RADHA GOVIND UNIVERSITY

RAMGARH, JHARKHAND

Syllabus

Bachelor of Technology(B.Tech)

Electrical & Electronics Engineering

(CHOICE BASED CREDIT SYSTEM)

Radha Govind University, Ramgarh, Jharkhand

Electrical & Electronics Engineering
(B.Tech)

Vision & Mission

Vision:

To be a pioneering hub of innovation and excellence in Electrical/ Electrical & Electronics Engineering, shaping future leaders equipped to tackle global challenges

Mission:

- Empower students with cutting-edge knowledge and skill in Electrical & Electronics Engineering through dynamic curriculum and experiential learning.
- Foster a collaborative environment that encourages research, innovation, and entrepreneurship.
- Cultivate ethical values, leadership qualities, and a commitment to societal impact among students and faculty.
- Forge strong industry partnerships to enhance real-world relevance and opportunity for students and faculty.
- Promote diversity, inclusivity, and sustainability in all aspect of our academic and research endeavours.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

1. Find employment in Core Electrical and Electronics Engineering and service sectors.
2. Get elevated to technical lead position and lead the organization competitively.
3. Enter into higher studies leading to post-graduate and research degrees.
4. Become consultant and provide solutions to the practical problems of core organization.
5. Become an entrepreneur and be part of electrical and electronics product and service industries.

PROGRAMME OUTCOMES (POs):

After going through the four years of study, our Electrical and Electronics Engineering Graduates will exhibit ability to:

PO#	Graduate Attribute Programme Outcome	Graduate Attribute Programme Outcome
1	Engineering knowledge	Apply knowledge of mathematics, basic science and engineering science.
2	Problem analysis	Identify, formulate and solve engineering problems.
3	Design/development of solutions	Design an electrical system or process to improve its performance, satisfying its constraints
4	Conduct investigations of complex problems	Conduct experiments in electrical and electronics systems and interpret the data.
5	Modern tool usage	Apply various tools and techniques to improve the efficiency of the system.
6	The Engineer and society	Conduct them to uphold the professional and social obligations.
7	Environment and sustainability	Design the system with environment consciousness and sustainable development.
8	Ethics	Interacting industry, business, and society in a professional and ethical manner.
9	Individual and team work	Function in a multidisciplinary team.
10	Communication	Proficiency in oral and written Communication
11	Project management and finance	Implement Cost effective and improved system.
12	Life-long learning	Continue professional development and learning as a life-long activity

PROGRAM SPECIFIC OUTCOMES (PSOs):

On completion of Electrical and Electronics Engineering program, the student will have the following Program Specific Outcomes.

1. Foundation of Electrical Engineering: Ability to understand the principles and working of electrical components, circuits, systems and control that are forming a part of power generation, transmission, distribution, utilization, conservation and energy saving. Students can assess the power management, auditing, crisis and energy saving aspects.

2. Foundations of Power System Development: Ability to understand the structure and development methodologies of electrical systems using knowledge on circuits, electronics for automation and control. Possess professional skills and knowledge of electrical system modeling and design of small and large systems. Familiarity and practical competence with a broad range of practice through experimentation on electrical circuits, electronic circuits and programming platforms.

3. Foundation of Mathematical Concepts, Computing and Research Ability: Ability to apply mathematical methodologies to solve problems related with electrical engineering using appropriate engineering tools and algorithms. Ability to use knowledge in various domains to identify research gaps and hence to provide solution which leads to new ideas and innovations.

Based on CBCS system & OBE model
Recommended scheme of study (EEE)

Sl. No.	Semester of Study	Category of course	Course Code	Subjects	Mode of delivery & credits *L-Lecture;T-Tutorial;P-Practical*			Total Credits *C- Credits*		
Theory										
1	**First**	Basic Science Course	BSC101	Physics I	3	1	0	4	30	70
2		Basic Science Course	BSC103	Mathematics – I	3	1	0	4	30	70
3		Engineering Science Courses/Basic Science Course	ESC101/ BSC102	Basic Electrical Engineering/ Chemistry I	3	1	0	4	30	70
		Total (A) = 12 Credits								
LABORATORIES										
4		Engineering Science Courses	ESC102	Engineering Graphics & Design	1	0	4	3	20	30
5		Basic Science Course	BSC101P	Physics Lab	0	0	3	1.5	20	30
6		Engineering Science Courses/Basic Science Course	ESC101P/ BSC102P	Basic Electrical Engineering Lab / Chemistry Lab	0	0	2	1	20	30
								Total(B) = 5.5 Credits		
								Grand Total (A) + (B) = 17.5 Credits		
Theory										
1	**Second**	Basic Science Course(BSE)	BSC105	Physics II	3	1	0	4	30	70
2		Engineering Science Courses/Basic Science Course	ESC101/ BSC102	Basic Electrical Engineering/ Chemistry I	3	1	0	4	30	70
3		Basic Science Course	BSC104	Mathematics – II	3	1	0	4	30	70
4		Engineering Science Courses	ESC103	Programming for Problem Solving	3	1	0	4	30	70
5		Humanities and Social Sciences including Management Courses	HSMC101	English	2	0	2	3	30	70
		LABORATORIES						**Total (A) = 19 Credits**		
6		Engineering Science Courses	ESC104	Workshop/ Manufacturing Practices	1	0	4	3	20	30
7		Engineering Science Courses/Basic Science Course	ESC101P/ BSC102P	Basic Electrical Engg. Lab / Chemistry Lab	0	0	2	1	20	30
8		Engineering Science Courses	ESC103P	Programming for Problem Solving	0	0	2	1	20	30
								Total(B) = 5 Credits		
								Grand Total (A) + (B) = 24 Credits		
		Grand Total for FirstYear = 41.5 Credits.								

Based on CBCS system & OBE model
Recommended scheme of study (EEE)

Sl. No.	Semester of Study	Category of course	Course Code	Subjects	Mode of delivery & credits *L-Lecture; T-Tutorial; P-Practical*			Total Credits *C- Credits*		
				Theory						
1	**Third**	Program Course(PC)	EE301	Electrical Machine-I	3	1	0	3	30	70
2		PC	EE302	Network Theory	3	1	0	3	30	70
3		General Engineering (GE)	EE303	Electromagnetic Field Theory	3	1	0	3	30	70
4		GE	EC301	Basic Electronics	3	1	0	3	30	70
5		BSE	BSC301	Mathematics-III	3	1	0	4	30	70
6		BSE	BSC302	Environmental Science	2	0	0	0	30	70
										Total (A) = 16 Credits
		LABORATORIES								
7		GE	EC301P	Basic Electronics Lab	0	0	3	1	20	30
8		PC	EE301P	Electrical Machine-I Lab	0	0	3	1	20	30
9		PC	EE302P	Network Theory Lab	0	0	3	1	20	30
10		MC	EX301	Extra Activities (NSO/NSS/NCC/Yoga / Creative Arts/Mini Project)	0	0	2	1	20	30
11		HSS	HS301	Communication Skill Lab	0	0	2	1	20	30
										Total(B) = 5 Credits
Grand Total (A) + (B) = 21 Credits										
				Theory						
1	**Fourth**	PC	EE401	Power System – I	3	1	0	3	30	70
2		PC	EE402	Measurement & Instrumentation	3	1	0	3	30	70
3		GE	EC401	Analog Electronics and Circuits	3	1	0	3	30	70
4		GE	EC403	Digital Electronics and Logic Design	3	1	0	3	30	70
5		GE	CS301	Data Structure and Algorithm	3	0	0	3	30	70
6		BSE	EN401/ IT402	Engineering Economics /Cyber Security	2	0	0	0	30	70
										Total (A) = 15 Credits
				LABORATORIES						
7		Engineering Science Courses	EE401P	Power System- I Lab	0	0	3	1	20	30
8		GE	EE402P	Measurement & Instrumentation Lab	0	0	3	1	20	30
9		GE	EC403P	Digital Electronics And Logic Design Lab	0	0	3	1	20	30
10			EX401	Extra Activities (NSO/NSS/NCC/Yoga/ Creative Arts/Mini Project)	0	0	2	1	20	30
11			IN401	Internship/ Tour & Training/Industrial Training	0	0	0	2	20	30
		Total(B) = 6 Credits								
		Grand Total for Second Year = 42 Credits.		**Grand Total (A) + (B) = 21 Credits**						

Based on CBCS system & OBE model
Recommended scheme of study (EEE)

Sl. No.	Semester of Study	Category of course	Course Code	Subjects	Mode of delivery & credits *L-Lecture; T-Tutorial; P-Practical*			Total Credits *C- Credits*		
				Theory						
1	**Fifth**	Professional Core Courses (PCC)	EEC501	Power System-II	3	1	0	4	30	70
2		PCC	EEC502	Control System	2	1	0	3	30	70
3		PCC	EEC503	Electrical Machine-II	2	1	0	3	30	70
4		PEC		Professional Elective Course -I	2	1	0	3	30	70
5		Open Elective Course (OEC)		Open Elective Course I	2	1	0	3	30	70
		Total (A) = 16 Credits								
		LABORATORIES								
6		PCC	EE501P	Power System -II Lab	0	0	2	1	20	30
7		PCC	EE502P	Control System Lab	0	0	2	1	20	30
8		PCC	EE503P	Electrical Machine-II lab	0	0	2	1	20	30
9		PCC	EE504P	Electrical and Electronics workshop Lab			2	1	20	30
10		PPT presentation	EE505G	Seminar (PPT presentation)	0	0	2	2	20	30
Total(B) = 6 Credits **Grand Total (A) + (B) = 22 Credits**										
				Theory						
1	**Sixth**	PCC	EEC601	Power Electronics	3	1	0	4	30	70
2		PCC	EEC602	Signals and Systems	2	1	0	3	30	70
3		PCC	EEC603	Microprocessors and Microcontroller	2	1	0	3	30	70
4		PEC		Professional Elective Course -II	2	1	0	3	30	70
5		OEC		Open Elective Course - II	2	1	0	3	30	70
				LABORATORIES			**Total (A) = 16 Credits**			
6		PCC	EE601P	Power Electronics Lab	0	0	2	1	20	30
7		PCC	EE602P	Signals and Systems Lab	0	0	2	1	20	30
8		PCC	EE603P	Microprocessors and Microcontroller Lab	0	0	2	1	20	30
9		PCC	EE604P	Electrical Simulation Lab	0	0	2	1	20	30
10		Project Work	EE605I	Internship/Tour and IndustrialTraining	0	0	2	2	20	30
		Total(B) = 6 Credits Grand Total for Third Year = 44 Credits. **Grand Total (A) + (B) = 22 Credits**								

Based on CBCS system & OBE model
Recommended scheme of study (EEE)

Sl. No.	Semester of Study	Category of course	Course Code	Subjects	Mode of delivery & credits *L-Lecture; T-Tutorial; P-Practical*			Total Credits *C- Credits*		
Theory										
1	**Seventh**	PCC	ELC701	Protection of Power Apparatus System	3	0	0	3	30	70
2		PEC	PEC-III	Professional Elective-III	3	0	0	3	30	70
3		PEC	PEC-IV	Professional Elective-IV	3	0	0	3	30	70
4		OEC	OEC III	Open Elective-III	3	0	0	3	30	70
5		OEC	OEC IV	Open Elective-IV	3	0	0	3	30	70
		Total (A) = 15 Credits								
LABORATORIES										
6		PCC	EL701P	Power System Protection and	0	0	2	1	20	30
7		Project	EE702D	Project Part - I	0	0	4	2	20	30
8		Internship	EE703I	Internship Assessment	0	0	2	2	20	30
Total(B) = 5 Credits										
Grand Total (A) + (B) = 20 Credits										
1	**Eighth**	Project	EE801D	Project-II	0	0	16	8		
							Total = 8 Credits			
		Grand Total for Fourth Year = 28 Credits.								

Professional Electives and Open Electives Courses offered by Department of EEE

Table 1: Professional Electives

Sl. No.	Code	Professional Elective-I (Any one)	Code	Professional Elective-II (Any one)
1	EEP504	Industrial Electrical Systems	EEP604	High Voltage Engineering
2	EEP505	Non-Conventional Energy System	EEP605	Advanced Control Systems
3	EEP506	Power Quality	EEP606	Digital Control Systems

Sl. No.	Code	Professional Elective-III(Any one)	Code	Professional Elective-IV(Any one)
1	ELP702	Electrical Drives and Control	ELP704	Antennae & Wave Propagation
2	ELP703	Utilization of Electrical Power	ELP708	Smart Grid Technology
3	ELP705	Power Quality	ELP709	Electrical and Hybrid Vehicles
4	ELP707	HVDC Transmission and FACTS		

Table 2: Open Electives

Sl. No.	Code	Open Elective-I (Any one)	Code	Open Elective-II (Any one)
1	CSO501	Artificial Intelligence	CSO601	Soft Computing Techniques
2	CSO502	Internet-of-Things	CSO602	Image Processing
3	ECO501	Communication and Networks	EEO607	Power Plant Engineering

Sl. No.	Code	Open Elective-III (Any one)	Code	Open Elective-IV (Any one)
1	ELO710	Soft Optimization Techniques	ELO713	Digital Signal Processing
2	ELO711	Illumination Technology	ELO714	Energy Storage Systems
3	ELO712	Process Instrumentation and Control	ELO715	Electrical machine and Power Systems

Semester of Study	Category of course	Course Code	Subjects	Mode of delivery & credits *L-Lecture; T-Tutorial; P-Practical*			Total Credits *C-Credits*
First	Basic Science Course	BSC101	Physics I	3	1	0	4
	Basic Science Course	BSC103	Mathematics – I	3	1	0	4
	Engineering Science Courses/Basic ScienceCourse	ESC101/ BSC102	Basic Electrical Engineering/ Chemistry I	3	1	0	4
	LABORATORIES						**Total (A) = 12 Credits**
	Engineering Science Courses	ESC102	Engineering Graphics & Design	1	0	4	3
	Basic Science Course	BSC101P	Physics Lab	0	0	3	1.5
	Engineering Science Courses/Basic ScienceCourse	ESC10 1P/ BSC10 2P	Basic Electrical Engineering Lab / Chemistry Lab	0	0	2	1
Total (B) = 5.5 Credits Grand Total (A) + (B) = 17.5 Credits							
Second	Basic Science Course(BSE)	BSC105	Physics II	3	1	0	4
	Engineering Science Courses/Basic ScienceCourse	ESC101/ BSC102	Basic Electrical Engineering/ Chemistry I	3	1	0	4
	Basic Science Course	BSC104	Mathematics – II	3	1	0	4
	Engineering Science Courses	ESC103	Programming for Problem Solving	3	1	0	4
	Humanities and Social Sciences includingManagement Courses	HSMC101	English	2	0	2	3
	LABORATORIES						**Total (A) = 19 Credits**
	Engineering Science Courses	ESC104	Workshop/ Manufacturing Practices	1	0	4	3
	Engineering Science Courses/Basic ScienceCourse	ES C10 1P/ BS C10 2P	Basic Electrical Engg. Lab / Chemistry Lab	0	0	2	1
	Engineering Science Courses	ESC103P	Programming for Problem Solving	0	0	2	1
	Total (B) = 5 Credits Grand Total (A) + (B) = 24 Credits						
	Grand Total for 1st Year = 41.5 Credits						

Course Code	**BSC 101**
Category	**Basic Science Course**
Course Title	**Physics-I** (i) Introduction to Electromagnetic Theory – For ME (ii) Introduction to Mechanics – For Civil, MEMS (iii) Oscillation, Waves and Optics - For EEE (iv) Semiconductor Physics – For ECE, CSE (v) Basics of Electricity, Magnetism & Quantum Mechanics- For Chemical Engg.

Scheme & Credits	**L**	**T**	**P**	**Credit**	**Semester I**
	3	**1**	**0**	**4**	

Pre-requisites Mathematics course with vector calculus, High-school educationMathematics course on differential equations and linear algebra

PHYSICS- I
INTRODUCTION TO ELECTROMAGNETIC THEORY 38hrs

COURSE OBJECTIVES:

1. Understand the fundamental principles of electrostatics in vacuum, including the calculation of electric fields and potentials for various charge distributions, and solve Laplace's and Poisson's equations.
2. Apply the principles of electrostatics in linear dielectric media, including the effects of electric polarization, electric displacement, and solve problems involving dielectrics.
3. Analyze magnetostatics, including the application of the Bio-Savart law, calculation of static magnetic fields, and understanding the concept of vector potential.
4. Apply the principles of magnetostatics in linear magnetic media, including the effects of magnetization and bound currents, and solve problems involving magnetic materials.
5. Understand Faraday's law of electromagnetic induction, including the calculation of EMF produced by changing magnetic flux, and analyze applications of electromagnetic braking.
6. Analyze Maxwell's equations, including the derivation of the differential form of Faraday's law

Module 1: Electrostatics in vacuum **8**

Electric field and electrostatic potential for a charge distribution; Laplace's and Poisson's equationsfor electrostatic potential and uniqueness of their solution. Boundary conditions of electric field and electrostatic potential; method of images; energy of a charge distribution and its expression in termsof electric field.

Module 2: Electrostatics in a linear dielectric medium **4**

Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement; Solving simple electrostatics problems inpresence of dielectrics – Point charge at the centre of a dielectric sphere, charge in front of a dielectricslab, dielectric slab and dielectric sphere in uniform electric field.

Module 3: Magneto static

Bio-Savart law, Static magnetic field; vector potential and calculating it for a given magnetic field;the equation for the vector potential and its solution for given current densities.

Module 4: Magneto statics in a linear magnetic medium **4**

Magnetization and associated bound currents; auxiliary magnetic field; Boundary conditions on **B** and **H**. Solving for magnetic field due to simple magnets like a bar magnet; magnetic susceptibility and ferromagnetic, paramagnetic and diamagnetic materials; Qualitative discussionof magnetic fieldin presence of magnetic materials.

Module 5: Faraday's law and Maxwell's equations **8**

Faraday's law in terms of EMF produced by changing magnetic flux; equivalence of Faraday's law and motional EMF; Lenz's law; Electromagnetic breaking and its applications; Differential form ofFaraday's law expressing curl of electric field in terms of time-derivative of magnetic field andcalculating electric field due to changing magnetic fields in quasi-static approximation; energy storedin a magnetic field.

Continuity equation for current densities; Modifying equation for the curl of magnetic field to satisfy continuity equation; displace current and magnetic field arising from time dependent electric field; calculating magnetic field due to changing electric fields in quasistatic approximation. Maxwell's equation in vacuum and non-conducting medium; Energy in an electromagnetic field; Flow of energy and Pointing.

Module 6: Electromagnetic waves **8**

The wave equation; Plane electromagnetic waves in vacuum, their transverse nature and polarization; Relation between electric and magnetic fields of an electromagnetic wave; energy carried by waves. Momentum carried by electromagnetic waves and resultant pressure. Reflection and transmission of electromagnetic waves from a non-conducting medium- vacuum interface for normal incidence.

COURSE OUTCOMES:

CO1 understand the basics of electrostatics in vacuum.
CO2 understand the basics of electrostatics in material medium.
CO3 Analyse the basics of magneto statics in vacuum.
CO4 Apply the basics of magneto in magnetic material medium.
CO5 Students to get familiarized with the Faraday's Law and Maxwell's equation leading to the application of EMW in vacuum and in media.
CO6 Design and development of engineering system

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	3	3	1	1	-	-	1	-	-	1	-	1	3	2	-
CO 2	3	3	1	1	-	-	1	-	-	1	-	1	3	2	-
CO 3	3	3	1	1	-	-	1	-	-	1	-	1	3	2	-
CO 4	3	3	1	1	-	-	1	-	-	1	-	1	3	2	-
CO 5	3	3	1	1	-	-	1	-	-	1	-	1	3	2	-
CO 6	3	3	1	1	-	-	1	-	-	1	-	1	3	2	-

Text Book:

- Introduction to Electrodynamics, D.J. Griffiths, 3rd Edition, 1998, Benjamin Cummings.

Reference books:

- Fundamentals of Physics Electricity and Magnetism, Halliday and Resnick, tenth edition(published 2013).
- W. Saslow, Electricity, magnetism and light, 1st edition
- Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, TataMcGraw
- Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.

Course Code	**BSC 103**				
Category	**Basic Science Course**				
Course Title	**Mathematics - I** Calculus and Linear Algebra **(Option 1) for All Branch excluding CSE** Calculus and Linear Algebra **(Option 2) for CSE**				
Scheme & Credits	**L**	**T**	**P**	**Credit**	**Semester I**
	3	**1**	**0**	**4**	
Pre-requisites	**Pre-requisites:** High-school education				

MATHEMATICS 1

CALCULUS AND LINEAR ALGEBRA 40hrs

Option 1 (For all branches) excluding CSE

COURSE OBJECTIVES:

1. Understand and apply the concepts of evolutes and involutes, and evaluate definite and improper integrals, including the use of Beta and Gamma functions and their properties.
2. Apply calculus techniques such as Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders, and L'Hospital's rule to solve problems related to indeterminate forms and Maxima and minima.
3. Analyze sequences and series, including convergence tests, power series, Taylor's series, and Fourier series, and apply them to solve problems involving exponential, trigonometric, and logarithm functions, as well as evaluate surface areas and volumes of revolutions.
4. Understand and apply concepts of multivariable calculus, including limit continuity and partial derivatives, directional derivatives, total derivative, tangent planes and normal lines, and solve optimization problems using the method of Lagrange multipliers.
5. Analyze matrices, including the calculation of inverse and rank of a matrix, solving systems of linear equations, properties of symmetric, skew symmetric, and orthogonal matrices, determinants, eigenvalues and eigenvectors, diagonalization of matrices, and apply them to solve problems involving orthogonal transformations and the Cayley-Hamilton Theorem.

Module 1: Calculus- **I6**

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

Module 2: Calculus-II **6**

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

Module 3: Sequences and series **10**

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

Module 4: Multivariable Calculus (Differentiation) **8**

Limit continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

Module 5: Matrices **10**

Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew symmetric and orthogonal matrices; Determinants; Eigen values and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.

COURSE OUTCOMES:

CO1 To Understsnd the idea of applying differential and integral calculus to notions of curvature and toimproper integrals.
CO2 To apply the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
CO3 To develop the tool of power series and Fourier series for learning advanced EngineeringMathematics.
CO4 the student will able to analyze with functions of several variables that is essential in most branches ofEngineering.
CO5 To develop the essential tool of matrices and linear algebra in a comprehensive manner.
CO6 To solve various engineering problems

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	2	3	2	-	-	-	-	-	-	2	-	
CO2	2	3	2	2	1	2	1	-	-	-	-	-	2	-	-
CO3	2	-	-	2	3	1	-	1	-	1	-	-	2	-	-
CO4	1	3	2	2	1	2	1	1	-	1	1	-	2	-	-
CO5	1	-	2	-	1	1	-	-	-	-	-	-	2	-	-
CO6	3	3	2	-	2	2	-	-	-	-	-	-	2	-	-

Text books/References:

- G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson,Reprint,2002.
- Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.
- Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi,2008.
- Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,11thReprint,2010.
- D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
- N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications,Reprint, 2008.
- B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Course Code	**ESC 101**				
Category	**Engineering Science Course**				
Course Title	**Basic Electrical Engineering**				
Scheme & Credits	**L**	**T**	**P**	**Credit**	**Semester I**
	3	**1**	**0**	**4**	
Pre-requisites	**Intermediate level Electricity**				

BASIC ELECTRICAL ENGINEERING 40hrs

COURSE OBJECTIVES:

1. Understand electrical circuit elements (R, L, and C), voltage and current sources.
2. Calculate real power, reactive power, apparent power, and power factor in AC circuits.
3. Understand auto-transformer and three-phase transformer connections.
4. Analyze loss components and efficiency, starting, and speed control of induction motor.
5. Describe single-phase and three-phase voltage source inverters, and sinusoidal modulation.
6. Describe types of batteries, and important characteristics for batteries.

Module 1: DC Circuits **7**

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

Module 2: AC Circuits **7**

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

Module 3: Transformers **6**

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Module 4: Electrical Machines **8**

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque- speed characteristic

and speed control of separately excited dc motor. Construction and working of synchronous generators.

Module 5: Power Converters **6**

DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

Module 6: Electrical Installations **6**

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculationsfor energy consumption, power factor improvement and battery backup.

Course Outcomes:

CO1: To understand and analyze basic electric and magnetic circuits.
CO2: To Understand the working principles of electrical machines and power converters.
CO3: To analyse the components of low voltage electrical installations.
CO4: Apply electric machine for industrial applications
CO5: Design power converters
CO6: Design and implementation of electrical installations

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	2	-	-	-	-	-	-	1	3	2	
CO2	2	1	1	2	-	-	1	2	-	-	-	1	2	2	1
CO3	1	2	1	1	2	1	-	-	-	1	-	1	1	1	1
CO4	3	3	-	-	-	-	2	-	-	-	-	1	3	3	3
CO5	2	2	-	1	2	1	-	-	3	1	-	1	-	-	-
CO6	3	3	-	-	2	-	-	-	-	-	-	-	-	-	-

Text / Reference Books:

- D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
- D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.
- L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
- E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
- V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989.

Course Code	**ESC 102**				
Category	**Engineering Science Course**				
Course Title	**Engineering Graphics & Design(Theory & Lab)**				
Scheme & Credits	**L**	**T**	**P**	**Credit**	**Semester I**
	1	**0**	**4**	**3**	
Pre-requisites	**Basic knowledge of Computer and Solid Geometry**				

ENGINEERING GRAPHICS & DESIGN **Lecture – 10hrs & Lab – 60hrs**

COURSE OBJECTIVES:

1. Understand the principles of Engineering graphics and their significance.
2. Explain the principles of orthographic projections and conventions.
3. Create floor plans that include windows, doors, and fixtures such as WC, bath, sink, shower, etc.
4. Project right angular solids, including prism, cylinder, pyramid, cone, and their auxiliary views.
5. Convert isometric views to orthographic views and vice versa, following conventions.
6. Create isometric views of lines, planes, simple, and compound solids using CAD software.

Traditional Engineering and Computer Graphics **10**

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance. Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modeling; Solid Modeling; Introduction to Building Information Modeling (BIM)

(Lab modules also include concurrent teaching)

Lab Module 1: Introduction to Engineering Drawing **5**

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

Lab Module 2: Orthographic Projections **5**

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to

bothplanes; Projections of planes inclined Planes - Auxiliary Planes;

Lab Module 3: Projections of Regular Solids **5**

Those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

Lab Module 4: and Sectional Views of Right Angular Solids **5**

Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids

-Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids,objects from industry and dwellings (foundation to slab only)

Lab Module 5: Isometric Projections **6**

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views andVice-versa, Conventions.

Lab Module 6: Overview of Computer Graphics **8**

Listing the computer technologies that impact on graphical communication, Demonstrating knowledgeof the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The StatusBar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids];

Lab Module 7: Customization & CAD Drawing **8**

Consisting of set up of the drawing page and the printer, including scale settings, setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

Lab Module 8: Annotations, layering & other functions **9**

Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layersto create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command;

orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non- parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multi view, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling;

Lab Module 9: Demonstration of a simple team design project 9

Geometry and topology of engineered components: creation of Engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for Engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modeling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).

COURSE OUTCOMES:

All phases of manufacturing or construction require the conversion of new ideas and design concepts into the basic line language of graphics. Therefore, there are many areas (civil, mechanical, electrical, architectural and industrial) in which the skills of the CAD technicians play major roles in the design and development of new products or construction. Students prepare for actual work situations through practical training in a new state-of-the-art computer designed CAD laboratory using Engineering software. This course is designed to address:

CO1 Able to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

CO2 Able to prepare to communicate effectively to use the techniques, skills, and modern Engineering tools necessary for Engineering practice.

