co., New Delhi, 2006.***
2. Ross T.J,"Fuzzy Logic with Engineering Applications", ***McGraw-Hill, Newyork, 2005.***
3. Sivanandham. SN and Deepa. SN, “Neural networks with Matlab”, TMH 2007.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Able to choose the suitable soft computing technique for the particular problem domain.
2. Recognize the feasibility of applying Artificial Neural Networks for a particular problem.
3. Apply Fuzzy Logic and reasoning to handle uncertainty and solve engineering problems.
4. Identify and apply Neuro-controller and Fuzzy Logic Controller for the solution of engineering problems.
5. Apply genetic algorithms to combinatorial optimization problems.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓							✓
CO2		✓	✓		✓							
CO3	✓		✓		✓							
CO4		✓			✓							✓
CO5	✓		✓	✓	✓							✓

EEOESCN	BIOMEDICAL ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

- To give an exposure to various systems of human body.
- To learn the various types of biological transducers used in medical engineering field for signal acquisition.
- To familiarize the students about the bio-potential electrodes and amplifiers used in biomedical engineering.
- To focus on various cardiovascular, respiratory therapy equipments used in medical field.
- To familiarize the students about recent trends in medical imaging.

Unit–I: Electrophysiology

Brief review of physiology and anatomy – Cell structure- Resting potential - Action potential - Propagation of action potentials - Bioelectric potentials - Cardiovascular dynamics - Electrode theory –Microelectrodes-Types of microelectrodes- Depth/Needle electrodes-Bipolar and unipolar electrodes - Surface electrodes –Transducers for bio-medical applications.

Unit–II: Bioelectric Signal Acquisition

Biomedical Instrumentation-Classification-design factors of biomedical instrumentation-Bio potential amplifiers - Instrumentation amplifier –Carrier amplifiers – Chopperamplifiers-Microprocessor/Microcontroller based instrumentation - Telemetry - Safety of biomedical equipments.

Unit–III: Bioelectric Potential and Cardiovascular Measurements

Electrocardiograph - Phonocardiography - Vector cardiography – Blood Pressure -Blood flow - Cardiac output - Plethysmography -Impedance cardiology - Cardiac arrhythmias - Pacemakers - Defibrillators – Electroencephalograph - Evoked potential response – Electromyograph - Fetal monitor.

Unit–IV: Respiratory, Pulmonary Measurements and Rehabilitation

Physiology of respiratory system - respiratory rate measurement - Temperature - Pulmonary function measurement - Oximeter –Audiometers-types- Hearing aids - Functional neuromuscular stimulation - Physiotherapy - Diathermy -Nerve simulator/pain killer.

Unit–V : Recent Trends in Medical Imaging

Medical imaging - LASER applications in medical field - Ultrasound scanner - Echo cardiography - CT scan -Magnetic Resonance Imaging (MRI) –X-Ray imaging using special techniques- Holter monitoring.

Text Books:

1. Leslie Cromwell, Fred J.Weibell and Erich A.Pfeiffer, "Biomedical Instrumentation and Measurements", Prentice Hall of India, New Delhi, 2006.
2. R.Anandanatarajan, "Biomedical Instrumentation and Measurements", PHI Learning Private Limited, Delhi-110092, 2013.

References

1. G.S.Sawhney, Biomedical Electronics and Instrumentation, I.K. International Pvt. Ltd, 1st Edition, 2012.
2. R.S. Khandpur, Handbook of Biomedical Instrumentation, Third Edition, McGraw Hill Education (India) Private Limited, 2014.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Provide idea about different types of physiological transducers used in medical engineering which can be used to acquire biological signals from the human body.
2. Explain the anatomy and physiology of various subsystems of human body.
3. Get knowledge about acquiring biological signal and bioelectric potential and cardiovascular measurement

4. Understand the principles of cardiovascular, respiratory and therapeutic assisting devices used in bio-medical field.
5. Describe the recent trends used in medical imaging.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓									
CO2	✓			✓								
CO3	✓		✓									
CO4			✓	✓								
CO5					✓							

EEOESCN	UTILIZATION OF ELECTRICAL ENERGY	L	T	P	C
		3	0	0	3

Course Objectives:

- To study about the different systems of electric traction
- To introduce the energy saving concept by different ways of illumination.
- To explore the utilisation of electrical energy for heating and welding
- To provide basic knowledge about Refrigeration and Air-conditioning
- To expose the students to the economics of Electrical Energy Utilization

Unit – I: Electric Drives And Traction

Fundamentals of electric drive – choice of an electric Motor – application of motors for particular services-Traction Motors – Characteristic features of traction motor – Systems of railway electrification – Electric braking – Train movement and energy consumption – Traction motor control – Track equipment and collection gear.

