GURU KASHI UNIVERSITY
PUNJAB - INDIA

Program Syllabus Booklet

Bachelor of Technology in Electrical Engineering (B. Tech EE-103)

Session: 2018-19

Guru Gobind Singh College of Engineering and Technology
Guru Kashi University, Talwandi Sabo

GURU KASHI UNIVERSITY
PUNJAB - INDIA

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Annexure -1

Program Name: Bachelor of Technology in Electrical Engineering. (B. Tech)

Program Code: 103

Program Outcome (PO): The Program Outcome for the Bachelor of Technology in Electrical Engineering. (B. Tech) program are the following:

PO	Statement
PO1	**Engineering knowledge:** To apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** To identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions:** To design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems**: To use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
PO5	**Modern tool usage:** To create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations..
PO6	**The engineer and society:** To apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice .
PO7	**Environment and sustainability:** To understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
PO8	**Ethics:** To apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
PO9	**Individual and team work:** To function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** To communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance:** To demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** To recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO): The Program Specific Outcome for the Bachelor in Electrical Engineering. (B. Tech) program are the following:

PSO	Statement
PSO1	To acquire basic knowledge and expertise necessary for professional practice in electrical engineering for higher studies and research and practice technical skills to identify, analyze and solve complex problems and issues related to electrical engineering
PSO2	To acquaint the students with the administrative and financial management principles for effective project implementation.
PSO3	To develop a professional attitude as an individual or a team member with consideration for society, professional ethics, environmental factors and motivation for life-long learning.

Annexure -2

Semester: 1st (Physics Group)										
Sr.No.	Subject Code	Subject Name	Type of Subject T/P	(Hours Per Week)			No. of Credits	Internal Marks	External Marks	Total Marks
				L	T	P				
1	A103101	Basic Electrical Engineering	T	3	1	0	4	40	60	100
2	103103	Physics – I (Waves and Optics and Introduction to Quantum Mechanics)	T	3	1	0	4	40	60	100
3	103104	Mathematics – I (Calculus and Differential Equations)	T	3	1	0	4	40	60	100
4	105105	Engineering Graphics & Design	T/P	1	0	4	3	40	60	100
5	103105	Physics – I (Waves and Optics and Introduction to Quantum Mechanics) Lab	P	0	0	4	2	30	20	50
6	A103102	Basic Electrical Engineering Lab	P	0	0	2	1	30	20	50
Total No. of Credits				18						

Semester: 2nd (Chemistry Group)										
Sr.	Subject Code	Subject Name	Type of Subject T/P	(Hours Per Week)			No. of Credits	Internal Marks	External Marks	Total Marks
				L	T	P				
1	A100102	Engineering Chemistry	T	3	1	0	4	40	60	100
2	103201	Mathematics –II (Linear Algebra Transform Calculus and Numerical Methods)	T	3	1	0	4	40	60	100
3	102202	Programming for Problem Solving	T	3	0	0	3	40	60	100
4	100108	English	T	2	0	0	2	40	60	100
5	105202	Workshop Manufacturing Practices	T/P	1	0	4	3	60	40	100
6	A100106	Engineering Chemistry Lab	P	0	0	4	2	30	20	50
7	102203	Programming for Problem Solving Lab	P	0	0	4	2	30	20	50
8	100109	English Lab	P	0	0	2	1	30	20	50
9	100304	Constitution of India	T	3	0	0	NC	NA	NA	NA
Total No. of Credits				21						

Semester: 3rd										
Sr.	Subject Code	Subject Name	Type of Subject T/P	(Hours Per Week)			No. of Credits	Internal Marks	External Marks	Total Marks
				L	T	P				
1	A103301	Electrical Circuit Analysis	T	3	1	0	4	40	60	100
2	A104502	Analog Electronics	T	3	0	0	3	40	60	100
3	A103302	Electrical Machines – I	T	3	0	0	3	40	60	100
4	A104403	Electromagnetic Fields	T	3	1	0	4	40	60	100
5	A104101	Basic Electronics	T	3	1	0	4	40	60	100
6	A104102	Basic Electronics Lab	P	0	0	4	2	30	20	50
7	A104507	Analog Electronics Lab	P	0	0	4	2	30	20	50
8	A103303	Electrical Machines – I Lab	P	0	0	4	2	30	20	50
9	A100302	Environmental Studies	T	3	0	0	NC	NA	NA	NA
10	A103304	Summer/Institutional Training	NA	NA	NA	NA	S/US *	NA	NA	NA
Total No. of Credits				24						

Note: Institutional Training will be imparted in the Institute at the end of 2nd Semester for 6-weeks duration. However this Subject is **not applicable to LEET Students**.
*** (S/US)** Satisfactory/Unsatisfactory

Semester: 4th										
Sr.	Subject Code	Subject Name	Type of Subject T/P	(Hours Per Week)			No. of Credits	Internal Marks	External Marks	Total Marks
				L	T	P				
1	A104401	Digital Electronics	T	3	0	0	3	40	60	100
2	A103401	Electrical Machines – II	T	3	0	0	3	40	60	100
3	A103402	Power Electronics	T	3	0	0	3	40	60	100
4	A104405	Signals and Systems	T	3	0	0	3	40	60	100
5	A103403	Mathematics-III (Probability & Statistics)	T	3	0	0	3	40	60	100
6	A103404	Measurements and Instrumentation Lab	P	0	0	4	2	30	20	50
7	A104407	Digital Electronics Lab	P	0	0	2	1	30	20	50
8	A103405	Electrical Machines – II Lab	P	0	0	2	1	30	20	50
9	A103406	Power Electronics Lab	P	0	0	2	1	30	20	50
10	100305	Essence of Indian Traditional Knowledge	T	3	0	0	NC	NA	NA	NA
11	100306	Mentoring and Professional Development of Students	P	0	0	2	S/US *	NA	NA	NA
Total No. of Credits				20						

*** (S/US) Satisfactory/Unsatisfactory**

Semester: 5th										
Sr.	Subject Code	Subject Name	Type of Subject T/P	(Hours Per Week)			No. of Credits	Internal Marks	External Marks	Total Marks
				L	T	P				
1	103510	Power System -I (Apparatus and Modelling)	T	3	0	0	3	40	60	100
2	103511	Control Systems	T	3	0	0	3	40	60	100
3	A104505	Microprocessors & its applications	T	3	0	0	3	40	60	100
4		***Program Elective -I**	T	3	0	0	3	40	60	100
5		****Open Elective -I**	T	3	0	0	3	40	60	100
6	A105920	Management Information System	T	3	0	0	3	40	60	100
7	103512	Power System -I Lab	P	0	0	2	1	30	20	50
8	103513	Control Systems Lab	P	0	0	2	1	30	20	50
9	A104509	Microprocessors & its applications Lab	P	0	0	2	1	30	20	50
Total No. of Credits			21							

***Professional Elective Course**: - All professional elective courses will be selective from the same group. (Min 5 student group is required for subject choice)

****Open Elective:-** The open elective will be taken by student as the list of open elective subjects offered by department.

Program Elective -I(Select one of the following subjects)

S.No	Subject Code	Subject Name
1	103514	Wind and Solar Energy
2	103515	Line Commutated and Active Rectifiers
3	103516	Power Quality and FACTS

Open Elective -I (Select one of the following subjects)		
1	103517	Electronic Devices & circuits
2	102611	Computer Networks
3	103518	Embedded Systems

Semester: 6th										
Sr.	Subject Code	Subject Name	Type of Subject T/P	(Hours Per Week)			No. of Credits	Internal Marks	External Marks	Total Marks
				L	T	P				
1	103611	Power Systems-II (Operation and Control)	T	3	0	0	3	40	60	100
2	A103604	Programmable Logic Controllers	T	3	0	0	3	40	60	100
3		***Program Elective -II**	T	3	0	0	3	40	60	100
4		***Program Elective -III**	T	3	0	0	3	40	60	100
5		****Open Elective -II**	T	3	0	0	3	40	60	100
6	A105918	Total Quality Management	T	3	0	0	3	40	60	100
8	103612	Power Systems-II Lab	P	0	0	2	1	30	20	50
9	A103607	Programmable Logic Controllers Lab	P	0	0	2	1	30	20	50
Total No. of Credits				20						
***Program Elective Course**: - All professional elective courses will be selective from the same group. (Min 5 student group is required for subject choice)										
****Open Elective:**- The open elective will be taken by student as the list of open elective subjects offered by department.										

Select one Program Elective -II and one Program Elective -III of the following subjects)		
S.No	**Subject Code**	**Subject Name**
1	103613	Electric Drives
2	A103603	Generation of Electrical Power
3	103614	Electrical Energy Conservation and Auditing
4	103615	Industrial Electrical Systems

Open Elective -II (Select one of the following subjects)		
1	103616	Power Plant Engineering
2	103617	Wavelet Transforms
3	103618	VLSI circuits

Semester: 7th										
Sr.	Subject Code	Subject Name	Type of Subject T/P	(Hours Per Week)			No. of Credits	Internal Marks	External Marks	Total Marks
				L	T	P				
1		**Program Elective -IV***	T	3	0	0	3	40	60	100
2		**Program Elective -V***	T	3	0	0	3	40	60	100
3		**Open Elective -III****	T	3	0	0	3	40	60	100
4		**Open Elective -IV****	T	3	0	0	3	40	60	100
5	100308	Education Technology and Society	T	3	0	0	3	40	60	100
6	103702	Project - I***	P	0	0	6	3	60	40	100
7	103703	Industrial/Institutional Training-I***	NA	NA	NA	NA	4	60	40	100
Total No. of Credits				22						

***Program Elective Course**: - All the professional elective course will be selective from the same group. (Min 5 student group is required for subject choice)
****Open Elective:**- The open elective will be taken by student as the list of open elective subjects offered by department.
***** Project -I:** The problem related with design, construction, computer modeling, fabrication, experimentation etc. based on specialization group of electives is to be carried out the result and analysis followed by discussion regarding suitability or non suitability of project with conclusion and recommendation for future extension of the project must be covered The project work will be carried out in groups(Maximum 5 students are allowed in one group)
****** Industrial/Institutional Training-I :-** The marks of industrial Training-I undergone at the end of 6th semester will be included here (Each students has to complete one project is concerned industry/institution)

Select one Program Elective -IV and one Program Elective -V of the following subjects)		
1	103704	Power System Protection
2	103705	High Voltage Direct Current
3	103706	Digital Control Systems
4	103707	Computer Architecture

Select one Open Elective -III and one Open Elective -IV of the following subjects)		
1	103708	Utilization of Electrical Engineering
2	103709	Estimating & Costing
3	102716	Image Processing
4	103710	Electrical Materials

Semester: 8th										
Sr.	Subject Code	Subject Name	Type of Subject T/P	(Hours Per Week)			No. of Credits	Internal Marks	External Marks	Total Marks
				L	T	P				
1		**Program Elective -VI***	T	3	0	0	3	40	60	100
2		**Open Elective -V****	T	3	0	0	3	40	60	100
3		**Open Elective -VI****	T	3	0	0	3	40	60	100
4	A105804	Operation Research	T	3	0	0	3	40	60	100
5	103810	Project II***	P	0	0	12	6	120	80	200
6	103811	Industrial/Institutional Training-II **	NA	NA	NA	NA	5	120	80	200
Total No. of Credits				23						

***Program Elective Course**: - All the professional elective course will be selective from the same group. (Min 5 student group is required for subject choice)
****Open Elective:**- The open c will be taken by student as the list of open elective subjects offered by department.
***** Project -I:** The problem related with design, construction, computer modeling, fabrication, experimentation etc. based on specialization group of electives is to be carried out the result and analysis followed by discussion regarding suitability or non suitability of project with conclusion and recommendation for future extension of the project must be covered The project work will be carried out in groups(Maximum 5 students are allowed in one group)
****** Industrial/Institutional Training-II :-** The marks of industrial Training-I undergone at the end of 6th semester will be included here (Each students has to complete one project is concerned industry/institution)

Program Elective -VI (Select one of the following subjects)		
S.No	**Subject Code**	**Subject Name**
1	A103801	Computer Aided Power System Analysis
2	103812	Advanced Electric Drives
3	103813	Electromagnetic Waves
4	103814	Digital Signal Processing

Select one Open Elective -V and one Open Elective -VI of the following subjects)		
S.No	**Subject Code**	**Subject Name**
1	A103802	Extra High Voltage Engineering
2	A105802	Industrial Safety and Environment
3	105945	Operations Management

Note: This study scheme (less semester 1 & semester 2) is also applicable to B. Tech EE LEET

Annexure -3

Course Name: Basic Electrical Engineering

Course Code: A103101

Semester: 1st

L T P

Credits: 04 **3 1 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO1	Discuss the DC and AC electrical circuit elements with RLC in detail.
CO2	Analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems.
CO3	Analyze Single Phase AC Circuits and representation of alternating quantities and determining the power in these circuits.
CO4	Classify the different types of Electrical machines.
CO5	Understand the different type of electrical installation devices.

Module 1: DC Circuits (8 hours)

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 (8 hours)

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 hours)

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 hours)

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 hours)

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

Module 6: Electrical Installations (6 hours)

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 calculations for energy consumption, power factor improvement and battery backup.

Suggested Text / Reference Books

(i) Kothari, D. P. and Nagrath, I. J. (2010). *Basic Electrical Engineering*. Tata McGraw Hill.
(ii) Kulshreshtha, D. C. (2009). *Basic Electrical Engineering*. McGraw Hill.
(iii) Bobrow, L. S. (2011). *Fundamentals of Electrical Engineering*. Oxford University Press.
(iv) Hughes, E. (2010). *Electrical and Electronics Technology.* Pearson,

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Basic Electrical Engineering

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	2	2	1	1	2	1	2	1	2	2	2	2
CO2	1	2	2	2	-	1	2	1	1	2	2	1	3	3	2
CO3	2	3	-	3	2	1	1	2	2	1	2	2	2	2	-
CO4	3	2	2	2	2	2	-	1	1	2	-	2	3	2	2
CO5	2	2	2	3	2	1	2	2	1	2	1	2	2	2	2
AVERAGE	**1.8**	**2.2**	**2**	**2.4**	**2**	**1.2**	**1.2**	**1.6**	**1.2**	**1.8**	**1.2**	**1.8**	**2.4**	**2.2**	**2**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Physics (Waves and Optics and Introduction to Quantum Mechanics) (103103)

Credits -4 **L T P**
Semester I **3 1 0**

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

CO	Statement
CO1	Describe and discuss experiments in which light behaves as a wave phenomenon and how these experiments can be described mathematically.
CO2	Verify Schrödinger equation in one dimension, wave functions and probability density at a general level.
CO3	Explain how light is reflected and refracted when it passes between media with different refraction index.
CO4	Use the basic concepts and carry out calculations and solve theoretical problems in the part of waves, optics and quantum physics
CO5	Carry out a simple analysis of experimental results and discuss the uncertainty and the reasonableness in the measured values.

Module 1: Waves (3 hours)
Mechanical and electrical simple harmonic oscillators, damped harmonic oscillator, forced mechanical and electrical oscillators, impedance, steady state motion of forced damped harmonic oscillator

Module 2: Non-dispersive transverse and longitudinal waves (4 hours)
Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, impedance matching, standing waves and their Eigen frequencies, longitudinal waves and the wave equation for them, acoustics waves.

Module 3: Light and Optics (3 hours)
Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them.

Module 4: Wave Optics (5 hours)
Huygens' principle, superposition of waves and interference of light by wavefront splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer, Mach Zehnder interferometer. Farunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power.

Module 5: Lasers (5 hours)
Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers (ruby, Neodymium), dye lasers; Properties of laser beams: mono-chromaticity.

Module 6: Introduction to Quantum Mechanics (5 hours)

Wave nature of Particles, Time-dependent and time-independent Schrodinger equation for wave function, Born interpretation, probability current, Expectation values, Free-particle wave function and wave-packets, Uncertainty principle.

Module 7: Solution of Wave Equation (6 hours)
Solution of stationary-state Schrodinger equation for one dimensional problems–particle in a box, particle in attractive delta-function potential, square-well potential, linear harmonic oscillator. Scattering from a potential barrier and tunneling; related examples like alphadecay, field-ionization and scanning tunneling microscope, tunneling in semiconductor structures. Three-dimensional problems: particle in three dimensional box and related examples.

Module 8: Introduction to Solids and Semiconductors (9 hours)
Free electron theory of metals, Fermi level, density of states in 1, 2 and 3 dimensions, Bloch's theorem for particles in a periodic potential, Kronig-Penney model and origin of energy bands. Types of electronic materials: metals, semiconductors, and insulators. Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p -n junction.

Text / References:
1. I. G. Main, (1993) "*Vibrations and waves in physics*", Cambridge University Press,.
2. H. J. Pain, (2006) "*The physics of vibrations and waves*", Wiley.
3. E. Hecht, (2008) "*Optics*", Pearson Education,.
4. A. Ghatak, (2012) "*Optics*", McGraw Hill Education.
5. O. Svelto, (2010) "*Principles of Lasers*", Springer Science & Business Media.
6. D. J. Griffiths, (2014) "*Quantum mechanics*", Pearson Education.
7. R. Robinett, (2006) "*Quantum Mechanics*", OUP Oxford.
8. D. McQuarrie, (2007) "*Quantum Chemistry*", University Science Books.
9. D. A. Neamen, (1997) "*Semiconductor Physics and Devices*", Times Mirror High Education Group, Chicago.
10. E.S. Yang, (1988) "*Microelectronic Devices*", McGraw Hill, Singapore.
11. B.G. Streetman, (1995) "*Solid State Electronic Devices*", Prentice Hall of India.

The mapping of PO/PSO/CO attainment is as follows:

PO/PSO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3

CO1	2	2	2	3	2	1	2	-	2	2	2	2	2	2	2
CO2	3	3	3	2	2	1	-	1	2	3	2	3	3	3	3
CO3	2	3	3	2	2	2	1	-	1	2	1	2	2	3	2
CO4	2	3	2	3	1	-	2	2	2	3	2	3	2	1	3
CO5	3	2	2	2	2	2	1	2	-	3	-	3	2	2	2
Average	**2.4**	**2.6**	**2.4**	**2.4**	**1.8**	**1.5**	**1.5**	**1.6**	**2.2**	**2.6**	**2.2**	**2.6**	**2.2**	**2.2**	**2.4**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Mathematics –I (Calculus and Differential Equations) (103104)

Credits -4 **L T P**
Semester I **3 1 0**

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

CO	Statement
CO1	Demonstrate the fundamental theorem of calculus and use it for evaluating definite integrals and derivatives of integrals with variable limits of integration
CO2	Distinguish between the concepts of *sequence and series*, and determine limits of sequences and convergence and approximate sums
CO3	Analyze the methods of forming and solving Ordinary differential equations and Solve linear differential equations with constant and variable coefficients
CO4	Explain the concept of differential equation and classifies the differential equations with respect to their order and linearity.
CO5	Set up and evaluate multiple integrals for regions in the plane to find area of the region bounded by curves and volume, surface area, Mass, C.G and M.I of solid geometric figures.

Module 1: Calculus (8 hours)
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. Rolle's theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Indeterminate forms and L'Hospital's rule; Maxima and minima.

Module 2: Sequences and Series (7 hours)
Convergence of sequence and series, tests for convergence, power series, Taylor's series. Series for exponential, trigonometric and logarithmic functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

Module 3: Multivariable Calculus: Differentiation (6 hours)

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 4: Multivariable Calculus: Integration (7 hours)
Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes by (double integration) Center of mass and Gravity (constant and variable densities). Theorems of Green, Gauss and Stokes, orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds.

Module 5: First Order Ordinary Differential Equations (3 hours)
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 6: Ordinary Differential Equations of Higher Order (6 hours)
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 7: Partial Differential Equations: First Order (3 hours)
First order partial differential equations, solutions of first order linear and non-linear PDEs.

Text / References:

1. Thomes, G.B.and Finney, R.L.(2010)*Calculus and Analytic Geometry*; Ninth Edition; Pearson Education
2. Kreyszig, E.(1998)*Advanced Engineering Mathematics*; Eighth Edition, Johnwiley and sons.
3. Grewal, B.S.(1965) *Higher Engineering Mathematics* ; Khanna Publishers, NewDelhi.
4. BabuRam (2009) *Advance Engineering Mathematics*; First Edition;PearsonEducation.
5. Richard Courant and Fritz John (2012) ***Introduction to Calculus and Analysis,*** **Volume II , V** Springer Publication
6. Harold M. Edwards (2013) *Advanced Calculus: A Differential Forms Approach*, Birkhauser.
7. Veerarajan, T. (2008). *Engineering Mathematics for first year*. Tata McGraw-Hill, New Delhi.
8. Ramana, B.V. (2010). *Higher Engineering Mathematics*, Tata McGraw Hill New Delhi, 11th Reprint.
9. Poole, D. (2005). *Linear Algebra*: *A Modern Introduction*, 2nd Edition, Brooks/Cole.

