RADHA GOVIND UNIVERSITY
RAMGARH, JHARKHAND

Department of Electrical Engineering

Under Faculty of Engineering and Technology

Choice Based Credit System Curriculum for B.Tech in Electrical Engineering

(Effective from Academic Session 2025-26)

29/3/25

1st SEMESTER
COURSE CONTENTS

1st semester course structure

Sl. No.	Category	Course Code	Course Title	Hours Per Week			Credit	Marks		
				L	T	P		IA	ESE	Total
Theory										
1	Basic Science Course	BSC101	Physics I	3	1	0	4	30	70	100
2	Basic Science Course	BSC103	Mathematics – I	3	1	0	4	30	70	100
3	Engineering Science Courses/ Basic Science Course	ESC101/ BSC102	Basic Electrical Engineering/ Chemistry I	3	1	0	4	30	70	100
			Total(A)				**12**	**90**	**210**	**300**
Practical/Drawing/Design										
4	Engineering Science Courses	ESC102	Engineering Graphics & Design	1	0	4	3	25	25	50
5	Basic Science Course	BSC101P	Physics Lab	0	0	3	1.5	25	25	50
6	Engineering Science Courses/ Basic Science Course	ESC101P/ BSC102P	Basic Electrical Engineering Lab / Chemistry Lab	0	0	2	1	25	25	50
			Total(B)				**5.5**	**75**	**75**	**150**
			Grand Total(A+B)				**17.5**	**165**	**285**	**450**

L-Lecture, T-Tutorial, P-Practical
IA- Internal Assessment, ESE-End Semester Examination

29/3/25

2nd SEMESTER
COURSE CONTENTS

2nd semester course structure

Sl. No.	Category	Course Code	Course Title	Hours Per Week			Credit	Marks		
				L	T	P		IA	ESE	Total
Theory										
1	Basic Science Course	BSC105	Physics -II	3	1	0	4	30	70	100
2	Engineering Science Courses/ Basic Science Course	ESC101/ BSC102	Basic Electrical Engineering/ Chemistry I	3	1	0	4	30	70	100
3	Basic Science Course	BSC104	Mathematics – II	3	1	0	4	30	70	100
4	Engineering Science Courses	ESC103	Programming for Problem Solving	3	1	0	4	30	70	100
5	Humanities and Social Sciences including Management Courses	HSMC101	English	2	0	2	3	30	70	100
Total(A)							**19**	150	350	500
Practical/Drawing/Design										
6	Engineering Science Courses	ESC104	Workshop/ Manufacturing Practices	1	0	4	3	25	25	50
7	Engineering Science Courses/ Basic Science Course	ESC101P/ BSC102P	Basic Electrical Engg. Lab / Chemistry Lab	0	0	2	1	25	25	50
8	Engineering Science Courses	ESC103P	Programming for Problem Solving	0	0	2	1	25	25	50
Total(B)							**5**	**75**	**75**	**150**
Grand Total(A+B)							**24**	**225**	**425**	**650**

L-Lecture, T-Tutorial, P-Practical
IA- Internal Assessment, ESE-End Semester Examination

29/3/25

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

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		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	4	1	0	4
6		BSE	BSC302	Environmental Science	2	0	0	0
	Third							**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		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
				LABORATORIES				**Total (A) = 15 Credits**
7	**Fourth**	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 (A) + (B) = 21 Credits						
		Grand Total for Second Year = 42Credits.						

29/3/25

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

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		Program Course (PC)	ELC501	Electrical Machine-II	4	1	0	4
2		PC	ELC502	Principles of Control Systems	3	1	0	3
3		PC	ELC503	Microprocessor and Microcontroller	3	1	0	3
4		PC	EC301	Professional Elective-I	3	1	0	3
5		PC	BSC301	Open Elective-I	3	1	0	3
								Total (A) = 16 Credits
	FIFTH	**LABORATORIES**						
6		GE	EC301P	Electrical Machine-II Lab	0	0	3	1
7		PC	EE301P	Principles of Control Systems Lab	0	0	3	1
8		PC	EE302P	Microprocessor and Microcontroller Lab	0	0	3	1
9		PC	EX301	Basic Computational Lab	0	0	2	1
10		HSS	HS301	General Proficiency/Seminar	0	0	2	2
								Total(B) = 6 Credits
Grand Total (A) + (B) = 22 Credits								
				Theory				
1		PC	ELC601	Power Systems-II	4	1	0	4
2		PC	ELC602	Power Electronics	3	1	0	3
3		PC	ELC603	Advanced Control Systems	3	1	0	3
4		PC	EC403	Professional Elective-II	3	1	0	3
5		PC	CS301	Open Elective-II	3	0	0	3
				LABORATORIES				**Total (A) = 16 Credits**
6		Engineering Science Courses	EL601P	Power System-II Lab	0	0	3	1
7	**SIXTH**	GE	EL602P	Power Electronics Lab	0	0	3	1
8		GE	EL603P	Simulation Lab	0	0	3	1
9			EL604P	Electrical Workshop	0	0	2	1
10			EL6051	Internship/Tour & Training/Industrial Training	0	0	0	2
								Total(B) = 6 Credits
		Grand Total (A) + (B) = 22 Credits						

Grand Total for Second Year = 44 Credits.

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

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		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
	Seventh							**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		Project	EE801D	Project-II	0	0	16	8
	Eighth							**Total = 8 Credits**
		Grand Total for Fourth Year = 28 Credits.						

Professional Electives and Open Electives Courses offered by Department of EE

Table 1: Professional Electives

Professional Elective-I V SEM	
ELP504	Signals & Systems
ELP505	Electrical Machine Design
ELP506	Transforms in Electrical Engineering
ELP507	Applied Electrical Engineering

Professional Elective-II VI SEM	
ELP604	Electrical Estimation and Costing
ELP605	Electrical Engineering Materials
ELP606	Power System Restructuring
ELP607	Green Energy Technology

Sl. No.	**Code**	**Professional Elective-III (Any one) VII SEM**	**Code**	**Professional Elective-IV(Any one) VII SEM**
1	ELP702	Electrical Drives and Control	ELP706	High Power Converters
2	ELP703	Utilization of Electrical Power	ELP707	HVDC Transmission and FACTS
3	ELP705	Power Quality	ELP709	Electrical and Hybrid Vehicles
4	ELP704	Power System Dynamics and Control	ELP708	Smart Grid Technology

Table 2: Open Electives

Open Elective-I V SEM	
EL0508	Power Plant Engineering
EL0509	Industrial Instrumentation and Automation
EL0510	Principles of Control Systems*
ELO511	Electromechanical Energy Conversion and Transformers*
Any paper floated by the other department can be selected/ opted by the Electrical Engineering Students	

***This course is not offered to Electrical Engineering students.**

Nishma Rupesh

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Open Elective-II VI SEM	
EL0608	Advanced Control Systems*
EL0609	Soft Computing Techniques
EL0610	Power Electronics*
EL0611	Mine Electrical Engineering*
ELO612	Green Energy Technology*
Any paper floated by the other department can be selected/ opted by the Electrical Engineering Students	

***This course is not offered to Electrical Engineering students.**

Sl. No.	Code	Open Elective-III (Any one) VII SEM	Code	Open Elective-IV (Any one) VII SEM
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

RADHA GOVIND UNIVERSITY
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JHARKHAND

Syllabus

For

B.Tech

In

Electrical Engineering

RADHA GOVIND UNIVERSITY
RAMGARH,
JHARKHAND

Syllabus

For

B.Tech 1st& 2nd Semester

In

Electrical Engineering

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	ES C10 1P/ BS C10 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.

RADHA GOVIND UNIVERSITY
RAMGARH, JHARKHAND

Syllabus

For

B.Tech 2nd Semester

In

Electrical Engineering

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.

RADHA GOVIND UNIVERSITY

RAMGARH, JHARKHAND

Syllabus

For

B.Tech 3rd & 4th Semester

In

Electrical Engineering

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

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
		LABORATORIES						**Total (A) = 16 Credits**
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
Grand Total (A) + (B) = 21 Credits								**Total(B) = 5 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
				LABORATORIES			**Total (A) = 15 Credits**	
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 (EE)

Total Credits 21

BSC301 MATHEMATICS III

Module-1: **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-2: **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-3: **6**

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

Module-4: **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-5: **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.

Note-Question no.1 will be compulsory, objective type with 7 sub-parts comprising of the whole syllabus.

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. Ter Morsche, 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

• R. J. Beerends ,H. G. Ter Morsche ,J. C. Van Den Berg, E. M. Van De Vrie, Fourier and Laplace Transforms, Cambridge University Press.

• Sastry S.S, Introductory Methods of Numerical Analysis, PHI.

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

BASIC ELECTRONICS (ECE, EE, 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 & Vandana Sachdeva, Paragaon International Publication

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

Course code -EE 301

ELECTRICAL MACHINES-I (EE, 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

Module I ELECTRO-MECHANICAL ENERGY CONVERSION 9

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 9

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 IVTHREE 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 IVTHREE 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 (EE)

Course code -EE 302

NETWORK THEORY(EE, EE, ECE)

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 Network Theorem: Substitution theorem, Tellegen's theorem, Reciprocity theorem. **3**

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 (EE)

Course code -EE 303
ELECTROMAGNETIC FIELD THEORY (ECE, EE, 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 fields and 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: Analyze Field due to discrete and continuous charges

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	3	2
CO6	3	2	1	1	--	--	1	1	--	--	--	1	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 (EE)

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 stepfunction and impulse function Inverse Laplace Transformation, Convolution Theorem,Applications of Laplace transforms in solving certain initial value problems & simultaneous differentialequations.

Module-II **10**

Numerical Method: Finite difference, Symbolic relations, Interpolation and Extrapolation,Newton- Gregory forward and backward formula, Lagrange's formula, Inverse Interpolation byLagrange's formula. Numerical Differentiation and Numerical Integration, Newton CotesQuadrature 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 ZTransformation.

Module-IV **8**

Fourier Series & Fourier Transform: Expansion of - Algebraic, Exponential &Trigonometricfunctions 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 methodSolution 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: Explain different types of Z Transformation.

CO6: Explain the concept of Laplace 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	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	--	--	--	1	3	3	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. Ter Morsche, 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. Ter Morsche ,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 (EE)

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, environmentalsegment and their importance.

Module-II **6**

Ecology: Ecosystem and its characteristics features, structure and function of forest ecosystemgrassland ecosystem, desert ecosystem and aquatic ecosystem, ecologicalbalance and consequences of imbalance.

Module-III **4**

Atmosphere: Atmospheric composition, energy balance, climate, weather, depletion ofozonelayer,greenhouse effect, acid rain, particles, ions and radicals in the atmosphere, chemical andphotochemical reactions in the atmosphere.

Module-IV **4**

Air pollution and control: Air pollutants, sources and effect of air pollutants, primary and secondarypollutants, photochemical smog, fly ash, inorganic and organic particulate matter. Air qualitystandards, sampling, monitoring and control measures for pollutants.

Module-V **4**

Water pollution and control: Aquatic environment, water pollution, sources and their effect, lakeand 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, soilerosion, landslides, desertification, pollutants (municipal, industrial, commercial, agricultural, hazardous solid wastes), origin and effects, collection and disposal of solid wastes, recoveryand 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 To describe and explain the components and interactions within various environmental 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	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	--	--	1	1	--	--	--	1	3	3	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 (EE)

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

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.
CO6: Identify and describe different types of electrical machines

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

Course code -EE 302P

NETWORK THEORY LAB (ECE, EE, 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

CO6:Identify and describe basic electrical components and elements used in networks

RADHA GOVIND UNIVERSITY

RAMGARH, JHARKHAND

Syllabus
For
B.Tech 4th Semester
In
Electrical Engineering

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

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: Analyze voltage sag problems and suggest preventive 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	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	--	--	--	--	--	--	--	--	3	3	2

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. Arun Ingole, "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. Hadi Saadat, ‘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 (EE)

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: Select various transducers for the measurement of physical quantities like temperature, pressure, distance and displacement

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	--	1	--	--	--	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	--	2	--	1	--	--	--	1	3	3	2

TEXT BOOKS:

1. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai 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 (EE)

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 (EE)

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-maprepresentations - minimization using K maps - simplification and implementation ofcombinational 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 Booleanexpressions.

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 (EE)

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

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

Module V
Hashing techniques, Hash function, Address calculation techniques- common hashing functionsCollision 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

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, Sartaj Sahni

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 (EE)

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

Module I:
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:
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:
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:
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:
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 (EE)

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

COURSE OBJECTIVES:

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

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

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

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

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: Analyze personal finances and investments in a fashion similar to corporate project finances

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	1	2	1	2	2	--	1	--	1	2	1	3	2	2	3

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 (EE)

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 (EE)

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 (EE)

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

RADHA GOVIND UNIVERSITY
RAMGARH, JHARKHAND

Detailed Syllabus

In

5th & 6th Semester

Department of Electrical Engineering

Course structure of Electrical Engineering

Semester -5'

Branch: Electrical Engineering

S.No	Course Code	Subject	L	T	P	Credit
01	**ELC501**	Electrical Machine-II	3	1	0	**4**
02	**ELC502**	Principles of Control Systems	2	1	0	3
03	**ELC503**	Microprocessor and Microcontroller	2	1	0	3
04		Professional Elective-I	2	1	0	3
05		Open Elective-I	2	1	0	3
	Laboratory/sessional					
01	**EL501P**	Electrical Machine-II Lab	0	0	2	**1**
02	**EL502P**	Principles of Control Systems Lab	0	0	2	**1**
03	**EL503P**	Microprocessor and Microcontroller Lab	0	0	2	**1**
04	**EL504P**	Basic Computational Lab	0	0	2	**1**
05	**EL505G**	General Proficiency/Seminar	0	0	2	2
Total Credits						**22**

Professional Elective-I	
ELP504	Signals & Systems
ELP505	Electrical Machine Design
ELP506	Transforms in Electrical Engineering
ELP507	Applied Electrical Engineering

Open Elective-I	
EL0508	Power Plant Engineering
EL0509	Industrial Instrumentation and Automation
EL0510	Principles of Control Systems*
ELO511	Electromechanical Energy Conversion and Transformers*
Any paper floated by the other department can be selected/ opted by the Electrical Engineering Students	

***This course is not offered to Electrical Engineering students.**

Course structure of Electrical Engineering

Semester -6th

Branch: Electrical Engineering

S.No	Course Code	Subject	L	T	P	Credit
01	ELC601	Power Systems-II	3	1	0	4
02	ELC602	Power Electronics	2	1	0	3
03	ELC603	Advanced Control Systems	2	1	0	3
04		Professional Elective-II	2	1	0	3
05		Open Elective-II	2	1	0	3
06						
	Laboratory/ Sessional					
01	EL601P	Power System-II Lab	0	0	2	1
02	EL602P	Power Electronics Lab	0	0	2	1
03	EL603P	Simulation Lab	0	0	2	1
04	EL604P	Electrical Workshop	0	0	2	1
05	EL605I	Internship/Tour & Training/Industrial Training	0	0	2	2
Total credit						22

Professional Elective-II	
ELP604	Electrical Estimation and Costing
ELP605	Electrical Engineering Materials
ELP606	Power System Restructuring
ELP607	Green Energy Technology

Open Elective-II	
EL0608	Advanced Control Systems*
EL0609	Soft Computing Techniques
EL0610	Power Electronics*
EL0611	Mine Electrical Engineering*
ELO612	Green Energy Technology*
Any paper floated by the other department can be selected/ opted by the Electrical Engineering Students	

***This course is not offered to Electrical Engineering students.**

ELC501 **Credit**

Electrical Machine-1I

3 l 4

DETAILED SYLLABUS

Module I: Fundamentals of A.C. Machines (08 Lectures)

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 (16 Lectures)

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, MME= method, ZPF method, power angle characteristics.