Unit – II: Illumination

Introduction – Definition and meaning of terms used in illumination Engineering – Classification of light sources- Incandescent lamps, sodium vapour lamps, mercury vapour lamps, fluorescent lamps – Design of illumination systems – Indoor lighting schemes – factory lighting halls – Outdoor lighting schemes – flood lighting – street lighting – Energy saving lamps.

Unit – III: Heating And Welding

Introduction – advantages of electric heating – Modes of heat transfer – Methods of electric heating – Resistance heating – Arc furnaces – Induction heating – Dielectric heating- Electric welding – Types – Resistance welding – Arc welding – Radiation welding – Requirements of good weld – Power supply for arc welding.

Unit – IV: Refrigeration and Air Conditioning

Introduction – Refrigeration cycle – Refrigeration system – Types of refrigerants – Domestic refrigerator – Water coolers – Air conditioning systems – Air conditioning cycle – Classification of air conditioning systems – Central system – Unitary systems

Unit – V: Economics of Electrical Energy Utilization

Economics of Electric power supply – General rule for charging the energy – Economical cross section of a conductor – Ratings of a motor – temperature rise in a motor – power factor improvement– Economic choice of equipment – energy management – energy auditing

Text Books:

1. Dr.N.V.Suryanarayana, "Utilisation of Electric power", Wiley Eastern Limited, New Age International Limited, 1993.
2. J.B.Gupta, "Utilisation Electric power and Electric Traction", S.K.Kataria and Sons, 2012.

References:

1. R.K.Rajput, "Utilisation of Electrical Power", Laxmi publications (P) Ltd., 2016.
2. H.Partab, "Art and Science of Utilisation of Electrical Energy", DhanpatRai and Co, New Delhi – 2017.
3. C.L.Wadhwa, "Generation, Distribution and Utilisation of Electrical Energy", New Age International Pvt. Ltd., 2003.

Course Outcomes:

At the end of this course the students will be able to

1. Discuss about different type of electric drives and systems employed in electric traction.
2. Describe various lamps and design illumination schemes.
3. Classify the existing methods used for heating and welding.
4. Discuss the concepts of refrigeration and air conditioning.
5. Analyze the various energy saving methods.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓			✓								
CO2			✓	✓								
CO3				✓								
CO4	✓				✓							
CO5					✓							

HONOUR ELECTIVES

EEHESCN	POWER SYSTEM DYNAMICS AND CONTROL	L	T	P	C
		3	1	0	4

Course Objectives:

- To introduce various aspects of power system operation, stability and control
- To discuss about the analysis of linear dynamical system and various numerical integration techniques.
- To analyze the modeling of synchronous machines and associated controllers in detail
- To explain the modeling of various power system components
- To understand various types of stability analysis of power system.

Unit - I: Introduction to Power System Operations

Introduction to power system stability.Power System Operations and Control.Stability problems in Power System.Impact on Power System Operations and control.

Unit - II: Analysis of Linear Dynamical System and Numerical Methods

Analysis of dynamical System, Concept of Equilibrium, Small and Large Disturbance Stability.Modal Analysis of Linear System.Analysisusing Numerical Integration Techniques. Issues in Modeling: Slow and Fast Transients, Stiff System.

Unit - III: Modeling of Synchronous Machines and Associated Controllers

Modeling of synchronous machine: Physical Characteristics.Rotor position dependent model.D-Q Transformation.Model with Standard Parameters.Steady State Analysis of Synchronous Machine.Short Circuit Transient Analysis of a Synchronous Machine.Modeling of Excitation and Prime Mover Systems.Physical Characteristics and Models.Automatic Voltage Regulator.Prime Mover Control Systems. SpeedGovernors.