The mapping of PO/PSO/CO attainment is as follows:

PO/PSO /CO	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2	3	2	1	1	2	1	1	1	2	2	2	2	2

CO2	2	3	3	2	2	1	2	-	2	3	2	2	2	1	1
CO3	3	2	2	2	1	-	2	1	-	-	2	3	1	2	2
CO4	2	2	2	2	2	2	-	2	2	3	1	3	2	2	3
CO5	2	2	2	3	1	1	1	-	2	1	1	2	1	3	2
Average	**2.4**	**2.2**	**2.4**	**2.2**	**1.4**	**1.2**	**1.7**	**1.3**	**1.7**	**2**	**1.6**	**2.4**	**1.6**	**2**	**2**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Engineering Graphics & Design

Course Code: 105105

Semester: 1st

Credits -3

L	**T**	**P**
1	**0**	**4**

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

CO	**On successful completion of this course, the students will be able to:**
CO1	Understand about engineering drawing applications and its importance in society.
CO2	Learn about the visual aspects of engineering design.
CO3	Understand the engineering graphics standards.
CO4	Understand the concept of solid modeling techniques.
CO5	Apply the computer-aided geometric design in engineering

Course Content

Module 1:

Introduction to Engineering Drawing covering, 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;

Module 2:

Orthographic Projectionscovering, Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;

Module 3:

Projections of Regular Solidscovering, 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.

Module 4:

Sections and Sectional Views of Right Angular Solidscovering, 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)

Module 5:

Isometric Projections covering, 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 and Vice-versa, Conventions;

Module 6:

Overview of Computer Graphics covering, listing the computer technologies that impact on graphical communication, Demonstrating knowledge of 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 Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids];

Module 7:

Customization& CAD Drawing 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 tolerance; 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;

Module 8:

Annotations, layering & other functions covering applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to 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, tolerance techniques; dimensioning and scale multi views of dwelling;

Module 9:

Demonstration of a simple team design project that illustrates 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 tolerance; 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 color coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modeling (BIM).

References Books:

1. Gill, P.S.(2001).*Engineering Drawing*. S.K; Kataria and Sons,Ludhiana.
2. Bhatt, N.D.(2012).*Engineering Drawing*. Charotar Book Stall, Tulsi Sadan, Anand.
3. French, T.E. and Vierck. C.J.(1993).*Graphic Science*. McGraw-Hill, New York.
4. Zozzora, F.(1958).*Engineering Drawing*.McGraw Hill, NewYork.

(Corresponding set of) CAD Software Theory and User Manuals

The mapping of PO/PSO/CO attainment is as follows:

PO/PSO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2	1	2	1	2	2	1	1	1	2	1	1
CO2	2	1	2	1	2	1	1	2	2	1	1	-	1	2	2
CO3	2	2	2	2	1	2	1	2	2	1	-	1	2	1	1
CO4	1	2	1	2	1	1	2	2	2	2	1	1	1	2	2
CO5	1	2	1	2	2	1	2	1	2	1	1	1	1	2	2
Average	**1.75**	**1.75**	**1.75**	**1.75**	**1.25**	**1.5**	**1.25**	**2**	**2**	**1.25**	**1**	**1**	**1.5**	**1.5**	**1.5**

Physics Lab (Waves and Optics and Introduction to Quantum Mechanics)

Course Code: 103105

Semester: 1st

Credits -2 **L T P**

Semester I **0 0 4**

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

CO	Statement
CO1	Carry out measurements and laboratory work in optics and spectroscopy.
CO2	Write an individual written report on the results of laboratory work and calculations
CO3	Use the basic concepts and carry out calculations and solve theoretical problems in the part of waves, optics and quantum physics that the course contains.
CO4	Explain how physical models can be derived from basic principles and be tested by experimental measurements.
CO5	Determine the stopping potential from the photocurrent versus applied potentialgraph.

Course Objectives: The aim and objective of the lab on **Waves and Optics and Introduction to Quantum Mechanics** is to introduce the students of B.Tech class to the formal structure of wave and optics, Quantum Mechanics so that they can use these in Engineering branch as per their requirement.

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

- Verify some of the theoretical concepts learnt in the theory courses.
- Trained in carrying out precise measurements and handling sensitive equipment.
- Introduced to the methods used for estimating and dealing with experimental uncertainties and systematic errors
- Learn to draw conclusions from data and develop skills in experimental design.
- Write a technical report which communicates scientific information in a clear and concise manner.

Note: Students are expected to perform about 10-12 experiments from the following list:

1. Tostudythelaserbeamcharacteristicslike; wavelengthusingdiffractiongratingaperture&divergence.
2. Study of diffraction using laser beam and thus to determine the gratingelement.
3. To study laser interference using Michelson'sInterferometer.
4. To determine the numerical aperture of a given optic fibre and hence to find its acceptanceangle.
5. To determine attenuation & propagation losses in opticalfibres.
6. To determine the grain size of a material using opticalmicroscope.
7. To find the refractive index of a material/glass usingspectrometer.
8. To find the refractive index of a liquid usingspectrometer.
9. To find the velocity of ultrasound inliquid.
10. To determine the specific rotation of sugar using Laurent's half-shadepolarimeter.
11. To find the resolving power of theprism.
12. To determine the angle of the givenprism.
13. To determine the refractive index of the material of aprism.
14. To calculate the beam divergence and spot size of the given laserbeam.
15. To determine the wavelength of a laser using the Michelsoninterferometer.
16. To revise the concept of interference of light waves in general and thin-film interference inparticular.
17. To set up and observe Newton'srings.
18. To determine the wavelength of the givensource.
19. To understand the phenomenon Photoelectric effect as awhole.
20. To draw kinetic energy of photoelectrons as a function of frequency of incidentradiation.

21. To determine the Planck's constant from kinetic energy versus frequencygraph.
22. To plot a graph connecting photocurrent and appliedpotential.
23. To determine the stopping potential from the photocurrent versus applied potentialgraph.

The mapping of PO/PSO/CO attainment is as follows:

PO/PSO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	2	2	2	2	2	2	2	2	2	2	3	2	3
CO2	1	1	2	1	1	1	2	1	2	2	-	2	2	3	2
CO3	2	1	2	2	2	2	1	-	2	2	2	3	2	3	2
CO4	1	1	2	1	1	2	-	2	1	-	2	2	2	2	2
CO5	1	1	1	2	1	-	1	2	-	2	1	3	3	3	3
Average	**1.5**	**1**	**2**	**1.5**	**1.5**	**1.5**	**1.25**	**1.7**	**1.7**	**2**	**1.5**	**2.4**	**2.4**	**2.6**	**2.4**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Basic Electrical Engineering Lab

Course Code: A103102

Semester: 1st

L T P

Credits: 01 **0 0 2**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO1	Analysis of Resistive Circuits and Solution of resistive circuits with independent sources
CO2	Two Terminal Element Relationships for inductors and capacitors and analysis of magnetic circuits
CO3	Analysis of Single Phase AC Circuits, the representation of alternating quantities and determining the power in these circuits
CO4	Categorize and compare different types of Electrical machines
CO5	Classify different electrical measuring equipment's and understanding their principles

Basic Electrical Engineering Lab (A103102)

Credits -1 **L T P**
Semester I **0 0 2**

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. Control of 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.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Basic Electrical Engineering Lab

PO/PSO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	1	2	2	1	1	1	2	1	1	2	1
CO2	2	1	1	2	2	1	1	2	1	2	1	2	2	1	2
CO3	2	2	1	1	1	2	1	1	2	1	1	2	1	1	1
CO4	1	1	1	2	2	2	1	2	2	1	2	2	2	2	1

CO5	1	1	1	2	2	1	1	2	2	1	1	1	2	2	1
AVERAGE	**1.6**	**1.4**	**1.2**	**1.6**	**1.6**	**1.6**	**1.2**	**1.6**	**1.6**	**1.2**	**1.4**	**1.6**	**1.6**	**1.6**	**1.2**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Engineering Chemistry

Course Code: A100102

Semester: 2nd

L T P

Credits: 04 **3 1 0**

Course Outcomes:

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

CO	Statements
CO1	Demonstrate Schrodinger equation, Particle in a box solution and their applications for conjugated molecules and Nanoparticles,
CO2	Evaluate band structure of solids and the role of doping on band structures.
CO3	Distinguish the ranges of Vibrational and rotational spectroscopy of diatomic molecules, Applications, Nuclear magnetic resonance and magnetic resonance imaging
CO4	Rationalize periodic properties such as ionization potential, electro-negativity, Oxidation states and electro-negativity.
CO5	List the Thermodynamic functions: energy, entropy and free energy and also Estimations of entropy and free energies.

Course Contents

Module 1: Atomic and molecular structure (12 lectures)
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 orbital's of diatomic molecules and plots of the multicenter orbital. Equations foratomic and molecular orbital. Energy level diagrams of diatomic. Pi-molecular orbital of 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 lectures)

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 lectures)
Ionic, Dipolar and Vander 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 lectures)
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 in metallurgy through Ellingham diagrams.

Module 5: Periodic properties (4 Lectures)
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 soft acids and bases, molecular geometries

Module 6: Stereochemistry (4 lectures)
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 7: Organic reactions and synthesis of a drug molecule (4 lectures)
Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

Suggested Text Books

i. Mahan, B. H. (1987). University chemistry.
ii. Sienko, M. J. & Plane, R. A. *Chemistry. (1979): Principles and* Applications. New York: McGraw-Hill.
iii. Banwell, C. N. (1966). *Fundamentals of Molecular Spectroscop.* New York, McGraw-Hill.
iv. Tembe, B. L., Kamaluddin & Krishnan, (2008). M. S. *Engineering Chemistry (NPTEL Web-book)*.

The mapping of PO/PSO/CO attainment is as follows:

PO/PSO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	3	2	1	2	-	2	2	2	2	2	2	2
CO2	3	3	3	2	2	1	-	1	2	3	2	3	3	3	3
CO3	2	3	3	2	2	2	1	-	1	2	1	2	2	3	2

CO4	2	3	2	3	1	-	2	2	2	3	2	3	2	1	3
CO5	3	2	2	2	2	2	1	2	-	3	-	3	2	2	2
Average	**2.4**	**2.6**	**2.4**	**2.4**	**1.8**	**1.5**	**1.5**	**1.6**	**2.2**	**2.6**	**2.2**	**2.6**	**2.2**	**2.2**	**2.4**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Mathematics –II (Linear Algebra, Transform Calculus and Numerical Methods) (103201)

Credits -4 **L T P**
Semester II **3 1 0**

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

CO	Statementc
CO1	Perform matrix operations and solve the matrix equation using elementary matrix operations
CO2	Use systems of linear equations and matrix equations to determine linear dependency or independency and Evaluate the eigen values and corresponding eigenvectors for a linear transformation
CO3	Use various interpolation methods and finite difference concepts to find roots of polynomial equations using numerical analysis.
CO4	Explain how to interpolate the given set of values and the curve fitting for various polynomials
CO5	Work numerically on the ordinary differential equations using different methods through the theory of finite differences and Runge-Kutta method.

Module 1: Matrices (10 hours)
Algebra of matrices, Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, Orthogonal transformation and quadratic to canonical forms.

Module 2: Numerical Methods-I (10 hours)
Solution of polynomial and transcendental equations – Bisection method, Newton-Raphson method and Regula-Falsi method. Finite differences, Interpolation using Newton's forward and backward difference formulae. Central difference interpolation: Gauss's forward and backward formulae. Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.

Module 3: Numerical Methods-II (10 hours)
Ordinary differential equations: Taylor's series, Euler and modified Euler's methods. Runge-

Kutta method of fourth order for solving first and second order equations. Milne's and Adam's predicator-corrector methods. Partial differential equations: Finite difference solution two dimensional Laplace equation and Poisson equation, Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods), Finite difference explicit method for wave equation.

Module 4: Transform Calculus (10 hours)
Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs and PDEs by Laplace Transform method. Fourier transforms.

Text / References:
1 Gupta, S.K. (2009). *Numerical Methods for Engineers (2nd Edition)*. New Age International Publishers.
2. Jain, M.K., Iyengar, S.R.K., &Jain, R.K. (2012).*Numerical Methods for Scientific and Engineering Computation.* New Age International.
3. Finlayson, B.A. (1980).*Nonlinear Analysis in Chemical Engineering.*MCGraw Hill
4. Villadsen, J. and Michelsen, M.L. (1978).*Solution of Differential Equation Models by Polynomial Approximation.* Prentice Hall.
5. Rice, R.G. & Do Duong, D. (1995).*Applied Mathematics and Modelling for Chemical Engineers.* John Wiley.
6. Sastry, S.S. (2005).*Introductory Methods of Numerical Analysis (4th Edition).* Prentice Hall of India.

The mapping of PO/PSO/CO attainment is as follows:

PO/PSO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	3	2	1	2	-	2	2	2	2	2	2	2
CO2	3	3	3	2	2	1	-	1	2	3	2	3	3	3	3
CO3	2	3	3	2	2	2	1	-	1	2	1	2	2	3	2
CO4	2	3	2	3	1	-	2	2	2	3	2	3	2	1	3
CO5	3	2	2	2	2	2	1	2	-	3	-	3	2	2	2
Average	**2.4**	**2.6**	**2.4**	**2.4**	**1.8**	**1.5**	**1.5**	**1.6**	**2.2**	**2.6**	**2.2**	**2.6**	**2.2**	**2.2**	**2.4**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Programming for Problem Solving

Course Code: 102202

Semester: 2nd

Credits- 04 **L T P**

3 1 0

Course Outcomes: On successful completion of this course, the students will able to:

CO	Statement
CO1	Design the algorithms to write a programs.
CO2	Apply arrays, pointers and structures to formulate algorithms and programs
CO3	Apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration
CO4	To implement conditional branching, iteration and recursion
CO5	Test and execute the programs and correct syntax and logical errors

Course Content

Unit 1: Introduction to Programming **(4 lectures)**
Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) - **(1 lecture).**
Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. **(1 lecture)**
From algorithms to programs; source code, variables (with data types) variables and memory Locations, Syntax and Logical Errors in compilation, object and executable code- **(2 lectures)**
Unit 2: Arithmetic expressions and precedence (**2 lectures**)

Unit 3: Conditional Branching and Loops **(6 lectures)**
Writing and evaluation of conditionals and consequent branching **(3 lectures)**
Iteration and loops **(3 lectures)**

Unit 4: Arrays **(6 lectures)**
Arrays (1-D, 2-D), Character arrays and Strings

Unit 5: Basic Algorithms **(6 lectures)**
Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of Equations, notion of order of complexity through example programs (no formal definition required)

Unit 6: Function **(5 lectures)**
Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference.

Unit 7: Recursion **(4 -5 lectures)**
Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

Unit 8: Structure **(4 lectures)**
Structures, Defining structures and Array of Structures

Unit 9: Pointers **(2 lectures)**
Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

Unit 10: File handling (only if time is available, otherwise should be done as part of the lab)

Text/Reference Books
1. Byron Gottfried, Schaum's (1995), *Outline of Programming with C*, McGraw-Hill
2. E. Balaguruswamy (2005) Programming in ANSI C, Tata McGraw-Hill

The mapping of PO/PSO/CO attainment is as follows:

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

Average	**2.8**	**2.0**	**1.8**	**2.4**	**2.4**	**1.8**	**1**	**1**	**2.0**	**2.2**	**2.0**	**2.4**	**2.2**	**2.0**	**2.4**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

English (100108)

Credit:- 02 **L T P**
2 0 0

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

CO	Statements
CO1	Develop vocabulary and improve the accuracy in Grammar.
CO2	Apply the concepts of accurate English while writing and become equally ease at using good vocabulary and language skills.
CO3	Develop and Expand writing skills through Controlled and guided activities.
CO4	Compose articles and compositions in English.
CO5	Become autonomous and self-directed English language learners.

Course Content

Unit 1: Vocabulary Building
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.

Unit 2: Basic Writing Skills
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

Unit 3: Identifying Common Errors in Writing
Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies, Clichés

Unit 4: Nature and Style of sensible Writing
Describing, Defining, Classifying, Providing examples or evidence, Writing introduction and conclusion

Unit 5: Writing Practices
Comprehension, Précis Writing, Essay Writing

Suggested Readings:

1. Swan, Michael. (1995). *Practical English*. OUP.
2. Wood, F.T. (2007). *Remedial English Grammar*. Macmillan.
3. Zinsser, W. (2001). *On Writing Well*. Harper Resource Book.
4. Lyons, L. H. & Heasly, B. (2006). *Study Writing*. Cambridge University Press.
5. Kumar, S & Lata, P. (2011). *Communication Skills*. Oxford University Press.
6. CIEFL, Hyderabad. *Exercises in Spoken English. Parts. I-III*. Oxford University Press.

The mapping of PO/PSO/CO attainment is as follows:

PO/PSO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	-	1	-	-	-	3	-	1	1	2	-
CO2	-	-	-	-	-	1	-	-	-	3	-	1	1	1	-
CO3	-	-	-	-	-	1	-	-	-	3	-	1	-	1	-
CO4	-	-	-	-	-	1	-	-	-	3	-	2	1	1	-
CO5	-	-	-	-	-	1	-	-	-	3	-	2	1	2	-
Average						1				3		1.4	0.8	1.4	

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Workshop Manufacturing Practices

Course Code: 105202

Semester: 2nd

L T P

Credits: 03 **1 0 4**

Course Outcomes:

CO	
CO1	Apply the various manufacturing methods in different fields of engineering.
CO2	Learn about the different fabrication techniques.
CO3	Learn about the practices in manufacturing of simple components using different materials.
CO4	Understand the advanced and latest manufacturing techniques being used in engineering industry.
CO5	Prepare different sand molds for various parts

Course Content

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

Module 2: (1 lecture)
CNC machining, Additive manufacturing

Module 3: (1 lecture)
Fitting operations & power tools

Module 4: (1 lecture)
Electrical & Electronics

Module 5: (1 lecture)
Carpentry

Module 6: (1 lecture)
Plastic moulding, glass cutting

Module 7: (1 lecture)
Metal casting

Module 8: (1 lecture)
Welding (arc welding & gas welding), brazing [More hours can be given to Welding for Civil Engineering students as they may have to deal with Steel structures fabrication and erection; 3D Printing is an evolving manufacturing technology and merits some lectures and hands-on training.]

Workshop Practice: (60 hours)
1. Machine shop - 10 hours
2. Fitting shop - 8 hours
3. Carpentry - 6 hours
4. Electrical & Electronics - 8 hours
5. Welding shop - 8 hours (Arc welding 4 hrs + gas welding 4 hrs)
6. Casting - 8 hours
7. Smithy - 6 hours
8. Plastic moulding & Glass Cutting -6 hours

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

References Books:-

1. Raghuwanshi, B.S.(2009*). A Course in Workshop Technology, Vol 1 & II*.Dhanpat Rai &Sons.
2. Jain, R.K.(2010*).Production Technology*.Khanna Publishers.
3. Singh, S.(2003).*Manufacturing Practice*.S.K. Kataria &Sons.

The mapping of PO/PSO/CO attainment is as follows:

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

Average	**2.4**	**2.6**	**2.6**	**2.6**	**2.4**	**2.6**	**2.8**	**3**	**2.6**	**2.4**	**2.4**	**2.4**	**2.8**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Engineering Chemistry Lab

Course Code: A100106

Semester: 2nd

L T P

Credits: 02 **0 0 4**

Course Outcomes:

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

CO	Statements
CO1	Estimate rate constants of reactions from concentration of reactants/products as a function of time
CO2	Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc
CO3	Apply the theoretical concepts for result analysis and interpret data obtained from experimentation
CO4	Identify the compound using a combination of qualitative test and analytical methods

Course Contents

Choice of 10-12 experiments from the following:

1. Determination of surface tension and viscosity
2. Thin layer chromatography
3. Ion exchange column for removal of hardness of water
4. Determination of chloride content of water
5. Colligative properties using freezing point depression
6. Determination of the rate constant of a reaction
7. Determination of cell constant and conductance of solutions
8. Potentiometry - determination of redox potentials and emfs
9. Synthesis of a polymer/drug
10. Saponification/acid value of an oil
11. Chemical analysis of a salt
12. Lattice structures and packing of spheres
13. Models of potential energy surfaces
14. Chemical oscillations- Iodine clock reaction
15. Determination of the partition coefficient of a substance between two immiscible liquids
16. Adsorption of acetic acid by charcoal

17. Use of the capillary viscosimeters 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 .

The mapping of PO/PSO/CO attainment is as follows:

PO/PSO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	3	2	1	2	-	2	2	2	2	2	2	2
CO2	3	3	3	2	2	1	-	1	2	3	2	3	3	3	3
CO3	2	3	3	2	2	2	1	-	1	2	1	2	2	3	2
CO4	2	3	2	3	1	-	2	2	2	3	2	3	2	1	3
CO5	3	2	2	2	2	2	1	2	-	3	2	3	2	2	2
Average	**2.2**	**2.6**	**2.2**	**2.2**	**1.8**	**1.5**	**1.5**	**1.6**	**1.7**	**2.6**	**1.8**	**2.6**	**2.2**	**2.2**	**2.4**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Programming for Problem Solving Lab

Course Code: 102203

Semester: 2nd

Credits- 02 **L T P**

0 0 4

Course Outcomes: On successful completion of this course, the students will able to:

CO	Statement
CO1	Create, read and write to and from simple text files.
CO2	Identify and correct logical errors encountered at run time
CO3	Apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration

CO4	Represent data in arrays, strings and structures and manipulate them through a program
CO5	Test and execute the programs and correct syntax and logical errors

Course Content

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, memory structure
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: 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

Text/Reference Books

1. Byron Gottfried, Schaum's (1995), *Outline of Programming with C*, McGraw-Hill
2. E. Balaguruswamy (2005) Programming in ANSI C, Tata McGraw-Hill.