CO3 Able to analyze Engineering design and its place in society Exposure to the visual aspects of Engineering design

CO4 analyze Engineering graphics standards and solid modelling

CO5 apply computer-aided geometric design for engineering problems

CO6 design and development of creating working drawings and Engineering communication

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	1	-	-	-	-	-	-	-	2	-	-
CO2	3	3	2	1	-	2	-	-	1	-	-	2	2	2	-
CO3	2	1	-	1	2	-	2	-	2	1	2	-	2	2	-
CO4	2	1	-	-	1	2	-	-	-	-	-	-	2	-	-
CO5	2	-	-	1	3	-	-	-	-	2	1	1	2	-	-
CO6	3	3	2	-	1	-	-	-	-	1	-	-	2	2	-

Suggested Text/Reference Books:

- Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engg Drawing, Charotar Pub House
- Shah, M.B. & Rana B.C. (2008), Engg Drawing & Comp. Graphics, Pearson Education
- Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
- Narayana, K.L. & P Kannaiah (2008), Text book on Engg Drawing, Scitech Publishers
- Corresponding set of CAD Software Theory and User Manuals

PHYSICS LABORATORY
Code: BSC101P

Choice of 08-10 experiments from the following:

- Experiments on electromagnetic induction and electromagnetic breaking;
- LC circuit and LCR circuit
- Resonance phenomena in LCR circuits
- Magnetic field from Helmholtz coil
- Measurement of Lorentz force in a vacuum tube
- Coupled oscillators
- Experiments on an air-track
- Experiment on moment of inertia measurement
- Experiments with gyroscope
- Resonance phenomena in mechanical oscillators
- Frank-Hertz experiment
- Photoelectric effect experiment
- Recording hydrogen atom Spectrum
- Diffraction and interference experiments (from ordinary light or laser pointers)
- Measurement of speed of light on a table top using modulation
- Minimum deviation from a prism

LABROTARY OUTCOMES:

Students to have hands on experiences with experiments on the basic's laws and principles of Physics in the field of Mechanics, Optics, Electricity, Magnetism, Modern Physics, etc.

BASIC ELECTRICAL ENGINEERING LABORATORY
Code: ESC101P

List of experiments/demonstrations:

- Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
- Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
- Transformers: Observation of the no-load current waveform on an oscilloscope (non sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
- Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase -shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
- Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging -slip ring arrangement) and single-phase induction machine.
- Torque Speed Characteristic of separately excited dc motor.
- Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super synchronous speed.
- Synchronous Machine operating as a generator: stand-alone operation with a load. Controlof voltage through field excitation.
- Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc- ac converter for speed control of an induction motor and (d) Components of LT switchgear.

LABORATORY OUTCOMES:

- Get an exposure to common electrical components and their ratings.
- Make electrical connections by wires of appropriate ratings.
- Understand the usage of common electrical measuring instruments.
- Understand the basic characteristics of transformers and electrical machines.

Course Code	**BSC 105**
Category	**Basic Science Course**
Course Title	**Course contents in Physics** (i) Introduction to Quantum Mechanics for Engineers – For EEE, CSE (ii) Semiconductor Optoelectronics – For ECE (iii) Mechanics of Solid – For Civil, ME, MEMS (iv) Optics & Fiber Optics – For Chemical Engineering

Scheme & Credits	**L**	**T**	**P**	**Credit**	**Semester II**
	2	**1**	**0**	**3**	

Pre-requisites	Mathematics course on differential equations and linear algebra Introduction to Electromagnetic Theory Semiconductor Physics

Physics-II

MECHANICS OF SOLIDS 40hrs

COURSE OBJECTIVES:

1. Understand and apply free body diagrams for typical supports and joints.
2. Understand stress transformation and principal stresses using Mohr's circle.
3. Describe one-dimensional material behavior, including concepts of elasticity, plasticity, strain hardening, and failure
4. Calculate bending stress, shear stress, and analyze cases of combined stresses.
5. Analyze deflection due to bending and integrate the moment-curvature relationship for simple boundary conditions.

Module 1: Statics **10**

Free body diagrams on modelling of typical supports and joints; Condition for equilibrium in three- and two- dimensions; Friction: limiting and non-limiting cases; Force displacement relationship; Geometric compatibility for small deformations.

Module 2: Stress and Strain at a point **6**

Concept of stress at a point; Planet stress: transformation of stresses at a point, principal stressesand Mohr’s circle; Displacement field; Concept of strain at a point; Planet strain: transformation of strain at a point, principal strains and Mohr’s circle

Module 3: Material behavior **7**

One-dimensional material behaviour; Concepts of elasticity, plasticity, strain hardening, failure (fracture / yielding); Idealization of one- dimensional stress-strain curve; Generalized Hooke's law withand without thermal strains for isotropic materials.

Module 4: Force analysis **8**

Force analysis — axial force, shear force, bending moment and twisting moment diagrams of slender members (without using singularity functions); Moment curvature relationship for pure bending of beams with symmetric cross-section; Bending stress; Shear stress; Cases of combined stresses.

Module 5: Strain energy **9**

Concept of strain energy; Yield criteria; Deflection due to bending; Integration of the moment- curvature relationship for simple boundary conditions; Method of superposition (without using singularity functions); Strain energy and complementary strain energy for simple structural elements (i.e, those under axial load, shear force, bending moment and torsion).

COURSE OUTCOME:

CO1: To familiarize students of civil and mechanical Engineering with the understanding of the elasticand plastic behavior of solids.
CO2: To understand the importance of stress and strain at a point on solid.
CO3: To be able to do force analysis and understand strain energy of solid.
CO4: Apply force analysis for engineering applications
CO5: Design sustainable engineering system
CO6: Implementation of engineering physics into complex system design for industrial applications

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	2	1	3	-	-	2		2		
CO2	2	2	2	3	2	2	-	3	-	2	-	-	-	-	-
CO3	2	2	-	3	2	3	2	3	2	3	2	-	-	-	-
CO4	3	3	3	3	2	3	-	-	3	3	2	-	-	-	-
CO5	2	2	-	-	2	3	2	2	2	2	2	-	-	-	-
CO6	3	3	2	-	-	3	2	-	2	-	-	-	-	-	-

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Reference books(1) An Introduction to the Mechanics of Solids, 2nd ed. with SI Units – SH Crandall, NC Dahl & TJ Lardner (2) Engineering Mechanics: Statics, 7th ed. — JL Meriam (3)Engineering Mechanics of Solids — EP Popov

Course Code	**BSC 102**				
Category	**Basic Science Course**				
Course Title	**Chemistry-I**				
	Contents				
	(i) Chemistry-I (Concepts in chemistry for Engineering)				
	(ii) Chemistry Laboratory				
Scheme & Credits	**L**	**T**	**P**	**Credit**	**Semester I**
	3	**1**	**0**	**4**	
Pre-requisites	**Knowledge of intermediate level chemistry**				

CHEMISTRY-I

CONCEPTS IN CHEMISTRY FOR ENGINEERING

COURSE OBJECTIVES:

1. Describe the forms of hydrogen atom wave functions and their spatial variations.
2. Analyze electronic spectroscopy, fluorescence, and their applications in medicine.
3. Explain equations of state of real gases and critical phenomena.
4. Estimate entropy and free energies, and their applications in chemical equilibria.
5. Describe effective nuclear charge, penetration of orbitals, and variations of s, p, d, and f orbital energies in the periodic table.
6. Introduce reactions involving substitution, addition, elimination, oxidation, reduction, cyclization, and ring openings.

Module 1: Atomic and molecular structure **12**

Schrodinger equation. Particle in a box solution and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multi centre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of di-atomics. Pi-molecular orbitalsof butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

Module 2: Spectroscopic techniques and applications **8**

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterization techniques.Diffraction and scattering.

Module 3: Intermolecular forces and potential energy surfaces 4

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena.Potential energy surfaces of H3, H2F and HCN and trajectories on these surfaces.

Module 4: Use of free energy in chemical equilibria 6

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies.Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations inmetallurgy through Ellingham diagram

Module 5: Periodic properties and Stereochemistry 8

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard softacids and bases, molecular geometries

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds

Module 6: Organic reactions and synthesis of a drug molecule 4

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

COURSE OUTCOMES:

CO1: Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.

CO2: Rationalise bulk properties and processes using thermodynamic considerations.

CO3: Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques

CO4: Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.

CO5: List major chemical reactions that are used in the synthesis of molecules.

CO6: Apply chemical reactions in industry applications

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	2	2	2	1	2	-	-	-	-	-	-
CO2	3	3	2	2	2	2	2	2	2	-	-	-	2	-	-
CO3	2	2	1	2	2	2	3	2	-	-	-	2	-	-	2
CO4	2	1	1	3	3	1	3	-	1	-	-	-	-	-	-
CO5	3	2	3	1	3	3	1	-	2	-	-	-	2	-	-
CO6	3	3	-	-	3	-	1	-	-	-	-	2	-	-	-

Textbooks:

- University chemistry, by B. H. Mahan
- Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
- Fundamentals of Molecular Spectroscopy, by C. N. Banwell
- Engg Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
- Physical Chemistry, by P. W. Atkins
- Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5thEditionhttp://bcs.whfreeman.com/vollhardtschore5e/default.asp

Course Code	**BSC 104**
Category	**Basic Science Course**
Course Title	**Mathematics – II**
	Contents
	Calculus, Ordinary Differential Equations and Complex Variable (Option 1) for All branches excluding CSE
	Probability and Statistics (Option I1) for CSE

Scheme & Credits	**L**	**T**	**P**	**Credit**	**Semester**
	3	**1**	**0**	**0**	**II**

Pre-requisites **Elementary Knowledge of calculus, Probability and Statistics**

MATHEMATICS – II
CALCULUS, ORDINARY DIFFERENTIAL EQUATIONS AND COMPLEXVARIABLE

COURSE OBJECTIVES:

1. Understand multiple integration, including double integrals in Cartesian coordinates, change of order of integration, and change of variables to polar coordinates.
2. Solve exact, linear, and Bernoulli's equations, as well as Euler's equations.
3. Solve Cauchy-Euler equations.
4. Understand elementary analytic functions such as exponential, trigonometric, and logarithmic functions and their properties.
5. Understand Taylor's series, zeros of analytic functions, singularities, and Laurent's series.

Module 1: **Multivariable Calculus (Integration):** **10**

Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities);Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

Module 2: First order ordinary differential equations: **6**

Exact, linear and Bernoulli’s equations, Euler’s equations, Equations not of first degree: equations

solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Module 3: Ordinary differential equations of higher orders: 8

Second order linear differential equations with variable coefficients, method of variation of parameters,Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Module 4: Complex Variable – Differentiation 8

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

Module 5: Complex Variable - Integration: 8

Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof),Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals usingthe Bromwich contour.

COURSE OUTCOME:

CO1: To familiarize the prospective engineers with techniques in multivariate integration,

ordinary and partial differential equations and complex variables.

CO2: To equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

CO3: Analyze high order ordinary differential equation

CO4: Apply complex variables for differentiation

CO5: Apply Integration of complex variables for different problems.

C06: Design and implementation of mathematical analysis for problem solving in engineering application

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	-	2	-	-	-	-	-	-	-	-
CO2	2	2	3	1	2	1	3	2	-	-	-	-	1	-	-
CO3	1	3	1	2	3	2	2	1	-	-	-	-	-	-	2
CO4	1	3	2	2	3	2	-	2	1		-	-		2	
CO5	3	2	2	2	1	3	-	2	-	1	-	-	1	-	-
CO6	3	1	1	3	1	-	-	-	-		-	-		-	-

Textbooks/References:

- G.B. Thomas & R.L. Finney, Calculus & Analytic geometry, Pearson, Reprint, 2002.
- Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.
- W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary ValueProblems, 9th Edition., Wiley India, 2009.
- S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
- E. A. Coddington, An Introduction to Ordinary Differential Equations, PHI, 1995.
- E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
- J. W. Brown & R. V. Churchill, Complex Variables & Appln, Mc-Graw Hill, 2004.
- N.P. Bali and Manish Goyal, Engineering Mathematics, Laxmi Pub, Reprint, 2008.
- B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Course Code	**ESC 103**				
Category	**Engineering Science Course**				
Course Title	**Programming for Problem Solving**				
Scheme & Credits	**L**	**T**	**P**	**Credit**	**Semester II**
	3	**0**	**0**	**3**	
Pre-requisites	Basic Knowledge of Computer and Mathematics				

PROGRAMMING FOR PROBLEM SOLVING

COURSE OBJECTIVES:

1. Define an algorithm and its representation using flowcharts or pseudo code.
2. Understand conditional branching and loops.
3. Define and utilize arrays, including 1-D and 2-D arrays.
4. Implement basic sorting algorithms such as Bubble, Insertion, and Selection sort.
5. Understand parameter passing in functions, including call by value.
6. Define structures and arrays of structures

Module 1: Introduction to Programming **6**

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.). Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudo code with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

Module2: Arithmetic expressions and precedencies **12**

Conditional Branching and Loops Writing and evaluation of conditionals and consequent branching, Iteration and loops.

Module 3: Arrays3

Arrays (1-D, 2-D), Character arrays and Strings

Module 4: Basic Algorithms, Searching, Basic Sorting Algorithms **4**

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

Module 5: Function and Pointers **6**

Functions (including using built in libraries), Parameter passing in functions, call by value, Passing

arrays to functions: idea of call by reference Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation).

Module 6: Recursion and Structure **9**

Recursion, as a different way of solving problems. Example programs, such as Finding, Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort Structures, Defining structures and Array of Structures

COURSE OUTCOMES:

CO1: Able to formulate simple algorithms for arithmetic and logical problems

CO2: able to translate the algorithms to programs (in C language).

CO3: able to apply test and execute the programs and correct syntax and logical errors.

CO4: able to implement conditional branching, iteration and recursion.

CO5: To use arrays, pointers and structures to formulate algorithms and programs.

CO6: To apply programming to solve matrix addition and multiplication problems and searching and sorting problems.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	-	2	-	-	-	-	-	-	-	-
CO2	2	2	3	1	2	1	3	2	-	-	-	-	1	-	-
CO3	1	3	1	2	3	2	2	1	-	-	-	-	-	-	2
CO4	1	3	2	2	3	2	-	2	1		-	-		2	
CO5	3	2	2	2	1	3	-	2	-	1	-	-	1	-	-
CO6	3	3	3	3	1	-	-	-	-		-	-	2	2	2

Suggested Text Books:

- Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
- E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

Suggested Reference Books:

- Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, PrenticeHall ofIndia

Course Code	**HSMC 101**				
Category	**Humanities and Social Sciences including Management Courses**				
Course Title	**English**				
Scheme & Credits	**L**	**T**	**P**	**Credit**	**Semester II**
	2	**0**	**2**	**3**	
Pre-requisites	**Basic Knowledge of English grammar and composition**				

ENGLISH

COURSE OBJECTIVES:

1. Learn synonyms, antonyms, and standard abbreviations.
2. Understand sentence structures and the use of phrases and clauses.
3. Identify and correct errors in subject-verb agreement, noun-pronoun agreement, misplaced modifiers, articles, prepositions, redundancies, and clichés.
4. Learn techniques for describing, defining, classifying, providing examples or evidence in writing.
5. Learn the art of précis writing and essay writing.
6. Improve pronunciation, intonation, stress, and rhythm in oral communication.

Module 1: Vocabulary Building **6**

The concept of Word Formation, Root words from foreign languages and their use in English, Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives, Synonyms, antonyms and standard abbreviations.

Module 2: Basic Writing Skills **6**

Sentence Structures, Use of phrases and clauses in sentences, Importance of proper punctuation, creating coherence, organizing principles of paragraphs in documents, Techniques for writing precisely.

Module 3: Identifying Common Errors in Writing **7**

Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies, Clichés.

Module 4: Nature and Style of sensible Writing **6**

Describing, Defining, Classifying, providing examples or evidence, Writing introduction and conclusion.

Module 5: Writing Practices **6**

Comprehension, Précis Writing, Essay Writing,

Module 6: Oral Communication **7**

(This unit involves interactive practice sessions in Language Lab)

Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common Everyday, Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations.

COURSE OUTCOMES:

CO1:The student will acquire basic proficiency in English

CO2: Apply proficiency in English for enhancing basic writing skills
CO3: Apply proficiency in English for identify common errors in writing.
CO4: analyze different nature and style of writing.
CO5: development of writing skill in individuals
CO6: enhance communication lead to draft engineering project proposals.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	-	2	-	-	-	-	-	-	-	-
CO2	2	2	3	1	2	1	3	2	-	-	-	-	1	-	-
CO3	1	3	1	2	3	2	2	1	-	-	-	-	-	-	2
CO4	1	3	2	2	3	2	-	2	1		-	-		2	
CO5	3	2	2	2	1	3	-	2	-	1	-	-	1	-	-
CO6	3	3	3	3	1	-	-	-	-		-	-	2	2	2

Suggested Textbooks:

- Practical English Usage. Michael Swan. OUP. 1995.
- Remedial English Grammar. F.T. Wood. Macmillan.2007
- On Writing Well. William Zinsser. Harper Resource Book. 2001
- Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
- Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
- Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Course Code	**ESC 104**				
Category	**Engineering Science Course**				
Course Title	**Workshop/Manufacturing Practices (Theory & Lab)**				
Scheme & Credits	**L**	**T**	**P**	**Credit**	**Semester II**
	1	**0**	**4**	**3**	
Pre-requisites	Basic Knowledge of Physics, Chemistry and Mathematics				

WORKSHOP/MANUFACTURING PRACTICES 10

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturingmethods **3hrs**
2. CNC machining, Additive manufacturing **1hr**
3. Fitting operations & power tools **1hr**
4. Electrical & Electronics **1hr**
5. Carpentry **1hr**
6. Plastic Moulding, glass cutting **1hr**
7. Metal casting **1hr**
8. Welding (arc welding & gas welding), brazing **1hr**

Suggested Text/Reference Books:

- Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
- Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition,Pearson Education India Edition, 2002.
- Gowri P. Hariharan & A. Suresh Babu, "Mfg. Tech- I" Pearson Education, 2008.
- Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, PHl, 1998.
- Rao P.N., "Manufacturing Technology", Vol. I & Vol. II, Tata McGrawHill House, 2017.

COURSE OUTCOMES:

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

WORKSHOP PRACTICE 60hrs

1. Machine shop	**10hrs**
2. Fitting shop	**8hrs**
3. Carpentry	**6hrs**
4. Electrical & Electronics	**8hrs**
5. Welding shop	**8hrs (Arc welding 4 hrs + gas welding 4 hrs)**
6. Casting	**8hrs**
7. Smithy	**6hrs**
8. Plastic Moulding & Glass Cutting	**6hrs**

LABORATORY OUTCOMES:

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

CHEMISTRY LABORATORY
Code: BSC 102P

Choice of 08-10 experiments from the following:

- Determination of surface tension and viscosity
- Thin layer chromatography
- Ion exchange column for removal of hardness of water
- Determination of chloride content of water
- Colligative properties using freezing point depression
- Determination of the rate constant of a reaction
- Determination of cell constant and conductance of solutions
- Potentiometry - determination of redox potentials and emfs
- Synthesis of a polymer/drug
- Saponification/acid value of an oil
- Chemical analysis of a salt
- Lattice structures and packing of spheres
- Models of potential energy surfaces
- Chemical oscillations- Iodine clock reaction
- Determination of the partition coefficient of a substance between two immiscible liquids
- Adsorption of acetic acid by charcoal
- Use of the capillary viscometers to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.

LABORATORY OUTCOMES:

- The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and Engineering. The students will learn to:
- Estimate rate constants of reactions from concentration of reactants/products as a function of time
- Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc
- Synthesize a small drug molecule and analyse a salt sample

LABORATORY - PROGRAMMING FOR PROBLEM SOLVING

Code: ESC103P

Tutorial 1: Problem solving using computers:

Lab1: Familiarization with programming environment

Tutorial 2: Variable types and type conversions:

Lab 2: Simple computational problems using arithmetic expressions

Tutorial 3: Branching and logical expressions:

Lab 3: Problems involving if-then-else structures

Tutorial 4: Loops, while and for loops:

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

Tutorial 5: 1D Arrays: searching, sorting:

Lab 5: 1D Array manipulation

Tutorial 6: 2D arrays and Strings

Lab 6: Matrix problems, String operations

Tutorial 7: Functions, call by value:

Lab 7: Simple functions

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

Lab 8 and 9: Programming for solving Numerical methods problems

Tutorial 10: Recursion, structure of recursive calls

Lab 10: Recursive functions

Tutorial 11: Pointers, structures and dynamic memory allocation

Lab 11: Pointers and structures

Tutorial 12: File handling:

Lab 12: File operations

LABORATORY OUTCOMES:

- To formulate the algorithms for simple problems.
- To translate given algorithms to a working and correct program.
- To be able to correct syntax errors as reported by the compilers.
- To be able to identify and correct logical errors encountered at run time.
- To be able to write iterative as well as recursive programs.
- To be able to represent data in arrays, strings and structures and manipulate them through aprogram.
- To be able to declare pointers of different types and use them in defining self-referentialstructures.
- To be able to create, read and write to and from simple text files.

Based on CBCS system & OBE model Recommended scheme of study (EEE)								
Sl. No.	**Semester of Study**	**Category of course**	**Course Code**	**Subjects**	**Mode of delivery & credits** *L-Lecture; T-Tutorial; P-Practical*			**Total Credits** *C- Credits*
Theory								
1	**Third**	Program Course(PC)	EE301	Electrical Machine-I	3	1	0	3
2		PC	EE302	Network Theory	3	1	0	3
3		General Engineering (GE)	EE303	Electromagnetic Field Theory	3	1	0	3
4		GE	EC301	Basic Electronics	3	1	0	3
5		BSE	BSC301	Mathematics-III	3	1	0	4
6		BSE	BSC302	Environmental Science	2	0	0	0
								Total (A) = 16 Credits
		LABORATORIES						
7		GE	EC301P	Basic Electronics Lab	0	0	3	1
8		PC	EE301P	Electrical Machine-I Lab	0	0	3	1
9		PC	EE302P	Network Theory Lab	0	0	3	1
10		MC	EX301	Extra Activities (NSO/NSS/NCC/Yoga / Creative Arts/Mini Project)	0	0	2	1
11		HSS	HS301	Communication Skill Lab	0	0	2	1
								Total(B) = 5 Credits
Grand Total (A) + (B) = 21 Credits								
Theory								
1	**Fourth**	PC	EE401	Power System – I	3	1	0	3
2		PC	EE402	Measurement & Instrumentation	3	1	0	3
3		GE	EC401	Analog Electronics and Circuits	3	1	0	3
4		GE	EC403	Digital Electronics and Logic Design	3	1	0	3
5		GE	CS301	Data Structure and Algorithm	3	0	0	3
6		BSE	EN401/ IT402	Engineering Economics /Cyber Security	2	0	0	0
							Total (A) = 15 Credits	
		LABORATORIES						
7		Engineering Science Courses	EE401P	Power System- I Lab	0	0	3	1
8		GE	EE402P	Measurement & Instrumentation Lab	0	0	3	1
9		GE	EC403P	Digital Electronics And Logic Design Lab	0	0	3	1
10			EX401	Extra Activities (NSO/NSS/NCC/Yoga/ Creative Arts/Mini Project)	0	0	2	1
11			IN401	Internship/ Tour & Training/Industrial Training	0	0	0	2
		Total(B) = 6 Credits Grand Total for Second Year = 42Credits.**Grand Total (A) + (B) = 21 Credits**						

2nd year, III Semester, UG course Engineering (EEE)

BASIC ELECTRONICS (ECE, EEE, EE, CSE, IT)
Course code -EC 301
L TP CR 3 1 0 3

COURSE OBJECTIVES:

- To understand the structure of basic electronic devices.
- To be exposed to active and passive circuit elements.
- To familiarize the operation and applications of transistor like BJT and FET.
- To explore the characteristics of SCR.
- To learn the required functionality of Digital logic and its implementation for circuit design.

Module I: **8**

Basic Electronic Components Active and Passive Components, Types of resistors and Colour coding, Capacitors, Inductors applications of Resistor, Capacitor and Inductor, Relay, LDR, Basic Integrated Circuits (IC 7805, 7809, 7812, 555 etc.). Measuring Instruments like CRO, Power supply, multi-meters etc.

Module II: **10**

Semiconductors Difference between Insulators, Semiconductors and Conductors, Mobility and Conductivity, Intrinsic and Extrinsic Semiconductors, Fermi Level, Energy band, Charge Densities in Semiconductors, Mass Action Law, Current Components in Semiconductors, Drift and Diffusion Current, The Continuity Equation, Injected Minority Charge Carrier, Hall Effect, P-N Junction Diode, construction, working, characteristics and diode equation Application of Diode, Rectifier: Half Wave, Full Wave and Bridge Rectifier, Zener Diode and its Applications, Varactor Diode, Schottky Diode, Regulated Power Supply using Zener Diode and Regulated ICs, LED, Photodetector.

Module III: **8**

Transistors Construction, Working, Modes and Configuration of BJT, Input and Output Characteristics of all Configurations, Comparison of all Configuration & Modes, BJT as a Switch and as an Amplifier. JFET Construction, working and characteristics. MOSFET Construction, working and Characteristics, Types of MOSFET.

Module IV: **9**

Power electronic devices &Communication engineering Construction, characteristics and working of SCR, DIAC, TRIAC and UJT. Introduction, Characteristics and applications of Operational Amplifier (Ic741). Modulation and its types.

Module V: **10**

Digital Logic and basic circuit Design Number systems and conversion (DECIMAL, OCTAL, HEXADECIMAL,BINARY, BCD etc.),binary addition and subtraction, Logic Gates and their truth-table ,Boolean algebra .Design of Single Stage Amplifier, LED Driver Circuit, Infrared Transmitter Receiver Circuit, LDR Driver Circuit, Relay Driver Circuit, Square Wave and Fix Frequency Generator using 555 IC.

COURSE OUTCOMES:

Upon successful completion of the course, the students will be able to:

CO1: Explain the structure and operation of PN junction devices (diode, Zener diode, LED and Laser diode)

CO2: Design clipper, clamper, half wave and full wave rectifier, regulator circuits using PN junction diodes

CO3: Analyze the structure and characteristics BJT, FET, MOSFET, UJT, Thyristor and IGBT

CO4: Analyze the performance of various configurations of BJT and MOSFET based amplifier

CO5: Explain the characteristics of MOS based cascade and differential amplifier

CO6: Explain the operation of various digital logic cicuits.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	--	--	1	--	--	--	1	3	--	2
CO2	2	2	3	2	2	--	--	1	--	--	--	1	3	--	1
CO3	2	2	3	2	2	--	--	1	--	--	--	1	3	--	1
CO4	2	2	3	2	2	--	--	1	--	--	--	1	3	--	2
CO5	2	2	3	2	2	--	--	1	--	--	--	1	3	--	1
CO6	2	2	3	2	2	--	--	--	--	--	--	1	3	--	1

Text Books

1. Basic Electronics and Linear Circuits by N. N. Bhargava, D. C. Kulshreshtha and S. C. Gupta, TMH Publications.
2. Op-Amps and Linear Integrated Circuits by Ramakant A. Gayakwad, PHI Publications.
3. Electronic Devices and Circuits by Godse and Bakshi Technical, Vol-1 Technical Publication Pune.

Reference Books

1. Integrated Devices & Circuits by Millman&Halkias, TMH Publications.
2. Electronics Devices and Circuit Theory by R. Boylestad& L. Nashelsky, Pearson Publication
3. Electronic Communication System by G. Kennedy, TMH Publications.
4. Basic Electronics by Sanjeev Kumar &VandanaSachdeva, Paragaon International Publication

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2nd year, III Semester, UG course Engineering (EEE)

Course code -EE 301

ELECTRICAL MACHINES-I (EEE, EE,)

L T P CR. 3 1 0 3

COURSE OBJECTIVES:

- To understand the concept of electromechanical energy conversion system.
- To identify the appropriate machine for a given application based on its characteristics.
- To identify the appropriate test to determine the performance parameters of a given machine.
- To familiarize with the procedure for parallel operation of generators and transformers.
- To deliberate the working of auto transformer and three phase transformers.
- To Familiarize with Induction machine and its application

Pre-Requisite: Basic electrical engg. and basic knowledge of electromagnetism

Module I ELECTRO-MECHANICAL ENERGY CONVERSION 8

Fundamentals of Magnetic circuits- Statically and dynamically induced EMF - Principle of electromechanical energy conversion forces and torque in magnetic field systems- energy balance in magnetic circuits- magnetic force- co-energy in singly excited and multi excited magnetic field system mmf of distributed windings – Winding Inductances-, magnetic fields in rotating machines- magnetic saturation and leakage fluxes. Introduction to Indian Standard Specifications (ISS) - Role and significance in testing

ModuleII DC MACHINE 10

Principle of operation, constructional details, armature windings and its types, EMF equation, wave shape of induced emf, armature reaction, demagnetizing and cross magnetizing Ampere turns, compensating winding, commutation, methods of improving commutation, interpoles, OCC and load characteristics of different types of DC Generators. Parallel operation of DC Generators, equalizing connections- applications of DC Generators. Principle of operation, significance of back emf, torque equations and power developed by armature, speed control of DC motors, starting methods of DC motors, load characteristics of DC motors, losses and efficiency in DC machine, condition for maximum efficiency. Testing of DC Machines: Brake test, Swinburne's test, Hopkinson's test, Field test, Retardation test, Separation of core losses-applications of DC motors.