Unit - IV: Modeling of other Power System Components

Modeling of Transmission Lines and Loads.Transmission Line Physical Characteristics.Transmission Line Modeling. Load Models - induction machine model. Frequency and Voltage Dependence of Loads.

Unit - V: Stability Analysis

Angular stability analysis in Single Machine Infinite Bus System.Angular Stability in multi-machine systems – Intra-plant, Local and Inter-area modes. Frequency Stability: Centre of Inertia Motion. Load Sharing: Governordroop. Single Machine Load Bus System: Voltage Stability.Stabilizing Controllers (Power System Stabilizers) Introduction to Torsional Oscillations and the SSR phenomenon.Operational Measures- Preventive Control.Emergency Control.

Text/References

1. K.R. Padiyar, “Power System Dynamics, Stability and Control”, B. S. Publications,2002.
2. P. Kundur, “Power System Stability and Control”, McGraw Hill,1995.
3. P. Sauer and M. A. Pai, “Power System Dynamics and Stability”, Prentice Hall,1997

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand basic power system operation
2. Understand the problem of power system stability and its impact on the system.
3. Analyze linear dynamical systems and use of numerical integration methods.
4. Model different power system components for the study of stability.
5. Understand the methods to improve stability.

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓		✓									
CO3			✓									
CO4	✓				✓							
CO5	✓		✓									

EEHESCN	RESTRUCTURED POWER SYSTEMS	L	T	P	C
		3	1	0	4

Course Objectives:

- To understand the fundamentals of restructured power systems
- To learn the significance of Independent System Operator
- To impart knowledge on transmission open access and pricing
- To know about the ancillary services and their management
- To study about the power system analysis under market environment

Unit–I: Introduction to Restructuring

Reasons for restructuring of power industry-Vertically Integrated Utilities and Power Pools-Different Entities involved-Market models-Benefits from a Competitive Electricity Market-Worldwide Movement of Power Industry Restructuring

Unit–II: Power System Operation in Competitive Environment

Role of the Independent System Operator (ISO)- Operational Planning Activities of ISO- The ISO in Pool Markets- The ISO in Bilateral Markets- Operational Planning Activities of a Genco- The Genco in Pool Markets- The Genco in Bilateral Markets- Market Participation Issues- Competitive Bidding.

Unit–III: Transmission Open Access and Pricing

Power Wheeling- Transmission Open Access- Types of Transmission Services in Open Access- Cost Components in Transmission- Pricing of Power Transactions- Embedded Cost Based Transmission Pricing- Incremental Cost Based Transmission Pricing.

Unit–IV: Ancillary Services Management

General Description of Some Ancillary Services-Frequency control-Reserves services-Reactive power and voltage control service-Black start capability service-Scheduling and Dispatch Services- Synchronous Generators as Ancillary Service Providers.

Unit–V: Power System Analysis in Market Environment

Electricity Price Forecasting- Issues of Electricity Pricing and Forecasting-Factors Considered in Price Forecasting- Performance Evaluation of Price Forecasting- Price Based Unit Commitment (PBUC)- PBUC Formulation- System Constraints- Unit Constraints- PBUC Solution- Electricity Market Analysis using AC Optimal Power Flow and Economic Load Dispatch.

Text Books:

1. K. Bhattacharya, M. Bollen, J.E. Daalder, "Operation of Restructured Power Systems", Kluwer Academic Publishers, 2001.
2. S.C. Srivastava and S.N. Singh, "Operation and Management of Power System in Electricity Market", Alpha Science, 2015.

References

1. Mohammad Shahidehpour and MuwaffaqAlomoush, "Restructured Electric Power System Operation Trading and Volatility", Marcel Dekker Inc.,2001.
2. Loi Lei Lai, "Power System Restructuring and Deregulation", John Wiley & Sons Ltd, England, 2001.
3. Xiao-Ping Zhang, "Restructured Electric Power Systems: Analysis of Electricity Markets with Equilibrium Models", John Wiley & Sons, 2010.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the difference between traditional and restructured power systems
2. Understand about various entities involved in power markets.
3. Familiarize with transmission open access and electricity pricing
4. Understand various ancillary services management
5. Understand the power system analysis under market environment

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			✓	✓								
CO2					✓							
CO3	✓											
CO4	✓		✓									
CO5	✓				✓							

EEHESCN	FLEXIBLE AC TRANSMISSION SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

- To emphasize the need for controllers and basic varieties of compensators.
- To study the characteristics, modeling and operating schemes of different types of shunt and series switched reactive power generating devices.
- To discuss the model and performance of emerging FACTS controllers and their performance in unbalanced A.C systems.
- To explain the techniques for co-ordination of the different FACTS controllers and different power control schemes.