The mapping of PO/PSO/CO attainment is as follows:

PO/PSO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	1	-	-	1	2	2	2	1	2	1
CO2	2	1	2	2	3	2	-	1	2	1	2	3	2	2	3
CO3	2	2	2	2	3	2	-	-	2	2	1	2	2	2	3
CO4	1	1	1	2	2	2	-	-	3	2	2	3	2	1	2
CO5	2	2	1	2	3	2	1	1	2	2	2	2	1	2	3
Average	**1.8**	**1.6**	**1.6**	**2**	**2.6**	**1.8**	**1**	**1**	**2**	**1.8**	**1.8**	**2.4**	**1.6**	**1.8**	**2.4**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

(100109): English Lab

Course Outcomes: On completion of this course, the successful students should be able:

Course Outcomes	Statement of CO
CO1	To learn the Listening Comprehension
CO2	How to pronunciation, Intonation, Stress and Rhythm
CO3	To solve common Everyday Situations: Conversations and Dialogues
CO4	How to do communication at Workplace
CO5	How to face Interviews

English Lab (100109)

Credit :- 01 **L T P**
0 0 2

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

CO	Statements
CO1	Illustrate the importance of pronunciation and apply the same day to day conversation
CO2	Apply verbal and non-verbal communication techniques in the Professional Environment
CO3	Develop coherence, cohesion and competence in Oral discourse.
CO4	Handle the interview process confidently.
CO5	Communicate contextually in specific personal and professional situations with courtesy.

COURSE CONTENT:

Oral Communication

(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

The mapping of PO/PSO/CO attainment is as follows:

PO/PSO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	-	1	-	-	-	3	-	1	1	2	-
CO2	-	-	-	-	-	1	-	-	-	3	-	1	1	1	-
CO3	-	-	-	-	-	1	-	-	-	3	-	1	-	1	-
CO4	-	-	-	-	-	2	-	-	-	3	-	2	1	1	-
CO5	-	-	-	-	-	1	-	-	-	3	-	1	1	2	-
Average						1.2				3		1.2	0.8	1.4	

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Constitution of India (100304)

Credits -NC **L T P**
Semester II **3 0 0**

Module 1

Introduction to the Constitution of India, The Making of the Constitution and Salient features of the Constitution.
Preamble to the Indian Constitution Fundamental Rights & its limitations.

Module 2

Directive Principles of State Policy & Relevance of Directive Principles State Policy Fundamental Duties.
Union Executives – President, Prime Minister Parliament Supreme Court of India.

Module 3

State Executives – Governor Chief Minister, State Legislature High Court of State.

Electoral Process in India, Amendment Procedures, 42 nd, 44th, 74th, 76th, 86th &91st Amendments.

Module 4

Special Provision for SC & ST Special Provision for Women, Children & Backward Classes Emergency Provisions. Human Rights –Meaning and Definitions, Legislation Specific Themes in Human Rights- Working of National Human Rights Commission in India
Powers and functions of Municipalities, Panchyats and Co – Operative Societies.

Module 5

Scope & Aims of Engineering Ethics, Responsibility of Engineers Impediments to Responsibility. Risks, Safety and liability of Engineers, Honesty, Integrity & Reliability in Engineering.

Text Books:

- Durga Das Basu: "Introduction to the Constitution on India", (Students Edn.) Prentice –Hall EEE, 19th / 20th Edn., 2001 2.
- Charles E. Haries, Michael S Pritchard and Michael J. Robins "Engineering Ethics" Thompson Asia, 2003-08-05.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Constitution of India

PO/PSO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	1	2	1	2	2	1	2	2	1	2	2	2
CO2	2	2	2	2	1	2	2	1	2	1	2	1	2	2	2
CO3	2	-	2	1	2	2	1	2	2	-	2	1	2	2	-
CO4	1	2	1	2	2	2	2	1	2	2	2	2	2	1	2
CO5	2	2	2	2	1	2	2	2	2	1	2	2	2	2	2
AVERAGE	**1.8**	**2**	**1.4**	**1.6**	**1.6**	**1.8**	**1.8**	**1.6**	**1.8**	**1.2**	**2**	**1.4**	**2**	**1.8**	**2**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation

Course Name: Electrical Circuit Analysis

Course Code: A103301

Semester: 3rd

L T P

Credits: 04 **3 1 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO1	Apply network theorems for the analysis of electrical circuits.
CO2	Obtain the transient and steady-state response of electrical circuits.
CO3	Analyze circuits in the sinusoidal steady-state (single-phase and three- phase). Analyze two port circuit behaviors.
CO4	Synthesize networks and filters.
CO5	It helps to improve skills in network functions and two port network in electrical circuits.

Course Content

Module 1: Basic Network Analysis (14 Hours)

Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks. Solution of first and second order differential equations for series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

Module 2: Electrical circuit and steady state analysis (14 Hours)

Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot convention in coupled circuits, Ideal Transformer. Analysis of electrical circuits using Laplace Transform for standard inputs, transformed network with initial conditions. Frequency response (magnitude and phase plots), series and parallel resonances.

Module 3: Network functions and two port network (10 Hours)

Driving point impedance and admittance, natural response of a network, transfer impedance and admittance, concept of pole and zeros in a network function, Routh Hurwitz criterion of stability.

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

interconnections of two port networks.

Module 4: Network Synthesis and Filters (10 Hours)
Network synthesis techniques for 2-terminal network, Foster and Cauer forms.
Filters: Classification of filters, characteristics impedance and propagation constant of pure reactive network, ladder network, T-section, π-section, terminating half section, pass bands and stop bands, Design of constant-K, m-derived filters.

Text / References:

(i) Van Valkenburg, M. E. (2006). *Network Analysis*. Prentice Hall.
(ii) Choudhury, D. Roy. (1998). *Networks and Systems*. New Age International Publication.
(iii) Hayt W. H. and Kemmerl,y J. E. (2013). *Engineering Circuit Analysis.* McGraw Hill Education.
(iv) Alexander C. K. and Sadiku, M. N. O. (2004). *Electric Circuits.* McGraw Hill Education.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Electrical Circuit Analysis

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	2	1	2	1	2	1	2	1	2	2
CO2	3	2	-	2	2	1	2	1	1	2	2	1	3	3	3
CO3	3	3	2	3	2	2	3	2	2	1	2	2	1	2	2
CO4	2	3	2	2	2	1	-	2	1	2	1	2	-	2	3
CO5	3	2	2	3	3	1	2	1	2	1	2	1	3	2	3
AVERAGE	**2.8**	**2.6**	**2**	**2.6**	**2.4**	**1.4**	**2**	**1.6**	**1.4**	**1.6**	**1.6**	**1.6**	**2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Analog Electronics

Course Code: A104502

Semester: 3rd

L T P

Credits: 04 **3 1 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO1	Acquire basic knowledge of physical and electrical conducting properties of semiconductors.
CO2	Develop the Ability to understand the design and working of BJT / FET amplifiers.
CO3	Able to design amplifier circuits using BJT s And FET's. and observe the amplitude and frequency responses of common amplifier circuits
CO4	Observe the effect of positive feedback and able to design and working of different Oscillators using BJTS.
CO5	Develop the skill to build, and troubleshoot Analog circuits.

Course Content

Module 1: Diode and BJT circuits (12 Hours)
Junction diode, *V-I* characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

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

Module 2: MOSFET circuits (10 Hours)
MOSFET structure and *V-I* characteristics, MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans- conductance, high frequency equivalent circuit.

Module 3: Differential, multi-stage and operational amplifiers (10 Hours)
Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product).

Module 4: Linear applications of op-amp (10 Hours)
Idealized analysis of op-amp circuits. Specifications. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, voltage regulator, Oscillators: Principle of operation, Wein's bridge and phase shift oscillator.

Text/References:

1. Sedra A. S. & Smith, K. C. (1998). *Microelectronic Circuits*. New York, Oxford University Press.
2. Wait, J. V. , Huelsman L. P. and Korn, G. A. (1992). *Introduction to Operational Amplifier theory and applications.* McGraw Hill U. S..
3. Millman J. and Grabel A. (1988). *Microelectronics.* McGraw Hill Education.

4. Horowitz, P. and Hill, W. (1989). *The Art of Electronics.* Cambridge University Press.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Analog Electronics

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	3	2	2	1	2	1	-	2	2	1	2	2
CO2	2	2	-	2	2	2	2	1	2	3	2	3	3	3	3
CO3	3	3	2	3	2	2	3	2	2	3	1	3	2	2	2
CO4	2	3	2	2	2	1	2	2	3	1	1	2	2	2	3
CO5	3	2	-	3	2	1	2	1	-	1	2	2	3	2	3
AVERAGE	**2.4**	**2.6**	**2**	**2.6**	**2**	**1.6**	**2**	**1.6**	**2**	**2**	**1.6**	**2.4**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Electrical Machines-I

Course Code: A103302

Semester: 3rd

L T P

Credits: 04 **3 1 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO1	Remember, understand and analyze the working of EMEC devices, Singly and doubly excited systems
CO2	Understand the response of the dc machine on the basis of Armature Reaction and commutation
CO3	Analyze the concept of starters and speed control of dc motors and evaluate the performance of

	dc machine by performing Swinburne' and Hopkinson's test.
CO4	Remember, understand and evaluate the performance of single-phase transformer by performing open circuit test, short circuit test and Sumpner's test.
CO5	Understand and apply the suitable connection of 3 phase transformers in 3 phase systems and analyze the effect of harmonics in transformers.

Course Content

Module 1: Magnetic fields and magnetic circuits (6 Hours)

Review of magnetic circuits - MMF, flux, reluctance, inductance; Visualization of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines.

Module 2: DC machines (12 Hours)

Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil. Armature winding and commutation - Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.

Module 3: DC machine - motoring and generation (12 Hours)

Armature circuit equation for motoring and generation, Types of field excitations - separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. *V-I* characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines

Module 4: Transformers (12 Hours)

Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency, Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses, Three- phase transformer - construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers, Autotransformers - construction, principle, applications and comparison with two winding transformer, Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers. Cooling of transformers.

Text / References:

(i) Fitzgerald E. and Kingsley, C. (2013). *Electric Machinery*. New York, McGraw Hill Education.

(ii) Clayton E. and Hancock, N. N. (2004). *Performance and design of DC machines*. CBS Publishers.
(iii) Say, M. G. (2002). *Performance and design of AC machines*. CBS Publishers.
(iv) Bimbhra, P. S. (2011). *Electrical Machinery*. Khanna Publishers.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Electrical Machines-I

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	1	2	1	-	2	3	1	2	2
CO2	2	2	1	2	2	2	2	1	2	1	2	3	3	3	3
CO3	2	3	2	3	2	2	3	2	2	3	1	3	2	2	2
CO4	2	2	-	2	2	1	2	2	3	-	1	2	2	2	3
CO5	3	2	2	3	-	1	2	1	1	2	2	2	3	2	3
AVERAGE	**2.4**	**2.4**	**2**	**2.6**	**2**	**1.6**	**2**	**1.6**	**1.8**	**2**	**1.6**	**2.6**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Electromagnetic Fields

Course Code: A104403

Semester: 3rd

L T P

Credits: 04 **3 1 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO1	Learn the basic mathematical concepts related to electromagnetic vector fields. .
CO2	Apply the principles of electrostatics to the solutions of problems relating to electric field and electric potential, boundary conditions and electric energy density.

CO3	Apply the principles of magneto statics to the solutions of problems relating to magnetic field and magnetic potential, boundary conditions and magnetic energy density.
CO4	Understand the concepts related to Faraday‘s law, induced emf and Maxwell‘s equations.
CO5	Apply Maxwell‘s equations to solutions of problems relating to transmission lines and uniform plane wave propagation.

Course Content

This course shall have Lectures and Tutorials. Most of the students find difficult to visualize electric and magnetic fields. Instructors may demonstrate various simulation tools to visualize electric and magnetic fields in practical devices like transformers, transmission lines and machines.

Module 1: **Review of Vector Calculus (8 hours)**
Vector algebra-addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus- differentiation, partial differentiation, integration, vector operator, del, gradient, divergence and curl; integral theorems of vectors. Conversion of a vector from one coordinate system to another.

Module 2: Static Electric Field (15 Hours)
Coulomb’s law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density.
Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson’s equation, Laplace’s equation, Solution of Laplace and Poisson’s equation, Application of Laplace’s and Poisson’s equations.

Module 3: Magnetic Forces, and Inductance (10 Hours)
Biot-Savart’s law, Ampere’s law of force, Ampere’s circuital law, Faraday’s law, Force on a moving charge, Force on a differential current element, Force between differential current elements, Magnetic boundary conditions, Magnetic circuits, calculations of inductances and mutual inductances for a solenoid and toroid.

Module 4: Maxwell’s Equations in Time Varying Fields and Wave theory (15 Hours)
Concept of displacement current and conduction current, Maxwell’s equation-differential and integral form, Poynting’s theorem, its significance and Poynting’s vector, Boundary Conditions.

Wave theory: Derivation of wave equation, uniform plane waves, Maxwell’s equation in Phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Attenuation, phase and propagation constant, intrinsic impedance, Relation between E & H, wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect.

Text / References:

1. Edward C. Jordan and Keith G. Balmain, (2003) *Electromagnetic Waves and Radiation System*, Prentice Hall of India. Pvt. Ltd.
2. Kraus/ Fleisch,(1999) *Electromagnetics*, Tata McGraw Hill.

3. Fraser,W. (2003) *Telecommunications*, CBS Publication and Distributor.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Electromagnetic Fields

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	2	2	2	3	2	-	1	2	2
CO2	1	2	2	2	2	2	3	1	3	2	1	-	3	3	3
CO3	3	3	2	3	1	2	3	2	-	-	3	3	2	2	2
CO4	3	2	2	2	2	1	2	2	3	3	2	3	2	2	3
CO5	3	2	3	3	2	1	3	1	2	2	3	2	3	2	3
AVERAGE	**2.6**	**2.4**	**2.4**	**2.4**	**1.8**	**1.6**	**2.6**	**1.6**	**2.5**	**2.5**	**2.2**	**2.6**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Basic Electronics

Course Code: A104403

Semester: 3rd

L T P

Credits: 04 **3 1 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO1	Know electronics component and equipments like C.R.O., Function Generator and power supplies.
CO2	Analyze the V-I characteristics of PN-Junction diode and determine static resistance and dynamic resistance
CO3	Familiar with zener diode and study the characteristics of zener diode.
CO4	Design and plot the input and output characteristics of common emitter transistor and calculate its input and output resistance

CO5	Analysis the truth tables of various basic digital gates.

Course Content

Module1: Diodes and Applications covering, Semiconductor Diode - Ideal versus Practical, Resistance Levels, Diode Equivalent Circuits, Load Line Analysis; Diode as a Switch, Diode as a Rectifier, Half Wave and Full Wave Rectifiers with and without Filters; Breakdown Mechanisms, Zener Diode – Operation and Applications; Opto-Electronic Devices – LEDs, Photo Diode and Applications; Silicon Controlled Rectifier (SCR) – Operation, Construction, Characteristics, Ratings, Applications;

Module 2: Transistor Characteristics covering, Bipolar Junction Transistor (BJT) – Construction, Operation, Amplifying Action, Common Base, Common Emitter and Common Collector Configurations, Operating Point, Voltage Divider Bias Configuration; Field Effect Transistor (FET) – Construction, Characteristics of Junction FET, Depletion and Enhancement type Metal Oxide Semiconductor (MOS) FETs, Introduction to CMOS circuits;

Module 3: Transistor Amplifiers and Oscillators covering, Classification, Small Signal Amplifiers – Basic Features, Common Emitter Amplifier, Coupling and Bypass Capacitors, Distortion, AC Equivalent Circuit; Feedback Amplifiers – Principle, Advantages of Negative Feedback, Topologies, Current Series and Voltage Series Feedback Amplifiers; Oscillators – Classification, RC Phase Shift, Wien Bridge, High Frequency LC and Non-Sinusoidal type Oscillators;

Module 4: Operational Amplifiers and Applications covering, Introduction to Op-Amp, Differential Amplifier Configurations, CMRR, PSRR, Slew Rate; Block Diagram, Pin Configuration of 741 Op-Amp, Characteristics of Ideal OpAmp, Concept of Virtual Ground;

Text/Reference Books:

(i) David. A. Bell. (2003). *Laboratory Manual for Electronic Devices and Circuits*, Prentice Hall, India.
(ii) L. Floyd and R. P. Jain (2009). *Digital Fundamentals*. Pearson Education.
(iii) Paul B. Zbar, A.P. Malvino and M.A. Miller. (2009). Basic Electronics – A Text-Lab. Manual, TMH.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Basic Electronics

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	2	2	2	2	1	-	3	1	2	2
CO2	2	2	2	2	1	2	3	1	1	2	2	3	2	3	3

CO3	3	3	2	1	2	2	3	2	2	3	2	3	2	2	2
CO4	3	2	2	2	2	1	2	2	-	2	2	2	2	2	3
CO5	3	2	3	3	2	1	3	1	2	1	3	2	3	2	3
AVERAGE	**2.8**	**2.2**	**2.4**	**2**	**1.8**	**1.6**	**2.6**	**1.6**	**1.75**	**1.8**	**2.25**	**2.6**	**2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Basic Electronics Laboratory

Course Code: A104102

Semester: 3rd

L T P

Credits: 01 **0 0 2**

(A104102): Basic Electronics

Course Outcomes: On completion of this course, the successful students should be able to:

CO	**Statement**
CO1	Know electronics component and equipments like C.R.O., Function Generator and power supplies.
CO2	Analyze the V-I characteristics of PN-Junction diode and determine static resistance and dynamic resistance
CO3	Familiar with zener diode and study the characteristics of zener diode.
CO4	Design and plot the input and output characteristics of common emitter transistor and calculate its input and output resistance
CO5	Analysis the truth tables of various basic digital gates.

Course Content

Suggested List of Experiments:

Module 1: Laboratory Sessions covering, Identification, Specifications, Testing of R, L, C Components (Colour Codes), Potentiometers, Switches (SPDT, DPDT and DIP), Bread Boards and Printed Circuit Boards (PCBs); Identification, Specifications, Testing of Active Devices –

Diodes, BJTs, JFETs, MOSFETs, Power Transistors, SCRs and LEDs.

Module 2: Study and Operation of Digital Multi Meter, Function / Signal Generator, Regulated Power Supply (RPS), Cathode Ray Oscilloscopes; Amplitude, Phase and Frequency of Sinusoidal Signals using Lissajous Patterns on CRO; (CRO).

Module 3: Experimental Verification of PN Junction Diode Characteristics in A) Forward Bias B) Reverse Bias, Zener Diode Characteristics and Zener Diode as Voltage Regulator, Input and Output Characteristics of BJT in Common Emitter (CE) Configuration, Drain and Transfer Characteristics of JFET in Common Source (CS) Configuration.

Module 4: Study of Half Wave and Full Wave Rectification, Regulation with Filters, Gain and Bandwidth of BJT Common Emitter (CE) Amplifier, Gain and Bandwidth of JFET Common Source (CS) Amplifier, Gain and Bandwidth of BJT Current Series and Voltage Series Feedback Amplifiers, Oscillation Frequency of BJT based RC Phase Shift, Hartley and Colpitts Oscillators.

Module 5: Op-Amp Applications – Adder, Subtractor, Voltage Follower and Comparator; Op-Amp Applications – Differentiator and Integrator, Square Wave and Triangular Wave Generation, Applications of 555 Timer – Astable and Monostable Multivibrators.