Theory of salient pole machine: Blondel'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's.

Module-III: Synchronous motor (08 Lectures)

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 motors (07 Lectures)

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 (03 Lectures)

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

Course Outcomes:

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

CO's	CO Description
CO1	Apply rotating machine fundamentals for construction and operation of Synchronous machines and Single Phase motors.
CO2	Analyze the characteristics and performance of synchronous machines, transformers and single phase motors
CO3	Compare various methods for finding voltage regulation of alternators.
CO4	Understand the concepts of rotating magnetic fields.
CO5	Importance of application of electrical Ac machines.
CO6	Demonstrate working of single and three phase AC machines.

CO's PO's Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3	3	-	-	3		1	1				2
CO2	3	3	2	3	3		1	1				2
CO3	3	3	2	3	3		1	1				2
C04	3	3	3	3	3		1	1				2
CO5	3	3	2	3	3		1	1				2
CO6	3	3	2	3	3		1	1				2

Text Books:

1lI.Electric Machines by 13.Nagrath & D.P.Kothari,Tata Mc Craw Hill. 7th FAiition.2005

121, Electrical machines by PS Bhimbra, Khanna Publishers.

t3]. Electric machinery by A.L. Fitzgerald, C.Kingsiey and SAJmans, Mc **Gram, Hi Companies, 5^{11} edition.**

[4].Electric Machinery Fundamentals **by Stephen Chapman Mc Graw Hilt** C:ompany,

Reference Books:

[1].Theory of Alternating Current Machinery- by Langsdorf, Tata McGraw-Hill Companies. 2r^{d} edition.

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

ELC502 **L T Credit**

Principles of Control System

2 1 3

DETAILED SYLLABUS

Module I: Introduction to Principles of Control System (8 Lectures)

Concept of systems and its classification; open-loop and closed-loop control system, benefits of feedback, mathematical modeling and representation of physical systems, analogous systems.

Transfer functions for different types of systems, block diagrams and its reduction techniques, Signal flow graphs and Mason's gain formula.

Module II: Time domain and Frequency domain (10 Lectures)

Time domain performance criterion, transient response of first order and second order systems; Steady state errors and error constants of different types of system; dynamic error constant: Derivation and its advantages; sensitivity; performance analysis for P, PI and PD controllers**.**

Module III: Stability Criterion (8 Lectures)

Concept of stability by Routh stability criterion. Stability analysis using root locus. Bode plot analysis. Absolute and Relative stability. Definition and computation of Gain Margin and Phase Margin. Comparison between time and frequency response plot.

Module IV: Stability Criterion Continued (6 Lectures)

Frequency response Polar plots and its stability criterion. Relative stability, Nyquist criterion; Graphical approach for gain and phase margin using polar plot; Advantages and disadvantages of frequency response plot.

Module V: Compensation design (4 Lectures)

Compensation - lag, lead and lag-lead networks, Compensation designs of networks using time domain analysis and frequency response analysis.

Module VI: State Space Analysis (6 Lectures)

Concepts of state, state variables, state space representation of systems, dynamic equations, transient matrix, merits for higher order differential equations and its solution; Concept of controllability and observability.

Course Outcomes:

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

CO's	CO Description
CO1	Analyzeelectromechanical systems by mathematical modeling.
CO2	DetermineTransient and Steady State behavior of systems using standard test signals.
CO3	Analyze linear systems for steady state errors, absolute stability and relative Stability using time domain and frequency domain techniques.
CO4	Identify and design a control system satisfying specified requirements.
CO5	Formulate different types of analysis in frequency domain to explain the nature of stability of t
CO6	Employ time domain analysis to predict and diagnose transient performance parameters of the

CO's PO's Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3	3	-	-	3		1	1				2
CO2	3	3	2	3	3		1	1				2
CO3	3	3	2	3	3		1	1				2
C04	3	3	3	3	3		1	1				2
CO5	3	3	2	3	3		1	1				2
CO6	3	3	2	3	3		1	1				2

Suggested Readings:

[1]. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009

[2]. B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.

[3]. K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.

[4]. H. Saeed, "Automatic Control System", S. K. Kataria & Sons, 2008.

[5]. S. K. Bhardwaj and S. K. Nagar, "Modern Control System with Advance Topics", New Age International, 2019.

ELC503 **L T Credit**

Microprocessor & Microcontroller

2 1 3

DETAILED SYLLABUS

Module-I **(6 Lectures)**

Brief introduction to 8085 CPU Architecture, Pin configuration, Addressing Modes, Registers, Memory Addressing, Instructions Set.

Module-II **(10 Lectures)**

THE 8086 ARCHITECTURE: Pin diagram of 8086 and description of various signals. Architecture block diagram of 8086 & description of sub-blocks such as EU & BIU & of various registers; Description of address computations & memory segmentation; addressing modes; Instruction formats.

Module-III **(4 Lectures)**

Interfacing of memory and peripherals with microprocessor, Architecture and modes of operation of 8255.

Module-IV **(10 Lectures)**

Microcontrollers— Type, processor architecture memory type, hardware features, 8051 Processor architecture, Memory mapping.

Addressing modes, 8051 Instruction Set — Data movement Instruction, arithmetic instruction, Logic instruction, Branch group Instruction

Module-V **(10 Lectures)**

Addressing modes, 8051 Instruction Set — Data movement Instruction, arithmetic instruction, Logic instruction, Branch group Instruction. 8051 microcontroller: Memory interfacing and address decoding, programming Input/ Output port/ timer programming and Serial data communication controller.

Course Outcomes:

After successful completion of the course students will be able to:

CO's	CO Description
CO1	**Categorize** the basic concepts of microprocessor & microcontrollers
CO2	**Interpret** different addressing modes and types of registers in processor or controller
CO3	**Execute** simple programs on microprocessor & microcontroller
C04	**Illustrate** how the different peripherals are interfaced with 8086 microprocessor
CO5	**Illustrate** how memory or I/O interfaced with 8051 microcontroller
CO6	Evaluate assembly language programs and download the machine code that will provide

CO's-PO's Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	2	1										
CO2	2	2	2									
CO3	3	3	3	2					1			2
C04	3		2	2	2				1			2
CO5	3		2	2	2				1			2
CO6	3	3	2	3	3		1	1				2

Suggested Readings:

[1].Brey , The Intel Microprocessors 8086- Pentium processor, PHI

[2].Badri Ram, Advanced Microprocessors and Interfacing, TMH

[3].Triekel & Singh, The 8088 & 8086 Microprocessors-Programming, Interfacing, Hardware &Applications: PHI.

[4].D. B. Hall , Microprocessor and Interfacing, McGraw Hill

[5].M. A. Mazidi & J. G. Mazidi,The 8051 Microcontroller & Embedded System, Pearson Education.

ELP504 **L T Credit**

Signals And Systems

2 1 3

DETAILED SYLLABUS

Module I **(5 Lectures)**

Introduction to signals and systems - Classification of signals - Basic operations on signals — Elementary signals - Concept of system - Properties of systems - Stability, invertability, time invariance - Linearity - Causality - Memory - Time domain description - Convolution - Impulse response.

Module II **(5 Lectures)**

Representation of LTI systems - Differential equation and difference equation representations of LTI systems, Continuous Time LTI systems and Convolution Integral, Discrete Time LTI systems and linear convolution.

Module III **(5 Lectures)**

Frequency Domain Representation of Continuous Time Signals- Continuous Time Fourier Series: Convergence. Continuous Time Fourier Transform: Properties.

Module IV **(9 Lectures)**

Frequency Domain Representation of Discrete Time Signals- Discrete Time Fourier Transform: Properties, Sampling Theorem, aliasing, reconstruction filter, sampling of band pass signals. Fourier Series Representation of Discrete Time Periodic Signals.

Module V **(10 Lectures)**

Laplace Transform — ROC — Inverse transform — properties — Analysis of Continuous LTI systems using Laplace Transform — unilateral Laplace Transform. Relation between Fourier and Laplace Transforms.

Laplace transform analysis of systems - Relation between the transfer function and differential equation - Causality and stability - Inverse system - Determining the frequency response from poles and zeros.

Module VI **(8 Lectures)**

Z Transform - Definition - Properties of the region of convergence - Properties of the Z transform - Analysis of LTI systems - Relating the transfer function and difference equation - Stability and causality - Inverse systems - Determining the frequency response from poles and zeros.

Course Outcomes:

After successful completion of the course students will be able to:

CO's	CO Description
CO1	Understand the concepts of continuous time and discrete time systems.
CO2	Analyze systems in complex frequency domain.
CO3	Understand sampling theorem and its implications
CO4	Convolution operator for continuous and discrete time system
CO5	The ability to analyze the system in s- domain
CO6	The ability to find correlation, CDF, PDF and probability of a given event

CO's-PO's Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3	3	3	1								2
CO2	3	2	3	1								2
CO3	3	3	3	2								2
CO4	2	2	2									
CO5	3	3	3	2					1			2
CO6	3		2	2	2				1			2

Suggested Readings:

[1].Haykin. S., Venn B. V. Signals and Systems

[2]. Oppenheim A.V., Willsky A.S. &Nawab S.H., Signals and Systems, Tata McGraw Hill

[3]. Taylor F.H, Principles of Signals and Systems, McGraw Hill

References

[1].Bracewell R.N., Fourier Transform & Its Applications, McGraw Hill

[2].Haykin S., Communication Systems, John Wiley

[3].Lathi B.P., Modern Digital& Analog Communication Systems, Oxford University Press

[4].Papoulis A., Fourier Integral & Its Applications, McGraw Hill

ELP505 **L T Credit**

Electrical Machine Design

2 1 3

DETAILED SYLLABUS

Module I: Factors in Design (8 Lectures)

Specifications for machines, output equation, limitations in design, electric and magnetic loadings, space factor, winding factor and their effects on machine performance, mechanical and high speed problems.

Module II: Design of Poly phase Asynchronous Machines (10 Lectures)

Details of construction, stator design, output equation, separation of D and L ,specific loadings, leakage reactance, rotor design, slip ring and squirrel cage motors, harmonic effects and slot combination, magnetizing current and losses, prediction of characteristics.

Module III: Design of Synchronous Machines (10 Lectures)

Details of construction, generators, salient and non-salient pole machines, specific loadings and output equation, stator design, harmonics and reduction, armature reaction, design of field winding, short circuit ratio, voltage regulation, efficiency, differences in design between salient and non-salient pole machine.

Module IV: Design of Transformers (8 Lectures)

Design of single and three phase transformers, output equation, specific loadings, electro mechanical stresses on windings, no load current, temperature rise.

Module V: Thermal aspects of Design (6 Lectures)

Generation, flow and dissipation of heat losses, thermal capacity, temperature rise curves, ratings of machines, cooling media, ventilation, types of cooling, standard enclosures.

Course Outcomes:
After successful completion of this course, student should be able to:

CO's	CO Description
CO1	**Understand** the construction and performance characteristics of electrical machines.
CO2	**Understand** the various factors which influence the design: electrical, magnetic and thermal loading of electrical machines.
CO3	**Understand** the principles of electrical machine design and carry out a basic design of an ac machine
C04	**Analyze** design aspects of rotating electrical machines.
CO5	**Use** software tools to do design calculations.
CO6	Apply network theorems for the analysis of electrical circuits.

CO'sPO's Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3	2	2	2	2							2
CO2	3	2	2	2	2							2
CO3	3	3	3	2	2							2
CO4	3	3	3	2	2							2
CO5	3	3	2	2	2							2
CO6	3		2	2	2				1			2

Suggested Readings:

[1].A.K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, 1970.

[2].M.G. Say, "Theory & Performance & Design of A.C. Machines", ELBS London.

[3].Ion Boldea, Syed A. Nasar, "The Induction Machines Design Handbook", CRC Press.

[4]. Juha Pyrhonen, Tapani Jokinen, Valeria Hrabovcova, "Design of Rotating Electrical Machines",Wiley

[5].K. M. V. Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications, 2008.

ELP506 **L T Credit**

Transforms in Electrical Engineering

2 1 3

DETAILED SYLLABUS

Module I: Discrete-Time Signals (4 Lectures)

Concept of discrete-time signal, basic idea of sampling and reconstruction of signal, sampling theorem, sequences,-periodic, energy, power, unit-sample, unit step, unit ramp &complex exponentials, arithmetic operations on sequences..

Module II: LTI Systems (6 Lectures)

Definition, representation, impulse response, derivation for the output sequence, concept of convolution, graphical, analytical and overlap-add methods to compute convolution supported with examples and exercise, properties of convolution, interconnection of LTI systems with physical interpretations, stability and causality conditions, recursive and non-recursive systems.

Module III: Discrete Fourier Transform (10 Lectures)

Concept and relations for DFT/IDFT, Relation between DTFT & DFT. Twiddle factors and their properties, computational burden on direct DFT, DFT/DFT as linear transformation, DFT/IDFT matrices, computation of DFT/IDFT by matrix method, multiplication of DFTs, circulation convolution, computation of circular convolution by graphical, DFT/IDFT and matrix methods, linear filtering using DFT, aliasing error, filtering of long data sequencesOverlap-Save and Overlap-Add methods with examples and exercises.

Module IV: Discrete Time Fourier Transform (5 Lectures)

Concept of frequency in discrete and continuous domain and their relationship (radian and radian/sec), freq. response in the discrete domain. Discrete system's response to sinusoidal/complex inputs (DTFT), Representation of LTI systems in complex frequency domain.

Module V: Fast Fourier Transforms (4 Lectures)

Radix-2 algorithm, decimation-in-time, decimation-in-frequency algorithm, signal flow graph, Butterflies, computations in one place, bit reversal, examples for DIT & DIF FFT Butterfly computations and exercises.

Module VI: Z- Transforms (8 Lectures)

Definition, mapping between s-plane & z-plane, unit circle, convergence and ROC, properties of Z-transform, Z-transform on sequences with examples & exercises, characteristic families of signals along with ROC, convolution, correlation and multiplication using Z- transform, initial value theorem, Parseval's relation, inverse Z transform by contour integration, power series & partial-fraction expansions with examples and exercises.

Module VII: Filter Design (5 Lectures)

Basic concepts of **IIR** and FIR filters, difference equations, design of Butterworth IIR analog filter using impulse invariant and bilinear transform, design of linear phase FIR filters no. of taps, rectangular, Hamming and Blackman windows. Effect of quantization.