Unit - I: Classification of Compensators

Reactive Power Control in AC Transmission lines –Uncompensated transmission line – Need for Controllers –Basic types of Controllers - shunt compensated controller– series compensated controller – Thyristor controlled voltage regulator – comparison of HVDC and FACTS technologies.

Unit–II: Static VAR Compensators (SVC)

Objectives of shunt compensation - Methods of controllable Var Generation - Merits of Hybrid compensators - General control scheme of static Var compensator – VI and VQ Characteristics of SVC – Voltage control by SVC – Influence of SVC on system voltage –Design of SVC voltage regulator.

Unit–III: Static Series Compensators (SSC)

Objectives of Series Compensation – Variable impedance type Series Compensators – Modeling and operating control schemes of TSSC,TCSC – Variable reactance model –Switching Converter type Series Compensators – Model and Operating Control scheme of SSSC – Capability to provide real power Compensation.

Unit–IV: Emerging Facts Controllers

Static Synchronous Compensator (STATCOM) –Transfer function model – Dynamic performance –Capability to exchange real power – Operation in unbalanced ac systems – Comparison between STATCOM and SVC – Special purpose FACTS Controller – NGH-SSR Damping Scheme – Thyristor Controlled Braking resistor.

Unit–V: Coordination of FACTS Controllers

Controller interactions –SVC – SVC interaction – Unified Power Flow Controller(UPFC) –Independent real and reactor Power flow Control – Control Schemes for P and Q Control – Interline Power flow Controller(IPFC) – Control Structure - Design of FACTS Controllers .

Text Books

1. Narain G. Hingorani, Laszio. Gyugy, Understanding FACTS Concepts and Technology of Flexible AC Transmission Systems, Standard Publishers Distributors, New Delhi, 2001.
2. Mohan Mathur, R., Rajiv K. Varma, Thyristor Based FACTS Controller for Electrical transmission Systems, IEEE Press, John Wiley and Sons, 2002.

References

1. Singh, S.N., Electric Power Generation Transmission and Distribution, PHI, New Delhi, 2003.
2. Narain G. Hingorani, High power Electronics and Flexible AC Transmission Systems, IEEE High PowerEngineering Review, 1998.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Learn the classification of compensators and its application
2. Learn the characteristics, modeling and operating schemes of different types of shunt and series switched reactive power generating devices.
3. Learn the effect of compensators
4. Knowledge about emerging facts controllers
5. Build an enhanced knowledge of how to realize control strategies to ensure a smooth transfer of power with improved performance indices

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			✓	✓								
CO2					✓							
CO3	✓											
CO4	✓		✓									
CO5	✓				✓							

EEHESCN	POWER QUALITY STUDIES	L	T	P	C
		3	0	0	3

Course Objectives:

- To introduce the definition of power quality disturbances along with cause, detrimental effects and mitigation methods.
- To learn the aspects of power quality in distribution system and various indices.
- To introduce the harmonic sources, active filters and standards.

Unit–I: Fundamentals of Power Quality

Characterization of Electric Power Quality: Transients- short duration and long duration voltage variations Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation, Power acceptability curves – power quality problems, Non linear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage – Power quality standards.

Unit–II: Analysis of Single Phase and Three Phase System

Single phase linear and non linear loads – single phase sinusoidal, non sinusoidal source – supplying linear and nonlinear load – three phase Balance system – three phase unbalanced system – three phase unbalanced and distorted source supplying non linear loads – concept of pf.

Unit–III: Conventional Load Compensation Methods

Principle of load compensation and voltage regulation – classical load balancing problem : open loop balancing – closed loop balancing, current balancing – harmonic reduction and voltage sag reduction – analysis of unbalance – instantaneous of real and reactive powers – Extraction of fundamental sequence component from measured values.