Module III SINGLE PHASE TRANSFORMER 9

Construction and principle of operation, equivalent circuit, phasor diagrams, testing - polarity test, open circuit and short circuit tests, voltage regulation, losses and efficiency, all day efficiency, back-to-back test, separation of core losses, parallel operation of single-phase transformers, applications of single-phase transformer.

Module IV THREE PHASE TRANSFORMER 9

Construction and working of auto transformer, comparison with two winding transformers, applications of autotransformer. Three Phase Transformer- Construction, types of connections and their comparative features, Scott connection, applications of Scott connection.

Module IV THREE PHASE INDUCTION MOTOR 9

Constructional features, Rotating magnetic field, principle of operation, phasor diagram, Equivalent circuit, Torque and power equation, Torque-Slip characteristics, No-load and blocked rotor test, Efficiency, Starting, Braking and speed control, Deep bar and double cage rotors, Cogging and Crawling, Induction Generators and its applications.

COURSE OUTCOMES:

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

CO1: Apply the laws governing the electromechanical energy conversion for singly and multiple excited systems.

CO2: Explain the construction and working principle of DC machines.

CO3: Interpret various characteristics of DC machines.

CO4: Compute various performance parameters of the machine, by conducting suitable tests.

CO5: Draw the equivalent circuit of transformer and predetermine the efficiency and regulation.

CO6: Describe the working principle of auto transformer, three phase transformer with different types of connections.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	--	--	1	--	--	--	1	3	2	2
CO2	3	3	1	1	1	--	--	1	--	--	--	1	3	1	1
CO3	3	3	1	1	1	--	--	1	--	--	--	1	3	1	1
CO4	3	3	1	1	1	--	--	1	--	--	--	1	3	3	2
CO5	3	3	1	1	1	--	--	1	--	--	--	1	3	3	2
CO6	3	3	1	1	1	--	--	1	--	--	--	1		3	2

TEXT BOOKS

1. I. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 5th Edition, 2017.

2. P. S. Bimbhra, “Electric Machinery”, Khanna Publishers, 2nd Edition, 2021.

REFERENCES

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery”, New York, McGraw Hill Education, 6th Edition 2017.

2. A. E. Clayton and N. N. Hancock, “Performance and design of DC machines”, CBS Publishers, 2018. 3. M. G. Say, “Performance and design of AC machines”, CBS Publishers, First Edition 2008.

4. Sahdev S. K. “Electrical Machines”, Cambridge University Press, 2018.

2nd year, III Semester, UG course Engineering (EEE)

NETWORK THEORY(EEE, EE, ECE)

Course code -EE 302

L T P CR. 3 1 0 3

COURSE OBJECTIVES:

1. To make the students capable of analyzing any given electrical network.
2. To make the students learn how to synthesize an electrical network from a given impedance/admittance function.

Module– I **3**

Network Theorem: Substitution theorem, Tellegen's theorem, Reciprocity theorem.

Module– II **10**

Network Topology: Definition and properties, Matrices of Graph, Network Equations &Solutions : Node and Mesh transformation, Generalized element, Source transformation, Formulation of network equations, Network with controlled sources, Transform networks, Properties of network matrices, Solution of equations. Linear time-invariant networks, Evaluation of initial conditions, Frequency and impedance scaling.

Module– III **6**

Multi-terminal Networks: Natural frequency, Network functions, Two-port parameters, Equivalent networks.

Module– IV **7**

Elements of Network Synthesis: Positive real function, Reactance functions, RC functions, RL Network, Two-port functions, Minimum phase networks.

Module– V **6**

Approximation: Filter specifications, Butterworth approximation, Chebyshev approximation, Comparison between Butterworth and Chebyshev transfer functions.

Module– VI **6**

Two-terminal network synthesis. Properties of Hurwitz polynomial and Positive real function. Synthesis of LC, RC and RL Networks, Foster Forms and Cauer Forms.

Module– VII **7**

Active Networks and Filters: Active elements, Single amplifier filters, State variable realization, All pass and notch filter, Higher order filter.

COURSE OUTCOMES:

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

CO1: apply the knowledge of basic circuital law and simplify the network using reduction techniques
CO2: Analyze the circuit using Kirchhoff's law and Network simplification theorems
CO3: Infer and evaluate transient response, Steady state response, network functions.

CO4: Obtain the maximum power transfer to the load , and Analyze the series resonant and parallel resonant circuit
CO5: evaluate two-port network parameters, design attenuators and equalizers
CO6: Synthesize one port network using Foster and Cauer Form

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	--	--	1	--	--	--	1	3	2	2
CO2	3	3	1	1	1	--	--	1	--	--	--	1	3	1	1
CO3	3	3	1	1	1	--	--	1	--	--	--	1	3	1	1
CO4	3	3	1	1	1	--	--	1	--	--	--	1	3	3	2
CO5	3	3	1	1	1	--	--	1	--	--	--	1	3	3	2
CO6	3	3	1	1	1	--	--	1	--	--	--	1		3	2

TEXT BOOK:

1. V.K. Aatre, Network Theory & Filter Design

Reference Book:

1. M.E. Van Valkenberg, Introduction to Modern Network Synthesis
2. Balabanian, N. and T.A. Bickart, “Electric Network Theory”, John Wiley & Sons, New York, 1969.
3. C. L. Wadhwa, Network Analysis and Synthesis

2nd year, III Semester, UG course Engineering (EEE)

Course code -EE 303
ELECTROMAGNETIC FIELD THEORY (ECE, EEE, EE)
L T P CR. 3 1 0 3

COURSE OBJECTIVES:

- To introduce the basic mathematical concepts related to electromagnetic vector fields
- To impart knowledge on the concepts of
  - Electrostatic fields, electric potential, energy density and their applications.
  - Magneto static fields, magnetic flux density, vector potential and its applications.
  - Different methods of emf generation and Maxwell's equations
  - Electromagnetic waves and characterizing parameters

Module I ELECTROSTATICS – I **9**

Sources and effects of electromagnetic fields – Coordinate Systems – Vector fields –Gradient, Divergence, Curl – theorems and applications - Coulomb's Law – Electric field intensity – Field due to discrete and continuous charges – Gauss's law and applications.

Module II ELECTROSTATICS – II **9**

Electric potential – Electric field and equipotential plots, Uniform and Non-Uniform field, Utilization factor – Electric field in free space, conductors, dielectrics - Dielectric polarization –Dielectric strength - Electric field in multiple dielectrics – Boundary conditions, Poisson's and Laplace's equations, Capacitance, Energy density, Applications.

Module III MAGNETOSTATICS **9**

Lorentz force, magnetic field intensity (H) – Biot–Savart's Law - Ampere's Circuit Law – H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization, Magnetic field in multiple media –Boundary conditions, scalar and vector potential, Poisson's Equation, Magnetic force, Torque, Inductance, Energy density, Applications.

Module IV ELECTRODYNAMIC FIELDS **9**

Magnetic Circuits - Faraday's law – Transformer and motional EMF – Displacement current - Maxwell's equations (differential and integral form) – Relation between field theory and circuit theory – Applications.

Module V ELECTROMAGNETIC WAVES **9**

Electromagnetic wave generation and equations – Waveparameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics, conductors- skin depth - Poynting vector – Plane wave reflection and refraction.

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO1: Visualize and explain Gradient, Divergence, and Curl operations on electromagnetic vector fieldsand identify the electromagnetic sources and their effects.

CO2: Compute and analyse electrostatic fields, electric potential, energy density along with their applications.

CO3: Compute and analyse magneto static fields, magnetic flux density, vector potential along with their applications.

CO4: Explain different methods of emf generation and Maxwell's equations

CO5: Explain the concept of electromagnetic waves and characterizing parameters

CO6: Design and develop magnetic circuits.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO3
CO1	3	2	--	--	--	--	3	1	--	--	--	1	3	2	2
CO2	3	2	1	1	--	--	1	1	--	--	--	1	3	1	1
CO3	3	2	1	1	--	--	1	1	--	--	--	1	3	1	1
CO4	3	2	1	1	--	--	1	1	--	--	--	1	3	3	2
CO5	3	2	1	1	--	--	1	1	--	--	--	1	3	3	2
CO6	3	2	1	1	--	--	1	1	--	--	--	2	3	3	2

TEXT BOOKS:

1. Mathew N. O. Sadiku, S.V. Kulkarni 'Principles of Electromagnetics', 6th Edition, Oxford University Press Inc. Asian edition, 2015.

2. William H. Hayt and John A. Buck, 'Engineering Electromagnetics', McGraw Hill Special Indian edition, 2014.

3. Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, 2010.

REFERENCES:

1. V.V.Sarwate, 'Electromagnetic fields and waves', Second Edition, Newage Publishers, 2018.

2. J.P.Tewari, 'Engineering Electromagnetics - Theory, Problems and Applications',

2nd year, III Semester, UG course Engineering (EEE)

Course code -BSC301
MATHEMATICS III
(All Branch)
L T P CR. 3 1 0 4

Course Objective:

- To make the students understand that Fourier series analysis is a powerful method where formulas are integrals and to have knowledge of expanding periodic functions that explore variety of applications of Fourier series
- To provide knowledge of Laplace transform of elementary functions including its properties and applications to solve ODE
- To have a thorough knowledge of PDE which arise in mathematical descriptions of situations in engineering
- To provide a sound background of complex analysis to perform a thorough investigation of major theorems of complex analysis and to apply these ideas to a wide range of problems that include the evaluation of both complex line integral and real integrals.

Module-I **8**

Laplace Transformation: Laplace Transformation and its properties, Periodic function, unit step function and impulse function Inverse Laplace Transformation, Convolution Theorem, Applications of Laplace transforms in solving certain initial value problems & simultaneous differential equations.

Module-II **10**

Numerical Method: Finite difference, Symbolic relations, Interpolation and Extrapolation, Newton - Gregory forward and backward formula, Lagrange's formula, Inverse Interpolation by Lagrange's formula. Numerical Differentiation and Numerical Integration, Newton Cotes Quadrature formula, Trapezoidal rule. Simpson's 1/3" rule, Simpson's 3/8" rule.

Module-III **6**

Z-Transform & Inverse Z-Transform- Properties - Initial and Final value theorems, Convolution theorem- Difference equations. Solution of difference equations using Z Transformation.

Module-IV **8**

Fourier Series & Fourier Transform: Expansion of - Algebraic, Exponential &Trigonometric functions in Fourier series, Change of interval, Even and odd function, half range sine and cosine series, Complex form of Fourier series.Fourier Transformation and inverse Fourier Transformation, Fourier sine & cosine transforms.Convolution theorem for Fourier transforms with simple illustrations.

Module-V **8**

Partial Differential Equations: Formation of partial differential equations, Linear partial differential equations of first order, Lagrange's linear equation, Non-linear equations of first order, Charpit's method Solution of one-dimensional Wave equation & Heat equation by the method of separation of
variables and its applications.

COURSE OUTCOME:

Upon the successful completion of the course, students will be able to:

CO1: Define Fourier series including half range series, harmonic analysis and variety of its applications
CO2: Define mathematically unit steps, unit impulse, Laplace transform, its properties, inverse and applications to solve ODE.
CO3: form and solve by direct integration method, linear equation of first order including homogeneous and non-homogeneous linear equations and also method of separation of variables.
CO4: Solve difficult problems using theorem of complex analysis and apply residue theorem to evaluate real integrals.
CO5: Solve difficult problems using theorem of Partial Differential Equations
CO6: Solve engineering problems

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	--	--	--	--	3	1	--	--	--	1	3	2	2
CO2	3	2	1	1	--	--	1	1	--	--	--	1	3	1	1
CO3	3	2	1	1	--	--	1	1	--	--	--	1	3	1	1
CO4	3	2	1	1	--	--	1	1	--	--	--	1	3	3	2
CO5	3	2	1	1	--	--	1	1	--	--	--	1	3	2	2
CO6	3	2	1	1	--	--	2	1	--	--	--	1	3	2	2

Text Books

1. Irwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,
2. Ramana R. V ., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,2010.
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition,

Reference Books

1. R. J. Beerends.H. G. TerMorsche, J. C. Van Den Berg. L. M. Van De Vrie, Fourier and Laplace Transforms, Cambridge University Press.
2. Sastry S.S. Introductory Methods of Numerical Analysis, PHI
3. R. J. Beerends ,H. G. TerMorsche ,J. C. Van Den Berg, E. M. Van De Vrie, Fourier and Laplace Transforms, Cambridge University Press.
4. Sastry S.S, Introductory Methods of Numerical Analysis, PHI.

2nd Year, III Semester, UG course Engineering (EEE)

Course code -BSC302
Environmental Science
(All Branch)
L T P CR. 20 0 0

OBJECTIVES:

- To study the nature and facts about environment.
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth‟s interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

Module-1 **2**
Concept and scope of Environment science, components of environment, environmental segment and their importance.

Module-II **6**
Ecology: Ecosystem and its characteristics features, structure and function of forest ecosystem grassland ecosystem, desert ecosystem and aquatic ecosystem, ecological balance and consequences of imbalance.

Module-III **4**
Atmosphere: Atmospheric composition, energy balance, climate, weather, depletion of ozone layer, greenhouse effect, acid rain, particles, ions and radicals in the atmosphere, chemical and photochemical reactions in the atmosphere.

Module-IV **4**
Air pollution and control: Air pollutants, sources and effect of air pollutants, primary and secondary pollutants, photochemical smog, fly ash, inorganic and organic particulate matter. Air quality standards, sampling, monitoring and control measures for pollutants.

Module-V **4**
Water pollution and control: Aquatic environment, water pollution, sources and their effect, lake and ground water pollution, eutrophication, water quality standard and water pollution controlmeasures, waste water treatment.

Module-VI **5**
Land pollution; Lithosphere, composition of soil, acid base and ion exchange reactions in soil, soil erosion, landslides, desertification, pollutants (municipal, industrial, commercial, agricultural, hazardous solid wastes), origin and effects, collection and disposal of solid wastes, recovery and conversion methods.

Module-VII **2**
Noise pollution; Noise classification and its sources, effects and measurement, noise pollution hazards, standards and noise pollution control.

COURSE OUTCOMES:

CO1 To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.

CO2 To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.

CO3 To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.

CO4 To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.

CO5 To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.

CO6 Design and development of sustainable and green model.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	--	--	--	2	3	1	--	--	--	2	--	--	--
CO2	3	2	--	--	--	3	3	1	--	--	--	2	--	--	--
CO3	3	--	1	--	--	2	2	1	--	--	--	2	--	--	--
CO4	3	2	1	1	--	2	2	1	--	--	--	2	--	--	--
CO5	3	2	1		--	2	2	1	--	--	--	1	--	--	--
CO6	3	2	1	1	--	2	2	1	--	--	--	2	--	--	--

BOOKS AND REFERENCES:

1. Master, G.M Introduction to environment engineering and science, Pearson Education.
2. Nebel, B.J., Environment science, Prentice Hall Inc.
3. Odum, E.P. Ecology: The link between the natural and social sciences. IBH Publishing Company Delhi
4. De, A.K. Environmental Chemistry, Merrut.
5. Sharma B.K Envrionmental Chemistry, Krishna Prakashan Media Merrut.
6. Kaushik, A and Kaushik, C.P. Perspectives in Environmental studies, New Age International
Publication.
7. Menon, S.E. Environmental Chemistry.

2nd Year, III Semester, UG course Engineering (EEE)

Course Code -ECE 301P
BASIC ELECTRONICS LAB (ECE, EEE, EE)

List of Experiments (Minimum 10)

1. Identification and testing of Resistors, Inductors, Capacitors, PN-Diode. Zener Diode, LED, LCD, LDR, BJT, Photo Diode, Photo Transistor,

2. Measurement of voltage and current using multimeter, Measure the frequency and Amplitude of a signal with the help of CRO and function generator.

3. Study of p-n junction diode AND Zener Diode I-V characteristics

4. Assemble the single-phase half wave and full wave bridge rectifier & the analyse effect of capacitor as a filter (only study of waveforms).

5. Study of Zener diode as voltage regulator.

6. Measurement & study of input characteristics of a BJT in CB configuration.

7. Measurement and study of characteristics of JFET and MOSFET

8. To design and simulate IR Transmitter and Receiver Circuit.

9. To design and simulate Motor Driver using Relay.

10. To design and simulate Light detector using LDR.

11. To design and simulate Constant frequency square wave generator using.

12. To design and simulate 5 volt DC power supply from 230 AC.

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

2nd Year, III Semester, UG course Engineering (EEE)

Course Code: EE301P
ELECTRICAL MACHINE LAB-I

COURSE OBJECTIVES:

- To expose the students to determine the characteristics of DC machines and transformers by performing experiments on these machines.
- To provide hands on experience to evaluate the performance parameters of DC machines and transformer by conducting suitable tests.

List of Experiments

1. To obtain the speed characteristics of a D.C shunt motor as a function of armature voltage, field current, and external resistance in the armature circuit.
2. To find the critical resistance (Rc) and critical speed (Nc) and O.C.C. of a dc shunt generator.
3. To conduct a load test on a dc shunt generator and obtain its internal and external characteristics. 4. To conduct load test on a dc series generator and to obtain its internal and external characteristics. 5. To perform Hopkinson's test on two similar DC shunt machines and obtain their efficiencies at various loads.
6. To separate the mechanical and iron losses (Retardation Test) of the given dc shunt machine.
7. To pre-determine the efficiency of a D.C shunt machine considering it as a motor by performing Swinburne's test on it.
8. To study about different types of DC motor starters.
9. To study power-sharing between two single-phase transformers operated in parallel.
10. To determine transformer winding polarity and explore the impact of connecting windings in series aiding and series opposing configurations.
11. To perform the short circuit and open circuit test of single-phase transformer and draw the equivalent circuit.
12.To determine Regulation and Efficiency of a single-phase transformer using direct loading test.

COURSE OUTCOMES:

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

CO1: Construct the circuit with appropriate connections for the given DC machine/transformer.
CO2: Experimentally determine the characteristics of different types of DC machines.
CO3: Demonstrate the speed control techniques for a DC motor for industrial applications.
CO4: Identify suitable methods for testing of transformer and DC machines.
CO5: Predetermine the performance parameters of transformers and DC motor. CO6: Understand DC motor starters and 3-phase transformer connections.

2nd Year, III Semester, UG course Engineering (EEE)

Course code -EE 302P

NETWORK THEORY LAB (ECE, EEE, EE)

COURSE OBJECTIVES:

- To gain practical experience on electric circuits and verification of theorems
- To simulate various electric circuits using Pspice/ Matlab/e-Sim / Scilab

List of Experiments

1. Transient response of RC circuit.
2. Transient response of RL circuit.
3. To find the resonance frequency, Band width of RLC series circuit.
4. To study and verify effect of R on frequency response of parallel resonance circuit.
5. To calculate and verify "Z" parameters of a two port network.
6. To calculate and verify "Y" parameters of a two port network.
7. To determine equivalent parameter of parallel connections of two port network.
8. To plot the frequency response of low pass filter and determine half-power frequency.
9. To plot the frequency response of high pass filters and determines the half-power frequency.
10. To plot the frequency response of band-pass filters and determines the band-width.
11. To calculate and verify "ABCD" parameters of a two port network.
12. To synthesize a network of a given network function and verify its response.
13. Introduction of P-Spice or other simulation software.

COURSE OUTCOMES:

CO1: Use simulation and experimental methods to verify the fundamental electrical laws for the given DC/AC circuit (Ex 1)

CO2: Use simulation and experimental methods to verify the various parameters of two port network for the given DC/AC circuit (Ex 5-7)

CO3: Analyze frequency response of the given RL/RC/RLC circuit using simulation and experimental methods (Ex 4)

CO4: Analyze frequency response of the given filters using simulation and experimentation methods (Ex 8-10)

CO5: Analyze the performance of the given three-phase circuit using simulation and experimental methods

Syllabus

For

B.Tech 4th Semester

In

Electrical & Electronics Engineering

2nd Year, IV Semester, UG course Engineering (EEE)

Course code -EE401
POWER SYSTEM I
L T P CR. 31 0 3

COURSE OBJECTIVES:

- To impart knowledge about the configuration of the electrical power systems.
- To study the line parameters and interference with neighbouring circuits.
- To understand the mechanical design and performance analysis of transmission lines.
- To learn about different insulators and underground cables.
- To understand and analyze the distribution system.

Module I TRANSMISSION LINE PARAMETERS 9

Structure of electric power system - Parameters of single and three phase transmission lines with single and double circuits -Resistance, inductance, and capacitance of solid, stranded, and bundled conductors - Typical configuration, conductor types - Symmetrical and unsymmetrical spacing and transposition – application of self and mutual GMD; skin and proximity effects - Effects of earth on the capacitance of the transmission line - interference with neighbouring communication circuits.

Module II MODELLING AND PERFORMANCE OF TRANSMISSION LINES 9

Performance of Transmission lines – short line, medium line and long line – equivalent circuits, phasor diagram, attenuation constant, phase constant, surge impedance – transmission efficiency and voltage regulation, real and reactive power flow in lines – Power Circle diagrams – Ferranti effect – Formation of Corona – Critical Voltages – Effect on line Performance.

Module III SAG CALCULATION AND LINE SUPPORTS 9

Mechanical design of overhead lines – Line Supports –Types of towers – Tension and Sag Calculation for different weather conditions – Methods of grounding - Insulators: Types, voltage distribution in insulator string, improvement of string efficiency, testing of insulators.

Module IV UNDERGROUND CABLES 9

Underground cables – Types of cables – Construction of single-core and 3-core belted cables – Insulation Resistance – Potential Gradient – Capacitance of single-core and 3-core belted cables – Grading of cables – Power factor and heating of cables– DC cables.

Module V DISTRIBUTION SYSTEMS 9

Distribution Systems – General Aspects – Kelvin's Law – AC and DC distributions – Concentrated and Distributed loading- Techniques of Voltage Control and Power factor improvement – Distribution Loss – Types of Substations – Trends in Transmission and Distribution: EHVAC, HVDC and FACTS (Qualitative treatment only).

COURSE OUTCOMES:

On the successful completion of the course, students will be able to:

CO1: Understand the structure of power system, computation of transmission line parameters for different configurations.

CO2: Model the transmission lines to determine the line performance and to understand the impact of Ferranti effect and corona on line performance.

CO3: Do Mechanical design of transmission lines, grounding and to understand about the insulators in transmission system.

CO4: Design the underground cables and understand the performance analysis of underground cable.

CO5: Understand the modelling, performance analysis and modern trends in distribution system.

CO6: Design and implement power system model.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	--	--	--	--	--	1	--	--	--	--	3	1	1
CO2	3	2	1	1	--	1	--	2	--	--	--	--	3	2	1
CO3	3	2	1	1	--	1	--	2	--	--	--	--	3	3	1
CO4	3	2	1	1	--	1	--	2	--	--	--	--	3	3	1
CO5	3	2	1	1	--	1	--	2	--	--	--	--	3	3	1
CO6	3	2	1	1	--	1	--	2	--	--	--	--	3	3	1

TEXT BOOKS:

1. D.P.Kothari, I.J. Nagarath, 'Power System Engineering', Mc Graw-Hill Publishing Company limited, New Delhi, Third Edition, 2019.

2. C.L.Wadhwa, 'Electrical Power Systems', New Age International Ltd, seventh edition 2022.

3. S.N. Singh, ‘Electric Power Generation, Transmission and Distribution’, Prentice Hall of India Pvt. Ltd, New Delhi, Second Edition, 2008.

REFERENCE BOOKS:

1. B.R.Gupta, ‘Power System Analysis and Design’ S. Chand, New Delhi, Sixth Edition, 2011.

2. Luces M.Fualken berry, Walter Coffer, ‘Electrical Power Distribution and Transmission’, Pearson Education, 2007.

3. ArunIngole, "Power transmission and distribution" Pearson Education, first edition, 2018

4. J.Brian Hardy and Colin R.Bayliss ‘Transmission and Distribution in Electrical Engineering’, Newnes; Fourth Edition, 2011.

5. HadiSaadat, ‘Power System Analysis’, McGraw Hill Education Pvt. Ltd., New Delhi, 3rd Edition, 23rd reprint, 2015.

6. R.K.Rajput, ‘A Text Book of Power System Engineering’ 2nd edition, Laxmi Publications (P) Ltd, New Delhi, 2016.

2nd Year, IV Semester, UG course Engineering (EEE)

Course code -EE402
MEASUREMENTAND INSTRUMENTATION
L T P CR. 31 0 3

COURSE OBJECTIVES

- To educate the fundamental concepts and characteristics of measurement and errors
- To impart the knowledge on the functional aspects of measuring instruments
- To infer the importance of various bridge circuits used with measuring instruments.
- To educate the fundamental working of sensors and transducers and their applications
- To summarize the overall measurement and instrumentation with the knowledge on digital instrumentation principles.

Module I CONCEPTS OF MEASUREMENTS 9

Instruments: classification, applications – Elements of a generalized measurement system - Static and dynamic characteristics - Errors in measurement -Statistical evaluation of measurement data.

Module II MEASUREMENT OF PARAMETERS IN ELECTRICAL SYSTEMS 9

Classification of instruments – moving coil and moving iron meters – Induction type, dynamometer type watt meters – Energy meter – Megger – Instrument transformers (CT & PT).

Module III AC/DC BRIDGES AND INSTRUMENTATION AMPLIFIERS 9

Wheatstone bridge, Kelvin double bridge - Maxwell, Hay, Wien and Schering bridges – Errors and compensation in A.C. bridges - Instrumentation Amplifiers.

Module IV TRANSDUCERS FOR MEASUREMENT OF NON-ELECT. PARAMETERS 9

Classification of transducers – Measurement of pressure, temperature, displacement, flow, angular velocity – Digital transducers – Smart Sensors.

Module V DIGITAL INSTRUMENTATION 9

A/D converters: types and characteristics – Sampling, Errors- Measurement of voltage, Current, frequency and phase - D/A converters: types and characteristics- DSO- Data Loggers – Basics of PLC programming and Introduction to Virtual Instrumentation - Instrument standards.

COURSE OUTCOMES:

Upon successful completion of the course, the students should have the: CO1: Ability to understand the fundamental art of measurement in engineering.

CO2: Ability to understand the structural elements of various instruments.

CO3: Ability to understand the importance of bridge circuits.

CO4: Ability to understand about various transducers and their characteristics by experiments.

CO5: Ability to understand the concept of digital instrumentation and virtual instrumentation by experiments.

CO6: Design and development of basic transducer

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	--	3	2	--	2	--	--	--	3	3	3	3
CO2	3	2	3	2	--		--	--	--	3	--	3	3	3	3
CO3	3	2	3	--	3	2	--	--	--	--	--	3	3	3	3
CO4	3	2	3	--	--	--	--	2	--	--	--	--	3	3	3
CO5	3	2	3	2	3	--	--	--	--	3	--	3	3	3	3
CO6	3	2	3	2	3	1	--	2	--	3	--	3	3	3	3

TEXT BOOKS:

1. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', DhanpatRai and Co, New Delhi, Edition 2011.

2. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010

REFERENCES:

1. M.M.S. Anand, 'Electronics Instruments and Instrumentation Technology', Prentice Hall India, New Delhi, 2009

2. J.J. Carr, 'Elements of Electronic Instrumentation and Measurement', Pearson Education India, New Delhi, 2011

2nd Year, IV Semester, UG course Engineering (EEE)

Course code -EC401
Analog Electronics and Circuits
L T P CR. 3 1 0 3

COURSE OBJECTIVES:

- To understand the structure of basic electronic devices.
- To be exposed to active and passive circuit elements.
- To familiarize the operation and applications of transistor like BJT and FET.
- To explore the characteristics of amplifier gain and frequency response.
- To learn the required functionality of positive and negative feedback systems.

Module I PN JUNCTION DEVICES **9**

PN junction diode –structure, operation and V-I characteristics, diffusion and transition capacitance – Clipping & Clamping circuits - Rectifiers – Half Wave and Full Wave Rectifier– Display devices- LED, Laser diodes, Zener diode characteristics- Zener diode Reverse characteristics – Zener diode as regulator.

Module II TRANSISTORS AND THYRISTORS **9**

BJT, JFET, MOSFET- structure, operation, characteristics and Biasing UJT, Thyristors and IGBT - Structure and characteristics.

Module III AMPLIFIERS **9**

BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response – MOSFET small signal model– Analysis of CS and Source follower – Gain and frequency response- High frequency analysis.

Module IV MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER **9**

BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response – Neutralization methods, power amplifiers –Types (Qualitative analysis).

Module V FEEDBACK AMPLIFIERS AND OSCILLATORS **9**

Advantages of negative feedback – voltage / current, series, Shunt feedback –positive feedback – Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators

COURSE OUTCOMES:

Upon successful completion of the course, the students will be able to:

CO1: Explain the structure and operation of PN junction devices (diode, Zener diode, LED and Laser diode)

CO2: Design clipper, clamper, half wave and full wave rectifier, regulator circuits using PN junction diodes

CO3: Analyze the structure and characteristics BJT, FET, MOSFET, UJT, Thyristor and IGBT

CO4: Analyze the performance of various configurations of BJT and MOSFET based amplifier

CO5: Explain the characteristics of MOS based cascade and differential amplifier

CO6: Explain the operation of various feedback amplifiers and oscillators

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	--	--	1	--	--	--	1	1	--	1
CO2	2	2	3	2	2	--	--	1	--	--	--	1	1	--	1
CO3	2	2	3	2	2	--	--	1	--	--	--	1	1	--	1
CO4	2	2	3	2	2	--	--	1	--	--	--	1	1	--	1
CO5	2	2	3	2	2	--	--	1	--	--	--	1	1	--	1
CO6	2	2	3	2	2	--	--	1	--	--		1	1	--	1

TEXT BOOKS:

1. David A. Bell , ”Electronic devices and circuits”, Oxford University higher education, 5th edition 2008.

2. Sedra and smith, “Microelectronic circuits”,7th Edition., Oxford University Press, 2017

REFERENCES:

1. Balbir Kumar, Shail.B.Jain, “Electronic devices and circuits” PHI learning private limited, 2nd edition 2014.

2. Thomas L.Floyd, “Electronic devices” Conventional current version, Pearson prentice hall, 10th Edition, 2017.

3. Donald A Neamen, “Electronic Circuit Analysis and Design” Tata McGraw Hill, 3rd Edition, 2003.

4. Robert L.Boylestad, “Electronic devices and circuit theory”, 11th edition, Pearson prentice Hall 2013.

5. Robert B. Northrop, “Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation”, CRC Press, Second edition, 2012.

2nd Year, IV Semester, UG course Engineering (EEE)

Course code -EC403
Digital Electronics and Logic Design
L T P CR. 3 1 0 3

COURSE OBJECTIVES:

- To introduce the fundamentals of combinational and sequential digital circuits.
- To study various number systems and to simplify the mathematical expressions.
- using Boolean functions word problems
- To study implementation of combinational circuits using Gates` and MSI Devices.
- To study the design of various synchronous and asynchronous circuits
- To introduce digital simulation techniques for development of application-oriented logic circuit

UNIT I NUMBER SYSTEMS AND DIGITAL LOGIC FAMILIES 9
Number system, error detection, corrections & codes conversions, Boolean algebra: De-Morgan's theorem, switching functions and minimization using K-maps & Quine McCluskey method - Digital Logic Families -comparison of RTL, DTL, TTL, ECL and MOS families - operation, characteristics of digital logic family.

UNIT II COMBINATIONAL CIRCUITS 9
Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps - simplification and implementation of combinational logic – multiplexers and de multiplexers - code converters, adders, subtractors, Encoders and Decoders.

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS 9
Sequential logic- SR, JK, D and T flip flops level triggering and edge triggering – counters-asynchronous and synchronous type - Modulo counters - Shift registers - design of synchronous sequential circuits – Moore and Mealy models- Counters, state diagram; state reduction; state assignment.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS AND PROGRAMMABILITY LOGIC DEVICES 9
Asynchronous sequential logic Circuits-Transition stability, flow stability-race conditions, hazards &errors in digital circuits; analysis of asynchronous sequential logic circuit's introduction to Programmability Logic Devices: PROM – PLA –PAL, CPLD-FPGA.

UNIT V VHDL 9
RTL Design – combinational logic – Sequential circuit – Operators – Introduction to Packages – Subprograms – Test bench. (Simulation /Tutorial Examples: adders, counters, flip flops, Multiplexers & De multiplexers).

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO1: Explain various number systems and characteristics of digital logic families.

CO2: Apply K-maps and Quine McCluskey methods to simplify the given Boolean expressions.

CO3: Explain the implementation of combinational circuit such as multiplexers and demultiplexers - code converters, adders, subtractors, Encoders and Decoders

CO4: Design various synchronous and asynchronous circuits using Flip Flops

CO5: Explain asynchronous sequential circuits and programmable logic devices.

CO6: Use VHDL for simulating and testing RTL, combinatorial and sequential circuits

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	3	--	--	1	--	--	--	1	3	--	1
CO2	3	3	3	1	3	--	--	1	--	--	--	1	3	--	1
CO3	3	3	3	1	3	--	--	1	--	--	--	1	3	--	1
CO4	3	3	3	1	3	--	--	1	--	--	--	1	3	--	1
CO5	3	3	3	1	3	--	--	1	--	--	--	1	3	--	1
CO6	3	3	3	1	3	--	--	1	--	--		1	3	--	1

TEXT BOOKS :

1. Kharate “Digital Electronics” OXFORD Publication

2. A. Anand Kumar ‘Fundamentals of Digital Circuits’. PHI Publications

3. R.P. Jain-‘Modern Digital Electronics’ IIIrd Edition- Tata Mc Graw Hill, Publication

4. Douglas Perry, “VHDL”, Tata McGraw Hill, 4th edition, 2002.

5. Charles Roth, “Digital System Design using VHDL”, Tata McGraw Hill 2nd edition

6. Bhaskar VHDL BASED DESIGN, PEARSON EDUCATION

Reference Books:

1. Rajkamal ‘Digital Systems Principals and Design’ Pearson Education

2. A.P. Malvino, D.P. Leach ‘Digital Principles & Applications’ -VIth Edition-TMH publication.

3. M. Morris Mano ‘Digital Design’ (Third Edition). PHI Publications

2nd Year, IV Semester, UG course Engineering (EEE)

Course code -CS301
DATA STRUCTURES AND ALGORITHMS
L T P CR. 3 1 0 3

COURSE OBJECTIVES:

- To understand the concepts of ADTs and linear data structures.
- To know the concepts of non-linear data structure and hashing.
- To familiarize the concepts of sorting and searching techniques.

Module I **8**
Basic concepts and notations: Data structures and data structure operations, Complexity Analysis: Mathematical notation and functions, algorithmic complexity and time space trade off, Big O Notation, The best, average & worst cases analysis of various algorithms. Arrays: Linear & Multidimensional Arrays, Representation & traversal. Sorting algorithms: Bubble sort, Selectionsort, Insertion sort, Merge sort and Quick sort, Counting Sort. Linear search and Binary search onsorted arrays.

Module II **9**
Abstract Data Types (ADTs) Stack: Push; Pop, stack representation using array and linked list,Applications of Stack, Recursion. Queue: Representation using array and linked list, Insertion and deletion operations, circular queue, Dequeue, priority queue. Linked Lists & their types.(Single, Double, Circular linked lists), Operations on Varieties of Linked Lists (Search andUpdate) with applications

Module III **7**
Introduction to Trees, Binary tree - definitions and properties; binary tree traversal algorithms with and without recursion., Binary Search Tree - creation, insertion and deletion operations, Threaded tree (One way and Two way). AVL tree balancing; B-tree

Module IV **9**
Graph Algorithms: Graphs and their Representations, Graph Traversal Techniques: Breadth FirstSearch (BFS) and Depth First Search (DFS), Applications of BFS and DFS, Minimum Spanning Trees (MST), Prim's and Kruskal's algorithms for MST, Connected Components, Dijkstra's Algorithm for Single Source Shortest Paths,, Floydd's Algorithm for All-Pairs Shortest Paths Problem

Module V **9**
Hashing techniques, Hash function, Address calculation techniques- common hashing functions Collision resolution, Linear probing, quadratic probing, double hashing, Bucket addressing. Rehashing

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1 Understand the concept of ADT

CO2 Identify data structures suitable to solve problems

CO3 Develop and analyse algorithms for stacks, queues

CO4 Develop algorithms for binary trees and graphs

CO5 Implement sorting and searching algorithms

CO6 Implement symbol table using hashing techniques

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	2	3	--	1	--	1	2	1	3	2	1	3
CO2	1	2	1	2	3	--	--	--	1	1	1	2	2	2	2
CO3	2	3	1	2	3	--	--	--	1	1	1	3	2	1	2
CO4	2	3	1	2	1	--	--	--	1	1	1	2	2	3	1
CO5	1	1	1	2	3	--	1	--	1	1	1	2	2	2	3
CO6	1	2	1	2	2	--	1	--	1	2	1	3	2	2	3
Avg.	1.5	2.3	1	2	2.5	--	1	--	1	1.3	1	2.5	2	1.8	2.3

Text Books:

1. Data Structures Using C – A.M. Tenenbaum (PHI)

2. Introduction to Data Structures with Applications by J. Tremblay and P. G. Sorenson (TMH)

3.Data Structures, Algorithms and Application in C, 2nd Edition, SartajSahni

4. Data Structures and Algorithms in C, M.T. Goodrich, R. Tamassia and D. Mount, WileyIndia.

REFERENCE BOOKS:

1. Data Structure and Program Design in C by C.L. Tondo.

2. Data Structures with C++, J. Hubbard, Schaum's Outlines, TMH.

3. Data Structures and Algorithms in C, M.T. Goodrich, R. Tamassia and D. Mount, WileyIndia.

4. Data Structures and Algorithm Analysis in C, 3rd Edition, M.A. Weiss, Pearson.

5. Classic Data Structures, D. Samanta, 2nd Edition, PHI.

6. Data Structure Using C by Pankaj Kumar Pandey.

7. Data Structure with C, Tata McGraw Hill Education Private Limited by SeymourLipschutz.

8. Data Structure through C in Depth, BPB Publication, by S.K. Srivastava.

9. Data Structure and algorithm Analysis in C 2nd Edition, PEARSON Publishing House, MarkAllen Weiss

2nd Year, IV Semester, UG course Engineering (EEE)

Course code -IT 402
CYBER SECURITY
L T P CR. 3 1 0 3

Module I: **9**

Introduction to Cybercrime: Introduction, Cybercrime, and Information Security, who are Cybercriminals, Classifications of Cybercrimes, and Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.

Module II: **9**

Cyber Offenses: How Criminals Plan Them: Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber Cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

Module III: **9**

Cybercrime : Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies an Measures in Mobile Computing Era, Laptops.

Module – IV: **9**

Tools and Methods Used in Cybercrime : Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

Module V: **9**

Cyber Security: Organizational Implications Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing, and the associated challenges for Organizations.

TEXT BOOK:

• Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and Sunil Belapure, Wiley INDIA.

REFERENCE BOOK:

• Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
• Introduction to Cyber Security ,Chwan-Hwa(john) Wu,J.DavidIrwin.CRC Press T&F Group

2nd Year, IV Semester, UG course Engineering (EEE)

Course code -EN 401
ENGINEERING ECONOMICS
L T P CR. 3 1 0 3

COURSE OUTLINE:

The basic purpose of this course is to provide a sound understanding of concepts and principles of engineering economy and to develop proficiency with methods for making rational decisions regarding problems likely to be encountered in professional practice.

Module -I **12**

Introduction of Engineering Economics and Demand Analysis: Meaning and nature of Economics, Relation between science, engineering, technology and economics; Nature of Economic problem, Production possibility curve, Concepts and measurement of utility, Law of Diminishing Marginal Utility, Law of equi-marginal utility – its practical application and importance. Meaning of Demand, Individual and Market demand schedule, Law of demand, shape of demand curve, Elasticity of demand, measurement of elasticity of demand, practical importance & applications of the concept of elasticity of demand.

Module -II **10**

Meaning of production and factors of production; Law of variable proportions, Returns to scale, Internal and External economics and diseconomies of scale. Various concepts of cost – Fixed cost, variable cost, average cost, marginal cost, money cost, real cost, opportunity cost. Shape of average cost, marginal cost, total cost, Cost curves.

Module III **8**

Meaning of Market, Types of Market – Perfect Competition, Monopoly, Oligopoly, Monopolistic Competition (Main features of these markets) Pricing Policies- Entry Deterring policies, Predatory Pricing, Peak load Pricing. Product Life cycle Firm as an organisation- Objective of the Firm, Type of the Firm, Vertical and Horizontal Integration, Diversification, Mergers and Takeovers.

Module -IV **10**

Nature and characteristics of Indian economy (brief and elementary introduction), Privatization – meaning, merits and demerits. Globalisation of Indian economy – merits and demerits. Elementary Concepts of VAT, WTO, GATT & TRIPS agreement, Business cycle, Inflation

COURSE OUTCOMES:
At the end of the course the student will be able to:

CO1: Upon successful completion of this course, students will acquire the skills to apply the basics of economics and cost analysis to engineering and take economically sound decisions

CO2: Evaluate the economic theories, cost concepts and pricing policies

CO3: Understand the market structures and integration concepts

CO4: Understand the measures of national income, the functions of banks and concepts of globalization

CO5: Apply the concepts of financial management for project appraisal.

CO6: Apply the concept of economics in engineering applications

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	--	3	--	2	--	--		--	--	2	1	3	1	3	--
CO2	--	3	--	2	--	--	--	--	--		1	2	--	2	2
CO3	--	2	--	2	--	--	--	--	--		1	3	--	--	--
CO4	2	3	3	2	2	--	--	--	--		1	2	2	3	--
CO5	3	3	3	2	2	--	--	--	--		1	2	2	--	2
CO6	3	3	3	2	2	--	--	--	--	2	1	2	2	3	2

RECOMMENDED BOOKS:-

1. R.PaneerSeelvan: Engineering Economics, PHI

2. Managerial Economics, D.N.Dwivedi, Vikash Publication

3. Managerial Economics, H.L. Ahuja, S. Chand and Co. Ltd.

4. Managerial Economics, Suma Damodaran, Oxford.

5. R.molrishnd Ro T.V S 'Theory of firms : Economics and Managerial Aspects'. Affiliated East West Press Pvt Ltd New Delhi

6. Managerial Economics, H. Craig Petersen &W. Cris Lewis, Pearson Education.

2nd Year, IV Semester, UG course Engineering (EEE)

Course code -EE 401

POWER SYSTEM I LAB

List of Experiments (Minimum 10)

1. To draw operating characteristics of DMT/IDMT relay.

2. To draw operating characteristics of differential relay.

3. To study Bucholtz Relay.

4. Testing of Transformer oil.

5. To find ABCD Parameters of a model of transmission line.

6. To observe Ferranti effect in a model of transmission line.

7. To study the microcontroller based differential relay for the protection of transformer.

8. To study electromechanical type negative sequence relay.

9. To study electromechanical type over current relay.

10. To study electromechanical type directional over current relay.

11. To study electromechanical type earth fault relay.

12. To determine the string efficiency of suspension type insulators with and without guard ring.

13. To plot Annual / monthly / daily load demand of nearby area.

14. To draw single line diagram of distribution system of JUVNL of nearby area of college concerned.

2nd Year, IV Semester, UG course Engineering (EEE)

Course code -EE 402

MEASUREMENTAND INSTRUMENTATION LAB

List of Experiments (Minimum 10)

1. Calibration of AC voltmeter and AC ammeter.

2. Measurement of inductance using Maxwell's Bridge.

3. Measurement of capacitance using Schering Bridge.

4. Measurement of low resistance using Kelvin's Double Bridge.

5. Measurement of Power using CT and PT.

6. Measuring displacement using LVDT.

7. Measuring temperature using thermocouple.

8. Measuring pressure using piezoelectric pick up.

9. Measurement of speed of DC motor by photoelectric pick up.

10. Speed measurement using Hall Effect sensor.

11. Measurement of a batch of resistors and estimating statistical parameters. Measurement of L using a bridge technique as well as LCR meter.

12. Measurement of C using a bridge technique as well as LCR meter. Measurement of Low Resistance using Kelvin's double bridge.

2nd Year, IV Semester, UG course Engineering (EEE)

Course code -EC302P

DIGITAL ELECTRONICS AND LOGIC DESIGN LAB

List of Experiments (Minimum 10)

1. Study of TTL gates – AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR.

2. Design & realize a given function using K-maps and verify its performance.

3. To verify the operation of multiplexer & Demultiplexer.

4. To verify the operation of comparator.

5. To verify the truth tables of S-R, J-K, T & D type flip flops.

6. To verify the operation of bi-directional shift register.

7. To design & verify the operation of 3-bit synchronous counter.

8. Design all gates using VHDL.

9. Design a multiplexer using VHDL

10. Design a decoder using VHDL

11. Write VHDL programs for the following circuits, check the wave forms and the hardware generated a. half adder b. full adder

12. Write VHDL programs for the following circuits, check the wave forms and the hardware generated a. multiplexer b. demultiplexer

Based on CBCS system & OBE model
Recommended scheme of study (EEE)

Sl. No.	Semester of Study	Category of course	Course Code	Subjects	Mode of delivery & credits *L-Lecture; T-Tutorial; P-Practical*			Total Credits *C- Credits*
				Theory				
1	**Fifth**	Professional Core Courses (PCC)	EEC501	Power System-II	3	1	0	4
2		PCC	EEC502	Control System	2	1	0	3
3		PCC	EEC503	Electrical Machine-II	2	1	0	3
4		PEC		Professional Elective Course -I	2	1	0	3
5		Open Elective Course (OEC)		Open Elective Course I	2	1	0	3
		Total (A) = 16 Credits						
		LABORATORIES						
6		PCC	EE501P	Power System -II Lab	0	0	2	1
7		PCC	EE502P	Control System Lab	0	0	2	1
8		PCC	EE503P	Electrical Machine-II lab	0	0	2	1
9		PCC	EE504P	Electrical and Electronics workshop Lab			2	1
10		PPT presentation	EE505G	Seminar (PPT presentation)	0	0	2	2
Total(B) = 6 Credits **Grand Total (A) + (B) = 22 Credits**								
				Theory				
1	**Sixth**	PCC	EEC601	Power Electronics	3	1	0	4
2		PCC	EEC602	Signals and Systems	2	1	0	3
3		PCC	EEC603	Microprocessors and Microcontroller	2	1	0	3
4		PEC		Professional Elective Course -II	2	1	0	3
5		OEC		Open Elective Course - II	2	1	0	3
		LABORATORIES					**Total (A) = 16 Credits**	
6		PCC	EE601P	Power Electronics Lab	0	0	2	1
7		PCC	EE602P	Signals and Systems Lab	0	0	2	1
8		PCC	EE603P	Microprocessors and Microcontroller Lab	0	0	2	1
9		PCC	EE604P	Electrical Simulation Lab	0	0	2	1
10		Project Work	EE605I	Internship/Tour and Training/Industrial Training	0	0	2	2
		Total(B) = 6 Credits **Grand Total (A) + (B) = 22 Credits** **Grand Total for Third Year = 44 Credits.**						

Professional Electives and Open Electives Courses offered by Department of EEE

Table 1: Professional Electives

Sl. No.	Code	Professional Elective-I (Any one) V SEM	Code	Professional Elective-II (Any one) VI SEM
1	EEP504	Industrial Electrical Systems	EEP604	High Voltage Engineering
2	EEP505	Non-Conventional Energy System	EEP605	Advanced Control Systems
3	EEP506	Power Quality	EEP606	Digital Control Systems

Table 2: Open Electives

Sl. No.	Code	Open Elective-I (Any one) V SEM	Code	Open Elective-II (Any one) VI SEM
1	CSO501	Artificial Intelligence	CSO601	Soft Computing Techniques
2	CSO502	Internet-of-Things	CSO602	Image Processing
3	ECO501	Communication and Networks	EEO607	Power Plant Engineering

3rd Year, V Semester, UG course Engineering (EEE)

Course code -EEC 501

POWER SYSTEMS-II

L T P CR. 3 1 0 4

COURSE OBJECTIVES:

- Impact knowledge on need for operational studies, and to model the power system under steadystate operating condition.
- To understand and apply iterative techniques for power flow analysis.
- To model of carry out short circuit studies for power system during symmetrical fault.
- To model of carry out short circuit – studies during
- To study about the various methods for analyzing power system stability

Module I POWER SYSTEM **8**

Need for system planning and operational studies - Power scenario in India - Power system components, Representation - Single line diagram - per Module quantities - p.u. impedance diagram - p.u. reactance diagram, Network graph Theory - Bus incidence matrices, Primitive parameters, Formation of bus admittance matrix – Direct inspection method – Singular Transformation method.

Module II POWER FLOW ANALYSIS **8**

Bus classification - Formulation of Power Flow problem in polar coordinates - Power flow solution using Gauss Seidel method - Handling of Voltage controlled buses - Power Flow Solution by Newton Raphson method – Flow charts – Comparison of methods.

Module III SYMMETRICAL FAULT ANALYSIS **8**

Assumptions in short circuit analysis - Symmetrical short circuit analysis using Thevenin's theorem - Bus Impedance matrix building algorithm (without mutual coupling) - Symmetrical fault analysis through bus impedance matrix - Post fault bus voltages - Fault level - Current limiting reactors.

Module IV UNSYMMETRICAL FAULT ANALYSIS **8**

Symmetrical components - Sequence impedances - Sequence networks - Analysis of unsymmetrical faults at generator terminals: LG, LL and LLG - unsymmetrical fault occurring at any point in a power system.

Module V STABILITY ANALYSIS **8**

Classification of power system stability – Rotor angle stability - Power-Angle equation – Steady state stability - Swing equation – Solution of swing equation by step by step method - Swing curve, Equal area criterion - Critical clearing angle and time, Multi-machine stability analysis – modified Euler method.

Module VI ECONOMIC OPERATION OF POWER SYSTEMS **6**

Input-output characteristics of thermal and hydro plants, Optimum generator allocations without and with transmission losses, calculation of penalty factors, incremental transmission loss, transmission loss coefficients and their calculations.

COURSE OUTCOMES:

Upon the successful completion of the course, students should have the:

CO1: Ability to model the power system under steady state operating condition.

CO2: Ability to carry out power flow analysis using.

CO3: Ability to infer the significance of short circuit studies in designing circuit breakers.

CO4: Ability to analyze the state of the power system for various unsymmetrical faults.

CO5: Ability to analyze the stability of power system using different methods.

CO6: design and implementation of power system model.

MAPPING OF COs WITH POs AND PSOs

COs	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	--	--	--	1	--	--	--	1	--	2
CO2	3	3	3	2	1	--	--	--	1	--	--	--	1	1	1
CO3	3	3	3	2	1	--	--	--	1	--	--	1	1	1	1
CO4	3	2	2	2	1	--	--	--	1	--	--	1	1	1	2
CO5	3	3	2	2	2	--	--	--	1	--	--	1	1	1	1
CO6	3	3	3	2	2	--	--	--	1	--	--	1	1	1	1

TEXT BOOKS:

1. John J. Grainger, William D. Stevenson, Jr, 'Power System Analysis', Mc Graw Hill Education (India) Private Limited, New Delhi, 2017.

2. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw-Hill Education, 3rd edition 2019.

3. Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.

REFERENCES

1. Pai M A, 'Computer Techniques in Power System Analysis', Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2007.

2. J. Duncan Glover, MulukutlaS.Sarma, Thomas J. Overbye, 'Power System Analysis & Design', Cengage Learning, Fifth Edition, 2012.

3. P. Venkatesh, B. V. Manikandan, A. Srinivasan, S. Charles Raja, "Electrical Power Systems: Analysis, Security and Deregulation" Prentice Hall India (PHI), second edition - 2017

4. Gupta B.R., 'Power System - Analysis and Design', S. Chand Publishing, Reissue edition 2005.

5. Kundur P., 'Power System Stability and Control', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2013

3rd Year, V Semester, UG course Engineering (EEE)

Course code -EEC 502

CONTROL SYSTEMS

L T P CR. 2 1 0 3

COURSE OBJECTIVES:

- To make the students to familiarize with various representations of systems.
- To make the students to analyze the stability of linear systems in the time domain and frequency domain.
- To make the students to analyze the stability of linear systems in the frequency domain.
- To make the students to design compensator based on the time and frequency domain specifications.
- To develop linear models: mainly state variable model and Transfer function model

Module I 8

Concepts of system, open loop and closed loop systems, Benefits of Feedback, Mathematical modelling and representation of physical systems, analogous systems. Transfer functions for different types of systems, block diagrams; Signal flow graphs and Mason‟s gain formula.

Module II 12

Time domain performance criterion, transient response of first order, second order systems; Steady state errors: static and dynamic error constants, system types, steady state errors for Moduley and non-Moduley feedback systems, performance analysis for P, PI and PID controllers. Concept of stability by Routh stability criterion, root-loci and root contours.

Module III 8

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.

Module IV 6

Compensation - lag, lead and lag-lead networks, design of compensation networks using time response and frequency response of the system.

Module V 6

Concepts of state, state variables, state variable representation of system, dynamic equations, merits for higher order differential equations and solution. Concept of controllability and observability and techniques to test them.

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO1: Represent simple systems in transfer function and state variable forms.

CO2: Analyze simple systems in time domain.

CO3: Analyze simple systems in frequency domain.

CO4: Infer the stability of systems in time and frequency domain.

CO5: Interpret characteristics of the system and find out solution for simple control problems.

CO6: Design and development of control system for various engineering problems

MAPPING OF COs WITH POs AND PSOs

COs	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	--	--	1	--	--	--	3	3	3	3
CO2	3	3	3	3	3	--	--	1	--	--	--	3	3	3	3
CO3	3	3	3	3	3	--	--	1	--	--	--	3	3	3	3
CO4	3	3	3	3	3	--	--	1	--	--	--	3	3	3	3
CO5	3	3	3	3	3	--	--	1	--	--	--	3	3	3	3
CO6	3	3	3	3	3	--	--	1	--	--	--	3	3	3	3

TEXT BOOKS:

1. Benjamin C. Kuo, “Automatic Control Systems”, 7th edition PHI Learning Private Ltd, 2010.

2. Nagarath, I.J. and Gopal, M., “Control Systems Engineering”, New Age International Publishers 2010.

REFERENCES:

1. Richard C.Dorf and Bishop, R.H., “Modern Control Systems”, Education Pearson, 3 Impression 2009.

2. John J.D., Azzo Constantine, H. and HoupisSttuart, N Sheldon, “Linear Control System Analysis and Design with MATLAB”, CRC Taylor& Francis Reprint 2009.

3. Katsuhiko Ogata, “Modern Control Engineering”, PHI Learning Private Ltd, 5thEdition, 2010 4. NPTEL Video Lecture Notes on “Control Engineering” by Prof.S.D.Agashe, IIT Bombay.

3rdYear, V Semester, UG course Engineering (EEE)

Course code -EEC 503

ELECTRICAL MACHINES-II

L T P CR. 2 1 0 3

COURSE OBJECTIVES:

To impart knowledge on the following Topics

- Construction and performance of salient and non – salient type synchronous generators.
- Principle of operation and performance of synchronous motor.
- Construction, principle of operation and performance of induction machines.
- Starting and speed control of three-phase induction motors.
- Construction, principle of operation and performance of single phase induction motors and special machines.