Course Outcomes:

After successful completion of the course students will be able to:

CO's	Description
CO1	Understand the concepts of continuous time and discrete time systems.
CO2	Understand the concepts of different discrete transforms.
CO3	Analyze systems in complex frequency domain.
CO4	Design of different types of filters.
CO5	Analyze the effect of switching conditions on Electrical circuits using Differential equations.
CO6	Analyze Electrical circuits using Graph Theory

CO's-PO's Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3	3	3	1								2
CO2	3	2	3	1								2
CO3	3	3	2	2								2
CO4	3	2	2	2								2
CO5	3	2	3	1								2
CO6	3	3	2	2								2

Suggested Readings:

[1].Digital Signal Processing-A computer based approach, S. Mitra, TMH

[2]. Digital Signal Processing: Principles, Algorithms & Application, J.C. Proakis& M.G. Manslakis, PHI

[3].Fundamental of Digital Signal Processing using MATLAB , Robert J. Schilling, S.L. Harris, Cengage Learning.

[4]. Digital Signal Processing-implementation using DSP microprocessors with examples from TMS320C54XX, Avtar Singh & S. Srinivasan, Cengage Learning.

Reference Books

[1].Digital Signal Processing, Chen, OUP

[2].Digital Signal Processing, Johnson, PHI

[3].Digital Signal Processing using MATLAB, Ingle, Vikas.

ELP 50'7 **L T Credit**

Applied Electrical Engineering

2 1 3

DETAILED SYLLABUS

Module I: Model of Physical Systems (8 Lectures)

Introduction to physical systems: Mass-spring-damper system, accelerometer, rotational mechanical system, gear trains, liquid level system; Circuit models: RL, RC, LC, RLC series and parallel circuits with sinusoidal and non-sinusoidal excitations, diode rectifier.

Module II: Solution of Differential Equations (12 Lectures)

Systems of linear equations, homogeneous and non-homogeneous linear equations, Polynomial equations, least squares fit; ordinary differential equations: Euler' s rrahttd, Runge method, Newton-Raphson method, Predictor-Corrector methods; Numerical integration:

Forward and backward integration rules, Trapezoidal rule, Simpson's rule, Errors of integration.

Module III: Simulation Techniques (6 Lectures)

Continuous state simulation: circuit level simulators, Discrete-event simulation: Fixed time step, variable time step; Response analysis of circuits: DC analysis, AC Analysis, Transient analysis.

Module IV: Programming in MATLAB (8 Lectures)

Programming a function, repetitive and conditional control structures, Iterative solution of equations, polynomial interpolation; Plotting and analysis: two-dimensional and three-dimensional plots, Histograms, Polar plots, Function evaluation; Handling external files: saving and loading data.

Module V: PSPICE Circuit Simulator (6 Lectures)

Introduction, circuit descriptions, Input files, nodes, circuit elements, element values, sources, output variables; Analysis: DC sweep, Transient and AC analysis. PSPICE models.

Course Outcomes:

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

CO's	CO Description
CO1	Capable to model the physical system into electrical system
CO2	Apply mathematics for electrical systems to analysis
CO3	Select simulation technique for DC and AC system analysis
CO4	Able to design the electro-mechanical systems
CO5	Analyze the effect of switching conditions on Electrical circuits using Differential equations.
CO6	Analyze Electrical circuits using Graph Theory

CO's-PO's Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3											
CO2		3		2								
CO3				2	3							
CO4			2									
CO5		3		2								
CO6				2	3							

Suggested Readings:

[1].Biran A. and Breiner M., "MATLAB 5 for Engineers", 2nd edition, Addison Wesley,1999

[2]. Rashid M. H. and Rashid H. M., "SPICE for Power Electronics and Electric Power", 2nd edition, Taylor & Francis,2009

[3]. William J. P., "Introduction to MATLAB for Engineers", 3rd edition,McGraw Hi11,2010.

EL0508 **L T Credit**

Power Plant Engineering

2 1 3

DETAILED SYLLABUS

Module I: Introduction (10 Lectures)

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 Lectures)

Basic thermodynamic cycles, various components of steam power plant-layout-pulverized coal burners-Fluidized bed combustion-coal handling systems-ash handling systems- Forced draft and induced draft fans- Boilers-feed pumps super heater- regenerator-condenser- de-aerators, cooling towers, electrostatic precipitators.

Module III: Hydel Power Plant (8 Lectures)

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 Lectures)

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: CoGeneration (6 Lectures)

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:

CO's	CO Descriptions
CO1	Describe and analyze different types of sources and mathematical expressions related to thermodynamics and various terms and factors involved with power plant operation.
CO2	Analyze 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 analyze 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	Discuss the working principle and basic components of the hydro electric plants and the economic principles and safety precautions involved with it.

CO'sPO's Mappings Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	2	3	2	3	1		2					1
CO2	2	2	3	1	2		1					1
CO3	2		2	1		1	2					1
CO4	2		2	1		1	2					1
CO5	2	2	1	2	1	2	1					1
CO6	2	2	1	2	1	2	1					1

Suggested Readings:

[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.

EL0509 **Industrial Instrumentation And Automation**

L	T	Credit
2	1	3

Pre-requisites: Measurements & Instrumentation

DETAILED SYLLABUS

Module I: **(4 Lectures)**

Introduction: Static and Dynamic characteristics of Instrument. Displacement and proximity gauges. Linear Variable Differential Transformer (LVDT), Hall-effect sensors.

Module II: **(10 Lectures)**

Measurement of Temperature, Flow, Level and Viscosity: Thermocouple, Resistance Temperature Detector (RTD), Thermistor, Radiation Pyrometer, Differential Pressure flow-meter, Variable area flow- meter, Variable reluctance transducer, Turbine flow-meter, Ultrasonic flow-meter (Both transit time and Doppler Shift), electromagnetic flow-meter and Mass flow meter, Capacitance based and Float based method, pH -probe and viscosity measurement.

Module III: **(6 Lectures)**

Measurement of Pressure, strain & Vibration: Elastic transducers (Bourdon Gauge, Bellow and Diaphragm Gauge). Low pressure measurement, Strain Gauge, unbalanced Wheatstone bridge, Load cell, Torque Cell, Piezo-eiectric sensors, accelerometers.

Module IV: **(10 Lectures)**

Signal Conditioning and Processing: Estimation of errors and Calibration, Fundamentals of 4-20 mA current loops, Regulators and power supplies for industrial instrumentation.

Basics of Data transmission: Synchro and Servo motor. IEEE-488 bus, RS 232 and RS 485 interface. Pneumatic and Hydraulic Instrumentation system

Automation: Benefits and Impact of Automation on Manufacturing and Process Industries; Architecture of Industrial Automation Systems. Data Acquisition systems and PC based automation.

Module V: **(6 Lectures)**

Introduction to Automatic Control: P-I-D Control, Controller Tuning, Special Control Structures, Feed- forward and Ratio Control, Predictive Control, Control of Systems with Inverse Response, Cascade Control. Process and Instrumentation Diagrams.

Module VI: **(6 Lectures)**

Sequence Control: PLCs and Relay Ladder Logic, Scan Cycle, RLL Syntax, Structured Design Approach, Advanced RLL Programming, Hardware environment; Control of Machine tools: Introduction to CNC Machines.

Course Outcomes:

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

CO's	CO Description
CO1	Apply the concepts and analyze the performance of physical systems using transducers for measurement of physical quantities.
CO2	Understand various Signal Conditioning operations and design Signal Conditioning circuitry of a measurement & instrumentation system.
CO3	Exposure to the technology of Industrial Automation and Control.
C04	Implementation of various PLCs to Automation problems in industries.
CO5	Identify special techniques for high temperature measurements
C06	Analyse a suitable instrumentation system for various industries

CO's-PO's Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3	3	3	3	2	3	2	2	1	1	2	2
CO2	3	3	3	3	3	2	2	1	2	2	2	2
CO3	3	3	3	3	2	2	2	1	2	1	3	2
CO4	3	3	3	3	3	2	1	1	3	2	3	2
CO5	3	3	3	3	3	2	2	1	2	2	2	2
CO6	3	3	3	3	2	2	2	1	2	1	3	2

Suggested Readings:

[1].Doebelin, Measurement Systems, Applications and Design, Tata McGraw Hill, 2008.

[2].Measurement & Instrumentation : Trends & Applications by M.K. Ghosh, S. Sen and S. Mukhopadhyay, Ane Books,2010

[3].Fundamentals of Industrial Instrumentation Alok Barua, Wiley India Pvt Ltd,2011

[4].Measurement and Instrumentation Principles, 3rdEdition, Alan S Morris, Butterworth-Heinemann, 2001

[5].Industrial Instrumentation, Control and Automation, S. Mukhopadhyay, S. Sen and A. K. Deb, Jaico Publishing House,2013

[6].Chemical Process Control, An Introduction to Theory and Practice, George Stephanopoulos, Prentice Hall India,2012

[7].Frank. D, Petruzella, "Programmable Logic Controllers", Tata McGraw Hill Third Edition-2010.

EL0510 **L T Credit**

Principles of Control System*

2 1 3

DETAILED SYLLABUS

Module I: Introduction to Principles of Control System (8 Lectures)

Concept of systems and its classification; open-loop and closed-loop control system, benefits of feedback, mathematical modeling and representation of physical systems, analogous systems.

Transfer functions for different types of systems, block diagrams and its reduction techniques, Signal flow graphs and Mason's gain formula.

Module II: Time domain and Frequency domain (10 Lectures)

Time domain performance criterion, transient response of first order and second order systems; Steady state errors and error constants of different types of system; dynamic error constant: Derivation and its advantages; sensitivity; performance analysis for P, **PI** and PID controllers.

Module III: Stability Criterion (8 Lectures)

Concept of stability by Routh stability criterion. Stability analysis using root locus. Bode plot analysis. Absolute and Relative stability. Definition and computation of Gain Margin and Phase Margin. Comparison between time and frequency response plot.

Module IV: Stability Criterion Continued (6 Lectures)

Frequency response Polar plots and its stability criterion. Relative stability, Nyquist criterion; Graphical approach for gain and phase margin using polar plot; Advantages and disadvantages of frequency response plot.

Module V: Compensation design (4 Lectures)

Compensation lag, lead and laglead networks, Compensation designs of networks using time domain analysis and frequency response analysis.

Module VI: State Space Analysis (6 Lectures)

Concepts of state, state variables, state space representation of systems, dynamic equations, transient matrix, merits for higher order differential equations and its solution; Concept of controllability and observability.

Course Outcomes:

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

CO's	CO Description
CO1	Analyze electromechanical systems by mathematical modeling.
CO2	Determine Transient and Steady State behavior of systems using standard test signals.
CO3	Analyze linear systems for steady state errors, absolute stability and relative Stability using time domain and frequency domain techniques.
CO4	Identify and design a control system satisfying specified requirements.
CO5	Formulate different types of analysis in frequency domain.
CO6	Characterize any system in Laplace domain to illustrate different specification of the system

CO's-PO's Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3	3	-	-	3		1	1				2
CO2	3	3	2	3	3		1	1				2
CO3	3	3	2	3	3		1	1				2
CO4	3	3	3	3	3		1	1				2
CO5	3	3	2	3	3		1	1				2
CO6	3	3	2	3	3		1	1				2

Suggested Readings:

[1].I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009

[2]. B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.

[3]. K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.

[4]. H. Saeed, "Automatic Control System", S. K. Kataria & Sons, 2008.

[5]. S. K. Bhardwaj and S. K. Nagar, "Modern Control System with Advance Topics", New Age International, 2019.

ELO511 **L T Credit**

Electromechanical Energy Conversion And Transformers*

2 1 3

(This course is not offered to Electrical Engg students)

DETAILED SYLLABUS

Module I: Principle of Electromechanical Energy Conversion (4 Lectures)

Energy stored in electric and magnetic fields, energy conversion in single and multi-excited systems and torque production, reluctance torque; Reluctance and hysteresis motors.

Module II: General Description of Electrical Machines (5 Lectures)

Constructional details of de and ac machines, description of magnetic and electric circuits in cylindrical rotor and salient pole machines, mmf distribution of current carrying single and multiple coils; Armature winding as a current sheet, associated mmf and flux density waves.

Module III: DC Machines and Commutations (9 Lectures)

Simplex lap and wave windings, emf and torque equations, interaction of the fields produced by field and armature circuits.

Module IV: DC Generators (4 Lectures)

Methods of excitation, shunt, series and compound generators, characteristics, testing.

Module V: DC Motors (4 Lectures)

Methods of excitation, characteristics, starting and speed control methods; Losses and their estimation, efficiency.

Module VI: Singlephase Transformers (9 Lectures)

Principle of operation, equivalent circuit, voltage regulation and efficiency; Parallel operation. Principle of operation and comparison with two winding transformer. Autotransformers:

Principle of operation and comparison with two winding transformer

Module VII: Three Phase Transformers (6 Lectures)

Various connections and their comparative features, harmonics in emf and magnetizing current, effect of connections and construction on harmonics; Parallel operation of three-phase transformers, sharing of load, 3-phase to 2-phase conversion, 3-phase to 6-phase conversion.

Course Outcome:

After successful completion of the course students will able to:

CO's	CO Description
CO1	Understand the principle of operation of Electromechanical energy conversion
CO2	Understand the construction and principle of operation of DC machines, single phase and three phase transformers and auto transformers.
CO3	Analyze starting methods and speed control of DC machines.
C04	Analyze parallel operation of DC Generators, single phase and three phase transformers.
CO5	Evaluate the performance of DC machines.
CO6	Evaluate the Losses and their estimation

CO'sPO's Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	**3**	**3**	**3**	**1**	**1**	**2**			**1**			**2**
CO2	3	3	3	1	1	2			1			2
CO3	3	3	3	2	1	2			1			2
CO4	3	3	3	2	1	2			1			2
CO5	3	3	3	2	1	2			1			2
CO6	3	3	3	2	1	2			1			2

Suggested Readings:

[1].Fitzgerald A. E., Kingsley C. and Kusko A., "Electric Machinery", 6th Ed., McGraw-Hill International Book Company,2008.

[2]. Say M. G., "The Performance and Design of Alternating Current Machines", CBS Publishers and Distributors,2005.

[3]. Say M. G. and Taylor E. 0., "Direct Current Machines", 3rd Ed.,ELBS and Pitman.1986

[4].Nagrath I. J. and Kothari D. P., "Electrical Machines", 3rd Ed., Tata McGraw-Hill Publishing Company Limited,2008.

[5].Chapman S. J., "Electric Machinery Fundamentals", 4th Ed.,McGraw-Hill International Book Company, 2005

[6].Clayton A. E. and Hancock N., "The Performance and Design of DC Machines", CBS Publishers and Distributors, 2003.

[7].Langsdorf A. S., "Theory of AC Machines", 2nd Ed., Tata McGraw-Hill Publishing Company Limited, 2008.

EL501P **P Credit**

Electrical Machines-II Laboratory

2 1

This Laboratory Experiments may be performed in physical/ virtual platform (as per availability of list of experiments in virtual lab portal).

List of the Experiments

Atleast 10 experiments should be performed in this Laboratory.