Unit–IV: Load Compensation Using DSTATCOM

Compensating single phase loads – Ideal three phase shunt compensator structure – generating reference currents using instantaneous PQ theory – Instantaneous symmetrical components theory – Generating reference currents when the source is unbalanced – Realization and control of DSTATCOM – DSTATCOM in Voltage control mode

Unit–V: Series Compensation of Power Distribution System

Rectifier supported DVR – DC Capacitor supported DVR – DVR Structure – voltage Restoration – Series Active Filter – Unified power quality conditioner.

Text Books:

1. ArindamGhosh, "Power Quality Enhancement Using Custom Power Devices", Kluwer Academic Publishers, 2002.
2. Dugan, R.C, McGranaghan, M.F., Santoso, S. and Wayne Beaty, H, "Electrical Power System Quality", McGraw Hill publishers, Second Edition, 2008.

References

1. Barry W. Kennedy, "Power Quality Primer", TheMcGrawHill Companies, 2000.
2. Bhim Singh, Ambrish Chandra and Kamal Al-Haddad, "Power Quality: Problems and Mitigation Techniques", Wiley Publications, 2014.
3. Heydt, G.T., "Electric Power Quality", Stars in a Circle Publications, 1994, 2nd edition.
4. Derek A. Paice, "Power Electronic Converter Harmonics", John Wiley &Sons, 1999.
5. Arrillga, A.J. and Neville R.Watson, "Power System Harmonics", John Wiley publishers, Second Edition, 2003.

Course **Outcomes**:

At the end of this course, students will demonstrate the ability to

Describe power quality issues in a power system.

1. Know the severity of power quality problems.
2. Understand and analyze single phase and three phase system
3. Compute the concept of improving the power quality to sensitive load by various mitigating methods.
4. Knowledge about load compensation using DSTATCON
5. Understand the series requirement of dynamic voltage regulation fills

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓		✓									
CO3	✓											
CO4			✓									
CO5	✓		✓									

EEHESCN	DIGITAL CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

Objectives:

- To develop a mathematical model of sample and hold cicuit
- To study Z and inverse Z transforms
- To analyze the stability of discrete time system
- To study the state space analysis of discrete time systems
- To analyze the design of discrete PID controller, discrete observer and discrete compensator

Unit - I: Discrete Representation of Continuous Systems

Basics of Digital Control Systems.Discrete representation of continuous systems. Sample and hold circuit. Mathematical Modelling of sample and hold circuit. Effects of Sampling and Quantization.Choice of sampling frequency.ZOH equivalent.

Unit - II: Discrete System Analysis

Transform and Inverse Z Transform for analyzing discrete time systems. Pulse Transfer function. Pulse transfer function of closed loop systems. Mapping from s-plane to z plane. Solution of Discrete time systems. Time response of discrete timesystem.

Unit - III: Stability of Discrete Time System

Stability analysis by Jury test. Stability analysis using bilinear transformation.Design of digital control system with dead beat response. Practical issues with dead beat responsedesign.

Unit - IV: State Space Approach for discrete time systems

State space models of discrete systems, State space analysis. Lyapunov Stability.Controllability, reach-ability, Reconstructibility and observability analysis. Effect of pole zero cancellation on the controllability & observability.

Unit - V: Design of Digital Control System

Design of Discrete PID Controller, Design of discrete state feedback controller.Design of set point tracker.Design of Discrete Observer for LTI System.Design of Discrete compensator.Design of discrete output feedback control.

Text Books

1. K. Ogata, “Digital Control Engineering”, Prentice Hall, Englewood Cliffs,1995.
2. M. Gopal, “Digital Control Engineering”, Wiley Eastern,1988.
3. G. F. Franklin, J. D. Powell and M. L. Workman, “Digital Control of Dynamic Systems”, Addison-Wesley,1998.
4. B.C. Kuo, “Digital Control System”, Holt, Rinehart and Winston,1980.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Obtain knowledge on discrete representation of LTI systems.
2. Analyse stability of open loop and closed loop discrete-time systems.
3. Design and analyse digital controllers.
4. Design state feedback and output feedback controllers.
5. Able to design discrete controllers

Mapping with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2								✓				
CO3			✓			✓						
CO4			✓			✓						
CO5			✓			✓						

MINOR ELECTIVES

EEMISCN	ANALOG ELECTRONIC CIRCUITS	L	T	P	C
		3	1	0	4

Course Objectives:

- To provide sound knowledge at the fundamental of electronics circuits
- To analyze the BJT circuits and its characteristics
- Introduction to MOSFET and small signal models
- To study multi-stage and operational amplifier
- To study the application Linear and non linear applications of op-amp circuits

Unit - I: Diode circuits

P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

Unit - II: BJT circuits

Structure and I-V characteristics 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 - III: 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, trans-conductance, high frequency equivalent circuit.