Module I: Fundamentals of A.C. Machines **8**

Fundamental principles of A.C. machines: E.M.F equation of an elementary alternator, single & three phase, factors affecting the induced e.m.f, full pitch & fractional pitch windings, winding factors, armature reaction, concept of time phasor & space phasor.

Module-II: Synchronous Generator **14**

Various types and construction, cylindrical rotor theory, phasor diagram, open circuit & short circuit characteristics, armature reaction, synchronous reactance, SCR, load characteristics, potier reactance, voltage regulation, E.M.F. method, MMF method, ZPF method, power angle characteristics. Theory of salient pole machine: Bonduel's two reaction theory, phasor diagram, direct axis and quadrature axis synchronous reactance, power angle characteristics, slip test, parallel operation: Synchronizing method, effect of wrong synchronization, load sharing between alternators in parallel, transient & sub-transient reactance.

Module-III: Synchronous motor **8**

General physical consideration, torque & power relations in salient and non-salient pole motors, V-curves & inverted V-curves, effect of change of excitation, synchronous condenser, stating of synchronous motor, performance characteristics of synchronous motor, hunting.

Module-IV: Single phase Induction motors **7**

Induction type, Double revolving field theory, equivalent circuit, characteristics & starting of single phase motor, shaded pole machine, synchronous type, hysteresis motor, reluctance motor.

Module V: Single phase special type of machines **3**

Switched reluctance motor, PMBLDC motor, tachometer, two phase control motor, Synchro

COURSE OUTCOMES:

Upon the successful completion of the course, students will have the:

CO1: Ability to understand the construction and working principle of Synchronous generator

CO2: Ability to understand the construction and working principle of Synchronous Motor

CO3: Ability to understand the construction and working principle of Three Phase Induction Motor

CO4: Acquire knowledge about the starting and speed control of induction motors.

CO5: To gain knowledge about the basic principles and working of Single phase induction motors and Special Electrical Machines.

CO6: Design and development of basic electrical machine

MAPPING OF COs WITH POs AND PSOs

COs	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	--	--	1	--	--	--	--	3	3	2
CO2	3	3	2	3	3	--	--	1	--	--	--	--	3	3	2
CO3	3	3	2	3	3	--	--	1	--	--	--	--	3	3	2
CO4	3	3	1	1	2	--	--	1	--	--	--	--	3	3	2
CO5	3	3	1	1	2	--	--	1	--	--	--	--	3	3	2
CO6	3	3	2	2	3	--	--	1	--	--	--	--	3	3	2

Text Books:

1.Electric Machines by I.J.Nagrath&D.P.Kothari,Tata Mc Graw Hill, 7th Edition.2005

2 Electrical machines by PS Bhimbra, Khanna Publishers.

3 Electric machinery by A.E. Fitzgerald, C.Kingsley and S.Umans, Mc Graw Hill Companies, 5th edition.

4.Electric Machinery Fundamentals by Stephen Chapman Mc Graw Hill Company.

Reference Books:

1 Theory of Alternating Current Machinery- by Langsdorf, Tata McGraw-Hill Companies, 2nd edition.

2 Performance and Design of AC Machines by M G. Say, BPB Publishers.

3rdYear, V Semester, UG course Engineering (EEE)
Professional Elective Course –I (ANY ONE)
Course code -EEP 504
INDUSTRIAL ELECTRICAL SYSTEMS
L T P CR. 2 1 0 3

COURSE OBJECTIVES:

To impart knowledge on,

- The significance of Industrial Electrical system operation and control.
- To give basic knowledge on residential, and commercial wiring systems.
- To understand the different applications like illumination
- To give a comprehensive idea on DG system, UPS, Electric traction and Industrial electrical systems
- SCADA and its application for real time operation and control of power systems.

Module I: Electrical System Components **10**

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.

Module II: Residential and Commercial Electrical Systems **8**

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 andprotection devices, earthing system calculations, requirements of commercial installation,deciding lighting scheme and number of lamps, earthing of commercial installation, selectionand sizing of components

Module III: Illumination Systems **6**

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 andtheir operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting.

Module IV: Industrial Electrical Systems I **8**

HT connection, industrial substation, Transformer selection, Industrial loads, motors, startingof 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.

Module V: Industrial Electrical Systems II **8**

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

COURSE OUTCOME:

After completion of the course the student will able to

CO1: Understand the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and single line drawings.

CO2: Understand various components of industrial electrical systems.

CO3: Analyse and select the proper size of various electrical system components.

CO4: Maintain/Troubleshoot various lamps and fitting in use

CO5: Design illumination systems for various applications

CO6:Work in the area of UPS systems and traction systems production, commissioning and maintenance

MAPPING OF COs WITH POs AND PSOs

COs	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	--	--	--	--	1	--	--	--	1	2	3	1
CO2	3	3	3	--	--	--	--	1	--	--	--	1	2	3	1
CO3	3	3	3	3	2	--	--	1	--	--	--	1	2	3	1
CO4	3	3	3	1	2	--	--	1	--	--	--	1	2	3	1
CO5	3	3	3	1	2	--	--	1	--	--	--	1	2	3	1
CO6	3	3	3	1	2	--	--					1	2		1

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”, Dhanpat Rai and Co., 1997.
4 H. Joshi, “Residential Commercial and Industrial Systems”, McGraw Hill Education, 2008.

3rdYear, V Semester, UG course Engineering (EEE)
Professional Elective Course –I

Course code -EEP 505

NON-CONVENTIONAL ENERGY SYSTEM

L T P CR. 2 1 0 3

COURSE OBJECTIVES:

- To learn the various types of renewable sources of energy.
- To understand the electrical machines to be used for wind energy conversion systems.
- To learn the principles of power converters used in solar PV system.
- To study the principle of power converters used in Wind system.

Module I: Introduction **6**

Basics of energy, conventional energy sources, fossil fuels limitations, renewable energy sources, advantages and limitations, global energy scenario, energy scenario of India, new technologies (hydrogen energy, fuel cells, bio fuels).

Module II: Solar Energy **12**

Theory of solar cells, solar cell materials, I-V characteristics of solar cell, PV module, PV array, MPPT, PV systems, Stand alone and grid connected PV systems, storage, PV based water pumping, solar radiation and its measurement, flat plate collectors and their materials, applications and performance, solar thermal power plants, limitations.

Module III: Wind Energy **8**

Wind power and its sources, site selection, power in the wind, impact of tower height, classification of wind turbine and rotors, wind energy extraction, betz's limit, wind characteristics, performance and limitations of wind energy conversion systems.

Module IV: Biomass and Geothermal energy **8**

Availability of biomass and its conversion theory, types of biomass, gasification, biogas plant, biomass cogeneration, resources of geothermal energy, thermodynamics of geo-thermalenergy conversion, geothermal power generation, environmental considerations.

Module V: Emerging technologies for power generation **6**

Introduction to tidal energy, tidal characteristics, tidal power plant, tidal power development in India, introduction to wave energy, factors affecting wave energy, principles of wave energy plant, OTEC, applications of OTEC, principle of working of various types of fuel cells and their working, performance and limitations, future potential of fuel cells, Emergenceof hydrogen, cost analysis of hydrogen production, hydrogen storage.

COURSE OUTCOME:

CO1: Identify different non-conventional energy system and explain the principle of thermo-electrical and thermionic conversions

CO2: Analyse the performance and limitations of the solar and wind energy conversion system

CO3: Illustrate the concept of geothermal energy.

CO4: Outline the basics of fuel cells.

CO5: Understand the principles behind the bio-mass, ocean thermal and wave energy conversions.

CO6: Examine the available renewable energy sources

MAPPING OF COs WITH POs AND PSOs

COs	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	--	1	1	--	1	--	--	--	--	1	2	3	1
CO2	3	2	2	2	1	--	1	--	--	--	--	1	2	3	1
CO3	1	1	--	1	1	--	1	--	--	--	--	1	2	3	1
CO4	2	1	1	1	1	--	1	--	--	--	--	1	2	3	1
CO5	2	1	1	1	1	--	1	--	--	--	--	1	2	3	1
CO6	3	1	1	1	1	--	1	--				1	2	3	1

Text/Reference Books:

1 Duffie and Beckmen, Solar Engineering of Thermal Processes, Wiley Publications,1991.

2 S. P. Sukhatme, Solar Energy, TMH, India. 2008.

3 John Twiden and Tony Weir, Renewable Energy Resources, BSP Publications, 2006.

4 D. P. Kothari, Rakesh Ranjan, Renewable Energy Sources and EmergingTechnologies, PHI, India, 2011.

5 Non Conventional Energy Resources, D.S. Chauhan, New Age International Pvt Ltd.,2006.

3rdYear, V Semester, UG course Engineering (EEE)
Professional Elective Course –I
Course code -EEP 506
POWER QUALITY

L T P CR. 2 1 0 3

COURSE OBJECTIVES:

- To learn the basic definitions in Power Quality.
- To study the power quality issues in Single Phase and Three Phase Systems.
- To understand the principles of Power System Harmonics.
- To know the way to use DSTATCOM for Harmonic Mitigation.
- To learn the concepts related with Series Compensation.

Module I INTRODUCTION **9**

Introduction – 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: poor load power factor, Non-linear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage – Power quality standards.

ModuleII ANALYSIS OF SINGLE PHASE AND THREE PHASE SYSTEM **9**

Single phase linear and non-linear loads – single phase sinusoidal, non-sinusoidal source – supplying linear and nonlinear loads – three phase balanced system – three phase unbalanced system – three phase unbalanced and distorted source supplying non-linear loads – concept of power factor – three phase- three wire – three phase - four wire system.

ModuleIII MITIGATION OF POWER SYSTEM HARMONICS **9**

Introduction - Principle of Harmonic Filters – Series-Tuned Filters – Double Band-Pass Filters – damped Filters – Detuned Filters – Active Filters – Power Converters – Harmonic Filter Design – Tuned Filter – Second-Order Damped Filter – Impedance Plots for Filter Banks – Impedance Plots for a Three-Branch 33 kV Filter.

ModuleIV LOAD COMPENSATION USING DSTATCOM **9**

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.

ModuleV SERIES COMPENSATION OF POWER DISTRIBUTION SYSTEM **9**

Rectifier supported DVR – DC Capacitor supported DVR – DVR Structure – Voltage Restoration – Series Active Filter – Unified Power Quality Conditioner.

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1: Use various definitions of power quality for power quality issues

CO2: Describe the concepts related with single phase / three phase, linear / nonlinear loads and single phase / three phase sinusoidal, non-sinusoidal source

CO3: Solve problems related with mitigation of Power System Harmonics

CO4: Use DSTATCOM for load compensation

CO5: Demonstrate the role of DVR, SAFs UPQC in power distribution systems

CO6: Application in power system design problems

MAPPING OF COs WITH POs AND PSOs

COs	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	--	3	3	--	3	--	3	3	3	3
CO2	3	3	3	3	1	--	3	3	--	3	--	3	3	3	3
CO3	3	3	3	3	1	--	3	3	--	3	--	3	3	3	3
CO4	3	3	3	3	1	--	3	3	--	3	--	3	3	3	3
CO5	3	3	3	3	1	--	3	3	--	3	--	3	3	3	3
CO6	3	3	3	3	1	--	3	3	--	3	--	3	3	3	3

TEXTBOOKS:

1. Arindam Ghosh and GeradLedwich “Power Quality Enhancement Using Custom Power Devices”, Kluwer Academic Publishers, First Edition,2002

2. G.T.Heydt, “Electric Power Quality”, Stars in a Circle Publications, Second Edition, 2011.

3. George J. Wakileh, “Power System Harmonics – Fundamentals, Analysis and Filter Design”, Springer – Verlag Berlin Heidelberg, New York, 2019.

REFERENCES:

1. R.C.Duggan “Electric Power Systems Quality”, Tata MC Graw Hill Publishers, Third Edition, 2012.

2. Arrillga “Power System Harmonics”, John Wiely and Sons, 2003 2nd Edition.

3. Derek A.Paice “Power Electronic Converter Harmonics” IEEE Press, 1995, Wiley – IEE Press 1999, 18th Edition.

3rd Year, V Semester, UG course Engineering (EEE)
Open Elective Course –I (ANY ONE)

Course code -CSO 501

ARTIFICIAL INTELLIGENCE

L T P CR. 2 1 0 3

OBJECTIVES:

The main objectives of this course are to:

1. Understand the importance, principles, and search methods of AI
2. Provide knowledge on predicate logic and Prolog.
3. Introduce machine learning fundamentals

Module I INTELLIGENT AGENT AND UNINFORMED SEARCH 6

Introduction - Foundations of AI - History of AI - The state of the art - Risks and Benefits of AI - Intelligent Agents - Nature of Environment - Structure of Agent - Problem Solving Agents - Formulating Problems - Uninformed Search - Breadth First Search - Dijkstra's algorithm or uniform-cost search - Depth First Search - Depth Limited Search

Module II: 9

Programming, Commands and Syntax, Packages and Libraries, Introduction to Data Types, Data Structures in R - Vectors, Matrices, Arrays, Lists, Factors, Data Frames, Importing and Exporting Data. Control structures and Functions, Descriptive Statistics, Data exploration (histograms, bar chart, box plot, line graph, scatter plot), Qualitative and Quantitative Data, Measure of Central Tendency (Mean, Median and Mode), Measure of Positions (Quartiles, Deciles, Percentiles and Quantiles), Measure of Dispersion (Range, Median, Absolute deviation about median, Variance and Standard deviation), Anscombe's quartet Other Measures: Quartile and Percentile, Interquartile Range

Module III: 8

Initial Data Analysis, Relationship between attributes: Covariance, Correlation Coefficient, hi Square, Measure of Distribution (Skewness and Kurtosis), Box and Whisker Plot (Box Plot and its parts, Using Box Plots to compare distribution) and other statistical graphs Probability, Probability (Joint, marginal and conditional probabilities), Probability distributions (Continuous and Discrete), Density Functions and Cumulative functions

Module IV: 8

Gather information from different sources. Internal systems and External systems. Web APIs, Open Data Sources, Data APIs, Web Scrapping, Relational Database access (queries) to

process/access data Data Pre-processing and Preparation, Data Munging, Wrangling Ÿ Plyr packages, Cast/Melt

Module V: **8**

Data Quality and Transformation, Data imputation, Data Transformation (minmax, log transform, z-score transform etc.). Binning, Classing and Standardization. Outlier/Noise& Anomalies Bag-of-words, Regular Expressions, Sentence Splitting and Tokenization, Punctuations and Stop words, Incorrect spellings, Properties of words and Word cloud, Lemmatization and Term-Document TxD computation, Sentiment Analysis (Case Study)

Module VI PROBLEM SOLVING WITH SEARCH TECHNIQUES **6**

Informed Search - Greedy Best First - A* algorithm - Adversarial Game and Search - Game theory - Optimal decisions in game - Min Max Search algorithm - Alpha-beta pruning - Constraint Satisfaction Problems (CSP) - Examples - Map Coloring - Job Scheduling - Backtracking Search for CSP

COURSE OUTCOMES:

CO1: Understand the foundations of AI and the structure of Intelligent Agents

CO2: Use appropriate search algorithms for any AI problem

CO3 To understand the various Programming, Commands and Syntax.

CO4 Understand initial Data Analysis, Relationship between attributes: Covariance, Correlation Coefficient

CO5 Understand Data Pre-processing and Preparation.

CO6 Understand Data Quality and Transformation

MAPPING OF COs WITH POs AND PSOs

COs	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	--	2	1	--	3	--	2	3	3	3
CO2	3	3	2	3	1	--	2	1	--	3	--	2	3	3	3
CO3	3	3	3	2	1	--	2	1	--	3	--	2	3	3	3
CO4	3	3	2	3	1	--	2	1	--	3	--	2	3	3	3
CO5	3	3	3	2	1	--	2	1	--	3	--	2	3	3	3
CO6	3	3	2	2			2	1				2	3	3	3

TEXT BOOK

1. S. Russell and P. Norvig, “Artificial Intelligence: A Modern Approach”, Prentice Hall, Fourth Edition, 2021

2. S.N.Sivanandam and S.N.Deepa, Principles of soft computing-Wiley India.3 rd ed,

3. Ginsberg, M., Essentials of Artificial Intelligence. Palo Alto, CA: Morgan Kaufmann (1993).

4. Luger, G. F., & Stubblefield, W. A., Artificial Intelligence - Structures and Strategies for Complex Problem Solving. New York, NY: Addison Wesley, 5th edition (2005).

5. Poole, D., Mackworth, A., and Goebel, R. Computational Intelligence - A Logical Approach. New York: Oxford University Press. (1998).

6. Nilsson, N. J. Artificial Intelligence - A Modern Synthesis. Palo Alto: Morgan Kaufmann. (1998).

3rd Year, V Semester, UG course Engineering (EEE)
Open Elective Course –I

Course code -ITO 502

INTERNET-OF-THINGS

L T P CR. 2 1 0 3

COURSE OBJECTIVES:

- To apprise students with basic knowledge of IoT that paves a platform to understand physical and logical design of IoT
- To teach a student how to analyse requirements of various communication models and protocols for cost-effective design of IoT applications on different IoT platforms.
- To introduce the technologies behind Internet of Things(IoT).
- To explain the students how to code for an IoT application using Arduino/Raspberry Pi open platform.
- To apply the concept of Internet of Things in real world scenario.

Module I INTRODUCTION TO INTERNET OF THINGS 8

Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT Models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT

Module II COMPONENTS IN INTERNET OF THINGS 8

Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Control Modules - Communication modules (Bluetooth, Zigbee,Wifi, GPS, GSM Modules)

Module III PROTOCOLS AND TECHNOLOGIES BEHIND IOT 8

IOT Protocols - IPv6, 6LoWPAN, MQTT, CoAP - RFID, Wireless Sensor Networks, BigData Analytics, Cloud Computing, Embedded Systems.

Module IV OPEN PLATFORMS AND PROGRAMMING 8

IOT deployment for Raspberry Pi /Arduino platform-Architecture –Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.

Module V IOT APPLICATIONS 8

Business models for the internet of things, Smart city, Smart mobility and transport, Industrial IoT, Smart health, Environment monitoring and surveillance – Home Automation – Smart Agriculture

COURSE OUTCOMES:

CO1: Explain the concept of IoT.

CO2: Understand the communication models and various protocols for IoT.

CO3: Design portable IoT using Arduino/Raspberry Pi /open platform

CO4: Apply data analytics and use cloud offerings related to IoT.

CO5: Analyze applications of IoT in real time scenario.

CO6: Design and implementation of IoT system in electrical engineering system

MAPPING OF COs WITH POs AND PSOs

COs	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	2	2	1	--	--	--	2	3	3	3
CO2	3	3	2	3	3	2	2	1	--	--	--	2	3	3	3
CO3	3	3	3	2	3	2	2	1	--	--	--	2	3	3	3
CO4	3	3	2	3	3	2	2	1	--	--	--	2	3	3	3
CO5	3	3	3	2	3	2	2	1	--	--	--	2	3	3	3
CO6	3	3	3	3	3	2	2	1	--	--	--	2	3	3	3

TEXTBOOKS

1. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, CISCO Press, 2017

2. Samuel Greengard, The Internet of Things, The MIT Press, 2015

REFERENCES

1. Perry Lea, “Internet of things for architects”, Packt, 2018

2. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012

3. IOT (Internet of Things) Programming: A Simple and Fast Way of Learning, IOT Kindle Edition.

4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.

5. ArshdeepBahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015

6. https://www.arduino.cc/ https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet

3rdYear, V Semester, UG course Engineering (EEE)
Open Elective Course –I
Course code -ECO 503
COMMUNICATION ENGINEERING
L T P CR. 2 1 0 3

Course Objectives:

- To develop ability to analyze system requirements of analog and digital communication systems.
- To understand the generation, detection of various analog and digital modulation techniques.
- To acquire theoretical knowledge of each block in AM, FM transmitters and receivers.
- To understand the concepts of baseband transmissions.

Module – I: **8**

Review of Fourier transform and Fourier series.

Amplitude modulation: Frequency domain representation of signals, Need of Modulation, normal AM, modulation index, Generation and demodulation- envelop and synchronous detector, DSB-SC: Generation and demodulation, SSB: Generation and Demodulation, Concept of VSB modulation, Frequency Division multiplexing.

Module – II: Angle Modulation **7**

Representation of FM and PM signals, Spectral characteristics of angle modulated signals, frequency deviation and modulation index, Narrowband FM, Generation of wideband FMArmstrong method, Direct method, Demodulation of WBFM using PLL.

Module - III: Noise **6**

Review of probability and random process, Type of Noise, Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and De-emphasis, Threshold effect in angle modulation.

Module– IV: Pulse modulation **9**

Sampling Theorem, Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM) - their generation and detection, Time Division Multiplexing. Digital communication: Pulse code modulation (PCM), Differential pulse code modulation (DPCM), Delta modulation, Noise considerations in PCM, Digital Modulation – ASK, BPSK, BFSK.

Module – V: Optical communication: **10**

Types of optical fibers - step index and graded index, multimode and single mode; Attenuation and Dispersion in fibers; Optical transmitters – LEDs and Laser Diode; Optical Receivers- PIN and APDs, Fiber optic links.

Microwave communication: Transmitter and Receiver antennas, Line of Sight Systems, Satellite Link-G/T Ratio of earth station, VSATS and GPSS, TDMA, FDMA, CDMA.

Course Outcomes:

Upon completing this course, the student will be able to
CO1: Analyze and design of various continuous wave and angle modulation and demodulation techniques.
CO2: Understand the effect of noise present in continuous wave and angle modulation techniques.
CO3: Attain the knowledge about AM, FM Transmitters and Receivers
CO4: Analyze and design the various Pulse Modulation Techniques.
CO5: Understand the concepts of Digital Modulation Techniques and Baseband transmission.
CO6: Design and implementation of modulation techniques.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO3
CO1	3	3	3	2	1	--		1	--	--	--	2	--	1	--
CO2	3	3	2	3	1	--		1	--	--	--	2	1	--	--
CO3	3	3	3	2	2	--		1	--	--	--	2	1	--	--
CO4	3	3	2	3	2	--		1	--	--	--	2	--	--	1
CO5	3	3	3	2	2	--		1	--	--	--	2	--	1	1
CO6	3	3	3	3	2	--		1	--	--	--	2	1	1	1

Text/Reference Books:

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
3. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill, 2001.
4. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering",John Wiley, 1965.
5. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004.
6. Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000.
7. Keiser Gerd, " OpticalFiber Communication", 2 nd Edition, McGraw Hill, 1991. 8. Liao, "Microwave Devices and circuits", prentice Hall of India.

3rdYear, V Semester, UG course Engineering (EEE)

Course code -EE501P

POWER SYSTEMS-II Lab

COURSE OBJECTIVES:

1 To provide a better understanding of modelling of transmission lines in impedance and admittance forms.
2 To apply iterative techniques for power flow analysis and to carry out short circuit and stability studies on power system.
3 To analyze the load – frequency and voltage controls.
4 To analyze optimal dispatch of generators and perform state estimation.
5 To understand the operation of relays, characteristics, and applications.

List of Experiments (Any Ten)

1. To obtain the DC Transmission line characteristics in different load resistance.
2. To obtain the correct phase sequence of three phase system.
3. To improvement of power factor control mechanism using APFC-relay kit.
4. Determination of positive, negative and zero-sequence reactance of 3-phase transformer usingsequence current excitation fault calculation.
5. To study three different transmission line models.
6. Study of different types of insulators.
7. To measurement of Earth Resistance using Earth Tester.
8. Study of different types of Earthing.
9. Study on (i) on load Time Delay Relay (ii) off load Time Delay Relay.
10. Polarity, Ratio and Magnetisation Characteristics Test of CT & PT.
11. Testing on (i) Under Voltage Relay and (ii) Earth Fault Relay.
12. Study on D C Load Flow.
13. Study of A C Load Flow Using Gauss – Seidel Method.
14. Study of A C Load Flow Using Newton Raphson Method.
15. Study on Economic Load Dispatch.
16. Study of Generator Protection by Simulation.

COURSE OUTCOMES:

On the successful completion of the laboratory, students will be able to:

CO1: Model and analyze the performance of the transmission lines.

CO2: Perform power flow, short circuit, and stability analysis for any power system network.

CO3: Understand, design, and analyze the load frequency control mechanism.

CO4: Perform optimal scheduling of generators and compute the state of the power system.

CO5: Understand, analyze, and apply the relays for power system protection.

3rdYear, V Semester, UG course Engineering (EEE)

Course code -EE502P

CONTROL SYSTEM LAB

COURSE OBJECTIVES:

- To make the students familiarize with various representations of systems.
- To make the students analyze the stability of linear systems in the time domain and frequency domain.
- To make the students design compensator based on the time and frequency domain Specifications. • To develop linear models mainly state variable model and transfer function model
- To make the students to design a complete closed loop control system for the physical systems.

List of Experiments (Any Ten)

1. To study and perform the synchro transmitter and receiver system as an indicating instrument.
2. To study the performance of stepper motor in (a) Wave drive mode (b) Full wave mode (c) Half wave mode
3. Demonstration of Pneumatic trainer kit.
4. Demonstration of Single and Double Acting Cylinder using Pneumatic Trainer Kit.
5. To study the "Proportional- Integral-Derivative (PID)" control for a temperature process controller using process control software.
6. To study the DC Servo Motor position control system.
7. To study the operation of a Proportional, Proportional-Integral (PI) ProportionalDerivative (PD) and Proportional- Integral-Derivative (PID) control systems.
8. To study the "Proportional-Integral-Derivative (PID)" control action for a using Matlab Simulink Software.
9. Study the effect of PI & PD controller on system performance.
10. VFD based Speed Control of Three Phase Induction Motor Using PLC.
11. Study of a DC Speed control system and determination of transfer function of a permanent magnet dc motor.
12. Study of a two-phase AC servomotor and its transfer function parameters.
13. Find the frequency response of a Lag and Lead compensator.
14. To observe the time response of a second order process with P, P+I, P+I+D control and apply PID control to a DC servomotor.
15. To study the characteristic of a relay and analyse the relay control system (Phase Plane).
16. Study of a DC position control system

COURSE OUTCOMES:

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

CO1: To model and analyze simple physical systems and simulate the performance in analog and digital platform.

CO2: To design and implement simple controllers in standard forms.

CO3: To design compensators based on time and frequency domain specifications.

CO4: To design a complete closed control loop and evaluate its performance for simple physical systems.

CO5: To analyze the stability of a physical system in both continuous and discrete domains.

3rdYear, V Semester, UG course Engineering (EEE)

Course code -EE503P

ELECTRICAL MACHINE-II LAB

COURSE OBJECTIVES:

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

List of Experiments (Any Ten)

1. To plot the "V" and inverted "Λ" curves of Synchronous motor.
2. To conduct the direct load test on the given three phase induction motor to determine and plot its performance characteristics.
3. To determine the equivalent circuit parameters of a single phase induction motor by performing the no- load and blocked rotor tests.
4. To conduct the direct load test on the given single phase induction motor and to determine and plot its performance characteristics.
5. To Study The Synchronization Of Alternator With Infinite Bus By Bright Lamp Method.
6. To study about the various types of AC starters.
7. Brake Test on Slip Ring Induction Motor.
8. No-load and block rotor tests on squirrel cage induction motor.
9. Equivalent circuit of single phase induction motor.
10. Regulation of alternator by synchronous impedance method and MMF method.
11. Regulation of alternator by Zero Power Factor method.
12. Determination of Xd and Xq of a salient pole synchronous machine from slip test.
13. Determination of sub-transient reactance of Salient Pole Synchronous Machine.
14. Determination of sequence impedances of Salient Pole Synchronous Machine.
15. Rotor resistance starter for slip ring induction motor.
16. Parallel operation of Alternators.

COURSE OUTCOMES:

At the end of the course, the student should have the:

CO1: Ability to understand and analyze EMF and MMF methods

CO2: Ability to analyze the characteristics of V and Inverted V curves

CO3: Acquire hands on experience of conducting various tests on alternators and obtaining their performance indices using standard analytical as well as graphical methods. to understand the importance of Synchronous machines

CO4: Acquire hands on experience of conducting various tests on induction motors and obtaining their performance indices using standard analytical as well as graphical methods. to understand the importance of single and three phase Induction motors

CO5: Ability to acquire knowledge on separation of losses

3rdYear, V Semester, UG course Engineering (EEE)

Course code -EE504P

ELECTRICAL AND ELECTRONICS WORKSHOP LAB

List of Experiments (Any Ten)

1. To understand & draw the symbols of various electronic devices and to identify resistors, capacitors using different codes.