Module 6:Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR Integrated Circuits (ICs); Truth Tables and Functionality of Flip-Flops – SR, JK and D Flip-Flop ICs; Serial-In-Serial-Out and Serial-In-Parallel-Out Shift operations using 4-bit/8-bit Shift Register ICs; Functionality of Up-Down / Decade Counter ICs.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Basic Electronics Laboratory

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
CO1	2	2	3	2	1	2	1	2	2	1	2	1	1	2	2
CO2	2	3	2	2	2	2	3	1	-	2	1	2	2	3	3
CO3	3	3	2	2	3	2	3	2	3	3	2	3	2	2	2
CO4	2	2	2	2	2	1	2	2	2	-	3	-	2	2	3
CO5	3	2	3	3	2	1	3	1	3	2	2	2	3	2	3
AVERAGE	**2.4**	**2.4**	**2.4**	**2.2**	**2**	**1.6**	**2.4**	**1.6**	**2.5**	**2**	**2**	**2**	**2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Analog Electronics Laboratory

Course Code: A104507

Semester: 3rd

L T P

Credits: 01 **0 0 2**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO1	Acquire basic knowledge of physical and electrical conducting properties of semiconductors.
CO2	Develop the Ability to understand the design and working of BJT / FET amplifiers.
CO3	Able to design amplifier circuits using BJT s And FET's. and observe the amplitude and frequency responses of common amplifier circuits
CO4	Observe the effect of positive feedback and able to design and working of different Oscillators using BJTS.
CO5	Develop the skill to build, and troubleshoot Analog circuits.

Course Content

Hands-on experiments related to the course contents

Note: A student to perform any 8-10 experiments and make one minor working model project.

Suggested List of Experiments:

1. To draw *V-I* characteristics of a PN junction diode (Ge, Si, switching and signal).
2. To design half wave rectifier.
3. To design full wave and bridge rectifiers.
4. To study the transistor characteristics in common base, common collector, and common emitter configurations.
5. To study the *V-I* characteristics of a MOSFET.
6. To design a voltage regulator IC using zener diode and also see the effect of line and load regulation
7. To design various clippers and clampers using diodes.
8. To obtain the frequency response of an amplifier and calculate the gain bandwidth of the amplifier.
9. To investigate the emitter follower (Buffer) amplifier and determine A_V,R_i, and R_O
10. To design and study various type of oscillators, and determine frequency of oscillations.
11. To design a transistor series voltage regulator with current limits and observe its current feedback characteristics.
12. To study the characteristics of a complementary symmetry amplifier.
13. To study the application of an Op-Amp (741) as inverting and non-inverting amplifier.
14. To use the OP-AMP as summing, scaling and averaging amplifier.
15. Design differentiator and integrator using OP-AMP and also determine the time constant and cut-off frequency.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Analog Electronics Laboratory

CO/PO/PSO	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	1	2	1	2	2	1	2	3	1	2	2
CO2	2	3	2	1	2	2	3	1	1	2	3	2	2	3	3
CO3	3	3	2	2	3	2	3	2	2	3	-	2	2	2	2
CO4	2	2	2	2	2	1	2	2	-	2	1	3	2	2	3
CO5	3	2	3	3	2	1	3	1	2	2	3	2	3	2	3
AVERAGE	**2.4**	**2.4**	**2.4**	**2**	**2**	**1.6**	**2.4**	**1.6**	**1.75**	**2**	**2.25**	**2.4**	**2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation

Course Name: Electrical Machines – I Laboratory

Course Code: A103303

Semester: 3rd

L T P

Credits: 01 **0 0 2**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO1	Analyze three-phase transformer/system connections.
CO2	Evaluation of equivalent circuit parameters, efficiency and voltage regulation by performing various tests on transformer.
CO3	Analyze parallel operation of transformers.
CO4	Analyze performance characteristics of DC generators.
CO5	Evaluate the performance of starters and working in small projects .

Course Content

Hands-on experiments related to the course contents

Note: A student to perform any 8-10 Experiments and make one minor working model project.

Suggested List of Experiments:

1. To perform the load test on a single phase transformer.
2. To perform open circuit and short circuit tests on a single phase transformer and hence draw the equivalent circuit, calculate the voltage regulation and efficiency.
3. To find the efficiency and voltage regulation of single phase transformer under different loading conditions.
4. To perform parallel operation of two single phase transformers.
5. To study the various connections of a three phase transformer.
6. To perform Scott connections on three phase transformer to get two phase supply.
7. To study the constructional details of DC machine and to draw sketches of different components.
8. To measure armature and field resistance of DC shunt generator and to obtain its open circuit characteristics.
9. To obtain load characteristics of DC shunt/series/compound generator.
10. To draw speed-torque and torque-speed characteristics of DC shunt/series /compound generator.
11. To study the three point and four point DC motor starters.
12. To perform Swinburne's test (no load test) to determine various losses of DC shunt motor.
13. To visualize the magnetic fields produced by a bar magnet and a current carrying coil using FEMM/ ANSYS Maxwell.
14. To visualize the magnetic field produced in an electrical machine using FEMM/ ANSYS Maxwell.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Electrical Machines – I Laboratory

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
CO1	3	2	3	2	1	2	1	2	2	1	3	2	1	2	2
CO2	2	3	2	2	2	2	3	1	-	3	1	2	2	3	3
CO3	3	3	3	2	3	3	3	2	3	2	2	-	2	2	2
CO4	2	2	2	2	2	2	2	2	2	2	3	2	2	2	3
CO5	3	2	3	3	2	1	3	1	2	1	2	2	3	2	3
AVERAGE	**2.6**	**2.4**	**2.6**	**2.2**	**2**	**2**	**2.4**	**1.6**	**2.25**	**1.8**	**2.2**	**2**	**2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Environmental Studies
Course Code: A100302

Semester: 3rd

L T P

Credits: 04 **3 1 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Identify environmental problems arising due to engineering and technological activities and the science behind those problems.
CO 2	Estimate the population - economic growth, energy requirement and demand
CO 3	Analyze material balance for different environmental systems.
CO 4	Realize the importance of ecosystem and biodiversity for maintaining ecological balance.
CO 5	Identify the major pollutants and abatement devices for environmental management and sustainable development

Course Content

1. Introduction: Definition and scope and importance of multidisciplinary nature of environment. Need for public awareness.

2. Natural Resources: Natural Resources and associated problems, use and over exploitation, case studies of forest resources and water resources.

3. Ecosystems: Concept of Ecosystem, Structure, interrelationship, producers, consumers and decomposers, ecological pyramids-biodiversity and importance. Hot spots of biodiversity

4. Environmental Pollution: Definition, Causes, effects and control measures of air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste Management: Causes, effects and control measure of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster Management :Floods, earthquake, cyclone and landslides.

5. Social Issues and the Environment From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns. Case studies. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act.

Water (Prevention and control of pollution) Act. Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation Public awareness

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

Suggested Readings / Books

1. 1. Agarwal, K. C.(1998) *Environment Biology*, Nidi Publ. Ltd. Bikaner.

2. Jadhav, H & Bhosale, V.M. (2001) *Environment Protection and Laws*. Himalaya Pub House, Delhi

3. Rao M. N. & Datta A.K.(1997) *Waste Water Treatment.* Oxford & IBH Publ. Co. Pvt. Ltd.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs)

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	3	2	3	2	2	3	2	3	4	1	2	2
CO2	2	2	2	2	2	2	3	2	-	2	3	3	2	3	3
CO3	3	3	3	2	2	2	3	2	1	2	1	2	3	2	2
CO4	3	3	2	2	2	-	2	2	2	1	2	1	2	2	3
CO5	2	2	3	3	3	1	3	1	1	2	2	1	3	2	3
AVERAGE	**2.4**	**2.4**	**2.2**	**2.4**	**2.2**	**2**	**2.6**	**1.8**	**1.75**	**1.8**	**2.2**	**2.2**	**2.2**	**2.2**	**2.6**

for Environmental Studies

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Digital Electronics
Course Code: A104401

Semester: 4th

L T P

Credits: 04 **3 1 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO1	Analyze the working of Schottky TTL and CMOS logic, interfacing CMOS.
CO2	Realize working of logic families and logic gates.
CO3	Design and implement Combinational and Sequential logic circuits.
CO4	Compute the process of Analog to Digital conversion and Digital to Analog conversion.
CO5	Be able to understand memories.

Course Content

Module 1: Fundamentals of Digital Systems and logic families (10 Hours)
Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

Module 2: Combinational Digital Circuits (10 Hours)
Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

Module 3: Sequential circuits and systems (12 Hours)
A 1-bit memory, the circuit properties of Bi-stable latch, the clocked SR flip flop, J- K-T and D- types flip flops, applications of flip flops, shift registers, applications of shift registers, serial o parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

Module 4: A/D and D/A Converters (10 Hours)
Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit
,analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using Voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs, concept of memories.

Text/References:

1. Malvino, (1998) *Digital principle and applications*, (TMH)
2. Jain, R. P.(2002) *Modern digital electronics*, (PHI)
3. Mano, M.M. (2001) *Digital Design* , (PHI)

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Digital Electronics

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	1	2	1	2	2	3	2	1	1	2	2
CO2	3	2	2	2	2	2	3	2	2	1	-	3	2	3	3
CO3	3	3	3	2	3	3	3	2	2	1	2	2	3	2	2
CO4	3	2	2	2	2	-	2	2	2	2	1	3	2	2	3
CO5	3	2	3	3	3	1	3	1	3	-	3	-	3	2	3
AVERAGE	**2.8**	**2.2**	**2.6**	**2.2**	**2.2**	**2**	**2.4**	**1.8**	**2.2**	**1.75**	**2**	**2.25**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Electrical Machines – II

Course Code: A103401

Semester: 4th

L T P

Credits: 04 **3 1 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO1	Understand the concepts of rotating magnetic fields.
CO2	Understand the operation of AC machines.
CO3	Analyze performance characteristics of AC machines.
CO4	To understand the difference between the synchronous machines and asynchronous machines
CO5	Be able to understand equivalents circuits and phasor of induction machines

Module 1: Fundamentals of AC machine windings (8 Hours)

Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single-turn coil - active portion and overhang; full-pitch coils, concentrated winding, distributed winding, winding axis, 3D visualization of the above winding types, Air-gap MMF distribution with fixed current through winding - concentrated and distributed, Sinusoidally distributed winding, winding distribution factor

Module 2: Pulsating and revolving magnetic fields (12 Hours)

Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement, Magnetic field produced by a single winding - fixed current and alternating current Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.

Module 3: Induction Machines (12 Hours)

Concept of rotating magnetic field, Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and maximum torque, power flow diagram, Equivalent circuit. Phasor diagram, Losses and efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-fed induction machines.

Single phase induction motors: Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications

Module 4: Synchronous machines (10 Hours)

Constructional features, cylindrical rotor and salient pole synchronous machine - generated EMF, coil span and distribution factor, equivalent circuit and phasor diagram, armature reaction at different power factor loads, voltage regulation by synchronous impedance and zero power factor method, concept of short circuit ratio, Operating characteristics of synchronous machines, V- curves and inverter-V curves. Hunting. Salient pole machine - two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division.

Text/References:

1. Fitzgerald A. E. and Kingsley C.(2013) *Electric Machinery* Mcgraw Hill Education

2. Alexander S. Langsdorf, (1955) *Theory Of A.C. Machines*, Mcgraw Hill Education

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Electrical Machines – II

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
CO1	2	2	3	2	2	2	1	2	2	1	2	3	1	2	2

CO2	3	2	2	2	2	2	3	2	2	2	3	1	2	3	3
CO3	2	3	3	2	3	2	3	2	3	3	2	1	3	2	2
CO4	3	2	2	2	2	2	2	2	-	2	2	1	2	2	3
CO5	3	2	3	3	3	1	3	1	2	3	2	-	3	2	3
AVERAGE	**2.6**	**2.2**	**2.6**	**2.2**	**2.4**	**1.8**	**2.4**	**1.8**	**2.25**	**2.2**	**2.2**	**1.5**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Power Electronics

Course Code: A103402

Semester: 4th

L T P

Credits: 04 **3 1 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO1	Understand the differences between signal level and power level devices.
CO2	Analyze controlled rectifier circuits.
CO3	Evaluate the operation of DC-DC choppers.
CO4	Analyses the operation of voltage source inverters.
CO5	Be able to understand Diode, Thyristor, MOSFET, IGBT and *V-I* characteristics

Course Content

Module 1: Power switching devices (8 Hours)
Diode, Thyristor, MOSFET, IGBT: *V-I* characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.

Module 2: Thyristor rectifiers (10 Hours)
Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R-load and highly inductive load; Three-phase full-bridge thyristor rectifier with R- load and highly inductive load; Input current wave shape and power factor.

Module 3: DC-DC buck converter (12 Hours)
Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty

ratio control of output voltage. DC-DC boost converter: Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

Module 4: Single-phase voltage source inverter (12 Hours)

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

Text/References:

(i) Reddi S R,(2002) *Fundamentals of Power Electronics*, Narosa Publishing House Pvt. Ltd, New Delhi
(ii) Mohammad H.(2005) *Power Electronics, Circuits Devices and Applications* Khanna Publishers, New Delhi
(iii) Bhattacharya S.K.(1998), *Industrial Electronics & Control* New Age international Publications(P) Ltd, New Delhi.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Power Electronics

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
CO1	2	2	3	2	2	2	1	2	2	1	-	3	1	2	2
CO2	3	2	2	2	2	2	3	2	-	2	1	2	2	3	3
CO3	2	3	3	2	3	2	3	2	2	1	2	1	3	2	2
CO4	3	2	2	2	2	2	2	2	2	1	-	3	2	2	3
CO5	3	2	3	3	3	1	3	1	1	2	3	2	3	2	3
AVERAGE	**2.6**	**2.2**	**2.6**	**2.2**	**2.4**	**1.8**	**2.4**	**1.8**	**1.75**	**1.4**	**2**	**2.2**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Signals and Systems

Course Code: A104405

Semester: 4th

L T P

Credits: 04 **3 1 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO1	Recognize the concepts of unit step, the unit impulse, the sinusoid, the complex exponential, and some special time-limited signals.
CO2	Identify with the concepts of continuous time and discrete time systems.
CO3	Analyze systems in complex frequency domain.
CO4	Understand sampling theorem and its implications.
CO5	Be aware of mathematical tools to be able to apply in state variable modeling

Course Content

Module 1: Introduction to Signals and Systems (12 hours):
Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift- invariance, causality, stability, realizability examples.

Module 2: Behavior of continuous and discrete-time LTI systems (12 hours)
Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State- space Representation of systems. State-Space Analysis, Multi-input, multi-output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

Module 3: Fourier, Laplace and z- Transforms (10 hours)
Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.

Module 4: Sampling and Reconstruction (8 hours)
The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.
Text/References:

(i) Oppenheim, V. Willsky, A.S. & Nawab, S.H. (1997). *Signals and systems*. Prentice Hall.
(ii) Proakis, G. and Manolakis, D. G. (2006). *Digital Signal Processing: Principles, Algorithms, and Applications*. Pearson.
(iii) Hsu, P. (2010). *Signals and systems*. McGraw Hill Education.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Signals and Systems

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	2	1	2	2	1	3	2	1	2	2
CO2	3	2	2	2	2	2	3	2	2	1	1	2	2	3	3
CO3	2	3	3	2	3	2	3	2	-	2	-	1	3	2	2
CO4	3	2	2	2	2	2	2	2	3	1	2	2	2	2	3
CO5	3	2	3	3	3	1	3	1	-	2	3	3	3	2	3
AVERAGE	**2.6**	**2.2**	**2.6**	**2.2**	**2.4**	**1.8**	**2.4**	**1.8**	**2.3**	**1.4**	**2.25**	**2**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Mathematics-III (Probability and Statistics)

Course Code: A100403

Semester: 4th

L T P

Credits: 04 **3 1 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO1	Have basics knowledge about measure of central tendency, skewness, kurtosis and moments and their applications in engineering fields.
CO2	Familiarize the student with expectations of discrete and continuous random variable.
CO3	Familiarize probability techniques and random variables and detailed knowledge of probability distribution with so as to use it with any date of engineering problem formulation.
CO4	Have basic idea about statistics including correlation, regression and then up to advanced level with testing of large samples that is important in solving problems

	related to engineering.
CO5	To fit the given data into curves by various methods which forms an important application in engineering .

Course Content

Section A **(22 lectures)**

Unit I

Measures of Central tendency: Moments, skewness and Kurtosis, Variance, Probability, conditional probability, Discrete and Continuous random variables, Expectations of Discrete and Continuous random variables.

Unit II

Probability distributions: Binomial, Poisson and normal, Poisson approximation to the binomial distribution, evaluation of statistical parameters for these three distribution, Bivariate distributions and their properties.

Section B **(20 lectures)**

Unit III

Correlation and regression for bivariate data, Rank correlation, Curve fitting by the method of least square, fitting of straight lines , second degree parabolas and more general curve.

Unit IV

Test of significances: Sampling and standard error, Tests of significance for large samples and small samples (t-distribution, F-distribution), Chi-square test for goodness of fit and independence of attributes.

Suggestion Text/Reference Books

1. Thomes, G. B. & Finney, R.L. (1998). *Calculus and Analytic Geometry*. Addison Wesley.
2. Kreyszig, E. (1998). *Advanced Engineering Mathematics*. Eighth edition, John Wiley.
3. Grewal, B.S. (1965). *Higher Engineering Mathematics*. Khanna Publishers, New Delhi.
4. Babu, R. (2009).*Advance engineering Mathematics*. Pearson Education.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Mathematics-III (Probability and Statistics)

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

CO5	3	2	3	3	3	1	3	1	2	3	2	3	3	2	3
AVERAGE	2.6	2.2	2.6	2.2	2.4	1.8	2.4	1.8	1.6	2.8	2	2	2.2	2.2	2.6

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Measurements and Instrumentation Laboratory

Course Code: A103404

Semester: 4th

L T P

Credits: 03 **2 0 2**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO1	Design and validate DC and AC bridges.
CO2	Analyze the dynamic response and the calibration of few instruments.
CO3	Learn about various measurement devices, their characteristics, their operation and their limitations.
CO4	Understand statistical data analysis.
CO5	Understand computerized data acquisition.

Course Content

Lectures/Demonstrations:

1. Concepts relating to Measurements: True value, Accuracy, Precision, Resolution, Drift, Hysteresis, Dead-band, Sensitivity.
2. Errors in Measurements. Basic statistical analysis applied to measurements: Mean, Standard Deviation, Six-sigma estimation, C_p, C_{pk}.
3. Sensors and Transducers for physical parameters: temperature, pressure, torque, Flow, Speed and Position Sensors.
4. Current and Voltage Measurements. Shunts, Potential Dividers. Instrument Transformers, Hall Sensors.
5. Measurements of R, L and C.
6. Digital Multi-meter, True RMS meters, Clamp-on meters, Meggers.
7. Digital Storage Oscilloscope.

Note: A student to perform any 8-10 Experiments and make one minor working model project.

Experiments

1. Measurement of a batch of resistors and estimating statistical parameters.
2. Measurement of L using a bridge technique as well as LCR meter.
3. Measurement of C using a bridge technique as well as LCR meter.
4. Measurement of Low Resistance using Kelvin's double bridge.
5. Measurement of High resistance and Insulation resistance using Megger.
6. Usage of DSO for steady state periodic waveforms produced by a function generator. Selection of trigger source and trigger level, selection of time-scale and voltage scale. Bandwidth of measurement and sampling rate.
7. Download of one-cycle data of a periodic waveform from a DSO and use values to compute the RMS values using a C program.
8. Usage of DSO to capture transients like a step change in R-L-C circuit.
9. Current Measurement using Shunt, CT, and Hall Sensor.
10. Measurement of frequency using Wein's Bridge.
11. To find 'Q' of an inductance coil and verify its value using Q- meter.
12. Plotting of Hysteresis loop for a magnetic material using flux meter.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Measurements and Instrumentation Laboratory

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	2	1	2	2	2	1	3	1	2	2
CO2	2	2	2	2	2	2	3	2	1	2	2	1	2	3	3
CO3	2	3	3	2	3	2	3	2	2	3	-	2	3	2	2
CO4	3	2	2	2	2	2	2	2	-	3	2	1	2	2	3
CO5	3	2	3	3	3	1	3	1	3	2	2	-	3	2	3
AVERAGE	**2.6**	**2.2**	**2.6**	**2.4**	**2.4**	**1.8**	**2.4**	**1.8**	**2**	**2.4**	**1.75**	**1.75**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Digital Electronics Laboratory

Course Code: A104407

Semester: 4th

L T P

Credits: 01 **0 0 2**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO1	Understand of basic electronic components and circuits
CO2	Understanding verify truth tables of TTL gates
CO3	Design and fabrication and realization of all gates and basic circuits
CO4	Design the truth tables and basic circuits
CO5	Testing of basic electronics circuits

Course Content

Hands-on experiments related to the course contents

Note: A student to perform any 8-10 Experiments and make one working minor project.