1) No Load & blocked rotor test on a three phase induction motor & draw the circle diagram.
2) Speed control of a 3-phase induction motor by rheostatic, cascading and pole changing methods.
3) Load test on three phase induction motor & draw the various characteristics.
4) To perform slip test on a given alternator and to determine d-axis reactance (Xd) and q-axis reactance (Xq)
5) Determination of sub-transient reactance of a synchronous generator by static method.
6) To perform load test on Schrage motor at different speed setting (1000, 1400 rpm).
7) To perform open circuit test and short circuit tests on a three phase Synchronous generator and calculate its voltage regulation by Synchronous impedance method.
8) Determination of V curve and Inverted V curve of a 3-phase Synchronous motor at no-load.
9) To perform load test on single phase capacitor motor.
10) To determine the negative and zero sequence reactance of a given alternator.
11) Synchronization of two alternators and their load sharing.
12) To perform open circuit test and short circuit tests on a three phase Synchronous generator and calculate its voltage regulation by Synchronous impedance method.
13) To determine voltage regulation of three phase Synchronous generator by ZPF method.
14) To determine the core loss of a single phase transformer at varying frequency and separate the hysteresis and eddy current loss.

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.

EL502P **P Credit**

Principles of Control System Laboratory

2 1

This Laboratory Experiments may be performed in physical/ virtual platform (as per availability of list of experiments in virtual lab portal).

List of the Experiments

Atleast 10 experiments should be performed in this Laboratory.

1) To Study the time response of a closed loop second order system.
2) Study of closed loop P, PI, PID Controllers.
3) Time response analysis of LEAD compensating network.
4) Frequency response analysis of LEAD compensating network.
5) Study of temperature control of oven using PID Controller.
6) To obtain the characteristics of Synchro Transmitter and Receiver
7) To obtain transfer function of a D.0 Shunt motor.
8) To plot and analyze the Root locus, Bode & Nyquist plots using MATLAB.
9) To perform dynamic system simulation using MATLAB.
10) Design of **PID** controller for speed control of a dc motor using MATLAB.

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.

EL503P **P Credit**

Microprocessor & Microcontroller Laboratory

2 1

This Laboratory Experiments may be performed in physical/ virtual platform (as per availability of list of experiments in virtual lab portal).

List of the Experiments Atleast 10 experiments should be performed in this Laboratory. **Microprocessor**

1) Write an ALP for addition of two 8 bit numbers, result may be of more than 8 bit.
2) Write an ALP to find the largest/ smallest number in a data array.
3) Write an ALP to arrange the numbers of data array in ascending/descending order.
4) Write an ALP to move a block of data from a location of memory to another location of memory.
5) Design an interfacing circuit to interface 64KB of memory with 8085 microprocessor.
6) Design an interfacing circuit to interface a common anode/ cathode seven segment LED display with microprocessor and write an ALP to display digit 0 to 9 and letter A to F.
7) Write a program for addition of content of the memory location 3000:0400H to the contents of 4000:0700H and store the result in 6000:0900H by using instructions of 8086 microprocessor.
8) Design an interfacing circuit to interface 8255 with 8085 microprocessor and write an ALP for controlling LEDs with switches.
9) Write an ALP to find square of an 8 bit number using look up table.
10) Write a program for generation of square wave.

Microcontroller

1) Write a program in assembly language/C language to send data on ports of 8051 microcontroller.
2) Write a program in assembly language/C language to perform various arithmetic operations.
3) Write a program in assembly language/C language to read dot-matrix keyboard.
4) Write a program in assembly language/C language to display massage on multiple 7 segment display.
5) Write a program in assembly language/C language to generate 1kHz square wave on port line of 8051
6) Write a program in assembly language/C language to perform various logical operations.
7) Write a program in assembly language/C language to display message on LCD display.
8) Write a program in assembly language/C language to rotate stepper motor in clockwise direction.
9) Write a program in assembly language/C language send MSBTE on hyper terminal of PC.
10) Write a program in assembly language/C language to read ADC.

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.

ELC601 **L T Credit**

Power Systems-II

3 1 4

DETAILED SYLLABUS

Module I: Per Unit System **(4 lectures)**

Per Unit meaning and its calculation. Need and advantages of per unit system, Single line diagram, Per unit representation of a given power system network, Change of base value Impedance diagram, Numerical problems

Module II: Faults Analysis: **(8 lectures)**

Symmetrical fault Analysis: Short Circuit Current and MVA Calculations, Fault levels, Reactors-Numerical Problems. Symmetrical Component Theory: Symmetrical Component Transformation, Sequence Networks: Positive, Negative and Zero sequence Networks for transformers, transmission line and synchronous machine, Numerical Problems. Unsymmetrical Fault Analysis: LG, LL, LLG faults, Interconnection of sequence networks, effect of fault impedance, Numerical Problems

Module III: Load Flow Analysis **(8 lectures)**

Bus classification, formulation of Ybus matrix, power flow equations. Gauss — Seidel method, algorithm, derivation of iterative equation, modification for PV bus, Advantages and disadvantages, acceleration factor, Numerical Problems, Newton — Raphson method, algorithm, power mismatch vector, size of Jacobian matrix and its elements. Advantages and disadvantages, Numerical Problems, FDLF.

Module IV: Economic Operation of Power Systems **(6 lectures)**

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.

Module V: Load Frequency Control **(8 lectures)**

Necessity of keeping frequency constant, Modeling of speed governing, steam turbine and generator, Definition of Control area, Block diagram representation of an isolated power system, Steady state analysis, Dynamic response, Proportional plus Integral control of single area and its block diagram representation, Two area system, block diagram, Tie-line-bias control.

Module VI: Stability **(8 lectures)**

Concept of stability and Classification, Description of Steady State Stability Power Limit, Transfer Reactance, Synchronizing Power Coefficient, Power Angle Curve and Determination of Steady State Stability, Methods to improve steady state stability. Derivation of Swing Equation, Determination of Transient Stability by Equal Area Criterion, Application of Equal Area Criterion, Critical Clearing Angle Calculation.

Course Outcomes:

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

CO's	CO Description
CO1	Illustrate power system components using single line diagram and usage of per unit system.
CO2	Calculate symmetrical components and examine different types of faults (both symmetrical and unsymmetrical).
CO3	Formulate nodal admittance (Y-bus) matrix, and develop load flow equations and find its solution.
CO4	Calculate optimal generator allocations and analyze single area power system for load frequency control
CO5	Illustrate the concept of stability, power angle curve, and swing equation and diagnose steady-state and transient stability of the power system.
CO6	Evaluate the impact of disturbances on stability of power system.

CO's-PO's Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3	2										
CO2	3	2	1	2								
CO3	3	3	1	3								1
CO4	3	3	1	2								1
CO5	3	3	1	3	2							1
CO6	3	3	1	3	2							1

Suggested Readings:

[1]. J Grainger and W.D. Stevenson , " Power System Analysis " , McGraw Hill Education , First Edition, 2017

[2].Hadi Sadat, "Power System Analysis", PSA Publishing LLC, Third Edition, 2011

[3].D.P. Kothari and I.J. Nagrath, " Modern Power System Analysis " ,McGraw Hill Education 2003

Reference Books:

[1].Prabha Kundur, "Power System Stability and Control", McGraw Hill Education; First Edition, 2006.

[2].A.J. Wood and B.F. Wollenberg, "Power Generation, Operation and Control", John Wiley and Sons, 2011.

ELC602

Power Electronics

L	T	Credit
2	1	3

DETAILED SYLLABUS

Module I: Power Semiconductor Devices (10 Lectures)

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

Module II: AC-DC Converters (8 Lectures)

Introduction, Single-phase half-wave and full-wave rectifiers with R, R-L and R-L-E load; effect of source inductance, Three-phase full-bridge rectifier with R, R-L and R-L-E load; freewheeling effect, power factor improvement.

Module III: DC-DC Buck and Boost Converter (6 Lectures)

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

Module IV: Single-Phase Voltage Source Inverter (6 Lectures)

Introduction, Single-phase voltage source inverter, operation and analysis, concept of average voltage over a switching cycle, sinusoidal pulse width modulation, modulation index and output voltage. Current source inverter.

Module V: Three-Phase Voltage Source Inverter (6 Lectures)

Three-phase voltage source inverter, operation and analysis, 120- degree conduction, 180-degree conduction, three-phase sinusoidal pulse width modulation.

Module VI: AC Voltage Controllers (6 Lectures)

Introduction, principle of on-off control, principle of phase control and integral cycle control, configuration of three phase controllers, Cycloconvertor.

Course Outcomes:

After successful completion of the course students will be able to:

CO's	CO Description
CO1	To understand different power semiconductor devices and their characteristics.
CO2	To understand the operation, characteristics and performance parameters of AC to DC Converters.
CO3	To study the operation and basic topologies of DC-DC Converters
CO4	To learn the different modulation techniques of PWM inverters and to understand commutation techniques.
CO5	To study the operation of AC voltage controller and it's various configurations.
CO6	Describe basic operation and compare performance of various power semiconductor devices, passive components and switching circuits

CO's-PO's Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3	2	2	2	1		1					1
CO2	2	2	3	3	2		1					1
CO3	2	2	3	2	1	1	1					1
CO4	2	3	2	2	2	1	1					1
CO5	2	3	3	2	1	1	1					1
CO6	3	3	1	3	2							1

Suggested Readings:

[1].M. **H.** Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 2009.

[2].N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.

[3].R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science &Business Media, 2007.

[4].L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.

ELC603 **L T Credit**

Advanced Control Systems

2 1 3

DETAILED SYLLABUS

Module I: Sampling and Reconstruction (8 Lectures)

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

Module II: Modeling discrete-time systems by pulse transfer function (8 Lectures)

Revisiting Z-transform: Introduction to Z — transforms, Theorems of Transforms, inverse Z-transforms, Z-Transform method for solving difference equations. Mapping of S-plane to Z-plane, Pulse transfer function, Pulse transfer function of closed loop system, sampled signal flow graph

Module III: State Space Analysis (12 Lectures)

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.

Discrete state space model: Introduction to state variable model, various canonical forms, Characteristic equation, state transition matrix, Solution to discrete state equation.

Module IV: Controllability, Observability & Stability (8 Lectures)

Concepts of Controllability and Observability, Tests for controllability and Observability Duality between Controllability and Observability. Stability analysis of discrete time systems: Jury stability test Stability analysis using Bi-linear transformation.

Module V: State Feedback Controller (6 Lectures)

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

Observer: Full Order Observer, Reduced Order Observer. Lyapunov Stability Theorem.

Course Outcomes:

After successful completion of the course, students should be able to:

CO's	CO Description
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	Analyze digital systems using the Z-transformation, state space methods.
CO4	Design digital controllers for physical systems.
CO5	Compute signal norms and system gains to evaluate and compare dynamic systems
CO6	Evaluate how design parameters influence the closed-loop system properties.

CO's-PO's Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3	2		1	1	1	1					1
CO2	3	1	3	2	2							
CO3	3	2		2	2							
CO4	3	3	3	3	3		1					2
CO5	3	1	3	2	2							
CO6	3	2		2	2							

Suggested Readings:

[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.

Professional Elective-II
(Any One)

ELP604

L	T	Credit
2	1	3

Electrical Estimation & Costing

DETAILED SYLLABUS

Module I: Principles of Estimation (5 Lectures)

Introduction to estimation & costing, Electrical Schedule, Catalogues, Market Survey and source selection, Recording of estimates, Determination of required quantity of material, Labor conditions, Determination of cost material and labour,Contingencies, Overhead charges, Profit, Purchase system, Purchase enquiry and selection of appropriate purchase mode, Comparative statement, Purchase orders, Payment of bills, Tender form, General idea about IE rule, Indian Electricity Act and major applicable I.E rules.

Module II: Residential Building Electrification (7 Lectures)

Introduction to electrical symbols, their advantages and requirement. Concept of wiring diagram, schematic diagrams and their types. General Rules guidelines for wiring of residential installation and positioning of equipments, Principles of circuit design in lighting and power circuits Procedures for designing the circuits and deciding the number of circuits, Method of drawing single line diagram. Selection of type of wiring and rating of wires and cables Load calculations and selection of size of conductor, Selection of rating of main switch Distribution board, protective switchgear ELCB and MCB and wiring accessories, Earthing of residential Installation, sequence to be followed for preparing estimate, Preparation of detailed estimates and costing of residential installation.

Module III: Electrification of Commercial Installation (7 Lectures)

Concept of commercial installation, Differentiate between electrification of residential and commercial installation, Fundamental considerations for planning of an electrical installation system for commercial building, Design considerations of electrical installation system for commercial building, Load calculation and selection of size of service connection and nature of supply, Deciding the size of the cables, busbar and bus bar chambers, Mounting arrangements and positioning of switchboards, distribution boards main switch etc, Earthing of the electrical installation, Selection of type wire, wiring system and layout, Sequence to be followed to prepare estimate, Preparation of detailed estimate and costing of commercial installation.

Module IV: Service Connection, Inspection and Testing of Installation (7 Lectures)

Concept of service connection, Types of service connection and their features, Method of installation of service connection, Estimates of underground and overhead service connections, Inspection of internal wiring installations, Inspection of new installations, testing of installations, testing of wiring installations, Reason for excess recording of energy consumption by energy meter.

Electrical Installation For Power Circuits: Introduction, Important considerations regarding motor installation wiring, Determination of input power, Determination of input current to motors Determination of rating of cables

Determination of rating of fuse, Determination of size of Condit, distribution Board main switch and starter.

Module V: Design & Estimation of Overhead Transmission & Distribution Lines (10 Lectures)

Introduction, Typical AC electrical power system, Main components of overhead lines, Line supports, Factors governing height of pole, Conductor materials, Determination of size of conductor for overhead transmission line, Cross arms, Pole brackets and clamps,Guys and Stays, Conductors configuration spacing and clearances, Span lengths, Overhead line insulators, Insulator materials, Types of insulators, Lightning Arrestors, Phase plates, Danger plates, Anti climbing devices, Bird guards, Beads of jumpers, Muffs, Points to be considered at the time of erection of overhead lines, Erection of supports, Setting of stays, Fixing of cross arms, Fixing of insulators, Conductor erection, Repairing and jointing of conductor , Dead end clamps, Positioning of conductors and attachment to insulators, Jumpers, Tee-offs, Earthing of transmission lines, Guarding of overhead lines, Clearances of conductor from ground, Spacing between conductors, Testing and commissioning of overhead distribution lines, Some important specifications.

Module VI: Design and Estimation of Substations (6 Lectures)

Introduction, Classification of substation, Indoor substations, Outdoor substations, Selection and location of site for substation, Main Electrical Connections, Graphical symbols for various types of apparatus and circuit elements on substation main connection diagram, Key diagram of typical substations, Equipment for substation and switchgear installations, Substation auxiliaries supply, Substation Earthing.