2. Verification of truth tables of logic gates (NAND, NOR, EX-OR, AND, OR, NOT).

3. To study cathode ray oscilloscope and perform measurements.

4. To study digital multi-meter and perform testing of various components.

5. To study function generator & power supply and perform measurements.

6. To study soldering- de-soldering techniques.

7. To study wiring diagram of ceiling fan.

8. How fluorescent lights work.

9. To study about stair case wiring two way switch.

10. To study half – wave rectifier.

11. To study stair case wiring and circuit of SMPS.

12. To study house wiring i.e, BATTEN, CLEAT, CASING-CAPING AND CONDUIT WIRINGS.

13. To study moving iron, moving coil, electro-dynamic and induction type meter.

14. To study circuit and working of UPS

15. To study circuit and working of home inverter

16. To study fuses MCBS and importance of earthing.

3rdYear, VI Semester, UG course Engineering (EEE)

Course code – EEC601

POWER ELECTRONICS

L T P CR 3 1 0 4

COURSE OBJECTIVES:

- To understand the various applications of power electronic devices for conversion, control and conditioning of the electrical power and to get an overview of different types of power semiconductor devices and their dynamic characteristics.
- To understand the operation, characteristics and performance parameters of controlled rectifiers
- To study the operation, switching techniques and basic topologies of DC-DC switching regulators.
- To learn the different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
- To study the operation of AC voltage controller and various configurations of AC voltage controller.

Module I: Power Semiconductor Devices **6**

Diode, Thyristor, MOSFET, IGBT, GTO: constructional features, I-V Characteristics; Firing circuit for thyristor; protection of thyristor and gate drive circuit, Turn on techniques, Voltage and current commutation of a thyristor.

Module II Uncontrolled Rectifiers **6**

Power Diode – half wave rectifier – mid-point secondary transformer based full wave rectifier – bridge rectifier – voltage doubler circuit – distortion factor – capacitor filter for low power rectifiers – LC filters – Concern for power quality – three phase diode bridge.

Module III Controlled Rectifiers **6**

SCR-Two transistor analogy based turn- ON – turn ON losses – thermal protection – controlled converters (1 pulse, 2 pulse, 3 pulse, 6 pulse) - displacement factor – ripple and harmonic factor - power factor mitigation, performance parameters – effect of source inductance - inverter angle limit.

Module IV AC Phase Controllers **8**

TRIAC triggering concept with positive and negative gate pulse triggering, TRIAC based phase controllers - various configurations for SCR based single and three phase controllers.

Module V: DC-DC Buck and Boost Converter **6**

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.

Module VI Inverters **7**

IGBT: Static and dynamic behavior - single phase half bridge and full bridge inverters - VSI :(1phase and three phase inverters square wave operation) - Voltage control of inverters

single, multi pulse, sinusoidal, space vector modulation techniques– various harmonic elimination techniques-CSI

COURSE OUTCOMES:
Upon the successful completion of the course, students will be able to:

CO1: Understand the operation of semiconductor devices and dynamic characteristics and to design &analyze the low power SMPS

CO2: Analyze the various uncontrolled rectifiers and design suitable filter circuits

CO3: Analyze the operation of the n-pulse converters and evaluate the performance parameters

CO4: Understand various PWM techniques and apply voltage control and harmonic elimination methods to inverter circuits.

CO5: Understand the operation of AC voltage controllers and its applications.

CO6: Design and implementation of power circuits

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	--	--	2	1	--	--	**3**	3	3	3	3
CO2	3	3	3	3	--	--	--	1	--	--	--	--	3	3	3
CO3	3	3	3	3	--	--	2	1	--	--	2	--	3	3	3
CO4	3	3	3	3	--	--	1	1	--	--	2	3	3	3	3
CO5	3	3	3	3	--	--	1	1	--	--	2	3	3	3	3
CO6	3	3	3	3	--	--	1	1	--	--	**2**	3	3	3	3

TEXT BOOKS:

1. Ned Mohan, T.M.Undeland, W.P.Robbins, "Power Electronics: Converters, applications and design", John Wiley and Sons, 3rd Edition (reprint), 2009

2. Rashid M.H., Power Electronics Circuits, Devices and Applications, Prentice Hall India, 3rd Edition, New Delhi, 2004.

REFERENCES:

1. Cyril. W.Lander, Power Electronics, McGraw Hill International, Third Edition, 1993.

2. P.S.Bimbhra, Power Electronics, Khanna Publishers, Third Edition 2003

3. Philip T.Krein, Elements of Power Electronics, Oxford University Press, 2013.

4. P.C.Sen, Power Electronics, Tata McGraw-Hill, 30th reprint, 2008.

3rdYear, VI Semester, UG course Engineering (EEE)

Course code – EEC602

SIGNALS AND SYSTEMS

L T P CR 2 1 0 3

COURSE OBJECTIVES:

- To understand the basic properties of signal & systems
- To know the methods of characterization of LTI systems in time domain
- To analyze continuous time signals and system in the Fourier and Laplace domain
- To analyze discrete time signals and system in the Fourier and Z transform domain

Module I Classification of Signals And Systems **9**

Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Timevariant& Time-invariant,Causal& Non-causal, Stable & Unstable.

Module II Analysis of Continuous Time Signals **9**

Fourier series for periodic signals - Fourier Transform – properties- Laplace Transforms and Properties

Module III Linear Time Invariant(LTI) and Continuous Time Systems **9**

Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in Analysis of CT systems - Systems connected in series / parallel.

Module IV Analysis of Discrete Time Signals **9**

Baseband signal Sampling–Fourier Transform of discrete time signals (DTFT)– Properties of DTFT - Z Transform & Properties

Module V Linear Time Invariant-Discrete Time Systems **9**

Impulse response–Difference equations-Convolution sum- Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel.

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1: Determine if a given system is linear/causal/stable.

CO2: Determine the frequency components present in a deterministic signal.

CO3: Characterize continuous LTI systems in the time domain and frequency domain.

CO4: Characterize discrete LTI systems in the time domain and frequency domain.

CO5: Compute the output of an LTI system in the time and frequency domains.

CO6: Design and development of LTI system

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	--	3	--	3	2	--	--	--	--	--	3	--	--	1
CO2	3	--	3	--	--	2	--	--	--	--	--	3	--	3	--
CO3	3	3	--	--	3	2	--	--	--	--	--	3	2	--	--
CO4	3	3	--	--	3	2	--	--	--	--	--	3	--	3	1
CO5	3	3	--	3	3	2	--	--	--	--	--	3	--	3	1
Avg.	3	3	3	3	3	2	--	--	--	--	--	3	2	3	1

TEXT BOOKS:

1. Oppenheim, Willsky and Hamid, “Signals and Systems”, 2nd Edition, Pearson Education, New Delhi, 2015.(Modules I - V)

2. Simon Haykin, Barry Van Veen, “Signals and Systems”, 2nd Edition, Wiley, 2002

REFERENCES :

1. B. P. Lathi, “Principles of Linear Systems and Signals”, 2nd Edition, Oxford, 2009.

2. M. J. Roberts, “Signals and Systems Analysis using Transform methods and MATLAB”, McGraw- Hill Education, 2018.

3. John Alan Stuller, “An Introduction to Signals and Systems”, Thomson, 2007.

3rdYear, VI Semester, UG course Engineering (EEE)

Course code – EEC603

MICROPROCESSORS AND MICROCONTROLLER

L T P CR 2 1 0 3

COURSE OBJECTIVES:

- To study the addressing modes & instruction set of 8085 & 8051
- To develop skills in simple program writing in assembly languages
- To introduce commonly used peripheral/interfacing ICs.
- To study and understand typical applications of micro-processors.
- To study and understand the typical applications of micro-controllers

Module I: Fundamentals of Microprocessors **11**

Fundamentals of 8 bit Microprocessor: Architecture, pin description, Timing diagram, Instruction set, Overview of 8085 Microprocessor, Data Transfer Scheme, Memory Basics of Memory and I/O Interfacing, Data Transfer Scheme (Serial & parallel data transfer scheme, Programmed & interrupt driven data transfer, Direct memory access, Programmable peripheral devices), Programmable interval timer, Analog input-output using AD & DA converter.

Module II: Fundamentals of Microcontrollers **5**

8-bit Microcontroller architecture, Comparison of Microprocessor and Microcontrollers, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers. Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems.

Module III: The 8051 Architecture **8**

Architecture of 8051, Internal Block Diagram, CPU, ALU, address, data and control bus, Pin description, I/O configuration, interrupts; Interrupt structure and interrupt priorities, Port structure and operation, Accessing internal & external memories and different mode of operations, Memory organization, Timing diagrams and Execution Cycles, Data and Program Memory,

Module IV: Instruction Set and Programming **8**

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, Assemblers and compilers. Programming and debugging tools.

Module V: Memory and I/O Interfacing **12**

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.

External Communication Interface

Asynchronous Communication. RS232, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee. Module6: Applications (06 Hours) LED, LCD and keyboard interfacing. Stepper motor interfacing, DC Motor interfacing, sensor interfacing.

COURSE OUTCOMES:

Upon successful completion of the course, the students should have the:

CO1: Ability to write assembly language program for microprocessor and microcontroller

CO2: Ability to design and implement interfacing of peripheral with microprocessor and microcontroller

CO3: Ability to analyze, comprehend, design and simulate microprocessor based systems used for control and monitoring.

CO4: Ability to analyze, comprehend, design and simulate microcontroller based systems used for control and monitoring.

CO5: Ability to understand and appreciate advanced architecture evolving microprocessor field.

CO6: Design and development of electrical engineering model using microcontroller

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	3	--	--	--	1	--	--	--	3	3	1	3
CO2	2	1	2	3	--	--	--	1	--	--	--	3	3	1	3
CO3	2	1	2	3	--	--	--	1	--	--	--	3	3	1	3
CO4	2	1	2	3	--	--	--	1	--	--	--	3	3	1	3
CO5	2	1	2	3	--	--	--	1	--	--	--	3	3	1	3
Avg.	2	1	2	3	--	--	--	1	--	--	--	3	3	1	3

TEXTBOOKS:

1. Ramesh S. Gaonkar, 'Microprocessor Architecture Programming and Application', Pen ram International (P)ltd., Mumbai, 6th Education, 2013.

2. Muhammad Ali Mazidi& Janice GilliMazidi, 'The 8051 Micro Controller and Embedded Systems', Pearson Education, Second Edition 2011.

3. Muhammad Ali Mazidi& Janice GilliMazidi, 'The PIC Micro Controller and Embedded Systems', 2010

REFERENCES:

1. Douglas V. Hall, "Micro-processors & Interfacing", Tata McGraw Hill 3rd Edition, 2017.

2. Krishna Kant, "Micro-processors & Micro-controllers", Prentice Hall of India, 2007.

3.Mike Predko, "8051 Micro-controllers", McGraw Hill, 2009 4. Kenneth Ayala, 'The 8051 Microcontroller', Thomson, 3rd Edition 2004.

3rdYear, VI Semester, UG course Engineering (EEE)
Professional Elective Course –II (ANY ONE)

Course code – EEP604

HIGH VOLTAGE ENGINEERING

L T P CR 2 1 0 3

COURSE OBJECTIVES:

- Various types of over voltages in power system and protection methods.
- Generation of over voltages in laboratories.
- Measurement of over voltages.
- Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.
- Testing of power apparatus and insulation coordination.

Module I: Introduction **6**

Introduction to High voltage Engineering, its scope, Latest Trends, HVDC Transmission. Introduction, breakdown in gases, Townsend‟s criterion for breakdown, numerical. Streamers theory, Paschen‟s law, time lag for break down, breaks down under ac voltage, impulse voltage. Break down in electro negative gases, vacuum break down.

Module II Over Voltages In Electrical Power Systems **9**

Causes of over voltages and its effects on power system – Lightning, switching surges and temporary over voltages – Reflection and Refraction of Travelling waves- protection against over voltages_ Insulation Coordination.

Module III Dielectric Breakdown **9**

Properties of Dielectric materials - Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids, Maintenance of oil Quality – Breakdown mechanisms in solid and composite dielectrics- Applications of insulating materials in electrical equipment.

Module IV Generation and Measurements of High Voltages And High Currents **9**

Generation of High DC, AC, impulse voltages and currents - Analysis of DC/AC and Impulse generator circuits - Tripping and control of impulse generators, Measurement of High voltages and High currents – High Resistance with series ammeter – Dividers - Resistance, Capacitance and Mixed dividers - Peak Voltmeter, Generating Voltmeters, Electrostatic Voltmeters – Sphere Gaps, High current shuntsDigital techniques in high voltage measurement.

Module V High Voltage Testing & Insulation Coordination **9**

High voltage testing of electrical power apparatus- International and Indian standards – Power frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators and transformers - Insulation Coordination.

Module VI Application in Industry **9**

Introduction – electrostatic applications- electrostatic precipitation, separation, painting / coating, spraying, imaging, printing, Transport of materials – manufacturing of sand paper – Smoke particle detector – Electrostatic spinning, pumping, propulsion – Ozone generation – Biomedical applications.

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO1: Explain various overvoltage's and its effects on power systems.

CO2: Understand the breakdown phenomena in different medium under uniform and non-uniform fields.

CO3: Explain the methods of generating and measuring High DC, AC, Impulse voltage and currents.

CO4: Suggest and Conduct suitable HV testing of Electrical power apparatus as per Standards

CO5: Explain the Industrial Applications of Electrostatic Fields.

CO6: Design and implementation of high voltage model for industrial application

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	--	--	--	--	--		--	--	--	--	3	2	--
CO2	3	2	--	1	--	--	--		--	--	--	--	3	--	--
CO3	2	2	3	1	--	--	--		--	--	**2**	3	3	2	--
CO4	1	2	3	1	--	--	--	1	**1**	--	--	3	3	2	--
CO5	2	2	1	--	--	**2**	--		--	--	**2**		3	--	2
Avg.	2	2	2.33	1	--	**2**	--	1	**1**	--	**2**	3	3	2	2

TEXT BOOKS

1. M.S.Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2013.

2. E. Kuffel and W.S. Zaengl, J.Kuffel, 'High voltage Engineering fundamentals', Newnes Second Edition, Elsevier , New Delhi, 2005.

3. C.L. Wadhwa, 'High voltage Engineering', New Age International Publishers, Fourth Edition, 2020.

REFERENCES

1. L.L.Alston, High Voltage Technology, Oxford University Press, First Indian Edition 2006.

2. C.L.Wadhwa, High voltage Engineering, New Age International Publishers, Fourth Edition, 2020

3. Mazen Abdel – Salam, Hussein Anis, Ahdab A-Morshedy, RoshdayRadwan, High Voltage Engineering – Theory &Practice,Second Edition, Taylor & Francis Gourp, 2019

4. Subir Ray." An Introduction to High Voltage Engineering "PHI Learning Private Limited, New Delhi, Second Edition-2011

3rdYear, VI Semester, UG course Engineering (EEE)
Professional Elective Course –II

Course code – EEP605

ADVANCED CONTROL SYSTEM

L T P CR 2 1 0 3

Prerequisite: Control Systems

COURSE OBJECTIVES:

- To understand the important of mathematical models for Industrial processes
- To acquaint students with different forms of mathematical models.
- To develop and simulate mathematical models for different Industrial processes.
- To apply Mathematical tools while developing mathematical models.
- To analyze the graphical response of developed mathematical models.

Module –I **10**

Mathematical modelling of dynamic systems in state space, State space representation of Mechanical and electrical systems, State space representation of transfer functions, relations between state equation and transfer functions, Characteristics equation, egenvalue and eigenvector of state matrix, Solution of time-invariant state equation, determination of State Transition Matrix, Use of Cayley –Hamilton Theorem, Minimal Polynomial, Sylvester‟s interpolations, Controllability, Observability.

Module –II **8**

Introduction to design of control systems in state space, design of phase lead and phase lag controllers in time and frequency domain, Pole placement design, State observers.

Module –III **4**

Sampling and signal reconstruction: Definition and Evaluation of Z-Transform, Properties of Z-Transform, Inverse Z-Transform, Mapping between S-plane and Z-plane, System descriptions by difference equations.

Module –IV **10**

Sampled Data Control Systems: Transfer Function f discrete data systems, Pulse and Z transform Functions, Transfer Function of discrete data systems with Cascade elements, Transfer Function of Zero- Order and 1st – Order Holds, Transfer Function of Closed Loop discrete data systems, State equations of discrete data systems, Solutions of discrete state equations, discrete state transition equations, Z-Transform solutions of discrete equations, Transfer Function Matrix and the Characteristic equation, Stability Tests of discrete state equations, Bilinear Transformation Method, Direct Stability Tests.

Module – V **10**

Nonlinear Systems: Common Physical nonlinearities, The Phase-Plane Method, Basic concepts, singular Points, Stability of nonlinear systems, Construction of Phase trajectories, Construction by analytical and graphical methods, System analysis by Phase Plane Method, The Describing function Method: Basic concepts, derivation of describing functions for common nonlinearities, Stability analysis by Describing Function approach, jump resonance, Lyapunov Stability Criterion, Popov‟s Stability Criterion.

COURSE OUTCOMES:

CO1 Will be able to understand different methods of developing models for industrial processes.

CO2 Evaluate the output of a digital system for a given input.

CO3 Describe the dynamics of a Linear, Time Invariant systems through difference equations.

CO4 Analyse digital systems using the Z-transformation, state space methods.

CO5 Analyse nonlinear systems

CO6 Design digital controllers for physical systems.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	**2**	**2**	1	1	1	1	1	1	1	1	2	2	2
CO2	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
CO3	3	3	3	2	1	1	1	1	1	1	1	1	2	2	2
CO4	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
CO5	3	3	3	**3**	1	1	1	1	1	1	1	1	2	2	2
CO6	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2

Text Books

1. Modern Control Engineering, K. Ogata (PHI)

2. Automatic Control System, B.C. Kuo (PHI)

3. Digital Control of Dynamic Systems, G. Franklin, J.D Powell, M. Workman (Pearson)

3rdYear, VI Semester, UG course Engineering (EEE)
Professional Elective Course –II

Course code – EEP606

DIGITAL CONTROL SYSTEM

L T P CR 2 1 0 3

Prerequisite: Control Systems

COURSE OBJECTIVES:

- To represent the linear time invariant System in discrete State Space form
- To analyze the controllability, observability and stability of a Discrete time System.
- To estimate model parameters from input/output measurements
- To Design Digital Controllers
- To Design Multi-loop and Multivariable Controllers for multivariable system

Module I: Sampling and Reconstruction **8**

Introduction, Examples of Data control systems, Sampler, Sampling Theorem, Signal Reconstruction-Digital to Analog conversion and Analog to Digital conversion, sample and hold operations.

Module II: The Z – Transforms **8**

Introduction, Linear difference equations, pulse response, Z – transforms, Theorems of Z – Transforms, inverse Z-transforms, Z-Transform method for solving difference equations; Pulse transforms function

Module III: State Space Analysis **12**

State variables, State model for linear continuous-time system. Types of state models, Eigen value and Eigen vectors, Solution of state equation, State transition matrix and its Properties, Methods for Computation of State Transition Matrix, State Space Representation of discrete time systems, Matrix solving discrete time state space equations, Discretization of continuous time state – space equations

Module IV: Controllability, Observability & Stability **8**

Concepts of Controllability and Observability, Tests for controllability and Observability Duality between Controllability and Observability, Transfer matrix. Analysis of closed loop systems in the Z-Plane. Jury stability test – Stability Analysis by use of the Bilinear Transformation.

Module V: State Feedback Controller **4**

Design of state feedback controller through pole placement – Necessary and sufficient conditions.

COURSE OUTCOMES:

CO1 Evaluate the output of a digital system for a given input.

CO2 Describe the dynamics of a Linear, Time Invariant systems through difference equations.

CO3 Analyse digital systems using the Z-transformation, state space methods.

CO4 Analyse controllability and observability of the system.

CO5 Design digital controllers for physical systems.

CO6 Ability to design different digital controllers to satisfy the required criterion.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	**2**	1	1	1	1	1	1	1	1	2	2	2
CO2	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
CO3	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
CO4	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
CO5	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
CO6	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2

Text Books:

[1]. Discrete-Time Control systems – K. Ogata, Pearson Education/PHI, 2nd Edition

[2].B. C Kuo, Digital Control Systems, 2nd Edition, Oxford University Press, Inc., 1992.

Reference Books:

[1]. F. Franklin, J.D. Powell, and M.L. Workman, Digital control of Dynamic Systems, Addison- Wesley Longman, Inc., Menlo Park, CA , 1998.

[2]. Digital Control and State Variable Methods by M.Gopal, TMH.

3rdYear, VI Semester, UG course Engineering (EEE)
Open Elective Course –II (ANY ONE)
Course code – CSO601
SOFT COMPUTING TECHNIQUES

L T P CR 2 1 0 3

COURSE OBJECTIVES:
To impart knowledge about the following topics:

- Basics of artificial neural network.
- Concepts of modelling and control of neural and fuzzy control schemes.
- Features of hybrid control schemes

Module I: Fundamentals of Soft Computing Techniques **8**

Conventional and Modern Control System, Intelligence, Soft and Hard Computing, Artificial Intelligence.

Module-II: Artificial Neural Network **10**

Introduction to Artificial neural networks-biological neurons, Basic models of artificial neural networks- Connections, Learning, Activation Functions, McCulloch and Pitts Neuron. Learning rule- Hebbian Learning, Perceptron Learning, Delta Learning- Training and Testing algorithm, Adaptive Linear Neuron, Back Propagation Network – Architecture, Training algorithm.

Module-III: Fuzzy Logic System-I **8**

Fuzzy Logic- Fuzzy sets- Properties- Operation on fuzzy sets, fuzzy relations- operations on fuzzy relations. Fuzzy membership functions, fuzzification, Methods of membership value assignmentsintuition- inference- rank ordering, Lambda- cuts for fuzzy sets, Defuzzification methods.

Module –IV: Fuzzy Logic System-II **8**

Truth values and Tables in Fuzzy Logic, Fuzzy propositions, Formation of fuzzy rules – Decomposition of rules- Aggregation of rules, Fuzzy Inference Systems- Mamdani and Sugeno types, Neuro-fuzzy hybrid systems – characteristics- classification

Module-V: **6**

Introduction to genetic algorithm, operators in genetic algorithm – coding – selection – cross over – mutation, Stopping condition for genetic algorithm flow, Generational Cycle, Applications. Evolutionary Programming, Multi-objective Optimization Problem Solving and its applications, Genetic- neuro hybrid systems, Genetic-Fuzzy rule based system.

COURSE OUTCOMES:

CO1 Distinguish the concept between the hard and soft computing techniques.

CO2 Understand the basic concept of the Artificial Neural Network (ANN).

CO3 Understand the basic concept of the fuzzy logic system

CO4 Explain the concept of Genetic Algorithm (GA) and its limitation.

CO5 Choose the different kind of evolutionary programming for multi objective optimization problem based on their application.

CO6 design and implementation of different techniques in engineering problems

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	2	--	--	--	--	--	--	2	3	2	--
CO2	3	3	3	2	2	--	--	--	--	--	--	2	3	--	--
CO3	3	3	3	2	2	--	--	--	--	--	--	2	3	2	--
CO4	3	3	3	2	2	--	--	--	--	--	--	2	3	2	--
CO5	3	3	3	2	2	2	--	--	--	--	--	2	3	--	2
CO6	3	3	3	2	2	2	--	--	--	--	--	2	3	2	2

Text Books:

[1].N.PPadhy, Artificial Intelligence and Intelligent Systems- Oxford University Press.

[2].S. N. Sivanandam and S. N. Deepa, Principles of Soft Computing- Wiley India.

[3].Timothy J. Ross, Fuzzy Logic with engineering applications – Wiley India.

[4].M.E. E1- Hawary , Artificial Intelligence application in Power Systems, IEEE Press,2009

[5].Jan Jantzen, Foundations of Fuzzy Control, A practical approach, Wiley,2013

[6].M Gopal, Digital Control and State Variable Methods, conventional and neural-fuzzy control system, Published by Tata McGraw Hill Education Private Ltd,2012

[7].David E Goldberg, Genetic Algorithms, published by Pearson 2008

Reference Books:

[1].Satish Kumar, Neural Networks- Prentice Hall of India.

[2].N. K. Sinha and M.M. Gupta, Soft Computing and Intelligent Systems: Theory & Applications- Academic Press/ Elsevier, 2009.

[3].SimonHaykin, Neural Network- A comprehensive Foundation- PHI, Inc.

[4].Eberhart and Y. Shi, Computational Intelligence: Concepts to Implementation, Morgan Kaufman/ Elsevier, 2007.

3rdYear, VI Semester, UG course Engineering (EEE)
Open Elective Course –II
Course code – EEO607
POWER PLANT ENGINEERING

L T P CR 2 1 0 3

COURSE OBJECTIVE:

• To introduce conventional energy conversion system with steam, hydro based and nuclear based power plant.

• To initiate non-conventional energy conversion system with solar, wind, fuel cell, tidal ocean, geothermal, biomass etc.

• To commence interconnection of energy source to gird, stand alone and hybrid system.

Module I: Introduction **10**

Conventional & Non-Conventional Sources of Energy and their availability in India, Different Types of Power Plants, Layout of Steam , Hydel , Diesel , MHD, Nuclear and Gas turbine power plants, Combined Power cycles – comparison and selection , Load duration Curves, Steam boilers and cycles – High pressure and Super Critical Boilers – Fluidized Bed Boilers.

Module II: Thermal Power Plants **10**

Basic thermodynamic cycles, various components of steam power plant-layout-pulverized coal burners-Fluidized bed combustion-coal handling systems-ash handling systems- Forced draft and induced draft fans- Boilers-feed pumps super heater- regenerator-condenser-deaerators, cooling towers, electrostatic precipitators.

Module III: Hydel Power Plant **8**

Principle of working, Classification, Site selection; Different components & their functions; Types of Dams;Types, Characteristics & Selection of Hydro-Turbines; Mini & Micro Hydro Power Plants, Pumped Storage Power Plants.

Module IV: Diesel And Gas Turbine Power Plant **8**

Types of diesel plants, components, Selection of Engine type, applications. Gas turbine power plant- Fuels- Gas turbine material, open and closed cycles, reheating, Regeneration and inter cooling, combines cycle.

Module V: Co-Generation **6**

Concept; Schemes; Brief Description; Benefits & Limitations; Applications. Non-Conventional Energy Sources, Types, Brief Description, Advantages & Limitations.

COURSE OUTCOMES:

After successful completion of the course students will be able to:

CO1 Describe and analyse different types of sources and mathematical expressions related to thermodynamics and various terms and factors involved with power plant operation.

CO2 Analyse the working and layout of thermal power plants and the different systems comprising the plant and discuss about its economic and safety impacts

CO3 To define the working principle of diesel power plant, its layout, safety principles and compare it with plants of other types.

CO4 Discuss and analyse the mathematical and working principles of different electrical equipment involved in the generation of power and to understand co-generation.

CO5 Discuss and analyze the mathematical and working principles of different electrical equipment involved in the generation of power and to understand co-generation.

CO6 design and development of power plant model.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	3	2	3	3	--	2	--	--	--	--	1	1	1	3
CO2	2	2	3	1	2	--	1	--	--	--	--	1	2	1	3
CO3	2	--	2	1	--	1	2	--	--	--	--	1	2	1	3
CO4	2	--	2	1	--	1	2	--	--	--	--	1	1	1	3
CO5	2	2	1	2	1	2	1	--	--	--	--	1	2	1	3
CO6	2	3	2	1	2	1.3	1	--	--	--	--	1	1	1	3

TEXT/REFERENCE BOOKS:

1. P.K.Nag, “Power Plant Engineering”, Tata McGraw Hill Publications.2007
2. EI-Wakil M.M, “Power Plant Technology,” Tata McGraw-Hill 1984
3. Power Plant Engineering, Gautam S, Vikas Publishing House. 2012
4. Power station Engineering and Economy by Bernhardt
5. G.A.Skrotzki and William A. Vopat- Tata McGraw Hill Publishing Company Ltd.2002
6. “Modern Power Station Practice”, Volume B, British Electricity International Ltd., Central Electricity Generating Board,Pergamon Press, Oxford.1991
7. Power Plant Familiarization – Vol. II“, NPTI Publication.