Suggested List of Experiments:

1. Design a delay circuit using 555 timer and study the monostable, bistable and astable operations using 555.
2. a) Verification of the truth tables of TTL gates viz; 7400, 7402, 7404, 7408,7432,7486.
   b) Design and fabrication and realization of all gates using NAND/NOR gates.
3. Verification of truth table of Mutiplexer(74150)/Demultiplexer(74154)
4. Design and verification of truth tables of half-adder, full-adder and subtractor circuits using gates 7483 and 7486(controlled inverter).
5. To study the operation of Arithmetic Logic Unit IC 74181.
6. Design fabrication and testing of
   a) Monostable multivibrator of t = 0.1ms approx. using 74121/123.testing for both positive and negative edge triggering, variation in pulse width and retriggering.
   b) Free running mutivibrator at 1KHz and 1Hz using 555 with 50% duty cycle. Verify the timing from theoretical calculations.
7. Design and test S-R flip-flop using NOR/NAND gates.
8. Design, fabricate and test a switch debouncer using 7400.
9. Verify the truth table of a JK flip flop using IC 7476,
10. Verify the truth table of a D flip flop using IC 7474 and study its operation in the toggle and asynchronous mode.
11. Operate the counters 7490, 7493 and 74193(Up/Down counting mode). Verify the frequency division at each stage. Using a frequency clock (say 1 Hz) display the count of LED's.
12. Verify the truth table of decoder driver7447/7448. Hence operate a 7 segment LED display through a counter using a low frequency clock. Repeat the above

with the BCD to Decimal decoder 7442.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Digital Electronics Laboratory

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	2	1	2	2	1	2	3	1	2	2
CO2	2	2	2	2	2	2	3	2	1	2	-	2	2	3	3
CO3	2	3	3	2	3	2	3	2	2	1	2	-	3	2	2
CO4	3	2	2	2	2	2	2	2	2	1	3	-	2	2	3
CO5	3	2	3	3	3	-	3	1	1	2	1	-	3	2	3
AVERAGE	2.6	2.2	2.6	2.4	2.4	2	2.4	1.8	1.6	1.4	2	2.5	2.2	2.2	2.6

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Electrical Machines-II Laboratory

Course Code: A103405

Semester: 4th

L T P

Credits: 01 **0 0 2**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Construct equivalent circuits induction motors by routine tests.
CO 2	Comprehend the requirement of starting and speed control methods of induction motors in the various applications of industry.
CO 3	Construct equivalent circuits of synchronous generator and motor.
CO 4	Apply knowledge to show utility of alternator, synchronous motors and synchronous condenser for various applications in power system.
CO 5	Construct characteristic curves for induction and synchronous machines

Course Content

Hands-on experiments related to the course contents

Note: A student to perform any 8-10 Experiments and make one hardware/software based minor project.

Suggested List of Experiments:

1. To perform load-test on three-phase Induction motor and to plot torque versus speed characteristics.
   a) To perform no-load and blocked–rotor tests on three-phase Induction motor to obtain equivalent circuit.
   b) To develop an algorithm (Matlab/C/C++) for speed torque characteristics using calculated equivalent circuit parameters.
2. To study the speed control of three-phase Induction motor by Kramer's Concept.
3. To study the speed control of three-phase Induction motor by cascading of two induction motors, i.e. by feeding the slip power of one motor into the other motor.
4. To study star- delta starters physically and
   a) to draw electrical connection diagram
   b) to start the three-phase Induction motor using it.
   c) to reverse the direction of three-phase Induction motor
5. To start a three-phase slip –ring induction motor by inserting different levels of resistance in the rotor circuit and plot torque –speed characteristics.
6. To perform no-load and blocked–rotor test on single-phase Induction motor and to determine the parameters of equivalent circuit drawn on the basis of double revolving field theory.
7. To perform no load and short circuit. Test on three-phase alternator and draw open and short circuit characteristics.
8. To find voltage regulation of an alternator by zero power factor (ZPF.) method.
9. To study effect of variation of field current upon the stator current and power factor with synchronous motor running at no load and draw Voltage and inverted Voltage curves of motor.
10. Parallel operation of three phase alternators using
    (i) Dark lamp method (ii) Two-Bright and one dark lamp method
11. To study synchroscope physically and parallel operation of three-phase alternators using synchroscope.
12. Starting of synchronous motors using:
    (i) Auxiliary motor (ii) Using Damper windings

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Digital Electronics Laboratory

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	2	2	2	2	3	3	-	1	2	2
CO2	2	2	2	2	2	2	3	2	1	3	3	2	2	3	3
CO3	2	-	3	2	-	2	3	2	2	2	3	3	3	2	2

CO4	3	3	-	2	2	-	2	2	1	3	2	2	2	2	3
CO5	2	2	3	3	3	1	3	1	2	3	2	3	3	2	3
Average	**2.4**	**2.25**	**2.5**	**2.4**	**2.25**	**1.75**	**2.6**	**1.8**	**1.6**	**2.8**	**2.6**	**2.5**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Power Electronics Laboratory

Course Code: A103406

Semester: 4th

L T P

Credits: 01 **0 0 2**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Recognize the properties and characteristics of thyristors.
CO 2	Understand the different types of waveforms of inverter and chopper circuits.
CO 3	Analyze speed and direction control of single phase and three phase electric motors using ac and dc drive.
CO 4	Be aware of the effect of free-wheeling diode on pf with RL load.
CO 5	Check the performance of a choppers, and inverter.

Course Content

Hands-on experiments related to the course contents.

Note: A student to perform any 8-10 Experiments and make one hardware/software based minor project.

Suggested List of Experiments:

1. To plot V-I characteristics and study the effect of gate triggering on turning on of SCR.
2. To study the effect of free-wheeling diode on power factor for single phase half-wave rectifier with R-L load.
3. To plot waveforms for output voltage and current, for single phase full-wave, fully controlled bridge rectifier, for resistive and resistive cum inductive loads.

4. Study of the microprocessor-based firing control of a bridge converter.
5. To study three phase fully controlled bridge converter and plot waveforms of output voltage, for different firing angles.
6. To study Jones chopper or any chopper circuit to check the performance.
7. Thyristorised speed control of a D.C. Motor.
8. Speed Control of induction motor using thyristors.
9. Study of series inverter circuit and to check its performance.
10. Study of a single-phase cycloconverter.
11. To check the performance of a McMurray half-bridge inverter.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Power Electronics Laboratory

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	3	2	2	2	1	2	3	1	2	2
CO2	2	2	2	2	2	-	3	2	1	2	2	2	2	3	3
CO3	3	3	3	2	2	2	3	2	2	1	2	1	3	2	2
CO4	3	3	2	2	2	-	2	2	2	1	-	-	2	2	3
CO5	2	2	3	3	3	1	3	1	-	1	1	-	3	2	3
AVERAGE	2.6	2.4	2.4	2.4	2.2	2	2.6	1.8	1.75	1.2	1.75	2	2.2	2.2	2.6

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Summer Industry Internship/ Field Training

Course Code: A103304

Semester: 4th

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Assess interests and abilities in their field of study.
CO 2	Learn to appreciate work and its function in the economy
CO 3	Develop work habits and attitudes necessary for job success.
CO 4	Develop communication, interpersonal and other critical skills in the job interview process.
CO 5	Acquire employment contacts leading directly to a full-time job following graduation

	from college.

Course Content

Six weeks in an Industry in the area of Electrical Engineering. The summer internship should give exposure to the practical aspects of the discipline. In addition, the student may also work on a specified task or project which may be assigned to him/her. The outcome of the internship should be presented in the form of a report. The student will make a presentation based upon the Industry Internship attended. Performance to be rated as Satisfactory/Un -Satisfactory (S/US). For unsatisfactory the internship to be repeated.

Evaluation scheme (Summer Industry Internship/ Field Training)

Internal (to be evaluated by Industry)	***Marks***	***External* (to be evaluated by Department)***	***Marks***
Attendance	10	Daily Dairy	10
Performance (Work done /simulation/hardware/project developed)	30	Report	10
Report	10	Presentation (Work done /simulation/hardware/project developed)	30
Total	***50***	***Total***	***50***

*External examiner not to be called.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Summer Industry Internship/ Field Training

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	3	2	2	2	3	-	1	1	2	2
CO2	2	2	2	2	2	-	3	2	1	3	2	1	2	3	3
CO3	3	3	3	2	2	2	3	2	2	2	2	1	3	2	2
CO4	3	3	2	2	2	-	2	2	1	3	2	1	2	2	3
CO5	2	2	3	3	3	1	3	1	2	3	-	2	3	2	3
AVERAGE	**2.6**	**2.4**	**2.4**	**2.4**	**2.2**	**2**	**2.6**	**1.8**	**1.6**	**2.8**	**2**	**1.2**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Essence of Indian Traditional Knowledge

Course Code: 100305

Semester: 4th

L T P

Credits: 00 **3 0 0**

(100305):

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Ability to understand connect up
CO 2	Explain basics of Indian traditional Knowledge in Modern scientific perspective.
CO 3	Explain basic principles of thought process, reasoning
CO 4	Inferencing. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature.
CO 5	Ability to understand Holistic life style of Yogic-science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions.

Course Content

Part-1

Course objective

The course aims at imparting basis principals of thought process. Reasoning and inferencing Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit Literature are also important in modern society with rapid technological advancements and societal disruptions Part-1 focuses on introduction to Indian Knowledge System. Indian perspective of modern scientific world -view and basis principal of Yoga and holistic health care system.

Course contents

i. Basic Structure of Indian Knowledge system
ii. Modern Science and Indian Knowledge system
iii. Yoga and Holistic Health Care
iv. Case studies

References

1. Fritzof Capra Too of Physics
2. Fritzof Capra The Wave of life
3. Yoga Sutra of Patanjali. Ramakrishna Mission. Kolkata.
4. RN Jha Science of Consciousness Psychotherapy and Yoga Practices. Vidyanidhi Prakashan. Delhi2016
5. PB Sharma (English translation) ShodashangHridayam

Pedagogy: Problem based learning, group discussion, collaborative mini projects
Outcome: Ability to understand connect up and explain basics of Indian traditional Knowledge in Modern scientific perspective.

Part-2

Course objective

The course aims at imparting basis principals of thought process. Reasoning and inferencing Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit Literature are also important in modern society with rapid technological advancements and societal disruptions Part-2 focuses on Indian philosophical traditions. Indian linguistic Tradition, and Indian artistic tradition.

Course contents

i. Philosophical Tradition
ii. Indian Linguistic Tradition (Phonology, morphology, syntax and semantics)
iii. Indian Artistic Tradition
iv. Case studies

References

1. V.Sivaramakrishnan (Ed.). (2014). *Cultural Heritage of India-Course materia*l, Bhartiya Vaidya Bhawan Mumbai 5th Edition .
2. Chaterjee S.C & Datta D.M . (1984*). An introduction to Indian Philosophy* ,University of Calcutta.

Pedagogy: Problem based learning, group discussion, collaborative mini projects
Outcome: Ability to understand connects up and explains basics of Indian traditional Knowledge in Modern scientific perspective.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Essence of Indian Traditional Knowledge

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	3	2	3	2	2	2	1	-	3	1	2	2
CO2	2	2	2	2	2	2	3	2	2	3	2	2	2	3	3
CO3	3	3	3	2	2	2	3	2	3	1	1	1	3	2	2
CO4	3	3	2	2	2	2	2	2	-	1	2	-	2	2	3
CO5	2	2	3	3	3	1	3	1	1	2	-	1	3	2	3
AVERAGE	**2.4**	**2.4**	**2.2**	**2.4**	**2.2**	**2**	**2.6**	**1.8**	**2**	**1.6**	**1.6**	**1.75**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Power System -I (Apparatus and Modelling)

Course Code: 103510

Semester: 5th

L T P

Credits: 03 **3 0 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Identify with the concepts of power systems.
CO 2	Comprehend the various power system components.
CO 3	Evaluate fault currents for different types of faults.
CO 4	Understand the generation of over-voltages and insulation coordination.
CO 5	Understand basic protection schemes.

Course Content

Module 1: Basic Concepts (4 hours)

Evolution of Power Systems and Present-Day Scenario. Structure of a power system: Bulk Power Grids and Micro-grids.

Generation: Conventional and Renewable Energy Sources. Distributed Energy Resources. Energy Storage. Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems). Synchronous Grids and Asynchronous (DC) interconnections. Review of Three-phase systems. Analysis of simple three-phase circuits. Power Transfer in AC circuits and Reactive Power.

Module 2: Power System Components (15 hours)

Overhead Transmission Lines and Cables: Electrical and Magnetic Fields around conductors, Corona. Parameters of lines and cables. Capacitance and Inductance calculations for simple configurations. Travelling-wave Equations. Sinusoidal Steady state representation of Lines: Short, medium and long lines. Power Transfer, Voltage profile and Reactive Power.

Characteristics of transmission lines. Surge Impedance Loading. Series and Shunt Compensation of transmission lines.

Synchronous Machines: Steady-state performance characteristics. Operation when connected to infinite bus. Real and Reactive Power Capability Curve of generators. Typical waveform under balanced terminal short circuit conditions – steady state, transient and sub-transient equivalent circuits. Loads: Types, Voltage and Frequency Dependence of Loads. Per-unit System and per-unit calculations.

Module 3: Over-voltages and Insulation Requirements (4 hours)

Generation of Over-voltages: Lightning and Switching Surges. Protection against Over- voltages, Insulation Coordination. Propagation of Surges. Voltages produced by traveling surges. Bewley Diagrams.

Module 4: Fault Analysis and Protection Systems (10 hours)

Method of Symmetrical Components (positive, negative and zero sequences). Balanced and Unbalanced Faults. Representation of generators, lines and transformers in sequence networks. Computation of Fault Currents. Neutral Grounding. Types of Circuit Breakers. Attributes of Protection schemes, Back-up Protection. Protection schemes (Over-current, directional, distance protection, differential protection) and their application.

Module 5: Introduction to DC Transmission & Renewable Energy Systems (9 hours)

DC Transmission Systems: Line-Commutated Converters (LCC) and Voltage Source Converters (VSC) based dc link, Real Power Flow control in a dc link. Comparison of ac and dc transmission. Solar PV systems: I-V and P-V characteristics of PV panels, power electronic interface of PV to the grid. Wind Energy Systems: Power curve of wind turbine. Fixed and variable speed turbines.

Text/References:

1. Elgerd O.L.(2001) *Electrical Energy System Theory - An introduction,* (TMH)

2. Stevenson Jr W.D.(1999) *Elements of Power System Analysis,* TMH

3. Wadhwa C.L. (2000) *Course in Electrical Power*, New Age Int.(P)Ltd.

4. Nagrath and Kothari,(2003) *Power System Analysis,* (TMH)

5. Gupta, B.R. (2001) *Power System Analysis & Design,* Wheeler Publishing.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Power System -I (Apparatus and Modelling)

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	3	2	3	2	2	2	1	2	-	1	2	2
CO2	2	2	-	2	2	2	3	2	-	2	2	1	2	3	3
CO3	-	3	3	2	2	2	3	2	2	1	2	1	3	2	2
CO4	-	3	3	2	2	2	2	2	1	2	1	2	2	2	3
CO5	2	2	3	3	3	1	3	1	-	-	2	1	3	2	3
AVERAGE	**2**	**2.4**	**3**	**2.4**	**2.2**	**2**	**2.6**	**1.8**	**1.6**	**1.5**	**1.8**	**1.25**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Control Systems
Course Code: 103511

Semester: 5th

L T P

Credits: 03 **3 0 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Understand the modeling of linear-time-invariant systems using transfer function and state-space representations.
CO 2	Analyze electromechanical systems by mathematical modeling.
CO 3	Determine Transient and Steady State behavior of systems using standard test signals.
CO 4	Analyze linear and non-linear systems for steady state errors, absolute stability and relative stability.
CO 5	Identify and design a control system satisfying requirements.

Course Content

Module 1: Introduction to control problem (4 hours)
Industrial Control examples. Control hardware and their models. Transfer function models of linear time-invariant systems.
Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.

Module 2: Time Response Analysis (10 hours)
Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response.
Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

Module 3: Frequency-response analysis (6 hours)
Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

Module 4: Introduction to Controller Design (10 hours)
Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems.
Root-loci method of feedback controller design.
Design specifications in frequency-domain. Frequency-domain methods of design.

Module 5: State variable Analysis (6 hours)
Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback.
Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.
Module 6: Introduction to Optimal Control and Nonlinear Control (5 hours) Performance Indices. Regulator problem, Tracking Problem. Nonlinear system–Basic concepts. -

Text/References:
1. Ogata, K. (1999) *Modern Control Engg.* Prentice Hall, New Delhi.
2. Gibsen, J.F. (2007) *Control System Components*, Mcgraw Hill.
3. Kuo, B.C.(1998) *Automatic Control System*, Prentice Hall.
4. Nagrath,I.J. (2004) *Control System Engineering*, Wiley Eastern Ltd., New Delhi.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Power System -I (Apparatus and Modelling)

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	3	2	3	2	2	2	1	-	3	1	2	2
CO2	2	2	2	2	2	2	3	2	2	3	2	2	2	3	3
CO3	3	-	3	2	2	2	3	2	3	1	1	1	3	2	2
CO4	3	-	2	2	2	2	2	2	-	1	2	-	2	2	3
CO5	2	2	3	3	3	1	3	1	1	2	-	1	3	2	3
AVERAGE	**2.4**	**2**	**2.2**	**2.4**	**2.2**	**2**	**2.6**	**1.8**	**2**	**1.6**	**1.6**	**1.75**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Microprocessors & its applications
Course Code: A104505

Semester: 5th

L T P

Credits: 03 **3 0 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Study of 8085 and 8086 Microprocessors.
CO 2	Do assembly language programming.
CO 3	Do interfacing design of peripherals like 8255, 8253,8279,8251 etc.

CO 4	Develop systems using different microprocessors.
CO 5	Identify and design a project using programmable Interrupt Controller

Module 1: Fundamentals of Microprocessors: (3 Hours)

Digital Computers: General architecture and brief description of elements, programming system, Buses and CPU Timings. Microprocessor and Microprocessor Development Systems: Evolution of Microprocessor, memory, data transfer schemes, architecture advancements of microprocessors, typical microprocessor development system, higher lever languages.

M**odule 2: The 8085 Architecture (10 Hours)**

Microprocessor architecture and its operations, Pin configuration, internal architecture. Timing & Signals: control and status, interrupt: ALU, machine cycles, Instruction format, op-codes, mnemonics, number. of bytes, Instruction Set of 8085: Addressing Modes: Register addressing, direct addressing; register indirect addressing, immediate addressing, and implicit addressing. RTL, variants, number. of machine cycles and T states, addressing modes. Instruction Classification: Data transfer, arithmetic operations, logical operations, branching operation, machine control; Writing assembly Language programs, Assembler directives.

M**odule 3: The 8086 Architecture (9 Hours)**

8086 Microprocessors: Architecture: Architecture of INTEL 8086 (Bus Interface Unit, Execution unit), register organization, memory addressing, memory segmentation, Operating Modes Instruction Set of 8086 Addressing Modes: Instruction format: Discussion on instruction Set: Groups: data transfer, arithmetic, logic string, branch control transfer, processor control. Interrupts: Hardware and software interrupts, responses and types.

Module4: Fundamental of Programming (9 Hours)

Development of algorithms, flowcharts in terms of structures ,(series, parallel, if-then-else etc.) Assembler Level Programming: memory space allocation (mother board and user program) Assembler level programs (ASMs) .

Module 5: Peripheral memory and I/O **Interfacing (8 Hours)**

Interfacing devices, Interfacing of Memory, Programmed I/O, Interrupt Driven I/O, memory I/O, 8255- Programmable peripheral interface, 8253/8254 Programmable timer/counter. 8259 programmable Interrupt Controller, 8251- USART

Text / References:

(i) Ramesh. S. Gaonkar,(2000) *Microprocessor Architecture, Programming and applications with the 8085*, Penran International Publishing
(ii) Muhopadhyay A.H.(1998) *Microprocessor Based Laboratory Experiments and Projects*, Wheeler Publishing.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Power System -I (Apparatus and Modelling)

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	1	3	2	-	2	2	2	1	2	1	1	2	2
CO2	2	2	2	2	2	2	3	2	-	2	1	2	2	3	3
CO3	3	3	3	2	2	2	3	2	1	2	-	-	3	2	2
CO4	3	3	2	2	2	2	2	2	1	-	2	1	2	2	3
CO5	-	2	3	3	3	-	3	1	3	2	1	2	3	2	3
AVERAGE	**3**	**2.4**	**2.2**	**2.4**	**2.2**	**2**	**2.6**	**1.8**	**1.75**	**1.75**	**1.5**	**1.5**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Management Information System
Course Code: A105920

Semester: 5th

L T P

Credits: 03 **3 0 0**

(A105920**):**
Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Describe The Role Of Information Technology And Information Systems In Business
CO 2	Analyze How Information Technology Impacts A Firm And Interpret How To Use Information Technology To Solve Business Problems
CO 3	Identity The Role Played By The Six Major Types Of Information Systems In Organizations And Their Relationship To Each Other.
CO 4	Define The Types Of Information Systems Supporting The Major Functional Of Areas The Business.
CO 5	Recognize The Relationship Between Information Systems And Organizations.