Course Outcomes:

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

CO's	CO Description
CO1	Understand the purpose of estimation and costing.
CO2	Understand distribution of energy in a building, wiring and methods of wiring, cables used in internal wiring, wiring accessories and fittings, fuses and types of fuses..
CO3	Analyze design of lighting points and its number, total load, sub-circuits, size of conductor.
CO4	Understand types of service mains and estimation of service mains and power circuits.
CO5	Estimate overhead transmission and distribution systems and its components.
CO6	Exposure to design and estimation of wiring

CO's-PO's Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	PO 10	PO 11	P012
CO1	3	3	3	2	1	1						2
CO2	3	3	3	2	1	1						2
CO3	3	3	3	2	1	1						2
CO4	3	3	3	2	1	1						2
CO5	3	3	3	2	1	1						2
CO6	3	3	3	2	1	1						2

Suggested Readings:

[1].Raina K.B. and Bhattacharya S.K., "Electrical Design, Estimating and Costing", New Age International, New Delhi, 2010

[2].N. Alagappan & S. Ekambaram, "Electrical Estimating & Costing", TMH,2006

[3]. Dr.S.L.Uppal, "Electrical Wiring, Estimating and Costing", 5th Edition, Khanna Publishers,2003.

[4]. M.V. Deshpande, "Elements of Electrical Power Station Design", PHI 2009.

[5].J. B. Gupta, "A Course in Electrical Installation Estimating and Costing", S. K. Kataria and Sons, India,2013.

[6].ISI, National Electric Code, Bureau of Indian Standard Publications, New Delhi, 2011.

ELP605 **L T Credit**

Electrical Engineering Materials

2 1 3

Course Outcomes:

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

CO's	CO Description
CO1	Understand various types of dielectric materials, their properties in various conditions.
CO2	Evaluate magnetic materials and their behavior.
CO3	Evaluate semiconductor materials and technologies.
C04	Acquire Knowledge on Materials used in electrical engineering and applications.
CO5	Select the electrical machines for different applications
CO6	Prepare for next-level learning in design aspects

CO's-PO's Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3	3	3	1								2
CO2	3	2	3	1								2
CO3	3	3	2	2								2
CO4	3	2	2	2								2
CO5	3	2	3	1								2
CO6	3	3	2	2								2

DETAILED SYLLABUS

Module I: Dielectric Materials

Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics, Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyroelectric materials.

Module II: Magnetic Materials

Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. Factors effecting permeability and hysteresis.

Module III: Semiconductor Materials

Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale integration techniques (VLSI).

Module IV: Materials for Electrical Applications

Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors, bimetals fuses, soft and hard solders, electric contact materials, electric carbon materials, thermocouple materials. Solid, Liquid and Gaseous insulating materials, Effect of moisture on insulation.

Module V: Special Purpose Materials

Refractory Materials, Structural Materials, Radioactive Materials, Galvanization and Impregnation of materials, Processing of electronic materials, Insulating varnishes and coolants, Properties and applications of mineral oils, Testing of Transformer oil as per ISI.

Suggested Readings:

[1]. "R K Rajput", " A course in Electrical Engineering Materials", Laxmi Publications, 2009

[2]."T K Basak", " A course in Electrical Engineering Materials", New Age Science Publications 2009

Reference Books:

[1]. TTTI Madras, "Electrical Engineering Materials", McGraw Hill Education, 2004.

[2]."AdrianusJ.Dekker", Electrical Engineering Materials, PHI Publication, 2006.

[3]. S. P. Seth, P. V. Gupta "A course in Electrical Engineering Materials", Dhanpat Rai &Sons, 2011.

ELP606 **L T Credit**

Power System Restructuring

2 1 3

DETAILED SYLLABUS

Module I: Introduction to Restructuring of Power Industry (8 Lectures)

Introduction: Deregulation of power industry, Restructuring process, Issues involved in deregulation, Deregulation of various power systems — Fundamentals of Economics: Consumer behavior, Supplier behavior, Market equilibrium, Short and long run costs, Various costs of production — Market models: Market models based on Contractual arrangements, Comparison of various market models.

Module II: Electricity Market Model (8 Lectures)

Separation of ownership and operation, Deregulated models, pool model, pool and bilateral trades model, multilateral trade model. Competitive electricity market: Independent System Operator activities in pool market, Wholesale electricity market characteristics, central auction, single auction power pool, double auction power pool, market clearing and pricing, Market Power and its Mitigation Techniques, Bilateral trading.

Module III: Transmission Congestion Management (8 Lectures)

Introduction: Definition of Congestion, reasons for transfer capability limitation, Importance of congestion management, Features of congestion management — Classification of congestion management methods — Calculation of ATC - Non — market methods — Market methods — Nodal pricing — Inter zonal and Intra zonal congestion management — Price area congestion Management.

Module IV: Locational Marginal Prices and Financial Transmission Rights (5 Lectures)

Mathematical preliminaries: - Locational marginal pricing— Lossless DCOPF model for LMP calculation — Loss compensated DCOPF model for LMP calculation — ACOPF model for LMP calculation — Financial Transmission rights.

Module — V: Transmission Pricing Schemes (7 Lectures)

Introduction to transmission pricing, Principles of transmission pricing, Classification of transmission pricing, Rolled-in transmission pricing paradigm, Marginal transmission pricing paradigm, Composite pricing paradigm, Merits and de-merits of different paradigms, Classification of loss allocation methods, Pro-rata methods, Incremental methods, Power flow tracing based allocation.

Module — VI: Ancillary Service Management **(4 Lectures)**

Introduction of ancillary services — Types of Ancillary services — Classification of Ancillary services — Load generation balancing related services — Voltage control and reactive power support devices — Black start capability service.

Module-VII: Reforms in Indian Power Sector **(2 Lectures)**

Introduction — Framework of Indian power sector — Reform initiatives - Availability based tariff — Electricity act 2003 — Open access issues — Power exchange — Reforms in the near future.

Course Outcomes:

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

CO1	Understand the developments of restructuring worldwide.
CO2	Identify the roles and responsibilities of different entities in power market.
CO3	Identify issues like congestion management Ancillary Services Management.
CO4	Evaluate the transmission pricing schemes
CO5	Explain the Ancillary Services Management and the reforms in Indian power sector
CO6	Generalize the functioning and planning activities of ISO.

CO's-PO's Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	PO 10	P011	P012
CO1	1	2	1	1								2
CO2	1	2	1	2		1						2
CO3	2	2	1	2		1			2			2
CO4	1	1	1	2					1			2
CO5	2	2	1	1								2
CO6	2	2	1	1								2

Suggested Readings:

[1]. Mohammad Shahidehpour, Muwaffaq Alomoush, Marcel Dekker, "Restructured electrical power systems: operation, trading and volatility" Pub., 2001.

[2].Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, "Operation of restructured power systems", Kluwer Academic Pub., 2001.

[3].Leo Lei Lai, "Power System Restructuring and Deregulation: Trading, Performance and Information Technology" Wiley Pub. November 2001.

[4]. Steven Stoft, "Power system economics: designing markets for electricity", John Wiley &Sons, 2002.

Reference Books:

[1].Making competition work in electricity Sally Hunt, John Wiley & Sons, Inc., 2002.

[2].Marija llic, Francisco Galiana and Lestor Fink , Power System Restructuring Engineering &Economics , Kulwer Academic Publisher, USA-2000.

ELP607 **L T Credit**

Green Energy Technology

2 1 3

DETAILED SYLLABUS

Module I: Introduction (4 Lectures)

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 Lectures)

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 (10 Lectures)

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

Module IV: Biomass and Geothermal energy (5 Lectures)

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

Module V: Tidal, Wave and Ocean energy (6 Lectures)

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.

Module VI: Emerging technologies for power generation (5 Lectures)

Fuel cells, Principle of working of various types of fuel cells and their working, performance and limitations, future potential of fuel cells, emergence of hydrogen, cost analysis of hydrogen production, hydrogen storage.

Course Outcome:

After successful completion of the course students will be able to:

CO1	Identify different non-conventional energy system and **realize** their importance in today's scenario.
CO2	Analyze the performance and limitations of the solar and wind energy conversion system.
CO3	Understand the concept behind the bio-mass, geothermal, tidal, ocean thermal and wave energy conversions.
CO4	Outline the basics of fuel cells and hydrogen production and storage.
CO5	Educate the wind energy operation and its types.
CO6	Able to understand the solar energy operation and its characteristics.

CO's-PO's Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3	1		1	1		1					1
CO2	3	2	2	2	1		1					1
CO3	2	1	1	1	1		1					1
CO4	2	1	1	1	1		1					1
CO5	2	1	1	1	1		1					1
CO6	2	1	1	1	1		1					1

Suggested Readings:

[1] Non-Conventional Energy Resources, D.S. Chauhan, New Age International Pvt Ltd., 2006.

[2] D. P. Kothari, Rakesh Ranjan, Renewable Energy Sources and Emerging Technologies, PHI, India,2011.

[3] Solar Cells: Operating principles, Technology and Systems Applications, Martin Green, UNSW, Australia, 1997

[4] S. P. Sukhatme, Solar Energy, TMH, India. 2008.

[5] Introduction to Wind Energy Systems: Basics, Technology and Operation (Green Energy and Technology), by Hermann Josef Wagner, ISBN: 9783642020223, Publisher: Springer, September 2009.

[6] Biofuels - Securing the Planet's Future Energy Needs, Edited by A Demirbas Springer 2009

[7] Fuel Cells: The Sourcebook - New Edition 2004 Escovale 2004.

Reference Books:

[1] John Twiden and Tony Weir, Renewable Energy Resources, BSP Publications, 2006.

[2] Renewable Energy, Third Edition, Bent Sorensen, Academic Press August 2004

[3] Wind Energy Explained: Theory, Design and Application, by J. F. Manwell, ISBN: 9780470015001, Publisher: John Wiley & Sons, Publication Date: February 2010 .

[4] L.L. Freris, Wind Energy Conversion Systems, Prentice Hall, 1990.

Open Elective-II
(Any One)

EL0608 **L T Credit**

Advanced Control Systems*

2 1 3

DETAILED SYLLABUS

Module I: Sampling and Reconstruction (8 Lectures)

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

Module II: Modeling discrete-time systems by pulse transfer function (8 Lectures)

Revisiting Z-transform: Introduction to Z — transforms, Theorems of Z — Transforms, inverse Z-transforms, Z-Transform method for solving difference equations. Mapping of S-plane to Z-plane, Pulse transfer function, Pulse transfer function of closed loop system, sampled signal flow graph

Module III: State Space Analysis (12 Lectures)

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.

Discrete state space model: Introduction to state variable model, various canonical forms, Characteristic equation, state transition matrix, Solution to discrete state equation.

Module IV: Controllability, Observability & Stability (8 Lectures)

Concepts of Controllability and Observability, Tests for controllability and Observability Duality between Controllability and Observability. Stability analysis of discrete time systems: Jury stability test Stability analysis using Bi-linear transformation.

Module V: State Feedback Controller (6 Lectures)

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

Observer: Full Order Observer, Reduced Order Observer. Lyapunov Stability Theorem.

Course Outcomes:

After successful completion of the course, students should be able to:

CO's	CO Description
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	Analyze digital systems using the Z-transformation, state space methods.
CO4	Design digital controllers for physical systems.
CO5	Compute signal norms and system gains to evaluate and compare dynamic systems
CO6	Evaluate how design parameters influence the closed-loop system properties.

CO's-PO's Mapping Matrix:

2. Moderate Medium

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3	2		1	1	1	1					1
CO2	3	1	3	2	2							
CO3	3	2		2	2							
CO4	3	3	3	3	3		1					2
CO5	3	2		2	2							
CO6	3	3	3	3	3		1					2

Suggested Readings:

[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.

EL0609 **L T Credit**

Soft Computing Techniques

2 1 3

DETAILED SYLLABUS

Module I: Fundamentals of Soft Computing Techniques (4 Lectures)

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

Module-II: Artificial Neural Network (10 Lectures)

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 Lectures)

Fuzzy Logic- Fuzzy sets- Properties- Operation on fuzzy sets, fuzzy relations- operations on fuzzy relations.

Fuzzy membership functions, fuzzification, Methods of membership value assignments- intuition- inference- rank ordering, Lambda- cuts for fuzzy sets, Defuzzification methods.

Module —IV: Fuzzy Logic System-II (7 Lectures)

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: (8 Lectures)

Introduction to genetic algorithm, operators in genetic algorithm — coding — selection — cross over — mutation, Stopping condition for genetic algorithm flow, Generational Cycle, Applications.

Module-VI: (5 Lectures)

Evolutionary Programming, Multi-objective Optimization Problem Solving and its applications, Genetic- neuro hybrid systems, Genetic-Fuzzy rule based system.

Course Outcomes:

After successful completion of the course students will be able to:

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	Understand soft computing techniques and their role in problem solving.

CO's-PO's Mapping Matrix:

1. Slight (low)) 3. Substantial (High)

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3	3	3	1	2							2
CO2	3	3	3	2	2							2
CO3	3	3	3	2	2							2
C04	3	3	3	3	2							2
CO5	3	3	3	2	2							2
CO6	3	3	3	2	2							2

Suggested Readings:

[1].N.P Padhy, 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. El- Hawary , Artificial Intelligence application in Power Systems, IEEE Press,2009

[5]. Jan Jantzen, Foundations of Fuzzy Control, A practical approach, Wiley,2013

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]. Simon Haykin, Neural Network- A comprehensive Foundation- PHI, Inc.

[4].Eberhart and Y. Shi, Computational Intelligence: Concepts to Implementation, Morgan Kaufman/ Elsevier, 2007.

EL0610 **L T Credit**

Power Electronics*

2 1 3

DETAILED SYLLABUS

Module I: Power Semiconductor Devices (10 Lectures)

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

Module II: AC-DC Converters (8 Lectures)

Introduction, Single-phase half-wave and full-wave rectifiers with R, R-L and R-L-E load; effect of source inductance, Three-phase full-bridge rectifier with R, R-L and R-L-E load; freewheeling effect, power factor improvement.

Module III: DC-DC Buck and Boost Converter (6 Lectures)

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

Module IV: Single-Phase Voltage Source Inverter (6 Lectures)

Introduction, Single-phase voltage source inverter, operation and analysis, concept of average voltage over a switching cycle, sinusoidal pulse width modulation, modulation index and output voltage. Current source inverter.

Module V: Three-Phase Voltage Source Inverter (6 Lectures)

Three-phase voltage source inverter, operation and analysis, 120- degree conduction, 180-degree conduction, three-phase sinusoidal pulse width modulation.

Module VI: AC Voltage Controllers (6 Lectures)

Introduction, principle of on-off control, principle of phase control and integral cycle control, configuration of three phase controllers, cycloconverter.

Course Outcomes:

After successful completion of the course students will be able to:

CO's	CO Description
CO1	To understand different power semiconductor devices and their characteristics.
CO2	To understand the operation, characteristics and performance parameters of AC to DC Converters.
CO3	To study the operation and basic topologies of DC-DC Converters
CO4	To learn the different modulation techniques of PWM inverters and to understand commutation techniques.
CO5	To study the operation of AC voltage controller and it's various configurations.
CO6	Formulate and analyze a power electronic design at the system level and assess the performance

CO's-PO's Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3	2	2	2	1		1					1
CO2	2	2	3	3	2		1					1
CO3	2	2	3	2	1	1	1					1
C04	2	3	2	2	2	1	1					1
CO5	2	3	3	2	1	1	1					1
CO6	3	3	3	2	2							2

Suggested Readings:

[1].M. H. Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 2009.

[2].N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.

[3].R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science &Business Media, 2007.

[4].L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.