3rdYear, VI Semester, UG course Engineering (EEE)
Open Elective Course –II
Course code – CSO602
IMAGE PROCESSING

L T P CR 2 1 0 3

COURSE OBJECTIVES:

The objective of this course is to make students able to:

• To become familiar with digital image fundamentals
• To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
• To learn concepts of degradation function and restoration techniques.
• To study the image segmentation and representation techniques.
• To become familiar with image compression and recognition methods

Module I Digital Image Fundamentals **9**
Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.

Module II Image Enhancement **9**
Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

Module III Image Restoration **9**
Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering

Module IV Image Segmentation **9**
Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing-erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.

Module V Image Compression and Recognition **9**
Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

COURSE OUTCOMES:

After successful completion of the course students will be able to:

CO1 To understand and be able to describe how digital images are represented, manipulated, encoded and processed.

CO2 Analyse algorithm design, implementation and performance evaluation.

CO3 Knowledge of Hardware and Software tools for Image Analysis.

CO4 Design and Analysis of Various Techniques and Process to Understand Image.

CO5 Application of Mathematics for Image Understanding and Analysis.

CO6 Design and Implementation of image processing system

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	--	--	--	--	--	2	1	--	1	--	2	1	1	3
CO2	2	--	3	2	--	2	--	--	--	--	--	--	2	1	3
CO3	2	3	--	2	3	2	2	--	--	--	--	--	2	1	3
CO4		3	--	3	3	2	--	--	2	--	--	2	1	1	3
CO5	2	--	3	2	--	2	--	--	--	--	--	--	2	1	3
CO6	2	3	3	3	3	2	2	1	2	1	--	2	1	1	3

TEXT/REFERENCE BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing Pearson, Third Edition, 2010

2. Anil K. Jain, Fundamentals of Digital Image Processing Pearson, 2002.

3. Kenneth R. Castleman, Digital Image Processing Pearson, 2006.

4. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, Digital Image Processing using MATLAB Pearson Education, Inc., 2011.

5. D,E. Dudgeon and RM. Mersereau, Multidimensional Digital Signal Processing Prentice Hall Professional Technical Reference, 1990.

6. William K. Pratt, Digital Image Processing John Wiley, New York, 2002

7. Milan Sonka et al Image processing, analysis and machine vision Brookes/Cole, Vikas Publishing House, 2nd edition, 1999

3rdYear, VI Semester, UG course Engineering (EEE)

Course code – EE601P

POWER ELECTRONICS LAB

COURSE OBJECTIVES:

- To study the VI characteristics of SCR, TRIAC, MOSFET and IGBT.
- To analyze the performance of semi converter, full converter, step up, step down choppers by simulation and experimentation.
- To study the behavior of voltage waveforms of PWM inverter applying various modulation techniques.
- To design and analyze the performance of SMPS.
- To study the performance of AC voltage controller by simulation and Experimentation.

List of Experiments (Any Ten)

1. Study of V-I characteristics of DIODE, ZENER, SCR, DIAC, and TRIAC
2. Study of V-I characteristics of UJT, MOSFET, BJT.
3. Different methods of triggering of SCR (a) Phase controlled method (b) UJT triggering method (c) Cosine controlled triggering method
4. Study of TRIAC and full wave voltage control method of it.
5. 1 phase half wave and full wave full controlled converter with R, R-L and D.C motor load with / without freewheel diode
6. 3-phase half and full wave full controlled converter with R, R-L and D.C motor load with/ without freewheeling diodes
7. Study of characteristics curves of a 3 phase diode bridge.
8. Study of DC chopper with PWM controller
9. Study of SCR communication (a) Forced communication (b) Load communication
10. Study of single phase series inverter
11. Three phases IGBT based four quadrant chopper drive for D.C motor
12. Study of 1 phase cyclo converter
13. Speed control of a 1 phase Induction motor.
14. AC Voltage control by using TRIAC & DIAC.
15. Oscillation Chopper Circuit.
16. DC Supply using Diode (Hardware).

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO1: Determine the characteristics of SCR, IGBT, TRIAC, MOSFET and IGBT

CO2: Find the transfer characteristics of full converter, semi converter, step up and step down choppers by simulation experimentation.

CO3: Analyze the voltage waveforms for PWM inverter using various modulation techniques.

CO4: Design and experimentally verify the performance of basic DC/DC converter topologies used for SMPS.

CO5: Understand the performance of AC voltage controllers by simulation and experimentation.

3rdYear, VI Semester, UG course Engineering (EEE)

Course code – EE604P

Electrical Simulation Lab

List of Experiment (Any 10)

1. Introduction to MATLAB and its basic commands.

2. Y bus formation for systems, without mutual coupling, by singular transformation.

3. Formation of Z-bus, using Z-bus build Algorithm without mutual

4. To find load flow solution of the given power system using Gauss-Seidel method theoretically for one iteration and obtain full solution using MATLAB.

5. To obtain original phasor from following symmetrical components of voltage in a 3phase system. The symmetrical components are as follows Vao=3.282∟23.960, Va1=14.842∟43.020, Va2=5.766∟-108.720

6. The fuel cost functions for three thermal plants in $/h are given by C1 = 500 + 5.3 P1 + 0.004 P1 2 ; P1 in MW C2 = 400 + 5.5 P2 + 0.006 P2 2 ; P2 in MW C3 = 200 +5.8 P3 + 0.009 P3 2 ; P3 in MW The total load , PD is 800MW.Neglecting line losses and generator limits, find the optimal dispatch and the total cost in $/h by analytical method. Verify the result using MATLAB program.

7. Find optimum loading of generators with penalty factor.

8. Determination of bus currents, bus power & line flows for a specified system voltage (bus) profile.

9. Simulink model for evaluating transient Stability of single machine connected to Infinite bus.

10. To find dynamic response of the given single area load frequency control problem theoretically and to plot and verify the results in SIMULINK.

11. To find dynamic response of the given two - area load frequency control problem theoretically and to plot and verify the results in SIMULINK.

12. Determination of step & impulse response for a Type „0", Type „1", Type „2" systems.

13. Determination of step & impulse response for the first order and second order Moduley feedback system using Matlab Software.

14. To obtain following using Matlab Software a) Pole, zero, gain values from a given transfer function b) Transfer function model from pole, zero, gain values c) Pole, zero plot of a transfer function

15. Determination of Bode plot, Root Locus and Nyquist plot using Matlab control system toolbox for 2nd order system & obtain controller specification parameters using Matlab Software.

16. Study the effect of addition of poles and zeros to the forward path transfer function of a closed loop system.

Based on CBCS system & OBE model
Recommended scheme of study (EEE)

Sl. No.	Semester of Study	Category of course	Course Code	Subjects	Mode of delivery & credits *L-Lecture; T-Tutorial; P-Practical*			Total Credits *C- Credits*
Theory								
1	**Seventh**	PCC	ELC701	Protection of Power Apparatus System	3	0	0	3
2		PEC	PEC-III	Professional Elective-III	3	0	0	3
3		PEC	PEC-IV	Professional Elective-IV	3	0	0	3
4		OEC	OEC III	Open Elective-III	3	0	0	3
5		OEC	OEC IV	Open Elective-IV	3	0	0	3
								Total (A) = 15 Credits
LABORATORIES								
6		PCC	EL701P	Power System Protection and	0	0	2	1
7		Project	EE702D	Project Part - I	0	0	4	2
8		Internship	EE703I	Internship Assessment	0	0	2	2
Total(B) = 5 Credits								
Grand Total (A) + (B) = 20 Credits								
1	**Eighth**	Project	EE801D	Project-II	0	0	16	8
							Total = 8 Credits	
		Grand Total for Fourth Year = 28 Credits.						

Professional Electives and Open Electives Courses offered by Department of EEE

Table 1: Professional Electives

Sl. No.	Code	Professional Elective-III (Any one) VII SEM	Code	Professional Elective-IV(Any one) VII SEM
1	ELP702	Electrical Drives and Control	ELP704	Antennae & Wave Propagation
2	ELP703	Utilization of Electrical Power	ELP708	Smart Grid Technology
3	ELP705	Power Quality	ELP709	Electrical and Hybrid Vehicles
4	ELP707	HVDC Transmission and FACTS		

Table 2: Open Electives

Sl. No.	Code	Open Elective-III (Any one)	Code	Open Elective-IV (Any one)
1	ELO710	Soft Optimization Techniques	ELO713	Digital Signal Processing
2	ELO711	Illumination Technology	ELO714	Energy Storage Systems
3	ELO712	Process Instrumentation and Control	ELO715	Electrical machine and Power Systems

4th Year, VII Semester, UG course Engineering (EEE)

Course code -ELP702

ELECTRICAL DRIVES AND CONTROL

L T P CR. 30 0 3

COURSE OBJECTIVES:

At the end of the course, students should have the:

- To understand steady state operation and transient dynamics of a motor load system.
- To study and analyze the operation of the converter / chopper fed dc drive, both qualitatively and quantitatively.
- To study and understand the operation and performance of AC Induction motor drives.
- To study and understand the operation and performance of AC Synchronous motor drives.
- To analyze and design the current and speed controllers for a closed loop solid state DC motor drives.

Module I DRIVE CHARACTERISTICS **8**

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

Module II CONVERTER / CHOPPER FED DC MOTOR DRIVE **8**

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

Module III INDUCTION MOTOR DRIVES **8**

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

Module IV SYNCHRONOUS MOTOR DRIVES **8**

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

Module V DESIGN OF CONTROLLERS FOR DRIVES **8**

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

COURSE OUTCOMES:

After completion the above subject, students will be able to

CO1: Understand the basic requirements of motor selection for different load profiles.

CO2: Analyse the steady state behaviour and stability aspects of drive systems.

CO3: Analyse the dynamic performance of the DC drive using converter and chopper control.

CO4: Simulate the AC drive.

CO5: Hardware Implementation of the Power Circuit

CO6: Design the controller for electrical drives.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	--	--	1	--	--	--	2	3	3	2
CO2	3	2	2	3	3	--	--	1	--	--	--	2	3	3	2
CO3	3	2	2	3	3	--	--	1	--	--	--	2	3	3	3
CO4	3	2	2	3	3	--	--	1	--	--	--	2	3	3	3
CO5	3	2	2	3	3	--	--	1	--	--	--	2	3	3	3
CO6	3	2	2	3	3	--	--	1	--	--	--	2	3	3	3

TEXTBOOKS:

1. Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 2nd Edition January 2010.

2. Bimal K.Bose. Modern Power Electronics and AC Drives, Pearson Education, 2002 1st Edition.

REFERENCES:

1. S.K.Pillai, A First course on Electrical Drives, Wiley Eastern Limited, 3rd Edition 2012.

2. Murphy J.M.D and Turnbull, Thyristor Control of AC Motor, Pergamon Press, Oxford 1988, 1st Edition.

3. Gopal K.Dubey, Power semiconductor controlled Drives, Prentice Hall Inc., New Jersey,1989, 1 st Edition.

4. R.Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Prentice hall of India, 2001, 1st Edition.

4th Year, VII Semester, UG course Engineering (EEE)

Course code -ELC 701

PROTECTION OF POWER APPARATUS SYSTEM

L T P CR. 30 0 3

COURSE OBJECTIVES:

- To understand the significance of protection, protection schemes and role of earthing.
- To study the characteristics, functions and application areas of various relays.
- To acquire practical knowledge about common faults in power system apparatus and applying suitable protective schemes.
- To understand the functioning of static relays and Numerical protection concepts.
- To understand the problems associated with circuit breaking and to discuss about various circuit breakers.

Module – I **5**

Basic concept & components of power system protection, types of relays-their operating principles, characteristics and their uses, Introduction to static relays and its advantages over electromagnetic relays.

Module – II **7**

Protection of Alternators: Protection of generators against Stator faults, Rotor faults, and abnormal Conditions. Restricted earth fault and Inter-turn fault Protection. Numerical problems on % winding unprotected.

Module III **7**

Protection of transformers: Percentage Differential Protection, Numerical Problem on Design of CT's Ratio, Buchholz relay Protection.

Module – IV **8**

Protection of Lines: Over Current, Carrier Current and Three - zone distance relay protection using Impedance relays. Translay relay. Protection of Bus bars –differential Protection.

Module – V 8

Theory of arc interruption, types of circuit breakers – air, air-blast, minimum oil, vacuum & SF6, resistance switching, current chopping, auto-reclosing, circuit breaker ratings. Protection against lightning over voltages - valve type and zinc - oxide lighting arresters,

Module – VI **5**

Grounded and ungrounded neutral systems, methods of neutral grounding: solid, resistance, reactance, resonant grounding.

COURSE OUTCOMES:

Upon the successful completion of the course, students will have theability to:

CO1: Understand and select proper protective scheme and type of earthing.

CO2: Explain the operating principles of various relays.

CO3: Suggest suitable protective scheme for the protection of various power system apparatus.

CO4: Analyze the importance of static relays and numerical relays in power system protection.

CO5: Summarize the merits and demerits and application areas of various circuit breakers.

CO6: Design the protection system for power apparatus

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2	1	2	1	1	1	1	2	--	3	1	--
CO2	3	1	1	2	1	2	1	1	1	1	2	--	3	1	--
CO3	3	1	1	2	1	2	1	1	1	1	2	--	3	2	--
CO4	3	1	1	2	1	2	1	1	1	1	2	--	3	2	1
CO5	3	1	1	2	1	2	1	1	1	1	2	--	3	1	1
CO6	3	1	1	2	2	2	1	1	1	1	2	--	3	1	1

TEXT BOOKS:

1. Sunil S.Rao, 'Switchgear and Protection', Khanna Publishers, New Delhi, Four Edition, 2010.
2. Badri Ram ,B.H. Vishwakarma, 'Power System Protection and Switchgear', New Age International Pvt Ltd Publishers, Second Edition 2011.
3. B.Rabindranath and N.Chander, 'Power System Protection and Switchgear', New Age International (P) Ltd., Second Edition, 2018.
4. Arun Ingole, 'Switch Gear and Protection' Pearson Education, 2018.

REFERENCES

1. Y.G.Paithankar and S.R.Bhide, 'Fundamentals of power system protection', Second Edition,Prentice Hall of India Pvt. Ltd., New Delhi, 2013.
2. C.L.Wadhwa, 'Electrical Power Systems', 6th Edition, New Age International (P) Ltd., 2018
3. VK Metha," Principles of Power Systems", S. Chand, Reprint, 2013
4. Bhavesh Bhalja, R.P. Maheshwari, Nilesh G. Chotani,'Protection and Switchgear' Oxford University Press, 2nd Edition 2018.

4th Year, VII Semester, UG course Engineering (EEE)

Course code -ELP 703

UTILIZATION OF ELECTRICAL POWER

L T P CR. 30 0 3

COURSE OBJECTIVES:

- To know various electric drives and traction motors with applications
- To introduce the energy saving concept by different ways of illumination.
- To understand the different methods of electric heating and electric welding.
- To know the conversion of solar and wind energies into electrical energy for different applications.
- To study the domestic utilization of electrical energy.

Module I: Industrial Drives **12**

Characteristics of electrical motors and their particular application for industrial drives. Motor enclosures, bearing, transmission of drives, choice of motor, motor used for lifts, cranes and general-purpose machines, typical application in sugar, textile, paper and steel industries. Motors used in mining operations, rating of electric motors, calculation of size load equation of flywheels electric breaking; plugging, dynamic and regenerative breaking, breaking current, torque, speed time curves (number of revolutions made before stop)

Module II: Electrical Traction **10**

General features and systems of track electrification, Tractive effort calculation of traction motors, traction motor control (series-parallel control). Track equipment and collection gear, train movement, speed-time curve, Specific Energy Consumption (SEC) and factors affecting it.

ModuleIII ILLUMINATION **9**

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, LED

Module IV HEATING AND WELDING **9**

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 - power supply for arc welding - radiation welding.

Module V DOMESTIC UTILIZATION OF ELECTRICAL ENERGY **5**

House wiring - working principle of air conditioning system, Induction based appliances, Online and OFF line UPS, Batteries - Power quality aspects – nonlinear and domestic loads – Earthing system for Domestic, Industrial and Substation.

COURSE OUTCOMES:

At the end of the course, students should have the:
CO1 Ability to choose suitable electric drives for different applications
CO2 Ability to design the illumination systems for energy saving
CO3 Ability to demonstrate the utilization of electrical energy for heating and welding purposes
CO4 Ability to know the effective usage of solar and wind energies for electrical applications
CO5 Ability to do electric connection for any domestic appliance like refrigerator, battery charging circuit for a specific household application.
CO6 To illustrate the need for energy conservation and to simulate three phase power control.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	--	1	--	1.5	--	--	--	--	3	--	--
CO2	2	1	3	--	--	--	--	1.5	--	--	--	--	3	--	--
CO3	3	2	2	--	--	1	--	1.5	--	--	--	--	3	--	--
CO4	1	2	3	--	--	--	--	1.5	--	--	--	--	3	--	--
CO5	1	1	3	--	--	1	--	1.5	--	--	--	--	3	3	2
CO6	3	3	3	--	--	--	--	1.5	--	--	--	--	3	3	3

TEXT BOOKS:

1. N.V. Suryanarayana, “Utilisation of Electric Power”, Wiley Eastern Limited, New Age International Limited, 1994 & Second Edition 2017 Feb.
2. J.B.Gupta, “Utilisation Electric power and Electric Traction”, S.K.Kataria and sons, 2000 2012th Edition, 2013, January.
3. G.D.Rai,”Non-Conventional Energy sources”,Khanna publications Ltd.,New Delhi 1998
4. D.P.Kothari, K.C.Singal, Rakesh Ranjan, “Renewable Energy Sources and Emerging Technologies”, PHI Learing Private Limited, 3rd Edition 2022.
5. Industrial Energy Conservation, Volume I-II, S C Bhatia, Sarvesh Devraj, Energy conservation and Managment by Akshay A pujara1st edition, June 2018.

REFERENCES:

1. R.K.Rajput, Utilisation of Electric Power, Laxmi publications 2nd Edition 2016.
2. H.Partab, Art and Science of Utilisation of Electrical Energy”, Edition, Dhanpat Rai and Co., New Delhi-2004.
3. C.L.Wadhwa, “Generation, Distribution and Utilisation of Electrical Energy”, New Age international Pvt.Ltd., 3rd Edition, 2015 January.

4th Year, VII Semester, UG course Engineering (EEE)

Course code -ELP 705

POWER QUALITY

L T P CR. 30 0 3

COURSE OBJECTIVES:

- To learn the basic definitions in Power Quality.
- To study the power quality issues in Single Phase and Three Phase Systems.
- To understand the principles of Power System Harmonics.
- To know the way to use DSTATCOM for Harmonic Mitigation.
- To learn the concepts related with Series Compensation.

Module I INTRODUCTION **9**

Introduction – 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: poor load power factor, Non-linear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage – Power quality standards.

Module II ANALYSIS OF SINGLE PHASE AND THREE PHASE SYSTEM **9**

Single phase linear and non-linear loads – single phase sinusoidal, non-sinusoidal source – supplying linear and nonlinear loads – three phase balanced system – three phase unbalanced system – three phase unbalanced and distorted source supplying non-linear loads – concept of power factor – three phase- three wire – three phase - four wire system.

Module III MITIGATION OF POWER SYSTEM HARMONICS **9**

Introduction - Principle of Harmonic Filters – Series-Tuned Filters – Double Band-Pass Filters – damped Filters – Detuned Filters – Active Filters – Power Converters – Harmonic Filter Design – Tuned Filter – Second-Order Damped Filter – Impedance Plots for Filter Banks – Impedance Plots for a Three-Branch 33 kV Filter.

Module IV LOAD COMPENSATION USING DSTATCOM **9**

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.

Module V SERIES COMPENSATION OF POWER DISTRIBUTION SYSTEM **9**

Rectifier supported DVR – DC Capacitor supported DVR – DVR Structure – Voltage Restoration – Series Active Filter – Unified Power Quality Conditioner.

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1 Use various definitions of power quality for power quality issues

CO2 Describe the concepts related with single phase / three phase, linear / nonlinear loads and single phase / three phase sinusoidal, non-sinusoidal source

CO3 Solve problems related with mitigation of Power System Harmonics

CO4 Use DSTATCOM for load compensation

CO5 Demonstrate the role of DVR, SAFs UPQC in power distribution systems

CO6 Design and implementation of power quality improvements in electrical systems

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	--	--	3	3	--	3	--	3	3	3	3
CO2	3	3	3	3	--	--	3	3	--	3	--	3	3	3	3
CO3	3	3	3	3	--	--	3	3	--	3	--	3	3	3	3
CO4	3	3	3	3	--	--	3	3	--	3	--	3	3	3	3
CO5	3	3	3	3	--	--	3	3	--	3	--	3	3	3	3
CO6	3	3	3	3	--	--	3	3	--	3	--	3	3	3	3

TEXTBOOKS:

1. Arindam Ghosh and GeradLedwich “Power Quality Enhancement Using Custom Power Devices”, Kluwer Academic Publishers, First Edition,2002

2. G.T.Heydt, “Electric Power Quality”, Stars in a Circle Publications, Second Edition, 2011.

3. George J. Wakileh, “Power System Harmonics – Fundamentals, Analysis and Filter Design”, Springer – Verlag Berlin Heidelberg, New York, 2019.

REFERENCES:

1. R.C.Duggan “Electric Power Systems Quality”, Tata MC Graw Hill Publishers, Third Edition, 2012.

2. Arrillga “Power System Harmonics”, John Wiely and Sons, 2003 2nd Edition.

3. Derek A.Paice “Power Electronic Converter Harmonics” IEEE Press, 1995, Wiley – IEE Press 1999, 18th Edition

4th Year, VII Semester, UG course Engineering (EEE)

Course code -ELP 707

HVDC TRANSMISSION AND FACTS

L T P CR. 30 0 3

Prerequisite: Power Electronics, Power System-II

COURSE OBJECTIVES:

To understand:

• The problems in AC transmission systems and DC transmission systems

• The operation and control of SVC and TCSC

• The concepts of IGBT based FACTS controllers

• The basic operation Line Commutated Converter (LCC) based HVDC links

• The features of voltage source converter based HVDC link.

Module I INTRODUCTION 9

Reactive power control in electrical power transmission lines–load & system compensation, Uncompensated transmission line–shunt and series compensation. Need for HVDC Transmission, Comparison between AC & DC Transmission, , Types of HVDC transmission System.

Module II STATIC VAR COMPENSATOR (SVC) AND THYRISTOR CONTROLLED SERIES COMPENSATOR (TCSC) 9

V-I characteristics of FC+TSR, TSC+TSR, Voltage control by SVC–Advantages of slope in dynamic characteristics–Influence of SVC on system voltage–Design of SVC voltage regulator, Thyristor Controlled Series Compensator (TCSC), Concept of TCSC, Operation of the TCSC– Different modes of operation, Applications:

Module III VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS 9

Static Synchronous Compensator (STATCOM)–Principle of operation–V-I Characteristics. Applications: Steady state power transfer-enhancement of transient stability-prevention of voltage instability. SSSC-operation of SSSC VI characteristics, Enhancement in Power transfer capability –, UPSC – Operation Principle Applications.

Module IV LINE COMMUTATED HVDC TRASMISSION 9

Operation of Gratz bridge - Effect of delay in Firing Angle – Effect of commutation overlap - Equivalent circuit,. Basic concept of HVDC transmission. Model of operations and control of power flow CC and CIA mode of operation

Module V VSC BASED HVDC TRANSMISSION 9

Basic 2 level IGBT inverter operation- 4 Quadrant operation- phase angle control- dq control- Control of power flow in VSC based HVDC Transmission, Topologies of MTDC system.

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

CO1: To Identify and understand the problems in AC transmission systems and understand the need for Flexible AC transmission systems and HVDC Transmission

CO2: To understand the operation and control of SVC and TCSC and its applications to enhance the stability and damping.

CO3: To Analyze basic operation and control of voltage source converter based FACTS controllers

CO4: To demonstrate basic operation and control of Line Commutated HVDC Transmission

CO5: To explain the d-q control based operation of VSC based HVDC Transmission

CO6: design and development of HVDC system

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3	1	--	--	--	--	--	--	--	2	3	3
CO2	3	3	1	2	3	--	--	--	--	--	--	--	2	3	3
CO3	3	3	1	3	1	--	--	--	--	--	--	--	2	3	3
CO4	3	3	1	2	3	--	--	--	--	--	--	--	2	3	3
CO5	3	3	1	3	1	--	--	--	--	--	--	--	2	3	3
CO6	3	3	1	3	2	--	--	--	--	--	--	--	2	3	3

TEXT BOOKS:

1. R.Mohan Mathur, Rajiv K.Varma ,"Thyristor–Based Facts Controllers for Electrical Transmission Systems", IEEE press andJohnWiley&Sons,Inc,2002.

2. NarainG.Hingorani, "Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors,Delhi-110006,2011.

REFERENCES:

1. K.R.Padiyar,"FACTS Controllersin Power Transmission and Distribution", New Age International (P) Limited, Publishers, New Delhi, 2008

2. A.T.John,"FlexibleA.C.TransmissionSystems",InstitutionofElectricalandElectronic Engineers(IEEE), 1999.

3. V.K.Sood, HVDC and FACTS controllers–Applications of Static Converters in Power System, APRIL2004,KluwerAcademic Publishers,2004.

4th Year, VII Semester, UG course Engineering (EEE)

Course code -EEP 704

ANTENNA AND WAVE PROPAGATION

L T P CR. 30 0 3

COURSE OBJECTIVES:

- Introduce the mechanism and models for radio-wave propagation
- Discuss the fundamental antenna parameters and numerical methods to analyse and differentiate the antennas
- Design antennas and study the radiation mechanism of various antennas and antenna arrays.
- Provide the principles of selection of Antennas for modern wireless applications.

Module I Antenna Fundamentals **8**

Introduction to antennas & its significance, Scalar electric potential, vector magnetic potential, radiation from an alternating current element, Induction field, radiation field, power radiated by a current element, Definition of electric dipole, radiation by a half wave dipole. Power by a half wave dipole & its radiation resistance, Radiation from a quarter wave monopole Power radiation and radiation resistance of dipole & monopole, Radiation resistance of aerials and loop, problems Isotropic radiator, network theorem, application of network theorem to antennas.

Module II Antenna Parameters **9**

Radiation pattern, power pattern, field pattern Radiation intensity, Antenna impedance, mutual impedance, gain and directivity, bandwidth, Polarization, efficiency, effective length, area or aperture, scattering loss, Collecting aperture, physical aperture, relation between large aperture and gain Effective aperture of a small elementary dipole, half wave antenna, effective length, front to back ratio, Antenna beamwidth and side lobes. Friss Transmission formula, Radar range equation**.**

Module III Design of Arrays **6**

N-element linear array- broadside array, End fire array, multiplication of patterns Effect of earth on vertical pattern mutual impedance effects, Binomial arrays, problem solving.

Module IV Practical antennas **8**

VLF, LF, MF transmitting antennas, resonant & non resonant antennas, V antenna, travelling wave antenna, Rhombic antenna, VHF &UHF antennas, horn antenna Folded dipole & Yagi-Uda antenna, Parabolic reflector antenna,, Corner reflector, Parabolic reflector antenna, Micro strip Antennas**.**

ModuleV Antenna impedance measurements **9**

Radiation pattern measurements Measurement of antenna beam width and gain, Polarization measurements. Measurement of radiation resistance. **Wave Propagation:** Types of wave propagation, space wave propagation and line of sight distance for flat and curved surfaces.