Uni - IV: 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)

Unit - V: Linear applications of op-amp

Idealized analysis of op-amp circuits. 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 Conversion. Zero Crossing Detector, Square-wave and triangular-wave generators

Text/References:

1. A. S. Sedra and K. C. Smith, “Microelectronic Circuits”, New York, Oxford University Press,1998.
2. J. V. Wait, L. P. HuelsmanandG. A. Korn, “Introduction to Operational Amplifier theory and applications”, McGraw Hill U. S.,1992.
3. J. Millman and A. Grabel, “Microelectronics”, McGraw Hill Education,1988.
4. P. Horowitz and W. Hill, “The Art of Electronics”, Cambridge University Press,1989.
5. P.R. Gray, R.G. Meyer and S. Lewis, “Analysis and Design of Analog Integrated Circuits”, John Wiley & Sons,2001.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the characteristics of transistors.
2. Design and analyse various rectifier and amplifier circuits.
3. Design sinusoidal and non-sinusoidal oscillators.
4. Understand the functioning of OP-AMP and design OP-AMP based circuits.
5. Understand the structure and I.V characteristics of MOSFET & BJT.

		L	T	P	C
EEMISCN	DIGITAL ELECTRONICS	3	0	0	3

Course Objectives:

- To review the fundamental concepts relating to Number systems, codes and Boolean algebra and to explain the working and the characteristics of Logic families and Logic packages.
- To bring out the function of logic gates, implementation of Boolean function using logic gates, simplification of Boolean Expression using K-map and implementation of various combinational circuits.
- To illustrate the function of various types of flip-flops and counters with the help of circuit diagram, truth table, state equation and timing diagram.
- To study about operation of A/D and D/A converters.
- To study the classification of semiconductor memories and programmable logic devices.

Unit - I: Fundamentals of Digital Systems and logic families

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic ,one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

Unit - II: Combinational Digital Circuits

Standard representation for logic functions, K-map representation, simplification oflogicfunctions using K-map, minimization of logical functions. Don't care conditions, Multiplexer ,De- Multiplexer/Decoders, Adders, Subtractors , BCD arithmetic, carry look ahead adder , serial adder , ALU, elementary ALU design, popular MSI chips, digital comparator ,parity checker/generator, code converters, priority encoders, decoders/drivers for display devices ,Q-M method of function realization.

Unit - III: Sequential circuits and systems

A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T and D- types flipflops, applications offlipflops, shiftregisters, applications of shiftregisters,serialtoparallel converter, parallel to serial converter, ring counter, sequence generator ,ripple(Asynchronous) counters, synchronous counters, counters design using flip flops ,special counter IC's, asynchronous sequential counters, applications of counters.

Unit - IV: A/D and D/A Converters

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter ,specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit ,analog to digital converters: quantization and encoding, parallel comparator A/D converter ,successive approximation A/D converter, counting A/D converter ,dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion,specificationsofA/Dconverters, example of A/D converter ICs

Unit - V: Semiconductor memories and Programmable logic devices.

Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array(FPGA).

Text/References:

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education,2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India,2016.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India,2016.
4. R.Anandh Digital Electronics – Kendra publishing house

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the working of logic families and logic gates.
2. Design and implement Combinational logic circuits.
3. Understand the process of Analog to Digital conversion and Digital to Analog conversion.
4. Able to use PLDs to implement the given logical problem.
5. Design and implement sequential logic circuits.

		L	T	P	C
EEMISCN	ELECTRICAL MEASUREMENTS & INSTRUMENTS	3	1	0	4

Course Objectives:

- To introduce the basic functional elements of instrumentation
- To discuss different methods of power and energy measurement.
- To explain various resistance and impedance measurement methods
- To study various storage and display devices
- To study various recorders, transducers and the data acquisition systems

Unit–I :Measurement of Voltage and Current

Units and standards-Dimensional analysis - D'Arsonval Galvanometer-Principle, construction, operation and comparison of moving coil, moving iron meters, dynamometer, induction type - Extension of range and calibration of voltmeter and ammeter – Errors and compensation.