ELO611 **L T Credit**

Mine Electrical Engineering*

2 1 3

Pre-requisite: Basic Electrical Engineering and Basic Electronics Engineering.

DETAILED SYLLABUS

Module I:

Types of electrical power supply systems for underground coal mines — solidly earthed, restricted neutral and insulated — neutral systems of electrical power supply; their comparisons.

Module II:

Earth fault protection techniques for above mine power supply systems, sensitive and fail-safe earth fault relays. On-line insulation monitoring for insulated-neutral electrical distribution system.

Module III:

Mining type circuit breakers — Air circuit breaker, vacuum and Hexa Sulfa Flouride (Sf6) circuit breakers, Field switch, Tran switch Unit, Gate End Box, Drill Panel.

Module IV:

Electrical power planning for mechanized longwall faces -general scheme of electrical power distribution, voltage drop problems and remedial measurers; Inbye substation capacity selection. General scheme of electrical power distribution in opencast projects, Quarry substation capacity selection. Choice of restricted-neutral and insulated-neutral systems in open cast mines.

Module V:

Illumination planning for mines — underground roadway lighting system; intrinsically-safe lighting system for longwall faces, opencast mine lighting. Unit-VI Earthing practice in mines — earth pits, earthing of mobile electrical equipment in mines. Mining cables — types, constructional details; layout of cables through shaft and other locations.

Module VI:

Principles of flame proof enclosures. Intrinsically safe circuit methods of attaining intrinsic safety, zeener safety barriers and their applications. Indian electricity rules as applied to mines.

Course Outcomes:

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

CO's	CO Description
CO1	Understand different types of power supply systems and protection schemes used underground coal mines.
CO2	Understand different types of circuit breakers and relay used in Mines.
CO3	Analyze illumination, Intrinsically Safe circuit methods of attaining intrinsic safety, Zener safety barriers and their applications in mines.
CO4	Gain Electrical knowledge required in mining operations
CO5	Can cope up the equipment and system established in mining operations?
CO6	Understand Mine Communication system, Safety Apparatus and other special topics

CO's-PO's Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3	3	2	1		1						2
CO2	3	3	2	1		1						2
CO3	3	3	2	1		1						2
C04	3	3	2	1		1						2
CO5	3	3	12	1		1						2
CO6	3	3	3	2	2							2

Suggested Readings:

[1] A Text Book on Power Systems Engineering — Soni Gupta, Bhatnagar, Chakarbarti, Dhanpat Rai & Sons.

[2] Electrical Equipment in mines- H. Cotton.

[3] Switchgear and Protection- S.S. Rao Khanna Publications.

[4] Indian Electricity Rules.

[5] Principles of Mine Planning J. Bhattacharya, Allied Publications

Reference Books:

[1] Universal Mining School Series (UK)

[2] Coal Mining Practice- J.C. F Statharm Vol III, Heart Series.

[3] Electrical Power Systems — C.L. Wadhwa, New Age International Publishers

EL0612 **L T Credit**

Green Energy Technology*

2 1 3

DETAILED SYLLABUS

Module I: Introduction (4 Lectures)

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 Lectures)

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 (10 Lectures)

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

Module IV: Biomass and Geothermal energy (5 Lectures)

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

Module V: Tidal, Wave and Ocean energy (6 Lectures)

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.

Module VI: Emerging technologies for power generation (5 Lectures)

Fuel cells, Principle of working of various types of fuel cells and their working, performance and limitations, future potential of fuel cells, emergence of hydrogen, cost analysis of hydrogen production, hydrogen storage.

Course Outcome:

After successful completion of the course students will be able to:

CO1	Identify different non-conventional energy system and **realize** their importance in today's scenario.
CO2	Analyze the performance and limitations of the solar and wind energy conversion system.
CO3	Understand the concept behind the bio-mass, geothermal, tidal, ocean thermal and wave energy conversions.
CO4	**Outline** the basics of fuel cells and hydrogen production and storage.
CO5	To understand the fundamentals of sustainable development
CO6	To understand the framework of sustainability

CO's-PO's Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3	1		1	1		1					1
CO2	3	2	2	2	1		1					1
CO3	2	1	1	1	1		1					1
CO4	2	1	1	1	1		1					1
CO5	2	1	1	1	1		1					1
CO6	2	1	1	1	1		1					1

Suggested Readings:

[1] Non-Conventional Energy Resources, D.S. Chauhan, New Age International Pvt Ltd., 2006.

[2] D. P. Kothari, Rakesh Ranjan, Renewable Energy Sources and Emerging Technologies, PHI, India,2011.

[3] Solar Cells: Operating principles, Technology and Systems Applications, Martin Green, UNSW, Australia, 1997

[4] S. P. Sukhatme, Solar Energy, TMH, India. 2008.

[5] Introduction to Wind Energy Systems: Basics, Technology and Operation (Green Energy and Technology), by Hermann Josef Wagner, ISBN: 9783642020223, Publisher: Springer, September 2009.

[6] Biofuels - Securing the Planet's Future Energy Needs, Edited by A Demirbas Springer 2009

[7] Fuel Cells: The Sourcebook - New Edition 2004 Escovale 2004.

Reference Books:

[1] John Twiden and Tony Weir, Renewable Energy Resources, BSP Publications, 2006.

[2] Renewable Energy, Third Edition, Bent Sorensen, Academic Press August 2004

[3] Wind Energy Explained: Theory, Design and Application, by J. F. Manwell, ISBN: 9780470015001, Publisher: John Wiley & Sons, Publication Date: February 2010 .

[4] L.L. Freris, Wind Energy Conversion Systems, Prentice Hall, 1990.

Laboratory/ Sessional

EL601P **P Credit**

Power Systems-II Laboratory

2 1

This Laboratory Experiments may be performed in physical/ virtual platform (as per availability of list of experiments in virtual lab portal).

List of the Experiments

Any 10 experiments out of which atleast 7 experiments from Group-A and 3 experiments from Group-B.

Group-A: SIMULATION BASED (USING MATLAB OR ANY OTHER SOFTWARE)

1) **Formation of Bus admittance matrix**
2) **Solution of load flow problem using Gauss-Seidel method**
3) **Solution of load flow problem using Newton-Raphson method.**
4) **Solution of load flow problem using Fast Decoupled Method**
5) **Formation of Z-bus matrix**
6) **Application of Swing equation and its solution to determine transient stability**
7) **Simulation of LFC for two area power system**
8) **Economic load dispatch without considering network losses**
9) **Economic load dispatch considering network losses**
10) **To perform symmetrical fault analysis in a power system**

Group B: HARDWARE BASED

1) **To determine negative and zero sequence synchronous reactance of an alternator.**
2) **To determine fault current for L-G, L-L, L-L-G and L-L-L faults at the terminals of an alternator at very low excitation.**
3) **To determine location of fault in a cable using cable fault locator**
4) **Determination of power angle characteristics of an Alternator**

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.

EL602P **P Credit**

Power Electronics Laboratory

2 1

This Laboratory Experiments may be performed in physical/ virtual platform (as per availability of list of experiments in virtual lab portal).

List of the Experiments

Atleast 10 experiments should be performed in this Laboratory.

1) To study 1-phase half wave and full wave mid-point uncontrolled rectifier
2) To study 1-phase half wave and full wave bridge controlled rectifier.
3) Study of three-phase half & fully wave controlled bridge converter with R and RL load.
4) To study V-I characteristics of SCR.
5) Study of AC voltage controller using TRIAC with R and RL load.
6) To study different triggering circuits for thyristors.
7) To study the operation of buck converter.
8) To study the operation of boost converter.
9) To study the function of Inverter trainer
10) To study class A and Class B commutation circuit.
11) To study class C and class D commutation circuit
12) To study the single phase cycloconverter with R and R-L Loads.
13) To study the operation of single phase dual converter fed PMDC motor
14) To determine speed vs load characteristics of BLDC motor.
15) To perform speed control of 3-phase induction motor using v/f control method

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.

EL603P **P Credit**

Simulation Laboratory

2 1

This Laboratory Experiments may be performed in physical/ virtual platform (as per availability of list of experiments in virtual lab portal).

List of the Experiments

Atleast 10 experiments should be performed in this Laboratory.
These experiments can be performed using any software / FOSS (Free and Open Source Software) available at the institute.

1) Simulation of Single Phase Half Wave Uncontrolled Rectifier with R and RL-Load.
2) Simulation of Single Phase Half Wave Controlled Rectifier with R and RL-Load.
3) Simulation of Single Phase Semi Controlled Rectifier with R and RL-Load.
4) Simulation of Single Phase Full Wave Uncontrolled Rectifier with R and RL- Load.
5) Simulation THD Analysis of Single Phase Full Wave Controlled Rectifier with R and RL-Load.
6) Simulation and **THD** Analysis of Single Phase Full Wave Rectifier with RLE-Load.
7) Simulation and THD Analysis of Three Phase Half Wave Rectifier using R and RL-Load.
8) Simulation and THD Analysis of Three Phase Full Bridge Converter using R and RL-Load.

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.

EL604P **P Credit**

Electrical Workshop

2 1

This Laboratory Experiments may be performed in physical/ virtual platform (as per availability of list of experiments in virtual lab portal).

List of the Experiments

Atleast 10 experiments should be performed in this Laboratory.

1) To study the different types of cable and conductors.
2) To perform house wiring for bulb, fan and a 3-pin socket.
3) To study the different types of motor starters.
4) To perform and verify the connection of fluorescent lamp, circuit, lines.
5) To Study Institute Substation.
6) Determination of dielectric strength of the given transformer oil.
7) To study different components of CT & PT.
8) To measure the resistance by using earth resistance tester.
9) To study of lap, wave, short pitch winding in machine.
10) To measure insulation resistance of 3 - induction motor.

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.

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

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
		LABORATORIES						**Total (A) = 15 Credits**
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 EE

Table 1: Professional Electives

Table 2: Open 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	ELP706	High Power Converters
2	ELP703	Utilization of Electrical Power	ELP707	HVDC Transmission and FACTS
3	ELP705	Power Quality	ELP709	Electrical and Hybrid Vehicles
4	ELP704	Power System Dynamics and Control	ELP708	Smart Grid Technology

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

Electrical Engineering			
ELC701	**Protection of Power Apparatus and System**	**L**	**T**
		3	**0**

DETAILED SYLLABUS

Module — I **(5 Lectures)**

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 **(8 Lectures)**

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 **(8 Lectures)**

Protection of transformers: Percentage Differential Protection, Numerical Problem on Design of CT's Ratio, Buchholz relay Protection.

Module — IV **(8 Lectures)**

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 Lectures)**

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 Lectures)**

Grounded and ungrounded neutral systems, methods of neutral grounding: solid, resistance, reactance, resonant grounding.

Course Outcomes:

After successful completion of the course students will be able to:

CO1: Analyze the need of power system protection and **classify** the different types of relayandtheir operating principle.
CO2: Distinguish the difference between the distribution line protection and transmission line protection.
CO3: Explain the protection of generator, busbar and transformer and its limitations.
C04: Select the different kind of circuit breaker based on their application.
CO5: Choose different type of protective devices against overvoltage as well as for earthing purpose.
CO6: Analyze the performance of power system transducers

CO-PO Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3	3		2								1
CO2	3	2		2								1
CO3	2	1		2								1
C04	3	3		3								1
CO5	3	3		2	3							1
CO6	3	3		2	3							1

Text Books

[1].Badri Ram, D. Vishwakarma, "Power System Protection and Switchgear", McGraw Hill, r^{d} Edition. [2].Y.G. Paithankar, S.R. Bhide, "Fundamentals of Power System Protection", PHI, 2n^{d} Edition

[3].BhuvaneshOza, Nirmal-Kumar Nair, Rashesh Mehta, Vijay Makwana, "Power System Protection & Switchgear, McGraw Hill, P^{t} Edition.

Reference Books

[1]. Stanley H. Horowitz, Arun G. Phadke, James K. Niemira, "Power System Relaying", Wiley, 4th Edition.

[2].R. van C. Warrington, "Protective Relays Their Theory and Practice", Springer, P^{t} Edition.

Electrical Engineering			
ELP702	**Electrical Drives and Control**	**L**	**T**
		3	**0**

DETAILED SYLLABUS

Module — I: Introduction to Electrical Drives (9 Lectures)

Concept, classification, parts and advantages of electrical dives. Types of Loads, Components of load toques, Fundamental torque equations, Equivalent value of drive parameters for loads with rotational and translational motion. Determination of moment of inertia, Multi quadrant operation of drives. Load equalization.

Module — II: Starting and Braking of Electrical Drives(^{9}Lectures)

Effect of starting on Power supply, motor and load. Methods of stating of electric motors. Acceleration time Energy relation during stating, methods to reduce the Energy loss during starting. Types of braking, braking of DC motor, Induction motor and Synchronous motor, Energy loss during braking.

Module — III: Solid State Speed Control of DC Motor(^{7}Lectures)

Single phase, three phases fully controlled and half controlled DC drives. Dual converter control of DC drives. DC chopper drives.

Module — IV: Solid State Speed Control of Induction Motor(^{7}Lectures)

Speed control of three phase induction motor — Voltage control, voltage / frequency control, slip power recovery scheme — Using inverters and AC voltage regulators — applications, Static Scherbius drive, Static Kramer drive.

Module-V: Synchronous Motor Drive(10Lectures)

Synchronous motor V/f control, Cycloconverter control, self-controlled synchronous motor drive. Drive consideration for Textile mills, Steel rolling mills, Cement mills, Paper mills, Machine tools. Cranes & hoist drives.

Course Outcomes: After successful completion of the course students will be able to:

CO's	CO Description
CO1	Classify electric drives and their specific application in industry.
CO2	Explain the operation of electric traction, energy consumption and it's advantages.
CO3	Make use of electric heating based on induction principle.
C04	List different light sources and illumination parameters.
CO5	Demonstrate electrolytic process and design motor control circuit.
CO6	Explain dynamics and different modes of operation of electric drives

COs-POs Mapping:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3	3		1								1
CO2	3	3	1	1								1
CO3	3	3	2	1								1
CO4	3	3	3	1								1
CO5	3	3	3	1								1
CO6	**3**	**3**		**2**	**3**							**1**

Text Books

[1].Fundamental of Electrical Drives, G.K. Dubey, New Age International Publication.

[2].Electric Drives, Vedam Subrahmanyam, TMH

[3].A first course on Electrical Drives, S.K. Pillai, New Age International Publication.

Reference Books

[1].Electric motor drives, R. Krishnan, PHI

[2].Modern Power Electronics & Ac drives, B.K. Bose, Pearson Education.

[3]. Electric Motor & Drives. Austin Hughes, Newnes.

Electrical Engineering			
ELP703	**Utilization of Electrical Power**	**L**	**T**
		3	0

DETAILED SYLLABUS

Module I: Industrial Drives (12 Lectures)

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 Lectures)

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.

Module III: Electric Heating (5 Lectures)

Introduction — Classification of methods of electric heating — Requirements of a good heating material — Design of heating element — Temperature control of resistance furnace — Electric arc furnace — Induction heating.