COURSE OUTCOMES:

After the completion of the course the student will be able to:

CO1 Understand the concept of radiation through mathematical formulation
CO2 Plot the characteristics of wire and aperture antennas
CO3 Develop the performance characteristics of array antennas
CO4 Measure the antenna parameters
CO5 Apply the concept of antenna in mobile communication
CO6 Design and development of antenna for communication

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	--	--	--	--	--	--	--	--	--	--	--	2	3	3
CO2	3	--	2	--	--	--	--	--	--	--	--	--	2	3	3
CO3	--	2	--	2	--	--	--	--	--	--	--	--	2	3	3
CO4	--	--	3	3	2	--	--	--	--	--	--	--	2	3	3
CO5	3	2	--	2	3	--	--	--	--	--	--	--	2	3	3
CO6	3	2	2.5	2.4	1.8	--	--	--	--	--	--	--	2	3	3

Text Books:

1. E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, PHI, 2007.
2. Antenna Theory: Analysis and Design, Constantine A. Balanis, John Wiley & Sons, 3rd Ed.,
2009.
3. David K. Cheng, "Field and Wave Electromagnetics", Pearson, 2e, 2014.
4. John D. Kraus, Antennas, 2nd Edition, McGraw Hill, 1988.
5. R.E. Collins, Antennas and Radio Propagation, Singapore: McGraw Hill, 1985.
6. David M. Pozar, "Microwave Engineering", Wiley, 4e, 2012.
7. Ahmed El Zooghby, 'Smart Antenna Engineering', ARTECH HOUSE, INC, 2005.
8. Frank B. Gross, 'Smart antenna with MATLAB', Second Edition, McGraw-Hill, 2015.

4th Year, VII Semester, UG course Engineering (EEE)

Course code -ELP 708

SMART GRID TECHNOLOGY

L T P CR. 30 0 3

COURSE OBJECTIVES:

- To understand the evolution of Smart and Interconnected energy systems.
- To understand the various challenges and benefits of smart grid and the national and international initiatives taken
- To understand the concepts related with transmission and distribution in smart grid technologies.
- To get an insight of the various smart measurement technologies.
- To understand the various computing technologies for Smart Operation of the Grid.

Module I INTRODUCTION **9**

Evolution of Energy Systems, Concept, Definitions and Need, Difference between Conventional & Smart Grid, Drivers, structures, functions, opportunities, challenges and benefits of Smart Grid, Basics of Micro grid, National and International Initiatives in Smart Grid.

Module II SMART METERING **9**

Introduction to Advanced Metering infrastructure (AMI) - drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Real time management and control, Phasor Measurement Unit (PMU).

Module III SMART GRID TECHNOLOGIES (Transmission) **9**

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, Wide area Monitoring, Protection and control.

Module IV SMART GRID TECHNOLOGIES (Distribution) **9**

DMS, Volt/VAr control, Fault Detection, Isolation and service restoration, Outage management, HighEfficiency Distribution Transformers, Phase Shifting Transformers, Electric Vehicles.

Module V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS **9**

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Computing technologies for Smart Grid applications (Web Service to CLOUD Computing), Role of big data and IoT, Cyber Security for Smart Grid.

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

CO1: To be able to understand the importance and objectives of Power System Grid.

CO2: To be able to know and understand the concept of a smart grid;

CO3: To identify and discuss smart metering devices and associated technologies.

CO4: To be able to get an overview of Microgrid and Electric Vehicle Technology.

CO5:To be able to have an up to date knowledge on the various computing technologies; to understand the role of Big Data and IoT for effective and efficient operation of Smart Grid.

CO6: Design and implementation of smart grid technology for practical application

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	--	--	1	--	--	--	2	3	3	--
CO2	3	3	2	3	3	--	--	1	--	--	--	2	3	3	--
CO3	3	3	2	3	3	--	--	1	--	--	--	2	3	3	--
CO4	3	3	2	3	3	--	--	1	--	--	--	2	3	3	--
CO5	3	3	2	3	3	--	--	1	--	--	--	2	3	3	--
CO6	3	3	2	3	3	--	--	1	--	--	--	2	3	3	--

TEXT BOOKS:

1. Smart Grids Advanced Technologies and Solutions, Second Edition, Edited by Stuart Borlase,CRC, 2018.

2. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, John Wiley,2012

3. James Momoh ,Smart Grid Fundamentals of Design and Analysis, IEEE press 2012.

REFERENCES:

1. Ahmed F. Zobaa, Trevor J. Bihl, Big data analytics in future power systems, 1st Edition, CRC press 2018.

2. C. Gungor et al., "Smart Grid Technologies: Communication Technologies and Standards," in IEEE Transactions on Industrial Informatics, vol. 7, no. 4, pp. 529-539, Nov. 2011.doi: 10.1109/TII.2011.2166794.

3. X. Fang, S. Misra, G. Xue and D. Yang, "Smart Grid — The New and Improved Power Grid: A Survey," in IEEE Communications Surveys & Tutorials, vol. 14, no. 4, pp. 944- 980, Fourth Quarter 2012. doi: 10.1109/SURV.2011.101911.00087.

4. Stuart Borlase “Smart Grid : Infrastructure, Technology and Solutions”, CRC Press 2012.

4th Year, VII Semester, UG course Engineering (EEE)

Course code -ELP 709

ELECTRICAL AND HYBRID VEHICLES

L T P CR. 30 0 3

COURSE OBJECTIVES:

- To learn the structure of Electric Vehicle, Hybrid Electric Vehicle
- To study about the EV conversion components
- To know about the details and specifications for Electric Vehicles
- To understand the concepts of Plug-in Hybrid Electric Vehicle
- To model and simulate all types of DC motors

Module I: Introduction to Hybrid Electric Vehicles and Conventional Vehicles 6

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

Module II: Hybrid Electric Drive-trains 6

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

Module III: Electric Propulsion Unit 9

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.

Module IV: Energy Storage 6

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, Electrical overlay harness and communications.

Module V: Sizing the Drive System 5

Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology.

Module VI Energy Management Strategies 13

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, Rule and optimization based energy management strategies (EMS). Case studies-Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1: Summarize the History and Evolution of EVs, Hybrid and Plug-In Hybrid EVs

CO2: Describe the various EV components

CO3: Describe the concepts related in the Plug-In Hybrid Electric Vehicles

CO4: Analyse the details and Specifications for the various EVs developed.

CO5: Describe the hybrid vehicle control strategy.

CO6: Design the hybrid electric vehicle and battery electric vehicle.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PS O2	PS O3
CO1	3	--	2		--		2	1	--	--	--	2	3	--	--
CO2	3	--	3	--	--	--	2	1	--	--	--	2	3	3	3
CO3	3	--	2	--	--	1	2	1	--	--	--	2	3	--	--
CO4	3	--	3	--	--	--	2	1	--	--	--	2	3	--	--
CO5	3	--	3	3	3	1	2	1	--	--	--	2	3	3	3
CO6	3	3	3	3	3	--	2	1	--	--	--	2	3	3	3

Text Books:

1. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications
with Practical Perspectives", , John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.

Reference Books:

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel
Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
2. T. Denton , "Electric and Hybrid Vehicles", Routledge, 2016.

4th Year, VII Semester, UG course Engineering (EEE)

Course code -ELO 710

SOFT OPTIMIZATION TECHNIQUES

L T P CR. 30 0 3

COURSE OBJECTIVE:

- This Course will provide exposure to theory as well as practical system and software practical systems and software using soft computing

Module I: Genetic Algorithm and Particle Swarm Optimization 15

Genetic algorithms- Genetic Algorithm versus Conventional Optimization Techniques – Genetic representations and selection mechanisms; Genetic operators- different types of crossover and mutation operators -Bird flocking and Fish Schooling – anatomy of a particle- equations based on velocity and positions -PSO topologies - control parameters. Application to SINX maximization problem.

Module II: Ant Colony Optimization and Artificial Bee Colony Algorithms 10

Biological ant colony system - Artificial ants and assumptions - Stigmergic communications – Pheromone updating- local-global - Pheromone evaporation - ant colony system- ACO models- Touring ant colony system-max min ant system - Concept of elistic ants-Task partitioning in honey bees - Balancing foragers and receivers - Artificial bee colony (ABC) algorithms-binary ABC algorithms.

Module III: Shuffled Frog-Leaping Algorithm and Bat Optimization Algorithm 10

Bat Algorithm- Echolocation of bats- Behavior of microbats- Acoustics of Echolocation- Movement of Virtual Bats- Loudness and Pulse Emission- Shuffled frog algorithm-virtual population of frogs comparison of memes and genes - memeplex formation- memeplex updation.

Module IV: Multi Objective Optimization 4

Application to multi-modal function optimization. Introduction to Multi- Objective optimization- Concept of Pareto optimality.

Module V: Evolutionary Computing 6

Evolutionary Computing, Simulated Annealing, Random Search, Downhill Simplex Search.

COURSE OUTCOMES:

CO1 Understand the concepts of population based optimization techniques
CO2 Examine the importance of exploration and exploitation in heuristic optimization techniques to attain near-global optimal solution

CO3 Evaluate the importance of parameters in heuristic optimization techniques
CO4 Apply for the solution of multi-objective optimization

CO5 Design hybrid system to revise the principles of soft computing in various applications

CO6 Design and development of electrical engineering problems using soft computing methods

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	2		--	--	--	--	--	2	3	--	--
CO2	3	3	3	1	2	--	--	1	--	--	--	2	3	3	3
CO3	3	3	2	1	2	1	--	1	--	--	--	2	3	--	--
CO4	3	3	3	1	2	--	--	1	--	--	--	2	3	--	--
CO5	3	3	3	1	2	1	--	1	--	--	--	2	3	3	3
Avg.	3	3	2.6	1	2	1	--	1	--	--	--	2	3	3	3

Text Books/Reference:

1. Xin-She Yang, "Recent Advances in Swarm Intelligence and Evolutionary Computation,Springer International Publishing, Switzerland, 2015.
2. Kalyanmoy Deb, Multi-Objective Optimization using Evolutionary Algorithms, John Wiley
& Sons, 2001.
3. James Kennedy and Russel E Eberheart, Swarm Intelligence, The Morgan Kaufmann Series
in Evolutionary Computation, 2001.
4. Eric Bonabeau, Marco Dorigo and Guy Theraulaz, Swarm Intelligence-From natural to
Artificial Systems, Oxford university Press, 1999.
5. David Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning,
Pearson Education, 2007.
6. Konstantinos E. Parsopoulos and Michael N. Vrahatis, Particle Swarm Optimization and
Intelligence: Advances and Applications, Information science reference, IGI Global, 2010.
7. N P Padhy, Artificial Intelligence and Intelligent Systems, Oxford University Press, 2005.

4th Year, VII Semester, UG course Engineering (EEE)

Course code -ELO 711

ILLUMINATION TECHNOLOGY

L T P CR. 30 0 3

COURSE OBJECTIVES:

- To understand the basic concept of different types of lamps
- To understand Illumination needs in various places
- To design and commission of lighting system

Module I: Ballast based Systems **6**

Introduction - Magnetic and Electronic Ballast – Dimming Electronic Ballast for Fluorescent lamps- Lamp Ballast interactions – Electronic Ballast for HID Lamps - Pulse start metal halide system,Compact Fluorescent lamp.

Module II: Solid State Lamps **13**

Introduction - Review of Light sources - white light generation techniques- Characterization ofLEDs for illumination application. Power LEDs- High brightness LEDs- Electrical and opticalproperties – LED driver considerations.Power management topologies- Thermal management considerations- Heat sink designphotometryand colorimetry - color issues of white LEDs- Dimming of LED sources –Designingusable lamp from white LEDs,- Luminaire design steps-SSL test standards. Dimming controlscheme - Lighting controls for LED lamps.

Module III: Lighting Controls & Management **8**

Introduction to lighting control – lighting control strategies - Energy Management strategies –Switching Control – sensor technology - occupancy sensors – PIR – Ultrasonic – location, coverage area & mounting configuration – special features

Module IV: Applications of Sensors **3**

Application. Photo sensors – spectral sensitivity – Photo sensor based control algorithms –Daylight-artificial light integrated schemes.

Module V: Commissioning of lighting controls **10**

NASHRAE / IESNA standards & energy codes – international energy conservation code – compliance with

controls Lighting Control Applications: Commercial lighting – stage and entertainment lighting –

Architectural lighting – Residential Lighting Energy Management and building control systems.

Course Outcomes:

After successful completion of the course, students should be able to:

CO1 Evaluate the characteristics of illumination sources/devices.
CO2 Understand and determine the performance of various lighting systems.
CO3 Design of lighting controls and management.
CO4 Understand the standards of lighting systems and commissioning.
CO5 Apply illumination engineering for commercial and house hold application

CO6 Design and development of commercial and residential lighting

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	1	--	--	--	--	--	2	3	--	--
CO2	3	3	2	1	1	--	--	1	--	--	--	2	3	3	3
CO3	3	3	2	1	1	--	--	1	--	--	3	2	3	--	--
CO4	3	3	2	1	1	--	--	1	--	--	--	2	3	--	--
CO5	3	3	2	1	1	1	--	1	--	--	--	2	3	3	3
CO6	3	3	2	1	1	1	--	1	--	--	--	2	3	3	3

Text Books/Reference:

1. Arturas Zukauskus, Michael S. Shur and Remis Gaska, “Introduction to solid state lighting”,Wiley- Interscience, 2002.
2. E. Fred Schubert, “Light Emitting Diodes” (2nd edition), Cambridge University Press, 2006.
3. Craig DiLouie, Advanced Lighting Controls: Energy Saving Productivity, Technology & Applications, Fairmont Press, Inc., 2006.
4. Mohan, Undeland and Robbins, “Power Electronics: Converters, Applications and Design”, John Wiley and Sons, 1989.
5. Steve Winder, “Power Supplies for LED Driving” Newnens Publication, 2008.
6. Robert S Simpson, Lighting Control: Technology and Applications, Focal Press, 2003.
7. IES Lighting Handbook, 10th Edition IESNA, 2011.

4th Year, VII Semester, UG course Engineering (EEE)

Course code -ELO 712

PROCESS INSTRUMENTATION AND CONTROL

L T P CR. 30 0 3

MODULE I: Introduction **7**

Special Characteristics of process systems: Large time constants, Interaction, Multi staging, Pure Lag; Control loops for simple systems: Dynamics and stability.

MODULE II: **10**

Generation of control actions in electronic pneumatic controller. Tuning of controllers Zeigler Nichols and other techniques. Different control techniques and interaction of process parameters e.g. Feed forward,cascade, ratio, Override controls. Batch and continuous process controls. Multi variable control. Feed forward control schemes.

MODULE III: **8**

Control valves, Valve positioners, Relief and safety valves, Relays, Volume boosters, Pneumatic transmitters for process variables. Various process schemes/ Unit operations and their control schemese.g. distillation columns , absorbers, Heat exchangers, Furnaces,Reactors, Mineral processing industries pH and blending processes.

MODULE IV: **12**

Measurement, control and transmission of signals of process parameters like flow, pressure, level and temperature.

MODULE V: **5**

Computer control of processes: Direct Digital Control, Supervisory Control and advanced control strategies.

Course Outcomes:

After successful completion of the course, students should be able to:

CO1 Evaluate the output of a digital system for a given input.

CO2 Describe the dynamics of a Linear, Time Invariant systems through difference equations.

CO3 Analyse different process controller

CO4 analyse control valve for different processes

CO5 Analyze digital systems using the Z-transformation, state space methods

CO6 Design digital controllers for physical systems.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	--	--	--	--	--	--	2	3	3	3
CO2	3	3	2	1	1	--	--	--	--	--	--	2	3	3	3
CO3	3	3	2	1	1	--	--	--	--	--	--	2	3	--	--
CO4	3	3	2	1	1	--	--	--	--	--	--	2	3	--	--
CO5	3	3	2	1	1	--	--	--	--	--	--	2	3	3	3
CO6	3	3	2	1	1	--	--	--	--	--	--	2	3	3	3

Text/Reference Books:

1. Stephananopoulos G- Chemical Process control- An Introduction to theory and practice,
PHI,1990
2. Luyben W L – Simulation and control for chemical engineers,1989, 2nd Edition, McGraw Hill,1989.

4th Year, VII Semester, UG course Engineering (EEE)

Course code -ELO 713

DIGITAL SIGNAL PROCESSING

L T P CR. 30 0 3

COURSE OBJECTIVES:

- To introduce the concept of analyzing discrete time signals & systems in the time andfrequency domain through mathematical representation.
- To study the various time to frequency domain transformation techniques.
- To Understand the computation algorithmic steps for Fourier Transform.
- To study about filters and their design for digital implementation.
- To introduce the programmable digital signal processor & its application.

Module I INTRODUCTION 6

Classification of systems: Continuous, discrete, linear, causal, stable, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect. Digital signal representation.

Module II DISCRETE TIME SYSTEM ANALYSIS 6

Z-transform and its properties, inverse z-transforms; difference equation ‑ Solution by z-transform, application to discrete systems - Stability analysis, frequency response ‑ Convolution ‑Introduction to Fourier Transform‑ Discrete time Fourier transform.

Module III DISCRETE FOURIER TRANSFORM & COMPUTATION 6

DFT properties, magnitude and phase representation - Computation of DFT using FFT algorithm ‑DIT & DIF - FFT using radix 2 ‑ Butterfly structure.

Module IV DESIGN OF DIGITAL FILTERS 6

FIR & IIR filter realization ‑ Parallel & cascade forms. FIR design: Windowing Techniques ‑ Needand choice of windows ‑ Linear phase characteristics. IIR design: Analog filter design – Butterworthand Chebyshev approximations; digital design using impulse invariant and bilinear transformation -Warping, prewarping -Frequency transformation.

Module V DIGITAL SIGNAL PROCESSORS 6

Introduction ‑ Architecture of one DSP processor for motor control ‑ Features ‑ AddressingFormats‑ Functional modes - Introduction to Commercial Processors

COURSE OUTCOMES:

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

CO1: Explain the concepts of digital signal processing

CO2: Illustrate the system representation using transforms

CO3: Learn the transformation techniques for time to frequency conversion

CO4: Analyse different digital FIR, IIR algorithm

CO5: Use digital signal processor for application development

CO6: Design suitable digital FIR, IIR algorithm for the given specification

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	2	2	1	--	--	--	--	--	--	2	1	2	1
CO2	2	3	3	2	2	--	--	--	--	--	--	2	2	3	1
CO3	3	3	3	3	3	--	--	--	--	--	--	2	2	2	2
CO4	3	3	3	3	3	--	--	--	--	--	--	2	2	2	3
CO5	3	3	3	2	1	--	--	--	1	--	--		2	2	3
CO6	3	3	3	2	2	--	--	--	1	--	--	2	2	2	2

TEXTBOOKS:

1. J.G. Proakis and D.G. Manolakis, ‘Digital Signal Processing Principles, Algorithms and Applications’, Pearson Education, New Delhi, 4th Edition 2007.

2. Robert J.Schilling & Sandra L.Harris ,’ Introduction to Digital Signal Processing using MATLAB’, Cengage Learning, 2nd Edition 2013.

REFERENCES:

1. Emmanuel C Ifeachor and Barrie W Jervis , Digital Signal Processing - A Practical approach” Pearson Education, Second edition, 2002.

2. Alan V. Oppenheim, Ronald W. Schafer and John R. Buck, ‘Discrete - Time Signal Processing’,Pearson Education, New Delhi, 2nd Edition 2012.

3. Sen M.kuo, Woonseng···s.gan, “Digital Signal Processors, Architecture, Implementations &Applications, Pearson, 1st Edition 2004.

4. S.K. Mitra, ‘Digital Signal Processing - A Computer Based Approach’, Tata McGraw Hill, NewDelhi, 4th Edition 2013.

5. B. Venkataramani, M. Bhaskar, ‘Digital Signal Processors, Architecture, Programming and Applications’, Tata McGraw Hill, New Delhi, 2003, 1st Edition.

4th Year, VII Semester, UG course Engineering (EEE)

Course code -ELO 714

ENERGY STORAGE SYSTEMS

L T P CR. 30 0 3

COURSE OBJECTIVES:

Students will be able to:

- understand the various types of energy storage Technologies.
- analyze thermal storage system.
- analyze different battery storage technologies
- analyze the thermodynamics of Fuel Cell
- study the various applications of energy storage systems.

Module I INTRODUCTION 9

Necessity of energy storage - types of energy storage - comparison of energy storage technologies - Applications.

Module II THERMAL STORAGE SYSTEM 9

Thermal storage - Types - Modeling of thermal storage units - Simple water and rock bed storage system - pressurized water storage system - Modelling of phase change storage system -Simple units, packed bed storage units - Modelling using porous medium approach, Use of TRNSYS.

Module III ELECTRICAL ENERGY STORAGE 9

Fundamental concept of batteries - measuring of battery performance, charging and discharging, power density, energy density, and safety issues. Types of batteries - Lead Acid, Nickel -Cadmium, Zinc Manganese dioxide, Li-ion batteries - Mathematical Modelling for Lead AcidBatteries - Flow Batteries.

Module IV FUEL CELL 9

Fuel Cell - History of Fuel cell, Principles of Electrochemical storage - Types - Hydrogen oxygencells, Hydrogen air cell, Hydrocarbon air cell, alkaline fuel cell, detailed analysis - advantages and disadvantages.

Module V ALTERNATE ENERGY STORAGE TECHNOLOGIES 9

Flywheel, Super capacitors, Principles & Methods - Applications, Compressed air Energy storage,Concept of Hybrid Storage - Applications, Pumped Hydro Storage - Applications.

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO1: Understand different types storage technologies

CO2: Design a thermal storage system

CO3: Model battery storage system

CO4: Analyze the thermodynamics of fuel cell

CO5: Analyze the appropriate storage technologies for different applications

CO6: explore the alternate energy storage technologies.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	--	--	--	--	--	--	--	--	--	--	2	--	3
CO2	3	--	2	--	--	--	--	--	--	--	--	--	2	--	3
CO3	3	--	2	--	--	--	--	--	--	--	--	--	2	--	3
CO4	3	--	2	--	--	--	--	--	--	--	--	--	2	--	3
CO5	3	--	2	--	--	--	--	--	--	--	--	--	2	--	3
CO6	--	3	--	--	--	2		1	--	--	--	--	2	--	3

TEXT BOOKS:

1. Ibrahim Dincer and Mark A. Rosen, 'Thermal Energy Storage Systems and Applications',John Wiley & Sons, 3rd Edition, 2021.

2. Ru-shi Liu, Lei Zhang and Xueliang sun, 'Electrochemical technologies for energy storageand conversion', Wiley publications, 2nd Volume set, 2012.

3. James Larminie and Andrew Dicks, 'Fuel cell systems Explained', Wiley publications, 3rdEdition, 2018.

REFERENCES:

1. Lunardini.V.J, 'Heat Transfer in Cold Climates', John Wiley and Sons 1981, 1stEdition.

2. Schmidt.F.W. and Willmott.A.J., 'Thermal Energy Storage and Regeneration',Hemisphere Publishing Corporation, 1981, 1st Edition.List of Open Source Software/ Learning website:

1. Prof. Subhasish Basu Majumder, "Electrochemical Energy Storage", NPTEL Course,https://nptel.ac.in/courses/113105102.

2. Prof. PK Das, "Energy conservation and waste heat recovery", NPTEL Course,https://nptel.ac.in/courses/112105221.

4th Year, VII Semester, UG course Engineering (EEE)

Course code -ELO 715

ELECTRICAL MACHINE AND POWER SYSTEMS

L T P CR. 30 0 3

Module I: Transformers **8**

Constructional features, types, Special constructional features – cruciform and multiple stepped cores, cooling methodology, conservators, breather, Buchholz relay, voltage, current and impedance relationships, equivalent circuits and phasor diagrams at no load and full load conditions, voltage regulation, losses and efficiency, all day efficiency, auto transformer and equivalent circuit, parallel operation and load sharing.

Module II: Asynchronous Machines **8**

General constructional features of poly phase asynchronous motors, concept of rotating magnetic field, principle of operation, phasor diagram, Equivalent circuit, torque and power equations, torque-slip characteristics, losses and efficiency.

Module III: Synchronous Machines **8**

General constructional features, armature winding, emf equation, effect of distribution and pitch factor, flux and mmf relationship, phasor diagram, non-salient pole machine, equivalent circuit, determination of equivalent circuit parameters by open and short circuit tests, voltage regulation using synchronous impedance method, power angle characteristics.

Module IV: Introduction to Power Systems **8**

Single line diagram of power system, brief description of power system elements, synchronous machine, transformer, transmission line, bus bar, circuit breaker and isolator. Supply System: different kinds of supply system and their comparison, choice of transmission voltage. Transmission Lines: configurations, types of conductors, resistance of line, skin effect.

Module V: Transmission Lines **8**

Calculation of inductance and capacitance of single phase, three phase, single circuit and double circuit, transmission lines, representation and performance of short, medium and long transmission lines, Ferranti effect, surge impedance loading.

Course Outcomes:

After successful completion of the course, students should be able to:

CO1 Understand the construction and principle of operation of transformers, auto transformers, asynchronous and synchronous machines.

CO2 Evaluate performance characteristics of induction machine and synchronous machines.

CO3 Analyze the effects of excitation and mechanical input on the operation of synchronous machine.

CO4 Understand different elements and supply systems of power systems.

CO5 Determine the parameters of transmission lines

CO6 Design and implementation of electrical systems

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	1	1	1	--	--	--	--	1	2	--	3
CO2	3	1	3	2	2	--	--	--	--	--	--	1	2	--	3
CO3	2	2	3	2	2	--	--	--	--	--	--	1	2	--	3
CO4	3	3	3	3	3	--	1	--	--	--	--	1	2	--	3
CO5	3	2	3	2	2	--	--	--	--	--	--	1	2	--	3
CO6	3	2	3	2	2	1	1	1	1	--	--	1	2	--	3

Text/Reference Books:

1. Fitzgerald. A.E., Charles KingselyJr, Stephen D.Umans, 'Electric Machinery', Tata McGraw Hill, 2006.
2. M.G. Say, 'Performance and Design of Alternating Current Machines', CBS Publishers,
New Delhi, 2008 Nagrath I. J and Kothari D.P. 'Electric Machines', Tata McGraw Hill
Publishing company Ltd, 2010.
3. Power System Analysis, J. Grainger and W.D. Stevenson, TMH, 2006.
4. Electrical Power Systems, C. L.Wadhwa, New age international Ltd. Third Edition,2010
5. Electric Power Generation, Transmission & Distribution, S.N.Singh, PHI Learning.

4th Year, VIII Semester, UG course Engineering (EEE)

Course code -EE801D

PROJECT II

L T P CR. 0 0 168

COURSE OBJECTIVES:

The student should be made to learn methodology to select a good project and able to work in a team leading to development of hardware/software product. prepare a good technical report. Gain Motivation to present the ideas behind the project with clarity.
A Project topic must be selected either from research literature or the students themselves may propose suitable topics in consultation with their guides. The aim of the project work is to deepen Comprehension of principles by applying them to a new problem which may be the design /fabrication of any power component / circuit / sensor / Activator / Controller, a research investigation, a computer or management project or a design problem. The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners constituted by the Head of the Department based on oral presentation and the project report.

COURSE OUTCOMES:

CO1 Ability to identify, formulate, design, interpret, analyse and provide solutions to complex engineering and societal issues by applying knowledge gained on basics of science and Engineering.

CO2 Ability to choose, conduct and demonstrate a sound technical knowledge of their selected project topics in the field of power components, protection, high voltage, electronics, process automation, power electronics and drives instrumentation and control by exploring suitable engineering and IT tools.

CO3 Ability to understand, formulate and propose new learning algorithms to solve engineering and societal problems of moderate complexity through multidisciplinary projects under standing commitment towards sustainable development.

CO4 Ability to demonstrate, prepare reports, communicate and work in a team as a member/leader by adhering to ethical responsibilities.

CO5 Ability to acknowledge the value of continuing education for oneself and to stay up with technology advancements.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	--	--	--	--	--	--	--	--	3	3	3
CO2	--	--	--	--	3	3	--	--	--	--	--	--	3	--	--
CO3	--	--	--	--	--	--	3	--	3	--	--	--	--	--	3
CO4	--	--	--	--	--	--	--	3	3	3	3	--	--	--	3
CO5	--	--	--	--	--	--	--	--	--	--	--	3	3	3	3