COURSE CONTENTS:

UNIT-I

Introduction: Definition, characteristics & significance of MIS, Structure and classification of MIS; Information Concepts: Data Vs Information, Quality of information, quality of information.

Introduction to Systems, basic concepts, types and elements of system.

UNIT-II

Decision Making: Simon's model of decision making, structured & unstructured decisions, Formal Vs. Informal systems. DSS- characteristics, role of DSS, objectives.

Design Methodology & Techniques: System development life cycle. System Analysis – SRS, DFD, DD & Decision tables.

UNIT-III

System Design – design methods, design documentation. System Implementation & testing.

Implementation & Evaluation: Planning & organizing, testing & changeover.

Suggested Readings:

- Goyal, D.P. (2003). *Management Information Systems.* MacMillon.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Management Information System

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	3	2	3	2	2	2	2	1	1	1	2	2
CO2	2	2	2	2	2	-	3	2	1	3	2	3	2	3	3
CO3	3	-	3	2	2	2	3	2	2	2	3	2	3	2	2
CO4	3	-	2	2	2	-	2	2	1	1	2	2	2	2	3
CO5	2	2	3	3	3	1	3	1	2	1	1	-	3	2	3
AVERAGE	**2.4**	**2**	**2.2**	**2.4**	**2.2**	**2**	**2.6**	**1.8**	**1.6**	**1.8**	**1.8**	**2**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Power System -I Lab
Course Code: 103512

Semester: 5th

L T P

Credits: 01 **0 0 2**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Identify with the concepts of power systems.
CO 2	Comprehend the various power system components.
CO 3	Evaluate fault currents for different types of faults.
CO 4	Understand the generation of over-voltages and insulation coordination.
CO 5	Understand basic protection schemes.

Course Content

Hands-on experiments related to the course contents.

Visits to power system installations (generation stations, EHV substations etc.) are Exposure to fault analysis and Electro- magnetic transient program (EMTP) and Numerical Relays are suggested.

Suggested List of Experiments:

(A) Hardware Based:

1. To measure negative sequence and zero sequence reactance of Synchronous Machines.
2. Fault analysis for line-to-line (L-L), Line-to-Ground (L-G) and double line to ground fault.
3. To study the performance of a transmission line and compute its ABCD parameters.
4. To study the earth resistance using three spikes.
5. To study the IDMT over current relay and determine the time current characteristics
6. To study percentage differential relay
7. To study Impedance, MHO and Reactance type distance relays.
8. To study operation of oil testing set.

(B) Simulation Based Experiments (using MATLAB or any other software)

9. To obtain steady state, transient and sub-transient short circuit currents in an alternator
10. To perform symmetrical fault analysis in a power system
11. To perform unsymmetrical fault analysis in a power system

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Power System -I Lab

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	3	2	3	2	2	2	3	2	1	1	2	3
CO2	2	2	2	2	2	2	3	2	1	3	-	2	2	3	3
CO3	3	3	2	2	2	2	3	2	2	2	2	2	3	2	3
CO4	3	3	2	2	2	-	2	2	1	3	3	2	2	2	3
CO5	2	2	-	3	3	1	3	1	2	3	3	-	3	2	3
AVERAGE	**2.4**	**2.4**	**2**	**2.4**	**2.2**	**2**	**2.6**	**1.8**	**1.6**	**2.8**	**2.5**	**1.75**	**2.2**	**2.2**	**3**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Control Systems Lab
Course Code: 103513

Semester: 5th

L T P

Credits: 01 **0 0 2**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Understand the modeling of linear-time-invariant systems using transfer function and state-space representations.
CO 2	Analyze electromechanical systems by mathematical modeling.
CO 3	Determine Transient and Steady State behavior of systems using standard test signals.
CO 4	Analyze linear and non-linear systems for steady state errors, absolute stability and relative stability.
CO 5	Identify and design a control system satisfying requirements.

Course Content

Hands-on experiments related to the course contents.
Note: A student to perform any 8-10 Experiments.

Suggested List of Experiments:

1. To study the characteristics of potentiometers and to use 2- potentiometers as an error detector in a control system.
2. To study the synchro Transmitter-Receiver set and to use it as an error detector
3. To study the Speed – Torque characteristics of an AC Servo Motor and to explore its applications.
4. To study the Speed – Torque characteristics of an DC Servo Motor and explore its applications.
5. To study the variations of time lag by changing the time constant using control engineering trainer
6. To simulate a third order differential equations using an analog computer and calculate time response specifications
7. To obtain the transfer function of a D.C. motor – D.C. Generator set using Transfer Function Trainer
8. To study the speed control of an A.C. Servo Motor using a closed loop and an open loop systems
   a) To study the operation of a position sensor and study the conversion of

position in to corresponding voltage

b) To study an PI control action and show its usefulness for minimizing steady state error of time response.

9. To measure Force / Displacement using Strain Gauge in a wheat stone bridge
10. To design a Lag compensator and test its performance characteristics.
11. To design a Lead-compensator and test its performance characteristics.
12. To design a Lead-Lag compensator and test its performance characteristics.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Control Systems Lab

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	3	2	3	2	2	2	3	2	1	1	2	2
CO2	2	2	2	2	2	2	3	2	1	3	-	2	2	3	3
CO3	2	3	3	2	2	2	3	2	2	2	2	3	3	2	2
CO4	-	3	2	2	2	-	2	2	1	3	2	1	2	2	3
CO5	2	2	3	3	3	1	3	1	2	3	2	-	3	2	3
AVERAGE	**2**	**2.4**	**2.2**	**2.4**	**2.2**	**2**	**2.6**	**1.8**	**1.6**	**2.8**	**2**	**1.75**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Microprocessors & its applications Lab
Course Code: A104509

Semester: 5th

L T P

Credits: 01 **0 0 2**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Study of 8085 and 8086 Microprocessors.
CO 2	Do assembly language programming.
CO 3	Do interfacing design of peripherals like 8255, 8253,8279,8251 etc.
CO 4	Develop systems using different microprocessors.
CO 5	Identify and design a project using programmable Interrupt Controller

Course Content

Hands-on experiments related to the course contents.
Note: A student to perform any 8-10 Experiments.

Suggested List of Experiments:

1. To study 8085 based microprocessor system
2. To study 8086 and 8086A based microprocessor system
3. To study Pentium Processor
4. To develop and run a program for finding out the largest/smallest number from a given set of numbers.
5. To develop and run a program for arranging in ascending/descending order of a set of numbers
6. To perform multiplication/division of given numbers
7. To perform conversion of temperature from 0 F to 0 C and vice-versa
8. To perform computation of square root of a given number
9. To perform floating point mathematical operations (addition, subtraction, multiplication and division) 10. To obtain interfacing of RAM chip to 8085/8086 based system
10. To obtain interfacing of keyboard controller, 8279
11. To obtain interfacing of PPI, 8255
12. To obtain interfacing of USART, 8251
13. To perform microprocessor-based stepper motor operation through 8085 kit
14. To perform microprocessor-based traffic light control
15. To perform microprocessor-based temperature control of hot water.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Microprocessors & its applications Lab

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	3	2	3	2	2	2	3	3	2	1	2	2
CO2	2	-	2	2	1	2	3	2	1	3	1	2	2	3	3
CO3	-	3	3	-	2	2	3	2	2	2	2	-	3	2	2
CO4	3	3	2	2	2	-	2	2	1	3	2	2	2	2	3
CO5	2	2	3	3	3	1	3	1	2	3	-	-	3	2	3
AVERAGE	**2.25**	**2.5**	**2.2**	**2.5**	**2**	**2**	**2.6**	**1.8**	**1.6**	**2.8**	**2**	**2**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Wind and Solar Energy
Course Code: 103514

Semester: 5th

L T P

Credits: 01 **0 0 2**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Identify with the energy scenario and the consequent growth of the power generation from renewable energy sources.
CO 2	Know the issues related to the grid-integration of solar and wind energy systems.
CO 3	Realize the basic physics of wind and solar power generation.
CO 4	Understand the power electronic interfaces for wind and solar generation.
CO 5	Value the basic physics of wind generator

Module 1: Physics of Wind Power: (5 Hours)

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

Module 2: Wind generator topologies: (12 Hours)

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

Module 3: The Solar Resource: (3 Hours)

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

Module 4: Solar photovoltaic: (8 Hours)

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

Module 5: Network Integration Issues: (8 Hours)

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

Module 6: Solar thermal power generation: (3 Hours)

Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

Text / References:

(i) Ackermann, T. (2005) *Wind Power in Power Systems*. John Wiley and Sons Ltd.
(ii) Masters, G. M. (2004). *Renewable and Efficient Electric Power Systems*. John Wiley and Sons.
(iii) Sukhatme, S. P. (1984). *Solar Energy: Principles of Thermal Collection and Storage*. McGraw Hill.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Wind and Solar Energy

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	3	2	3	2	2	2	1	2	-	1	2	2
CO2	2	2	2	2	2	2	3	2	-	2	2	3	2	3	3
CO3	3	3	3	2	2	2	3	2	3	2	1	2	3	2	2
CO4	3	3	2	2	2	2	2	2	-	2	2	1	2	2	3
CO5	2	2	3	3	3	1	3	1	-	-	2	1	3	2	3
AVERAGE	**2.4**	**2.4**	**2.2**	**2.4**	**2.2**	**2**	**2.6**	**1.8**	**2.5**	**1.75**	**1.8**	**1.75**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Line Commutated and Active Rectifiers
Course Code: 103515

Semester: 5th

L T P

Credits:03 **3 0 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Understand the differences between signal level and power level devices.
CO 2	Analysis controlled rectifier circuits.
CO 3	Evaluate the operation of DC-DC choppers.
CO 4	Explore the operation of voltage source inverters.
CO 5	Understand the basic physics of thyristor and Three phase sinusoidal pulse width modulation

Course Content

Module 1: Diode rectifiers with passive filtering:

Single phase half wave diode rectifier with R and RL load ,Single phase half wave diode rectifier with RC load, input current wave shape, Single phase full wave diode rectifier with R ,RL and RC load, Performance parameter of single phase full wave diode rectifier, continuous and discontinuous conduction, Three phase diode rectifier, Effect of source inductance, commutation overlap.

Module 2: Thyristor rectifiers.

Principle of phase controlled converter operation, single phase Half-wave thyristor rectifier with R load and RL load , continuous and discontinuous conduction, input current wave shape, 1-phase Full wave thyristor rectifier with R and RL load, Thyristor rectifier in inverting mode, Rectification and regenerating modes, Performance parameter of half wave and full wave converter, Single phase dual converter

Module 3: Multi-Pulse converter

Three phase thyristor rectifier 13 output voltage equation of three phase rectifiers, Review of transformer phase shifting, 6- pulse converters with inductive loads, 12- pulse converters with inductive loads, output voltage equation

Module 4: Pulse Width Modulated rectifier

Power factor improvement of controlled rectifier, Concept of Pulse width modulated rectifier, power circuit of single-switch ac-dc converter, Single phase sinusoidal pulse width modulation, Three phase PWM rectifier, Three phase sinusoidal pulse width modulation

Module 5: DC to AC converter

Review of 1-phase inverter, power circuits of 1-phase dc to ac converter, Review of 3-phase inverter, power circuits of 3-phase dc to ac converter, Pulse Width Modulated inverter, Single pulse width modulation, multiple pulse width modulation, Three phase PWM rectifier.

Module 6: Isolated single phase dc-dc converter

Review of DC to DC converters: Buck and Boost converter, Review of DC to DC converters: BuckBoost and Cuck converter, Review of linear power supplies, Advantages of SMPS over linear power supplies, dc-dc flyback converter, output voltage as a function of duty ratio and transformer turns ratio, Power circuit of dc-dc forward converter, push pull converter

Text/References:

(i) Rashid, M. H. (2009). *Power electronics: circuits, devices, and applications*. Pearson Education India.
(ii) Mohan N. and Undeland, T. M. (2007). *Power Electronics: Converters, Applications and Design*. John Wiley & Sons.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Line Commutated and Active Rectifiers

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	3	2	2	2	-	-	3	1	2	2
CO2	3	2	2	2	2	2	3	2	2	2	2	2	2	3	3
CO3	3	3	3	2	2	2	3	2	2	3	-	2	3	2	2
CO4	3	3	2	2	2	2	2	2	-	1	1	3	2	2	3
CO5	2	2	3	3	3	1	3	1	3	2	1	2	3	2	3
AVERAGE	**2.8**	**2.4**	**2.6**	**2.4**	**2.2**	**2**	**2.6**	**1.8**	**2.25**	**2**	**1.33**	**2.4**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Power Quality and FACTS
Course Code: 103516

Semester: 5th

L T P

Credits:03 **3 0 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Understand the differences between Shunt and series compensation.
CO 2	Understand the characteristics of ac transmission and the effect of shunt and series reactive compensation.
CO 3	Understand the working principles of FACTS devices and their operating characteristics.
CO 4	Understand the basic concepts of power quality.
CO 5	Understand the working principles of devices to improve power quality

Course Content

Module 1: Transmission Lines and Series/Shunt Reactive Power Compensation (4 hours)

Basics of AC Transmission. Analysis of uncompensated AC transmission lines. Passive Reactive Power Compensation. Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation.

Module 2: Thyristor-based Flexible AC Transmission Controllers (FACTS) (6 hours)

Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch. Configurations/Modes of Operation, Harmonics and control of SVC and TCSC. Fault Current Limiter.

Module 3: Voltage Source Converter based (FACTS) controllers (8 hours)

Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs. Selective Harmonic Elimination, Sinusoidal PWM and Space Vector Modulation. STATCOM: Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation and Control. Working principle of Interphase Power Flow Controller. Other Devices: GTO Controlled Series Compensator. Fault Current Limiter.

Module 4: Application of FACTS (4 hours)

Application of FACTS devices for power-flow control and stability improvement. Simulation example of power swing damping in a single-machine infinite bus system using a TCSC. Simulation example of voltage regulation of transmission mid-point voltage using a

STATCOM.

Module 5: Power Quality Problems in Distribution Systems (4 hours)

Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations. Flicker and its measurement. Tolerance of Equipment: CBEMA curve.

Module 6: DSTATCOM (8 hours)

Reactive Power Compensation, Harmonics and Unbalance mitigation in Distribution Systems using DSTATCOM and Shunt Active Filters. Synchronous Reference Frame Extraction of

Reference Currents. Current Control Techniques in for DSTATCOM.

Module 7: Dynamic Voltage Restorer and Unified Power Quality Conditioner (6 hours)

Voltage Sag/Swell mitigation: Dynamic Voltage Restorer – Working Principle and Control Strategies. Series Active Filtering. Unified Power Quality Conditioner (UPQC): Working

Principle. Capabilities and Control Strategies.

Text/References

(i) Hingorani N. G. and Gyugyi, L. (1999). *Understanding FACTS: Concepts and Technology of FACTS Systems*. Wiley-IEEE Press.
(ii) Padiyar, K. R. (2007). *FACTS Controllers in Power Transmission and Distribution*. New Age International (P) Ltd.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Power Quality and FACTS

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	3	2	3	2	2	3	2	3	4	1	2	2
CO2	-	2	2	-	2	2	3	2	-	2	3	3	2	-	3
CO3	3	3	-	2	2	2	-	2	1	2	1	2	3	2	2
CO4	3	-	2	2	2	2	2	2	2	-	2	-	2	2	3
CO5	2	2	3	3	3	1	3	1	1	2	2	1	3	2	3

AVERAGE	**2.5**	**2.25**	**2**	**2.5**	**2.2**	**2**	**2.5**	**1.8**	**1.75**	**2**	**2.2**	**2.5**	**2.2**	**2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Electronic Devices & circuits
Course Code: 103517

Semester: 5th

L T P

Credits:03 **3 0 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Understand the PN junction diode –structure, operation and V-I characteristics
CO 2	Understand the structure of basic electronic devices.
CO 3	Be exposed to active and passive circuit elements.
CO 4	Familiarize the operation and applications of transistor like BJT and FET.
CO 5	Explore the characteristics of amplifier gain and frequency response.

Course Content

Module 1: PN JUNCTION DEVICES
PN junction diode –structure, operation and V-I characteristics, diffusion and transition capacitance –
Rectifiers – Half Wave and Full Wave Rectifier,– Display devices- LED, Laser diodes, Zener diodecharacteristics- Zener Reverse characteristics – Zener as regulator

Module 2: TRANSISTORS AND THYRISTORS
BJT, JFET, MOSFET- structure, operation, characteristics and Biasing UJT, Thyristors and IGBT Structure and characteristics.

Module 3: AMPLIFIERS
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 4: MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER

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 5:FEEDBACK AMPLIFIERS AND OSCILLATORS
Advantages of negative feedback – voltage / current, series , Shunt feedback –positive feedback Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

Text / References:

1. Millman, J and Halkiias, (1998) *Integrated Electronics*, TMH.
2. Ryder,J.D.(2003) *Electronic Fundamentals & Application*, PHI.
3. Boylestad R.L. (1997) *Electronic Devices and Circuit Theory, VIII Edition,* Pearson Education.
4. Sedra & Smith. (2000) *Microelectronic Circuits, , V Edition,* Oxford University Press.
5. Millman and Taub. (2004) *Pulse digital and switching waveforms,* Mcgraw Hill, USA

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Electronic Devices & circuits

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	3	2	3	2	2	2	1	2	3	1	2	2
CO2	3	2	2	2	2	2	3	2	1	2	1	2	2	3	3
CO3	3	3	3	2	2	2	3	2	2	1	2	-	3	2	2
CO4	3	3	2	2	2	2	2	2	2	2	1	2	2	2	3
CO5	2	2	3	3	3	1	3	1	-	1	1	2	3	2	3
AVERAGE	**2.6**	**2.4**	**2.6**	**2.4**	**2.2**	**2**	**2.6**	**1.8**	**1.75**	**1.4**	**1.4**	**2.25**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Computer Networks
Course Code: 102611

Semester: 5th

L T P

Credits:03 **3 0 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	**Statement**

CO 1	Capability to understand the terminology and concepts of the OSI reference model and the TCP:IP reference model.
CO 2	Ability to understand the concepts of protocols, network interfaces, design/performance issues in local area networks and wide area networks.
CO 3	Be familiar with wireless networking concepts.
CO 4	Explore contemporary issues in networking technologies.
CO 5	Ability to understand the network tools and network programming.

Course Content

OBJECTIVES: - To provide students with a theoretical and practical base in computer networks issues, Student will be able purse his study in advanced networking courses, Prepare students for easy transfer from academia into practical life (i.e. summer traning, Coop, etc.)

COURSE CONTENTS

Computer Networks

Introduction, Classification of Computer Networks, LAN, MAN, WAN. Internet, Intranet & Extranet, Wired Network Vs Wireless Network, Network Topologies.

Data Communication Concepts

Digital & Analog Signals, Synchronous & Asynchronous, Data Transmission Modes.

Network Reference Models

OSI reference Model, Functions of each layer, TCP/IP reference Model, comparison of OSI & TCP/IP Models.

Networking Hardware

Ethernet cabling, NIC, Repeater, Router, Bridges, Switches, Transceivers, hubs, Cable and Modems.

Multiplexing and Switching

FDM, TDM, WDM, Circuit Switching, Packet Switching & Message Switching & Comparison of Various Switching techniques.

Data link & Network Layer:

Services provided to N/W layer, Framing, Data link control: Flow Control, Error Detection & Correction Methods, HDLC & SDLC, Concept of Routing& its Algorithms, Congestion control

LAN standards

(IEEE PROJECT 802): Ethernet, CSMA/CD, Token Ring, Token Bus & their frame formats. FDDI.

Transport Layer:

Transport layer Protocols like TCP, UDP, Connection Oriented Transport Protocol, TCP services.

N/W Protocols: FTP, SMTP & MIME & POP3

Modern Applications:

Web Applications: - HTTP, Internet and its Applications.