Module IV: Welding and Illumination (13 Lectures)

Dielectric heating — Electric welding — Resistance welding — Electric arc welding. Sources of light, incandescent and fluorescent lamps, Lighting Fittings, reflection factor illumination, calculation, solid angle, candle power, units of light and illumination, power curves, M. H. C. P and M. S. C. P. Illumination level and its measurement coefficient of utilization, waste light factor, illumination calculations for building and playgrounds, flood lighting, industrial lighting, Street lighting.

Module V (2 Lectures)

Electrolytic process and motor control circuit

Course Outcomes:

After successful completion of the course students will be able to:

CO's	CO Description
CO1	Classify electric drives and their specific application in industry.
CO2	Explain the operation of electric traction, energy consumption and it's advantages.
CO3	Make use of electric heating based on induction principle.
C04	List different light sources and illumination parameters.
CO5	Demonstrate electrolytic process and design motor control circuit.
CO6	Explain the operation of power system equipment protection system.

CO's-PO's Mapping Matrix:

COs/ POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3	2	2	2	3							1
CO2	3	2	2				2					1
CO3	3	2	2		2							1
C04	3	2	2									1
CO5	3	2	2	2	2							1
CO6	**3**	**3**		**2**	**3**							**1**

Text Books:

[1]."A first course on Electric Drives", S.K.Pillai, Wiley Eastern Ltd.

[2]."Utilization of Electrical Energy", (S.I. Units), E.Open Shaw Taylor and V.V.L.Rao, Orient Long man.

[3]."Generation, Distribution and Utilization of Electrical Energy", C.L. Wadhwa; Wiley Eastern Ltd.

Electrical Engineering			
ELP704	**Power System Dynamics and Control**	**L**	**T**
		3	**0**

DETAILED SYLLABUS

Module I **(12 Lectures)**

A review of synchronous machine (cylindrical rotor and salient pole), Equations, Phasor diagrams under steady state and transient condition.

Meaning of stability in power system, explanation of steady state and transient stability, development of swing equations for a multi machine system; assumptions generally made for solution of swing equation.

Module II **(10 Lectures)**

Synchronous machine modeling: sub- transient model , two axis model , one axis (flux decay) model , classical model .

Excitation systems modeling: DC excitation, AC excitation and static excitation. Prime mover and energy supply systems modeling. Transmission line modeling, load modeling.

Module III **(10 Lectures)**

Equal area criterion for a two machine system without and including transmission losses; pre-determined swing curves; application of equal area criteria to understand the effect of various factors on transient stability limit. equal area criterion, critical clearing angle, application of critical clearing angle to transient stability of synchronous machine.

Module IV **(5 Lectures)**

Methods of improving transient stability: reducing fault clearance time, automatic reclosing, single phase reclosing, electric braking, voltage regulators, fast governor action, high speed excitation system.

Module V **(5 Lectures)**

Classification of voltage stability, modeling requirement s of voltage stability analysis: static and dynamic, sensitivity analysis, modal analysis, voltage collapse, prevention of voltage collapse.

Course Outcomes:

After successful completion of the course student will be able to:

COs	CO Description
CO1	Outline basic concepts of synchronous machine and its modeling
CO2	Model excitation systems, prime-mover, transmission line and load
CO3	Apply the concept of equal area criteria and critical clearing angle to transient stability of the machine.
C04	Explain various methods for transient stability improvement
CO5	Classify voltage stability and outline its modeling requirements
CO6	Development of various types of models used for synchronous machines, Hydro & steam

CO's-PO's Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	2	1										1
CO2	2	2										1
CO3	2	2	2									1
C04	2	1	1									1
CO5	2	2										1
CO6	2	2										1

Text Books:

[UP. Kundur, 'Power System Stability and Control', McGraw Hill Inc, New York, 1995.
[2].Edward Wilson Kimbark, "Power System Stability, Volumes I, II, III," Wiley-IEEE Press, 1995.

Reference Books:

[1].K.R.Padiyar, "Power System Dynamics, Stability & Control", 2nd Edition, B.S. Publications, Hyderabad, 2002.
[2].P.Sauer&M.A.Pai, "Power System Dynamics & Stability", Prentice Hall, 1997.

Electrical Engineering			
ELP705	**Power Quality**	**L**	**T**
		3	0

DETAILED SYLLABUS

Module - I: Overview of Power Quality (10 Lectures)

Classification of power quality issues, characterization of electric power quality, power acceptability curves — power quality problems: poor load power factor, non linear and unbalanced loads, dc offset in loads, notching in load voltage, disturbance in supply voltage, flicker, transient phenomenon, voltage fluctuations, sags/swells, voltage unbalance, power quality indices, distortion index, C-message index, IT product, IEEE guides and recommended practices.

Module- II: Measurement and Analysis Methods (8 Lectures)

Voltage, current, power and energy measurements, power factor measurement and definitions, time domain methods, Instantaneous Reactive Power Theory, Synchronous Frame Theory, Synchronous Detection Method, instantaneous symmetrical components, Instantaneous real and reactive powers

Module- III: Harmonics & Voltage Fluctuations (8 Lectures)

Sources and effect of harmonics and inter harmonics, voltage fluctuations, flicker and impulses, flicker calculations, effect of voltage fluctuations and impulses, occurrence and causes of voltage unbalance, standardization, decomposition into symmetrical components.

Module IV: Power Quality Improvement-I (8 Lectures)

Utility- Customer interface, harmonic filter: passive, active and hybrid filter, compensation using shunt devices-DSTATCOM, voltage regulation using DSTATCOM, principle, working and construction, algorithms for control of DSTATCOM, some case study examples.

Module V: Power Quality Improvement-II (8 Lectures)

Series compensation, protecting sensitive loads using DVR, principle, working construction and control schemes for DVR, hybrid devices —UPQC, principle, working and construction, some case study examples.

Course Outcomes:

After successful completion of the course students will be able to:

COs	CO Description
CO1	To understand the various power quality issues.
CO2	Evaluate the power quality indices used in industrial power system.
CO3	Understand various mitigation techniques for compensating devices to improve the power quality.
CO4	Simulate the compensating devices to improve the power quality
CO5	Understand the basic concepts of Power Quality
CO6	Understand the working principles of devices to improve power quality

CO's-PO's Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	2	-	-	-	-	-	2	1	-	1	-	2
CO2	2	-	3	2	-	2	-	-	-	-	-	-
CO3	2	3	-	2	3	2	2	-	-	-	-	-
CO4	-	3	-	3	3	2		-	2	-	-	2
CO5	2	3	-	2	3	2	2	-	-	-	-	-
CO6	-	3	-	3	3	2		-	2	-	-	2

Text /reference Books:

[1].Power Quality Enhancement Using Custom Power Devices, Arindam Ghosh, Gerard Ledwich, Springer, 2009

[2].Power Quality: VAR Compensation in Power Systems R. Sastry Vedam, Mulukutla S. Sarma, CRC Press, 2008

[3].Understanding Power Quality Problems: Voltage Sags and Interruptions, Math H.J. Bollen, Wiley India Pvt Ltd, 2011.

[4].Power Quality: Mitigation Technologies in a Distributed Environment,A Moreno Munoz, Springer India Private Limited 2007.

[5].Power System Quality Assessment J.Arrillaga, N.R.Watson, S.Chen, Wiley India Pvt Ltd, 2011.

Electrical Engineering			
ELP706	**High Power Converters**	**L**	**T**
		3	**0**

Prerequisite: Power Electronics

DETAILED SYLLBUS

Module I: Diode rectifiers with passive filtering (6 Lectures)

Half-wave diode rectifier with RL and RC loads; 1-phase full-wave diode rectifier with L, C and LC filter; 3-phase diode rectifier with L, C and LC filter; continuous and discontinuous conduction, input current wave shape, effect of source inductance; commutation overlap.

Module II: Thyristor rectifiers with passive filtering (6 Lectures)

Half-wave thyristor rectifier with RL and RC loads; 1-phase thyristor rectifier with L and LC filter; 3-phase thyristor rectifier with L and LC filter; continuous and discontinuous conduction, input current waveshape.

Module III: Multi-Pulse converter (8 Lectures)

Review of transformer phase shifting, generation of 6-phase ac voltage from 3-phase ac, 6-pulse converter and 12-pulse converters with inductive loads, steady state analysis, commutation overlap, notches during commutation.

Module IV: Single-phase AC-DC single-switch boost converter (6 Lectures)

Review of dc-dc boost converter, power circuit of single-switch ac-dc converter, steady state analysis, unity power factor operation, closed-loop control structure.

Module V: AC-DC bidirectional boost converter (6 Lectures)

Review of 1-phase inverter and 3-phase inverter, power circuits of 1-phase and 3-phase ac-dc boost converter, steady state analysis, operation at leading, lagging and unity power factors. Rectification and regenerating modes. Phasor diagrams, closed-loop control structure.

Module VI: Isolated single-phase AC-DC flyback converter (10 Lectures)

DC-DC flyback converter, output voltage as a function of duty ratio and transformer turns ratio. Power circuit of ac-dc flyback converter, steady state analysis, unity power factor operation, closed loop control structure.

Course Outcomes:

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

COs	Description
CO 1	Analyze controlled rectifier circuits.
CO 2	Explain in basic operation and compare the performance of various power semiconductor devices and switching circuits.
CO3	Design and analyze power converter circuits and learn to select suitable power electronic devices and assessing the requirements of applications field.
CO 4	Illustrate the operation of line-commutated rectifiers-6 pulse and multi-pulse configurations.
CO 5	Explain the operation of PWM rectifiers—operation in rectification and regeneration modes and lagging, leading and unity power factor mode.
CO 6	Ability to dynamic analysis of power Converters

CO's-PO's Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	**3**	**1**	**1**	**2**	**1**							
CO2	**1**	**3**	**1**	**2**								
CO3	**1**	**1**	**2**	**2**	**1**							
C04	**2**	**2**		**1**	**2**							
CO5	**2**	**1**	**2**	**1**	**2**							
CO6	**2**	**1**	**2**	**1**	**2**							

Text / References Books:

[1].G. De, "Principles of Thyristorised Converters", Oxford &**IBH** Publishing Co, 1988.

[2].J.G.Kassakian, M. F. Schlecht and G. C. Verghese, "Principles of Power Electronics", Addison-Wesley, 1991.

[3].L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.

[4].N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.

[5].R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science &Business Media, 2001

Electrical Engineering			
ELP707	**HVDC Transmission and Facts**	**L**	**T**
		3	0

Prerequisite: Power Electronics, Power System-II

DETAILED SYLLABUS

Module I: HVDC Power Transmission Technology (4 Lectures)

Evolution of HVDC transmission, Comparison of HVDC & HVAC system, Economics of power transmission, Technical performance, Reliability, Applications of HVDC transmission, Types of HVDC transmission links, Components of Converter station, Planning for HVDC transmission, Operating problems in HVDC system.

Module II: Analysis of HVDC converter (7 Lectures)

Introduction, Types of converters, Line commutated converter, Analysis of Line commutated converter, Choice of converter configuration for any pulse number, Analysis of voltage source converter, Basic 2-level Graetz bridge converter, 3 level voltage source converter, Converter charts.

Module III: HVDC System control (7 Lectures)

Principles of HVDC control links, Converter control characteristics, Control schemes & control comparisons, Firing angle control, current & Extinction angle control, Energization &de-energization of bridges, Starting & stopping of DC links, power control. Effects of Harmonics, sources of harmonic generation, Types of filters—Design examples

Module- IV: Flexible AC Transmission Systems (FACTS) (5 Lectures)

FACTS concepts and general system conditions: Power flow in AC systems, Relative importance of controllable parameters, Basic types of FACTS controllers, shunt and series controllers, Current source and Voltage source converters.

Module V: Static Shunt Compensators (8 Lectures)

Objectives of shunt compensation, Methods of controllable VAR generation, Static Var Compensator, its characteristics, TCR, TSC, FC-TCR configurations, STATCOM, basic operating principle, control approaches and characteristics.

Module VI: Static Series Compensators (6 Lectures)

Objectives of series compensator, variable impedance type of series compensators, TCSC, TSSC-operating principles and control schemes, SSSC, Power Angle characteristics, Control range and VAR rating, Capability to provide reactive power compensation, external control.

Module VII: Combined Compensators (5 Lectures)

Introduction to Unified Power Flow Controller, Basic operating principles, Conventional control capabilities, Independent control of real and reactive power.

Course Outcome:-

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

COs	CO Description
CO1	Compare HVDC and EHVAC transmission systems
CO2	Analyze converter configurations used in HVDC and evaluate the performance metrics.
CO3	Understand controllers for controlling the power flow through a dc link and compute filter Parameters
CO4	Describe the Types of HVDC Links and FACTS devices
CO5	Explain various parameters in HVDC.
CO6	Compare AC and DC systems

CO's-PO's Mapping Matrix:

Enter correlation levels 1, 2 or 3 as defined below-

1. Slight (lowl 2. Moderate Medium 3. Substantial Hi h

COs/ POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	PO 12
CO1	2	3	-	-	2	1	2	2	-	-		2
CO2	1	2	-	1	2	2	2	-	-	-	2	
CO3	-	3	-	2	2	-	-	-	-	-		2
CO4	-	3	-	3	3	2	1	-	-	-		
CO5	1	2	-	1	2	2	2	-	-	-	2	
CO6	-	3	-	2	2	-	-	-	-	-		2

Text Books:

[1].K. R. Padiyar, "HVDC Power Transmission Systems", New Age International Publishers, 2011

[2].J. Arrillaga, "High Voltage Direct Current Transmission", Peter Peregrinus Ltd., 1983.

[3].NarainG.Honorani, Laszlo Gyugyi: Understanding FACTS —Concepts and Technology of Flexible AC Transmission Systems, Wiley-IEEE Press, 2000.

[4].Yong Hua Song, Allan T Johns: Flexible AC Transmission Systems, The Institution of electrical Engineers, 1999.

Reference Book:

[1].E. W. Kimbark, "Direct Current Transmission", Vol.1, Wiley Inter science, 1971.

Electrical Engineering			
ELP708	**Smart Grid Technology**	**L**	**T**
		3	0

Module II **(14 Lectures)**

Communication Technologies for Power System: Fiber Optical Networks, WAN base on Fiber Optical Networks, IP based Real Time data Transmission, Substation communication network, Zigbee. Information System for Control Centers (ICCS): ICCS Configuration, ICCS communication Network, ICCS Time Synchronization. E-Commerce of Electricity, GIS, GPS.

Module III **(8 Lectures)**

Integration, Control and Operation of Distributed Generation: Distributed Generation Technologies and its benefits, Distributed Generation Utilization Barriers, Distributed Generation integration to power grid.

Module IV: **(12 Lectures)**

Monitoring the smart grid: Load dispatch centers, wide-area monitoring system (WAMS), Phasor

Measurement Unit(PMU),;Smart sensors/telemetry, advanced metering infrastructure.(AMI);smart metering; smart grid system monitoring; communication infrastructure and technologies; self-healing. Concept of Islanding.

Module V: **(3 Lectures)**

Micro grid: Integration of distributed energy sources; concept, operation, control and protection of Micro.