Unit–II :Measurement of Power and Energy

Measurement of power in single phase and three phase circuits – Moving coil - DC potentiometer-Dynamometer type wattmeter - LPF wattmeter - compensated wattmeter, hall Effect wattmeter, thermal type wattmeter - Errors and compensation. Measurement of energy in single phase and three phase circuits - Induction type energy meter - Errors and compensation - Calibration.

Unit–III : Resistance and Impedance Measurements

Measurement of low, medium & high resistance – Ammeter, voltmeter method – Wheatstone bridge –A.C bridges – Measurement of inductance, capacitance – Q of coil – Maxwell Bridge – Wein's bridge – Schering bridge – Anderson bridge- Kelvin double bridge – Series and shunt type ohmmeter – High resistance measurement, Earth resistance measurement.

Unit–IV :Storage and Display Devices

Sampling- CRO dual trace and dual beam oscilloscope- applications-Digital storage oscilloscope and applications - XY Mode - Phase measurement using oscilloscope –Null balance method- Phase shift to pulse conversion method Magnetic disk and tape, digital plotters and printers- CRT display- digital CRO-LED-LCD.

Unit–V :Recorders, Transducers and Data Acquisition Systems

Recorders - XY recorders. Strip chart recorder – XY plotters - UV recorders-magnetic tape recording - FM digital recording –interference and screening-component impurities – electrostatic and electromagnetic interference-practical aspects of interference reduction. Classification of transducers- Selection of transducers- Elements of data acquisition system- A/D, D/A converters - Smart sensors.

Text Books:

1. A.K. Sawhney, A Course in Electrical & Electronic Measurements & Instrumentation, DhanpatRai and Co, New Delhi, 2010.
2. E.W. Golding &F.C.Widdis, 'Electrical Measurements & Measuring Instruments', A.H.Wheeler& Co, 2001.

Reference Books

1. J.B.Gupta, 'A Course in Electronic and Electrical Measurements and Instrumentation', S.K.Kataria& Sons, Delhi, 2003.
2. S.K.Singh, 'Industrial Instrumentation and Control', Tata McGraw Hill, 2nd edn., 2002.
3. R.B. Northrop, Introduction to Instrumentation and Measurements, Taylor & Francis, New Delhi, 2008.
4. M.M.S. Anand, Electronics Instruments and Instrumentation Technology, Prentice Hall India, New Delhi, 2009.
5. J.J. Carr, Elements of Electronic Instrumentation and Measurement, Pearson Education India, New Delhi, 2011.
6. Martin U. Reissland, 'Electrical Measurement – Fundamental Concepts and Applications', New Age International (P) Ltd., 2001.
7. BouwensA.J.,"Digital Instrumentation", Tata McGraw Hill Publishing Co. Ltd., New Delhi -1997.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Ability to understand and apply basic science, circuit theory, control theory and signal processing concepts to engineering problems.
2. Acquire knowledge about of display instruments, amplifier measurements and CRO
3. Able distinguish recorders, transducers, data acquisition systems and display devices.

4. Understand frequency and periodic measurements.
5. Obtain knowledge on data acquisition systems.

		L	T	P	C
EEMISCN	MICROPROCESSOR AND MICROCONTROLLER	3	0	0	3

Course Objectives:

- To Study the architectures of 8085 microprocessor and 8051 microcontroller
- To study the addressing modes and instruction set
- To gain knowledge about interrupt ,I/O and communication interface

Unit - I: Fundamentals of Microprocessors:

Fundamentals of Microprocessor Architecture -8-bit Microprocessor and Microcontroller architecture, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers. Architecture of 8085 microprocessor, memory organization, timing diagram and interrupts, interfacing of I/O devices.

Unit - II: The 8051 Architecture:

Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and Reset circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles.

Unit - III: Instruction Set and Programming:

Addressing modes: Introduction, Instruction syntax, Data types, Subroutines, Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing. 8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs.

Unit - IV: Memory ,I/O and communication Interfacing:

Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, timers, counters, memory devices. Synchronous and Asynchronous Communication. RS232, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-Bee.