References Books:

(i) William S. (1999). *Computer Networking with Internet Protocols And Technology*. Pearson Education, Delhi.
(ii) Keneth C. Mansfield, Jr. James L. Antonakos. (2001). *An Introduction to Computer Networking*. PHI.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Computer Networks

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	3	1	2	2	2	2	1	1	2	2
CO2	3	2	3	2	2	1	-	1	1	3	2	1	3	3	3
CO3	3	3	2	3	2	2	3	2	2	2	-	2	1	2	2
CO4	1	2	2	2	2	1	-	2	1	3	3	-	-	2	3
CO5	3	2	2	3	3	1	2	1	2	3	3	2	3	2	3
AVERAGE	**2.6**	**2.2**	**2.2**	**2.2**	**2.4**	**1.6**	**2**	**1.6**	**1.6**	**2.6**	**2.5**	**1.5**	**2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Embedded Systems
Course Code: 103518

Semester: 5th

L T P

Credits:03 **3 0 0**

(103518**):** Embedded Systems

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Suggest design approach using advanced controllers to real-life situations.
CO 2	Design interfacing of the systems with other data handling / processing systems.
CO 3	Appreciate engineering constraints like energy dissipation, data exchange speeds etc.
CO 4	Explore interfacing between analog and digital blocks.
CO 5	Ability to understand the real time programming languages and operating systems for embedded systems

Course Content

The concept of embedded systems design, Embedded microcontroller cores, embedded memories. Examples of embedded systems, Technological aspects of embedded systems: interfacing between analog and digital blocks, signal conditioning, digital signal processing. sub system interfacing, interfacing with external systems, user interfacing. Design tradeoffs due to process compatibility, thermal considerations, etc., Software aspects of embedded systems: real time programming languages and operating systems for embedded systems.

Text/Reference Books:

1. Valvano, J.W. (2000). *Embedded Microcomputer System: Real Time Interfacing*. Brooks/Cole.

2. Jack G. (1999). *The Art of Designing Embedded Systems*. Newness.

3. David S. (2000). *An Embedded Software Primer*. Addison Wesley.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Embedded Systems

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	-	3	2	2	3	2	1	2	1	2	2
CO2	3	2	2	2	2	2	3	2	2	2	1	1	2	3	3

CO3	3	3	3	2	-	2	3	2	-	1	1	1	3	2	2
CO4	3	3	2	2	2	2	2	2	-	2	1	2	2	2	3
CO5	2	2	3	3	3	1	3	1	3	2	-	1	3	2	3
AVERAGE	**2.8**	**2.4**	**2.6**	**2.4**	**2.2**	**2**	**2.6**	**1.8**	**2.6**	**1.8**	**1**	**1.4**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Power Systems-II (Operation and Control)
Course Code: 103611

Semester: 6th

L T P

Credits:03 **3 0 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Develop small scale model of alternator, excitation and governing systems.
CO 2	Decide the scheduling of thermal units and hydro-thermal units for overall economy.
CO 3	Design and apply control for frequency and voltage of power system represented by multi area
CO 4	Comprehend power system security and contingency.
CO 5	Computation of small scale and voltage stability.

Course Content

Economic Operation of Power Systems: Fuel consumption, Characteristics of thermal unit, Incremental fuel rate and their approximation, Minimum and maximum power generation limits.

Economic Dispatch: Economic dispatch problem with and without transmission line losses, Unit Commitment, methods for their solutions. Hydrothermal Co-ordination: Hydro-scheduling, Plant models, Scheduling problems, Hydrothermal scheduling problems and its approach.

Power System Control: Ideas of load frequency and voltage control, Reactive power control, Block diagrams of P-f and Q-V controllers, ALFC control, Static and dynamic performance characteristics of ALFC and AVR controllers, Excitation systems model, concept of area and Tie-line operations.

Power System Security: Factors affecting security, Contingency analysis, Network sensitivity, correcting the generation dispatch by using sensitivity method and linear programming. Small Scale Stability Analysis: d-q model of generator, State space representation, Eigen value and participation factor analysis.

Voltage Stability: Basic concepts, Voltage collapse, P-V and Q-V curves, Impact of load, Static and dynamic analysis of voltage stability, Prevention of voltage collapse.

Text/Reference Books:

1. Rao, S. (2001). *Testing, Commissioning, Operation and Maintenance of Electrical Equipment by Khanna Technical Publication*. New Delhi

2. Wadhwa, C.L. (1996) *Electrical Power Systems*. Wiley Eastern Ltd. New Delhi

3. Uppal, S.L. (2003). *Electrical Power*. Dr. Khanna Publications. Delhi.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Power Systems-II (Operation and Control)

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	3	1	2	2	2	2	1	1	2	2
CO2	3	2	3	2	2	1	2	1	1	3	2	1	3	3	3
CO3	3	-	2	3	2	2	3	2	2	2	-	2	1	2	2
CO4	1	2	2	2	2	1	-	2	1	3	3	-	-	2	3
CO5	3	2	2	3	3	1	2	1	2	3	3	2	3	2	3
AVERAGE	**2.6**	**2**	**2.2**	**2.2**	**2.4**	**1.6**	**2**	**1.6**	**1.6**	**2.6**	**2.5**	**1.5**	**2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Programmable Logic Controllers
Course Code: A103604

Semester: 6th

L T P

Credits:03 **3 0 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Analyze the major components of PLC.
CO 2	Interpret the operation of PLC modules.
CO 3	Execute the PLC programming with different conditions.
CO 4	Establish communication and networking with PLC.
CO 5	Computation of Programming based on basic instructions, timer, counter, sequencer

Course Content

Objective: - To learn the basic principle of operation of programmable logic controllers and ladder diagrams.

Introduction to PLC Introduction, relative merits over hard-wired logic and relay. PLC based design of power converters, PLC based control of DC and AC Drives Process Control, Advantages, Applications Building blocks of PLC, Functions of various blocks, concept of PLC.

Working of PLC Basic operation and principles of PLC Architectural details processor Memory structures, I/O structure Programming terminal, power supply

Instruction Set Basic instructions like latch, master control, self-holding relays. Timer instruction like retentive timers, resetting of timers. Counter instructions like up counter, down counter, resetting of counters. Sequencers, output sequencers, input sequencers, time driven, and event driven sequencers, masking etc. Comparison instructions like equal, not equal, greater, greater than equal, less than, less than equal, mask equal limit etc.

Ladder Diagram Programming Programming based on basic instructions, timer, counter, sequencer, and comparison instructions using ladder program.

Text/Reference Books:

1. Otter, J.D. (2000). *Programmable Logic Controller*. P.H. International, Inc, USA
2. Dunning, G. (1999). *Introduction to PLCs*. McGraw Hill

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Programmable Logic Controllers

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

AVERAGE	**2.4**	**2.4**	**2.4**	**2.4**	**2.2**	**2**	**2.4**	**1.8**	**1.6**	**2.8**	**2.4**	**2**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Total Quality Management
Course Code: A105918

Semester: 6th

L T P

Credits:03 **3 0 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Analyze the Excellence in manufacturing/service, factors of excellence, relevance of TQM.
CO 2	Recognize the concept of Quality
CO 3	Understand the Implication of Quality on Business
CO 4	Implement Quality Implementation Programs
CO 5	Exposure to challenges in Quality Improvement Programs

Course Content

Quality and Total Quality Management: Excellence im manufacturing/service, factors of excellence, relevance of TQM.

Concept and definition of quality: total quality control (TQC) and Total Quality Management (TQM), salient features of TQC and TQM. Total Quality Management Models, benefits of TQM.

Just-in-time (JIT): Definition: Elements, benefits, equipment layout for JIT system, Kanban system MRP (Material Requirement planning) vs. JIT system, Waste elimination, workers involvement through JIT: JIT cause and effect chain, JIT implementation.

Customer: Satisfaction, data collection and complaint, redressed mechanism.

Planning Process: Policy development and implementation; plan formulation and implementation.

Process Management: Factors affecting process management, Quality function development (QFD), and quality assurance system.

Total Employees Involvement (TEI): Empowering employees: team building; quality circles; Reward and Recognition; education and training, Suggestion schemes.

Problems solving Defining problem; Problem identification and solving process; QC tools.

Benchmarking definition, concept, process and types of benchmarking.

Quality Systems: Concept of quality system standards: relevance and origin of ISO 9000; Benefits; Elements of ISO 9001, ISO 9002, ISO 9003.

Advanced techniques of TQM: Design of experiments: failure mode effect analysis: Taguchi methods

Text/Reference Books:

1. Sunder, R. (2001). *Total Quality Management*. Tata McGraw Hill
2. Zairi M. (2000). *TQM for Engineers.* Aditya Books

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Total Quality Management

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	3	2	3	2	2	2	1	2	3	1	2	2
CO2	3	2	2	2	2	2	3	2	-	-	3	2	2	3	3
CO3	2	3	-	2	2	2	2	2	2	2	2	-	3	2	2
CO4	3	3	2	2	2	2	2	2	3	-	1	2	2	2	3
CO5	2	2	-	3	3	1	3	1	-	3	2	1	3	2	3
AVERAGE	**2.4**	**2.4**	**2**	**2.4**	**2.2**	**2**	**2.4**	**1.8**	**2. 3**	**2**	**2**	**2**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Power Systems-II Lab
Course Code: 103612

Semester: 6th

L T P

Credits:01 **0 0 2**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Knowledge of various abnormal conditions that could occur in power system
CO 2	Design various protective devices in power system for protecting equipment and personnel.
CO 3	Familiarity of various types of existing circuit breakers, their design and constructional details.
CO 4	Awareness of various conventional relays, their design and latest developments.

CO 5	Knowledge of standards and specifications related to switchgear and protection

Course Content

Laboratory Work:

Simulation of thermal scheduling with and without losses, Unit commitment by dynamic programming, simulation of hydro-thermal scheduling by gradient method, Stability analysis of single area frequency control, Bias control of two area system and AVR.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Power Systems-II Lab

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	3	2	3	2	2	2	1	3	2	1	2	2
CO2	3	-	2	2	2	-	3	2	2	1	2	2	2	3	3
CO3	2	3	3	-	2	2	2	2	3	2	1	2	3	2	2
CO4	3	3	2	2	2	2	2	-	2	2	-	-	2	2	3
CO5	2	2	3	3	3	1	3	1	3	2	3	2	3	2	3
AVERAGE	**2.4**	**2.5**	**2.4**	**2.5**	**2.2**	**2**	**2.4**	**1.75**	**2.4**	**1.6**	**2.25**	**2**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Programmable Logic Controllers Lab

Course Code: A103607

Semester: 6th

L T P

Credits:01 **0 0 2**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Acquire the knowledge of various abnormal conditions that could occur in power system

CO 2	Ability to design various protective devices in power system for protecting equipment and personnel.
CO 3	Knowledge of various types of existing circuit breakers, their design and constructional details.
CO 4	Knowledge of various conventional relays, their design and latest developments.
CO 5	Knowledge of standards and specifications related to switchgear and protection

LIST OF PRACTICALS

1. Familiarization with the working of PLC

2. Components/Sub-Components of a PLC, learning functions of different modules of PLC System

3. Introduction to step 5 programming language, ladder diagram concepts, instruction list syntax

4. Basic logic operations, AND, OR, NOT functions

5. Logic control systems with time response as applied to clamping operation

6. Sequence control system eg. In lifting a dense for packaging and counting

7. Wiring, entering and testing programs wiring a hand-held programmer for the following operations:
- Ladder Logic, Timers, Counters, Sequencers

Wiring, entering and testing programs using computers for the following operations:

- Ladder logic, timers, counters, sequencers

Assembly language programming
C language programming
Write a program for LCD interface
Write a program for A/D converter, result on LCD
Write a program for D/A converter, showing the result on LCD
Write a program for serial data transmission from kit to PC

1. Development of a small working programs using PLC

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Programmable Logic Controllers Lab

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	3	2	3	2	2	2	1	-	3	1	2	2
CO2	3	2	-	2	2	2	3	2	1	2	2	1	2	3	3

CO3	2	3	3	2	2	2	2	2	2	1	2	1	3	2	2
CO4	3	3	3	2	2	2	2	2	1	2	2	1	2	2	3
CO5	2	2	3	3	3	1	3	1	2	1	-	3	3	2	3
AVERAGE	**2.4**	**2.4**	**3**	**2.4**	**2.2**	**2**	**2.4**	**1.8**	**1.6**	**1.4**	**2**	**1.8**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Electric Drives
Course Code: 103613

Semester: 6th

L T P

Credits:03 **3 0 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Understand the various drive mechanisms and methods for energy conservation.
CO 2	Apply power electronic converters to control the speed of DC motors and induction motors.
CO 3	Evaluate the motor rating for duty cycles.
CO 4	Understand the dynamics of Electric Drives.
CO 5	Knowledge of single-phase and three-phase semi converter and full-converter phase-controlled configurations

Objective:- To understand the dynamics of electrical drives and static control of electric motors.

Definitions, Dynamics of Electric Drives: Concept of electric drive and its classifications, Types of loads, Four-quadrant drive, and dependence of load torque on various factors, Dynamics of motor-load combination, Steady state stability of an electric drive system. Load Equalization

Drive Features of Importance: Multi-quadrant operations of DC and AC motors. Energy relations during starting and braking.

Static Control of Motors: Contactors and relays for electric drives. Control circuits for automatic starters of DC and AC motors including definite time accelerating type.

Estimation of Motors Rating: Types of duty cycles, Calculation of motor rating for duty cycles, Use of load diagrams.

Semiconductor Controlled Drives: Control of DC drives fed through single-phase and three-phase semi converter and full-converter phase-controlled configurations. Their analysis, Regeneration and braking through static power converters, Control of three phase induction motors by stator voltage and frequency control for speeds below and above synchronous speed. Static Rotor resistance control, Static Kramer and Scherbius drives.

Recommended Books

1. Pillai, S.K. (2000) *A First Course On Electrical Drives*, New Age Publications.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Electric Drives

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	2	3	2	2	2	1	3	2	1	2	2
CO2	-	2	2	-	2	-	3	2	2	1	2	1	2	3	3
CO3	2	3	3	1	2	-	2	2	1	2	3	2	3	2	2
CO4	-	3	2	-	2	2	2	2	1	1	1	1	2	2	3
CO5	2	2	3	1	3	1	3	1	2	3	-	2	3	2	3
AVERAGE	**2**	**2.4**	**2.4**	**1**	**2.2**	**2**	**2.4**	**1.8**	**1.6**	**1.6**	**2.2**	**1.6**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Generation of Electrical Power

Course Code: A103603

Semester: 6th

L T P

Credits:03 **3 0 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Get knowledge of India's power scenario, power system structure and related agencies.
CO 2	Select the methods and size of plant generating power for overall economy.
CO 3	Decide the tariff structure for different type of users.
CO 4	Understand the Power Plant Economics
CO 5	Knowledge of Energy and environment, Air pollution, Aquatic impacts, nuclear plant and hydro plant impacts

Course Content

Objective:- To learn the basic concepts of load curves, tariffs, economics operations of power systems and pollution control.

Introduction: Electrical energy sources, organization of power sector in India, single line diagram of thermal, hydro and nuclear power stations.

Loads and Load curves: Maximum demand, Group diversity factor, Peak diversity factor, Types of load, chronological load curves, load-duration Curve, mass curves, load factor, capacity factor, utilization factor, base load and peak load plants, load forecasting.

Power Plant Economics: Capital cost of plants, annual fixed cost, operating costs and effect of load factor on cost of energy, depreciation.

Tariffs and power factor improvement: Objectives of tariff making, different types of tariff for domestic, commercial, agricultural and Industrial loads. Need for p.f. improvement, p.f. improvement using capacitors, determination of economic p.f.

Selection of plant: Plant location, plant size, no. and size of units in plants, economic comparison of alternatives , annual cost , rate of return, present worth and capitalized cost methods.

Economic operation of steam plants: Methods of loading turbo-generators, input- output curve, heat rate, incremental cost , method of lagrangian multiplier, effect of transmission losses, co ordination equations, iterative procedure to solve co-ordination equations.

Hydro-thermal co-ordination: Advantages, combined working of run off river plant and steam plant , reservoir hydro plants and thermal plants-long term operational aspects, scheduling methods.

Pollution and environmental problems: Energy and environment, Air pollution, Aquatic impacts, nuclear plant and hydro plant impacts.
Cogeneration: Definition and scope, Topping and Bottoming Cycles, Benefits, cogenerationtechnologies.

Books:

1. Gupta, B.R.(2000). Generation of Electric Energy. S.Chand & Co. Delhi.

2. Dom, K. (1998) Power Plant Engineering S.Chand & Co. Delhi.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Generation of Electrical Power

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

CO5	2	2	3	3	3	1	3	1	1	2	2	-	3	2	3
AVERAGE	**2.4**	**2.4**	**2.4**	**2.4**	**2.2**	**2**	**2.4**	**1.8**	**2.4**	**2**	**2.25**	**2**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Electrical Energy Conservation and Auditing

Course Code: 103614

Semester: 6th

L T P

Credits:03 **3 0 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Get knowledge of Sector wise Energy consumption, demand supply gap, Scope for energy conservation
CO 2	Energy conservation by VSD, Methods and techniques of energy conservation in ventilation.
CO 3	Identify the demand supply gap of energy in Indian scenario.
CO 4	Carry out energy audit of an industry/Organization.
CO 5	Draw the energy flow diagram of an industry and identify the energy wasted or a waste stream.

Course Content

Unit-1: Elements of Energy Conservation and Management
General energy problem, Sector wise Energy consumption, demand supply gap, Scope for energy conservation and its benefits Energy conservation Principle – Maximum energy efficiency, Maximum cost effectiveness, Mandatory provisions of EC act, Features of EC act-Standards and labeling, designated consumers, Energy Conservation Building Codes (ECBC), Energy management concept and objectives, Initializing Planning, Leading, Controlling, Promoting, Monitoring and Reporting. energy management programmes

Unit-2: Energy Conservation Approaches In Industries
Energy saving opportunities in electric motors, Benefits of Power factor improvement and its techniques-Shunt capacitor, Synchronous Condenser etc., Effects of harmonics on – Motors, and remedies leading to energy conservation., Energy conservation by VSD, Methods and techniques of energy conservation in ventilation and air conditioners,compressors pumps, fans and blowers,Area Sealing, Insulating the Heating / cooling fluid pipes , automatic door closing- Air curtain, Thermostat / Control., Energy conservation in electric furnaces, ovens and boilers., lighting techniques – Natural , CFL, LED lighting sources and fittings

Unit-3: Techno-economic Evaluation of Energy Conservation Option
New equipment, technology, staffing, training,Calculation and costing of energy conservation project., Depreciation cost, sinking fund method., Cost evaluation by Return On Investment(ROI) and pay back method etc., Risk analysis., Case study

Unit-4: Energy Conservation in Power Generation, Transmission and Distribution
Performance improvement of existing power plant: co-generation , small hydro ,DG Set, Demand side management, Load response programmes, Types of tariff and restructuring of electric tariff, Technical measures to optimize T and D losses

Unit-5: Energy Audit
Energy audit and its benefits, Energy flow diagram, Preliminary, Detailed energy audit., Methodology of preliminary energy audit and Detailed energy audit – Phase I, Pre audit, Phase II- Audit and Phase III- Post audit, Energy audit report., Electrical Measuring Instruments - Power Analyser, Combustion analyzer, fuel efficiency monitor, thermometer-contact, infrared, pitot tube and manometer, water flowmeter, leak detector, tachometer and luxmeter, IE rules and regulations for energy audit, Electricity act(Numerical)

Books:

1 Sivaganaraju, S. (1998). *Electric Energy Generation, Utilisation and Conservation*. Pearson, New Delhi1

2 Prasanna C. (2000). *Project Management*. Tata Mcgraw Hill, New Delhi.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Electrical Energy Conservation and Auditing

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	3	2	2	2	1	1	3	1	2	2
CO2	3	2	2	2	2	2	3	2	2	1	1	2	2	3	3
CO3	2	3	2	2	2	2	2	2	3	1	-	-	3	2	2
CO4	2	3	2	2	2	-	2	2	2	1	2	1	2	2	3
CO5	2	2	3	3	3	1	3	1	2	1	2	-	3	2	3
AVERAGE	**2.4**	**2.6**	**2.2**	**2.4**	**2.2**	**2**	**2.4**	**1.8**	**2.2**	**1**	**1.5**	**2**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Power Plant Engineering

Course Code: 103616

Semester: 6th

L T P

Credits:03 **3 0 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Find out the efficiency and output of Rankine cycle Steam Power Plant from given data, including, super heat, reheat, regeneration and reversibility's.
CO 2	Explicate the blade shapes, and calculate work output of typical turbine stages.
CO 3	Explain major types of hydro power and wind power turbines.
CO 4	Clarify the basic principal of thermal fission and fast breeder nuclear power plant.
CO 5	Understand the basics of pollution control methods.

Course Content

Steam Generators, Condensers and Turbines: Classification of steam generators, selection, operation of locomotive, Babcock Wilcox, Cochran boilers, Types of condensers, effect of air in condensers, Dalton's law of partial pressure, cooling water calculations, steam nozzles, types of steam turbine efficiencies, compounding, governing and control.

Steam Power Plant: Classification, Operation, Description of Rankine cycle, Regenerative cycle, Reheat-Regenerative Cycle, Binary Vapour Cycle, Selection of plant site and its layout, coal handling system, combustion system, Fluidized bed combustion, Ash handling, Feed pumps, Heat exchangers, Economizers, Super heaters, Reheaters, Air preheaters, Feed water heaters, Evaporators.