Course Outcomes:

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

CO's	CO Description
CO1	Understand features of Smart Grid in the context of Indian Grid
CO2	Assess the role of automation in Transmission/Distribution
CO3	Apply Evolutionary Algorithms for the Smart Grid/Distribution Generation.
CO4	Understand operation and importance of PMUs, PDCs, WAMS, Voltage and frequency control in microgrids
CO5	Develop concepts of smart grid technologies in hybrid electrical vehicles
CO6	Understand smart substations, feeder automation, GIS

COs-POs Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3	3	2	1	2	1	-	-	-	-	-	2
CO2	3	3	2	1	2	-	-	1	-	-	-	2
CO3	3	3	2	1	2	-	-	1	-	-	3	2
CO4	3	3	2	1	2	1	-	-	-	-	-	2
CO5	3	3	2	1	2	-	-	1	-	-	-	2
CO6	3	3	2	1	2	-	-	1	-	-	3	2

Text/Reference Books:

[1]. Smart power grids by A Keyhani, M Marwali.

[2]. Computer Relaying for Power Systems by Arun Phadke

[3].Microgrids Architecture and control by Nikos Hatziargyriou

[4].Renewable Energy Systems by Fang Lin Luo, Hong Ye

[5]. Voltage-sourced converters in power systems_ modeling, control, and applications by Amirnaser Yazdani, Reza Iravani"grid. Hybrid Power Systems: Integration of conventional and non-conventional energy sources.

Electrical Engineering			
ELP709	**Electrical and Hybrid Vehicles**	**L**	**T**
		3	0

DETAILED SYLLABUS

Module I: Introduction to Hybrid Electric Vehicles and Conventional Vehicles (3 Lectures)
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 Lectures)

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

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 Lectures)

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 Lectures)

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 Lectures)

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.

Course Outcomes:

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

CO's	CO Description
CO1	Demonstrate the drive train and propulsion unit of hybrid vehicles and their performance
CO2	Identify the different possible ways of energy storage.
CO3	Generalize the different strategies related to energy management system.
CO4	Design the hybrid electric vehicle and battery electric vehicle.
CO5	Analyze and model the power management systems for electric and hybrid vehicles
CO6	Understand the architecture and vehicle dynamics of electric and hybrid vehicles

CO's-PO's Mapping Matrix:

Enter correlation levelsl, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3	2	-	1	2	3	3	-	-	-	1	3
CO2	-	2	3	1	3	-	2	1	-	-		
CO3	2	3	-	2	2	-	2	1	-	-	3	1
CO4	3	1	3	3	2	1	2				1	3
CO5	2	3	-	2	2	-	2	1	-	-	3	1
CO6	3	1	3	3	2	1	2				1	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.

Electrical Engineering			
EL0710	**Soft Optimization Techniques**	**L**	**T**
		3	**0**

Pre-requisite: None

DETAILED SYLLABUS

Module I: Genetic Algorithm and Particle Swarm Optimization (12 Lectures)
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 Lectures)
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 Lectures)
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 Lectures)
Application to multi-modal function optimization.Introduction to Multi- Objetive optimization- Concept of Pareto optimality.

Module V: Evolutionary Computing (6 Lectures)
Evolutionary Computing, Simulated Annealing, Random Search, Downhill Simplex Search.

Course Outcomes:

After successful completion of the course, students should be able to:

CO's	Descriptions
CO1	Understand the concepts of population based optimization techniques.
CO2	Evaluate the importance of parameters in heuristic optimization techniques.
CO3	Apply for the solution of multi-objective optimization.
CO4	Formulate the engineering problems as an optimization problem
CO5	Apply necessary and sufficient conditions for a given optimization problem for optimality
CO6	Solve Engineering Design and Manufacturing related optimization problem using software tools.

COs-POs Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3	3	2	1	2	1	-	-	-	-	-	2
CO2	3	3	2	1	2	-	-	1	-	-	-	2
CO3	3	3	2	1	2	-	-	1	-	-	3	2
CO4	3	3	2	1	2	1	-	-	-	-	-	2
CO5	3	3	2	1	2	-	-	1	-	-	-	2
CO6	3	3	2	1	2	-	-	1	-	-	3	2

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].EricBonabeau, 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.

Electrical Engineering			
ELO711	**Illumination Technology**	**L**	**T**
		3	0

DETAILED SYLLABUS

Module I: Ballast based Systems (6 Lectures)

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 Lectures)

Introduction - Review of Light sources - white light generation techniques- Characterization of LEDs for illumination application. Power LEDs- High brightness LEDs- Electrical and optical properties — LED driver considerations.

Power management topologies- Thermal management considerations- Heat sink design- photometry and colorimetry - color issues of white LEDs- Dimming of LED sources -Designing usable lamp from white LEDs,- Luminaire design steps-SSL test standards. Dimming control scheme - Lighting controls for LED lamps.

Module III: Lighting Controls & Management (8 Lectures)

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 Lectures)

Application. Photo sensors — spectral sensitivity — Photo sensor based control algorithms — Daylight-artificial light integrated schemes.

Module V: Commissioning of lighting controls (10 Lectures)

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:

COs	CO Description
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	Design efficient outdoor lighting systems
CO6	Design efficient indoor lighting systems

CO's-PO's Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3	3	2	1	1	1	-	-	-	-	-	2
CO2	3	3	2	1	1	-	-	1	-	-	-	2
CO3	3	3	2	1	1	-	-	1	-	-	3	2
CO4	3	3	2	1	1	-		1	-	-	-	2
CO5	3	3	2	1	1	-	-	1	-	-	3	2
CO6	3	3	2	1	1	-		1	-	-	-	2

Text Books/Reference:

[1].ArturasZukauskus, 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].CraigDiLouie, 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.

Electrical Engineering			
EL0712	**Process Instrumentation and Control**	**L**	**T**
		3	0

DETAILED SYLLABUS

MODULE I: Introduction **(7 Lectures)**

Special Characteristics of process systems: Large time constants, Interaction, Multistaging, Pure Lag; Control loops for simple systems: Dynamics and stability.

MODULE II: **(10 Lectures)**

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 Lectures)**

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 Lectures)**

Measurement, control and transmission of signals of process parameters like flow, pressure, level and temperature.

MODULE V: **(5 Lectures)**

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:

CO's	CO Description
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	Analyze digital systems using the Z-transformation, state space methods.
CO4	Design digital controllers for physical systems.
CO5	Describe the direct digital control
CO6	Generation of control actions in electronic pneumatic controller

CO's-PO's Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3	3	2	1	1	-	-	-	-	-	-	2
CO2	3	3	2	1	1	-	-	-	-	-	-	2
CO3	3	3	2	1	1	-	-	-	-	-	-	2
CO4	3	3	2	1	1	-		-	-	-	-	2
CO5	3	3	2	1	1	-	-	-	-	-	-	2
CO6	3	3	2	1	1	-		-	-	-	-	2

Text/Reference Books:

[1].StephananopoulosG- 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 Hi11,1989.

Electrical Engineering			
EL0713	**Digital Signal Processing**	**L**	**T**
		3	**0**

DETAILED SYLLABUS

Module I: Discrete-Time Signals (04 Lectures)

Concept of discrete-time signal, basic idea of sampling and reconstruction of signal, sampling theorem, sequences,-periodic, energy, power, unit-sample, unit step, unit ramp &complex exponentials, arithmetic operations on sequences..

Module II: LTI Systems (06 Lectures)

Definition, representation, impulse response, derivation for the output sequence, concept of convolution, graphical, analytical and overlap-add methods to compute convolution supported with examples and exercise, properties of convolution, interconnection of LTI systems with physical interpretations, stability and causality conditions, recursive and non recursive systems.

Module III: Discrete Fourier Transform (10 Lectures)

Concept and relations for DFT/IDFT, Relation between DTFT & DFT. Twiddle factors and their properties, computational burden on direct DFT, DFT/DFT as linear transformation,DFT/IDFT matrices, computation of DFT/IDFT by matrix method, multiplication of DFTs, circulation convolution, computation of circular convolution by graphical, DFT/IDFT and matrix methods, linear filtering using DFT, aliasing error, filtering of long data sequences-Overlap-Save and Overlap-Add methods with examples and exercises.

Module IV: Discrete Time Fourier Transform (05 Lectures)

Concept of frequency in discrete and continuous domain and their relationship (radian and radian/sec), freq. response in the discrete domain. Discrete system's response to sinusoidal/complex inputs (DTFT), Representation of LTI systems in complex frequency domain.

Module V: Fast Fourier Transforms (04 Lectures)

Radix-2 algorithm, decimation-in-time, decimation-in-frequency algorithm, signal flow graph, Butterflies, computations in one place, bit reversal, examples for DIT & DIF FFT Butterfly computations and exercises.

Module VI: Z- Transforms (08 Lectures)

Definition, mapping between s-plane & z-plane, unit circle, convergence and ROC, properties of Z-transform, Z-transform on sequences with examples & exercises, characteristic families of signals along with ROC, convolution, correlation and multiplication using Z- transform, initial value theorem, Perseval's relation, inverse Z transform by contour integration, power series & partial-fraction expansions with examples and exercises.

ModuleVII: Filter Design (5 Lectures)

Basic concepts of IIR and FIR filters, difference equations, design of Butterworth IIR analog filter using impulse invariant and bilinear transform, design of linear phase FIR filters no. of taps, rectangular, Hamming and Blackman windows. Effect of quantization.

Course Outcomes:

After successful completion of the course students will be able to:

CO's	Description
CO1	Understand the concepts of continuous time and discrete time systems.
CO2	Understand the concepts of different discrete transforms.
CO3	Analyze systems in complex frequency domain.
CO4	Design of different types of filters.
CO5	Understand of interconnection of LTI systems with physical interpretations
CO6	Concept of discrete-time signal

CO's-PO's Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3	3	3	1								2
CO2	3	2	3	1								2
CO3	3	3	2	2								2
CO4	3	2	2	2								2
CO5	3	3	2	2								2
CO6	3	2	2	2								2

Text Books:

[1]. Digital Signal Processing-A computer based approach, S. Mitra, TMH

[2]. Digital Signal Processing: Principles, Algorithms & Application, J.C. Proakis& M.G. Manslakis, PHI

[3].Fundamental of Digital Signal Processing using MATLAB , Robert J. Schilling, S.L. Harris, Cengage Learning.

[4]. Digital Signal Processing-implementation using DSP microprocessors with examples from TMS320C54XX, Avtar Singh & S. Srinivasan, Cengage Leasrning.

Reference Books

[1].Digital Signal Processing, Chen, OUP

[2].Digital Signal Processing, Johnson, PHI

[3].Digital Signal Processing using MATLAB, Ingle, Vikas.

Electrical Engineering			
EL0714	**Energy Storage Systems**	**L**	**T**
		3	**0**

DETAILED SYLLABUS

Module I: Electrical Energy Storage Technologies (08 Lectures)
Characteristics of electricity, Electricity and the roles of EES, High generation cost during peak-demand periods, Need for continuous and flexible supply, Long distance between generation and consumption, Congestion in power grids, Transmission by cable.

Module II: Needs for Electrical Energy Storage (08 Lectures)
Emerging needs for EES, More renewable energy, less fossil fuel, Smart Grid uses, The roles of electrical energy storage technologies, The roles from the viewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy.

Module III: Features of Energy Storage Systems (08 Lectures)
Classification of EES systems , Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES), Flywheel energy storage (FES),Electrochemical storage systems, Secondary batteries, Flow batteries, Chemical energy storage, Hydrogen (H2),Synthetic natural gas (SNG).

Module IV: Types of Electrical Energy Storage systems (06 Lectures)
Electrical storage systems, Double-layer capacitors (DLC) ,Superconducting magnetic energy storage (SMES),Thermal storage systems ,Standards for EES, Technical comparison of EES technologies.

Module V: Applications (10 Lectures)
Present status of applications, Utility use (conventional power generation, grid operation &service) , Consumer use (uninterruptable power supply for large consumers),New trends in applications ,Renewable energy generation, Smart Grid, Smart Micro grid, Smart House, Electric vehicles, Management and control hierarchy of storage systems, Internal configuration of battery storage systems, External connection of EES systems ,Aggregating EES systems and distributed generation (Virtual Power Plant), Battery SCADA—aggregation of many dispersed batteries.

Course Outcomes:

After successful completion of this course, students will be able to:

CO's	CO Descriptions
CO1	Analyze the characteristics of energy from various sources and need for storage
CO2	Classify various types of energy storage and various devices used for the purpose
CO3	Identify various real time applications
CO4	Analyze the flywheel energy storage (FES),
CO5	Long distance between generation and consumption,
CO6	Analyze the double-layer capacitors (DLC)

COs-POs Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3	2	3	1	1	1	1					1
CO2	3	1	3	2	2							1
CO3	3	2	3	2	2							1
CO4	3	3	3	3	3		1					1
CO5	3	2	3	2	2							1
CO6	3	2	3	2	2							1

Electrical Engineering			
EL0715	**Electrical Machines and Power Systems**	**L**	**T**
		3	**0**

DETAILED SYLLABUS

Module I: Transformers (8 Lectures)

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,voltageregulation, losses and efficiency, all day efficiency, auto transformer and equivalent circuit, parallel operation and load sharing.

Module II: Asynchronous Machines (8 Lectures)

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 (9 Lectures)

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 (9 Lectures)

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.

sModule V: Transmission Lines (8 Lectures)

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:

CO's	CO Description
CO1	Understand the construction and principle of operation of transformers, auto transformers, asynchronous and synchronous machines.
CO2	Evaluat**e** 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	Calculation of inductance and capacitance of single phase, three phase

COs-POs Mapping Matrix:

COs/POs	P01	P02	P03	PO4	P05	P06	P07	P08	P09	P010	P011	P012
CO1	3	2	3	1	1	1	1					1
CO2	3	1	3	2	2							1
CO3	3	2	3	2	2							1
CO4	3	3	3	3	3		1					1
CO5	3	2	3	2	2							1
CO6	3	2	3	2	2							1

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.

B. Tech 7th Semester (EE/EEE)

EL701P	**Power System Protection Laboratory**	**P**	**Credit**
		3	**1**

List of Experiments
Atleast 10 experiments should be performed from the following list of experiments.

1. To determine the operating current of a definite time over current relay.
2. To plot characteristics of an electromagnetic Inverse Defmite Minimum Time (IDMT) relay.
3. To study the definite time relay testing kit and to compute its operating voltage.
4. To perform the Merz price/ differential protection for the transformer.
5. To perform the over voltage protection using transformer protection simulator.
6. To perform the over current protection using transformer protection simulator.
7. To determine the earth fault current of a 3-phase AC generator with 25% of its rated voltage.
8. To study operating mechanism of Vacuum Circuit Breaker (VCB) & Minimum Oil Circuit Breaker (MOCB).
9. To study the parallel feeder protection scheme.
10. To study the protection scheme of a synchronous Generator/Alternator.
11. To plot the operating characteristics of Numerical differential relay for protecting 3-phase transformer protection.
12. To study the protection scheme of induction motor using Numerical relay.
13. To study the High rupturing capacity (HRC) fuse & tripping of bi-metallic thermal overload protection and its characteristics.
14. To study the relay coordination in radial distribution system.
15. To study the working principle of impedance relay and its effect during faults in a transmission line.