Unit - V: Application:

LED, LCD and Keyboard interfacing.stepper motor interfacing ,D.C motor interfacing ,sensor interfacing ,introduction to 16-bit microcontroller - 8097

Text / References:

1. M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, "The8051Microcontroller and Embedded Systems: Using Assembly and C",Pearson Education,2007.
2. K. J. Ayala, "8051 Microcontroller", Delmar CengageLearning,2004.
3. R. Kamal, "Embedded System", McGraw HillEducation,2009.
4. R. S. Gaonkar, ", Microprocessor Architecture: Programming and Applications with the 8085", Penram International Publishing,1996

5. D.A. Patterson and J.H. Hennessy, "Computer Organization and Design: The Hardware/Software interface", Morgan Kaufman Publishers, 2013.
6. D. V. Hall, "Microprocessors & Interfacing", McGraw Hill Higher Education,1991.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Do assembly language programming.
2. Do interfacing design of peripherals like I/O, A/D, D/A, timer etc.
3. Develop systems using different microcontrollers.
4. Interface the memory and peripheral devices design the microprocessors controller systems of various applications.
5. Understand the microprocessor based automation system.

		L	T	P	C
EEMISCN	CONTROL SYSTEMS	3	0	0	3

Course Objectives:

- To develop a mathematical model for physical systems – translational and rotational system block diagram reduction techniques for obtaining transfer function.
- To study time response analysis of various standard inputs for first order and second order systems.
- To study frequency response analysis and frequency domain specification by bode plot and polar plot.
- To analyze stability of system and application of controllers
- To study the concept of controllability and observability and state space analysis. (Obtaining state equation for physical, phase and canonical variable)

Unit - I: Introduction to control problem

Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems.

Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.

Unit - II: Time Response Analysis

Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

Unit - III: Frequency-response analysis

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

Unit - IV: Introduction to Controller Design

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems.Root-loci method of feedback controller design.Design specifications in frequency-domain. Frequency-domain

methods of design.Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs.Analog and Digital implementation of controllers.

Unit - V: State variable Analysis

Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability.

Pole-placement by state feedback.Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems. Performance Indices. Regulator problem, Tracking Problem. Nonlinear system–Basic concepts and analysis.

Text/References:

1. M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education,1997.
2. B. C. Kuo, "Automatic Control System", Prentice Hall,1995.
3. K. Ogata, "Modern Control Engineering", Prentice Hall,1991.
4. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International,2009
5. Ambikapathy,"control systems ",khanna book publishing co.(p) ltd,Delhi.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the modeling of linear-time-invariant systems using transfer function and state- space representations.
2. Understand the concept of stability and its assessment for linear-time invariant systems.
3. Design simple feedbackcontrollers.
4. Design simple feedback controllers.
5. Acquire knowledge about state variable analysis.

		L	T	P	C
EEMISCN	INDUSTRIAL ELECTRICAL SYSTEMS	3	0	0	3

Course Objectives:

- To impart a wide knowledge about the components of industrial, residential and Commercial Electrical systems.
- To enable the student to acquire thorough knowledge about the automation of Industrial Electrical systems

Unit - I: Electrical System Components

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices

Unit - II: Residential and Commercial Electrical Systems

Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, Earthling system calculations,

requirements of commercial installation, deciding lighting scheme and number of lamps, Earthing of commercial installation, selection and sizing of components.

Unit - III: Industrial Electrical Systems

HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

Unit - IV: Industrial Electrical System and Automation

DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

Unit - V: Illumination Systems

Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, floodlighting.

Text/Reference Books

1. S.L. Uppal and G.C. Garg, “Electrical Wiring, Estimating &Costing”, Khanna publishers,2008.
2. K. B. Raina, “Electrical Design, Estimating & Costing”, New age International,2007.
3. S. Singh and R. D. Singh, “Electrical estimating and costing”, DhanpatRai and Co.,1997.
4. Web site for IS Standards.
5. H. Joshi, “Residential Commercial and Industrial Systems”, McGraw Hill Education,2008.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawing single line diagram.
2. Understand various components of industrial electrical systems.
3. Analyze and select the proper size of various electrical system components.
4. Understand the design of illumination system.
5. Acquire knowledge about various automation system.