Hydro-Electric Power Plants: Hydrological Cycle, Hydrograph, Flow duration curve, Selection of site, Essential features, Classification of hydro plants, Selection of water turbines for hydro power plant, Automatic and remote control of hydro station, layout of hydro power plant.

Nuclear power plants: Nuclear physics, Binding energy, Radio active decay. Fertile material, Mass defect, Nuclear reactions type and application, Generation of nuclear energy by fission, Nuclear reactors. Site selections, safety measures, plant layout, Fusion reaction, Future of nuclear power.

Gas Turbine: Elements of gas turbines, Open and closed cycles for gas turbines, Performance terms, Thermal refinement to gas turbines cycle, Plant layout, applications, gas turbines Cycle calculations.

Diesel Power Plants: Classifications of IC Engines and their performance, Four stroke and two stroke diesel engines, combustion phenomenon; Essential components, Celane number, knocking, super charging, operation and layout of diesel power plant.

Combined Operation of Different Power Plants: Advantages of combined operation of plants, load division between power stations, coordination of different types of Power Plants.

Pollution Control: Pollution from thermal & nuclear plants, Particulate emission and control, electrostatic precipitator, solid waste disposal.

Reference Books:

1. Sharma, P.C. (1999) *Power Plant Engineering* (Kataria & Sons)

2. Skrotzki, B.G.A. & Vapot, W. (2001) *A Power Station Engineering and Economy* (TMH)

3. Rajput, R.K. (1997) *Power Plant Engineering* (Luxmi Publications)

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Power Plant Engineering

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	3	2	1	2	2	2	3	-	2	1	2	2
CO2	3	2	2	2	2	1	3	2	3	2	3	2	2	3	3
CO3	2	3	2	2	2	-	2	2	2	32	1	1	3	2	2
CO4	2	3	2	2	3	-	2	2	3	1	2	1	2	2	3
CO5	2	2	3	3	3	1	3	1	1	2	1	-	3	2	3
AVERAGE	**2.2**	**2.6**	**2.2**	**2.4**	**2.4**	**1.8**	**2.4**	**1.8**	**2.2**	**8**	**1.75**	**1.5**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Wavelet Transforms

Course Code: 103617

Semester: 6th

L T P

Credits:03 **3 0 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Understand about windowed Fourier transform and difference between windowed Fourier transform and wavelet transform.
CO 2	Understand wavelet basis and characterize continuous and discrete wavelet transforms
CO 3	Understand multi resolution analysis and identify various wavelets and evaluate their time- frequency resolution properties
CO 4	Implement discrete wavelet transforms with multirate digital filters
CO 5	Understand about wavelet packets

Course Content

Introduction Stationary and non-stationary signals, Signal representation using basis and frames, Brief introduction to Fourier transform and Short time Fourier transform, Timefrequency analysis, Bases of time frequency: orthogonal, Filter banks, Multi resolution formulation: Wavelets from filters, Classes of wavelets: Haar, Daubechies, bi-orthogonal.

Continuous Wavelet Transform Continuous wavelet transform (CWT), Time and frequency resolution of the continuous wavelet transform, Construction of continuous wavelets: Spline, orthonormal, bi-orthonormal, Inverse continuous wavelet transform, Redundancy of CWT, Zoom property of the continuous wavelet transform, Filtering in continuous wavelet transform domain.

Discrete Wavelet Transform And Filterbanks Orthogonal and biorthogonal two-channel filter banks, Design of two-channel filter banks, Tree-structured filter banks, Discrete wavelet transform, Non-linear approximation in the Wavelet domain, multi resolution analysis, Construction and Computation of the discrete wavelet transform, the redundant discrete wavelet transform.

Multi Resolution Analysis Multirate discrete time systems, Parameterization of discrete wavelets, Bi-orthogonal wavelet bases, Two dimensional, wavelet transforms and Extensions to higher dimensions, wave packets

Applications Signal and Image compression, Detection of signal changes, analysis and classification of audio signals using CWT, Wavelet based signal de-noising and energy compaction, Wavelets in adaptive filtering, Adaptive wavelet techniques in signal acquisition, coding and lossy transmission, Digital Communication and Multicarrier Modulation, Trans multiplexers , Image fusion, Edge Detection and object isolation.

Reference Books:

1. Mallat, S. (1999). *A Wavelet Tour of Signal Processing, 2nd edition*. Academic Press.
2. Vetterli M. and Kovacevic J. (1995). *Wavelets and Sub band Coding*. Prentice Hall.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Wavelet Transforms

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	2	2	2	2	1	3	2	1	2	2
CO2	3	2	-	2	2	2	3	2	-	-	1	2	2	3	3
CO3	2	3	2	2	2	2	2	2	2	1	-	-	3	2	2
CO4	2	3	2	2	3	2	2	2	3	2	2	1	2	2	3
CO5	2	2	-	3	3	1	3	1	3	-	1	2	3	2	3
AVERAGE	**2.4**	**2.6**	**2**	**2.4**	**2.4**	**1.8**	**2.4**	**1.8**	**2.5**	**1.3**	**1.75**	**1.75**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: VLSI circuits

Course Code: 103618

Semester: 6th

L T P

Credits:03 **3 0 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Design logic circuit layouts for both static CMOS and dynamic clocked CMOS circuits
CO 2	Extract the analog parasitic elements from the layout and analyze the circuit timing using a logic simulator and an analog simulator
CO 3	Perform testing of hardware into the VLSI chip and analyze VLSI circuit timing using logical effort analysis and to estimate and compute the power consumption of a VLSI chip.
CO 4	Implement MOS Transistor, CMOS logic, Inverter, Pass Transistor, Transmission gate.
CO 5	Understand about Static latches and Registers, Dynamic latches and Registers

Course Content

OBJECTIVES:

- Study the fundamentals of CMOS circuits and its characteristics.
- Learn the design and realization of combinational & sequential digital circuits.
- Architectural choices and performance trade-offs involved in designing and realizing the circuits in CMOS technology are discussed
- Learn the different FPGA architectures and testability of VLSI circuits.

UNIT I

INTRODUCTION TO MOS TRANSISTOR

MOS Transistor, CMOS logic, Inverter, Pass Transistor, Transmission gate, Layout Design Rules, Gate Layouts, Stick Diagrams, Long-Channel I-V Charters tics, C-V Charters tics, Non ideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate, Scaling.

UNIT II

COMBINATIONAL MOS LOGIC CIRCUITS

Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL, Circuit Pitfalls.

Power: Dynamic Power, Static Power, Low Power Architecture.

UNIT III

SEQUENTIAL CIRCUIT DESIGN

Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmitt Trigger, Monostable Sequential Circuits, Astable Sequential Circuits.Timing Issues : Timing Classification Of Digital System, Synchronous Design.

UNIT IV

DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM

Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters, ALUs, power and speed tradeoffs, Case Study: Design as a tradeoff.Designing Memory and Array structures: Memory Architectures and Building Blocks, Memory
Core, Memory Peripheral Circuitry.

UNIT V

IMPLEMENTATION STRATEGIES AND TESTING

FPGA Building Block Architectures, FPGA Interconnect Routing Procedures. Design for Testability: Ad Hoc Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability, Boundary Scan.

Books:

1. Neil H.E. Weste, David Money Harris . (2017). *CMOS VLSI Design: A Circuits and Systems Perspective‖, 4th Edition*. Pearson.
2. Jan M. Rabaey ,Anantha Chandrakasan, Borivoje. Nikolic. (2016). *Digital Integrated Circuits:A Design perspective‖, Second Edition*. Pearson.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for VLSI circuits

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	2	2	2	2	1	3	2	1	2	2
CO2	2	2	2	2	2	2	3	2	2	3	2	1	2	3	3
CO3	2	3	2	2	2	2	2	2	3	2	-	2	2	2	2
CO4	2	3	2	2	3	2	2	2	2	2	2	3	2	2	3
CO5	2	2	3	3	3	1	3	1	-	2	3	-	3	2	3
AVERAGE	**2.2**	**2.6**	**2.2**	**2.4**	**2.4**	**1.8**	**2.4**	**1.8**	**2.25**	**2**	**2.5**	**2**	**2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Power System Protection

Course Code: 103704

Semester: 7th

L T P

Credits:03 **3 0 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Calculation of both symmetrical and un-symmetrical fault currents.
CO 2	Understanding the fundamentals of electromechanical relays and digital protective relaying
CO 3	The basic methods of calculating the magnitude and angle of voltage and current for the digital relaying
CO 4	The methods to choose suitable current transformer, voltage transformer and circuit breakers etc for fulfilling power system protection
CO 5	Design of over current protection and its coordination

Course Content

Introduction to Power System Protection:

Need for protective schemes, Nature and Cause of Faults, Types of Fault,Effects of Faults, Fault Statistics, Zones of Protection, Primary and Backup Protection, Essential Qualities of Protection,Performance of Protective Relaying, Classification of Protective Relays, Automatic Reclosing, Current Transformers for protection, Voltage Transformers for Protection.

Relay Construction and Operating Principles:

Introduction, Electromechanical Relays, Static Relays – Merits and Demerits of Static Relays, Numerical Relays, Comparison between Electromechanical Relays and Numerical Relays.

Overcurrent Protection:

Introduction, Time – current Characteristics, Current Setting, Time Setting. Overcurrent Protective Schemes, Reverse Power or Directional Relay, Protection of Parallel Feeders, Protection of Ring Mains, Earth Fault and Phase Fault Protection, Combined Earth Fault and Phase Fault Protective Scheme, Phase Fault Protective Scheme, Directional Earth Fault Relay, Static Overcurrent Relays, Numerical Overcurrent Relays.

Distance Protection:

Introduction, Impedance Relay, Reactance Relay, Mho Relay, Angle Impedance Relay, Effect of Arc Resistance on the Performance of Distance Relays, Reach of Distance Relays. Effect of Power Surges(Power Swings) on Performance of Distance Relays, Effect of Line Length and Source Impedance on Performance of Distance Relays.

Pilot Relaying Schemes:

Introduction, Wire Pilot Protection, Carrier Current Protection

Differential Protection:

Introduction, Differential Relays, Simple Differential Protection, Percentage or Biased Differential Relay, Differential Protection of 3 Phase Circuits, Balanced (Opposed) Voltage Differential Protection.

Rotating Machines Protection:

Introduction, Protection of Generators.

Transformer and Buszone Protection:

Introduction, Transformer Protection, Buszone Protection, Frame Leakage Protection.

Circuit Breakers:

Introduction, Fault Clearing Time of a Circuit Breaker, Arc Voltage, Arc Interruption, Restriking Voltage and Recovery Voltage, Current Chopping, Interruption of Capacitive Current, Classification of Circuit Breakers, Air – Break Circuit Breakers, Oil Circuit Breakers, Air – Blast Circuit Breakers, SF6 Circuit Breakers, Vacuum Circuit Breakers, High Voltage Direct Current Circuit Breakers, Rating of Circuit Breakers, Testing of Circuit Breakers.

Fuses:

Introductions, Definitions, Fuse Characteristics, Types of Fuses, Applications of HRC Fuses, Selection of Fuses, Discrimination.

Protection against Overvoltages:

Causes of Overvoltages, Lightning phenomena, Wave Shape of Voltage due to Lightning, Over Voltage due to Lightning, Klydonograph and Magnetic Link, Protection of Transmission Lines against Direct Lightning Strokes, Protection of Stations and Sub – Stations from Direct Strokes, Protection against Travelling Waves, Insulation Coordination, Basic Impulse Insulation Level (BIL).

Textbook

1. Elgerd O.L.(2001) *Electrical Energy System Theory - An introduction,* (TMH)

2. Stevenson Jr W.D.(1999) *Elements of Power System Analysis,* TMH

3. Wadhwa C.L. (2000) *Course in Electrical Power*, New Age Int.(P)Ltd.

4. Nagrath and Kothari,(2003) *Power System Analysis,* (TMH)

5. Gupta, B.R. (2001) *Power System Analysis & Design,* Wheeler Publishing.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Power System Protection

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	2	2	2	2	2	1	-	1	2	2
CO2	2	2	2	2	2	2	3	2	2	3	2	3	2	3	3
CO3	3	3	2	2	2	2	2	2	1	2	2	1	2	2	2
CO4	2	3	2	2	3	2	2	2	1	1	1	2	2	2	3
CO5	2	2	3	3	3	1	3	1	-	2	2	-	3	2	3
AVERAGE	2.4	2.6	2.2	2.4	2.4	1.8	2.4	1.8	1.5	2	1.6	2	2	2.2	2.6

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: High Voltage Direct Current

Course Code: 103705

Semester: 7th

L T P

Credits:03 **3 0 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Understand the importance of Transmission power through HVDC.
CO 2	Analyze the HVDC Converter operation.
CO 3	Discuss firing angle control of 6 pulse,12 pulse circuits.
CO 4	Discuss harmonics in HVDC.
CO 5	Identify the importance of filters for HVDC system.

Course Content

Direct Current (DC) power transmission technology: Introduction, comparison of Alternating Current (AC) and Direct Current (DC) transmission, application of DC transmission, application of DC transmission, description of DC transmission system, Configurations, planning for High Voltage Direct Current (HVDC) transmission, modern trends in DC transmission. Introduction to Device: Thyristor valve, valve tests, recent trends.

Analysis of High Voltage Direct Current (HVDC) converters: Pulse number, choice of converter configuration, simplified analysis of Graetz circuit, converter bridge characteristics, characteristics of a twelve -pulse converter, detailed analysis of converters with and without overlap.

Converter and HVDC system control: General, principles of DC link control, converter control characteristics, system control hierarchy, firing angle control, current and extinction angle control, starting and stopping of DC link, power control, higher level controllers, telecommunication requirements.

Converter faults and protection: Introduction, converter faults, protection against over-currents, over-voltages in a converter station, surge arresters, protection against over-voltages.

Smoothing reactor and DC line: Introduction, smoothing reactors, DC line, transient over voltages in DC line, protection of DC line, DC breakers, Monopolar operation, effects of proximity of AC and DC transmission lines.

Component models for the analysis of AC/DC systems: General, converter model, converter control, modelling of DC network, modelling of AC network.

References:

1. Bagamudre, R. D. (2000). *E.H.V. A.C. Transmission Engg*. New Age International Publishers.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for High Voltage Direct Current

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

CO5	2	-	3	3	3	-	3	1	2	2	-	2	3	2	3
AVERAGE	**2.4**	**2**	**2.2**	**2.4**	**2.4**	**2**	**2.4**	**1.8**	**1.8**	**2.2**	**2**	**2.25**	**2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Digital Control Systems

Course Code: 103706

Semester: 7th

L T P

Credits:03 **3 0 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Use ordinary differential equations and Laplace transformation to model physical systems,
CO 2	Obtain dynamic responses of linear systems and determine their stability
CO 3	Construct root-locus and Bode plots, and apply Nyquist criterion in the context of controller design
CO 4	Obtain and manipulate state-space representation of dynamical systems using linear algebra
CO 5	The students should be able to translate a set of performance specifications given in words to a formal description of a design problem, and then design a suitable feedback-controller using design tools, followed by simulation and verification using software tools.

Course Content

Course Objectives:

- To explain basic and digital control system for the real time analysis and design of control systems.
- To apply the knowledge state variable analysis in the design of discrete systems.
- To explain the concept of stability analysis and design of discrete time systems.

UNIT – I: Introduction: Block Diagram of typical control system- advantages of sampling in control systems – examples of discrete data and digital systems – data conversion and quantization – sample and hold devices – D/A and A/D conversion – sampling theorem – reconstruction of sampled signals –ZOH. Z-transform: Definition and evaluation of Z-transforms – mapping between s-plane and z-plane – inverse z-plane transform – theorems of the Z-transforms –

limitations of z-transforms –pulse transfer function –pulse transfer function of ZOH –relation between G(s) and G(z) – signal flow graph method applied to digital systems.

UNIT- II: State Space Analysis: State space modeling of digital systems with sample and hold – state transition equation of digital time in variant systems – solution of time in variant discrete state equations by the Z-Transformation – transfer function from the state model – Eigen values – Eigen vector and diagonalisation of the A-matrix – Jordan canonical form. Computation of state transition matrix-Transformation to phase to variable canonical form-The state diagram – decomposition of digital system – Response of sample data system between sampling instants using state approach. Stability: Definition of stability – stability tests – The second method of Liapunov.

UNIT- III: Time Domain Analysis: Comparison of time response of continuous data and digital control systems-correlation between time response and root locus j the s-plane and z-plane – effect of polezero configuration in the z-plane upon the maximum overshoot and peak time of transient response – Root loci for digital control systems – steady state error analysis of digital control systems – Nyquits plot – Bode plot-G.M and P.M.

UNIT- IV: Design: The digital control design with digital controller with bilinear transformation – Digital PID controller-Design with deadbeat response-Pole placement through state feedback-Design of full order state observer-Discrete Euler Lagrance Equation – Discrete maximum principle.

UNIT-V: Digital State Observer: Design of – Full order and reduced order observers. Design by max. Principle: Discrete Euler language equation-discrete maximum principle.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Digital Control Systems

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	3	2	3	2	2	2	1	-	3	1	2	2
CO2	2	2	2	2	2	2	3	2	2	3	2	2	2	3	3
CO3	3	3	3	2	2	2	3	2	3	1	1	1	3	2	2
CO4	3	3	2	2	2	-	2	2	-	1	2	-	2	2	3
CO5	2	2	3	3	3	1	3	1	1	2	-	1	3	2	3
AVERAGE	**2.4**	**2.4**	**2.2**	**2.4**	**2.2**	**2**	**2.6**	**1.8**	**2**	**1.6**	**1.6**	**1.75**	**2.2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Computer Architecture

Course Code: 103707

Semester: 7th

L T P

Credits:03 **3 0 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Ability to understand the fundamentals organization of computer system.
CO 2	Ability to Identify, understand and apply different number systems, codes. Binary addition and subtraction, 1' & 2's complement representation and operations with this representation.
CO 3	Ability to understand the digital representation of data in a computer system.
CO 4	Ability to formulate the computer arithmetic operations and solve its problems.
CO 5	Ability to examine the performance requirements of systems.

Course Content

OBJECTIVES:

• To learn the basic structure and operations of a computer.
• To learn the arithmetic and logic unit and implementation of fixed-point and floating point arithmetic unit.
• To learn the basics of pipelined execution.
• To understand parallelism and multi-core processors.
• To understand the memory hierarchies, cache memories and virtual memories.
• To learn the different ways of communication with I/O devices.

UNIT I BASIC STRUCTURE OF A COMPUTER SYSTEM

Functional Units – Basic Operational Concepts – Performance – Instructions: Language of the Computer – Operations, Operands – Instruction representation – Logical operations – decision making – MIPS Addressing.

UNIT II ARITHMETIC FOR COMPUTERS

Addition and Subtraction – Multiplication – Division – Floating Point Representation – Floating Point Operations – Subword Parallelism

UNIT III PROCESSOR AND CONTROL UNIT

A Basic MIPS implementation – Building a Datapath – Control Implementation Scheme –

Pipelining – Pipelined datapath and control – Handling Data Hazards & Control Hazards – Exceptions.

UNIT IV PARALLELISIM

Parallel processing challenges – Flynn‘s classification – SISD, MIMD, SIMD, SPMD, and Vector Architectures – Hardware multithreading – Multi-core processors and other Shared Memory Multiprocessors – Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Message-Passing Multiprocessors.

UNIT V MEMORY & I/O SYSTEMS

Memory Hierarchy – memory technologies – cache memory – measuring and improving cache performance – virtual memory, TLB‘s – Accessing I/O Devices – Interrupts – Direct Memory Access – Bus structure – Bus operation – Arbitration – Interface circuits – USB.

TEXT BOOKS:

(i) David A. Patterson and John L. Hennessy.(2014). *Computer Organization and Design: The Hardware/Software Interface, Fifth Edition*. Morgan Kaufmann / Elsevier.
(ii) John P. Hayes. (2012). *Computer Architecture and Organization, Third Edition*. Tata McGraw Hill.
(iii) John L. Hennessey and David A. (2012). *Patterson, Computer Architecture – A Quantitative Approach*. Morgan Kaufmann / Elsevier Publishers, Fifth Edition.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Computer Architecture

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	2	2	2	3	2	-	1	2	2
CO2	1	2	2	2	2	2	3	1	3	2	1	-	3	3	3
CO3	3	3	2	3	1	2	3	2	-	-	3	3	2	2	2
CO4	3	2	2	2	2	1	2	2	3	3	2	3	2	2	3
CO5	3	2	3	3	2	1	3	1	2	2	3	2	3	2	3
AVERAGE	**2.6**	**2.4**	**2.4**	**2.4**	**1.8**	**1.6**	**2.6**	**1.6**	**2.5**	**2.5**	**2.2**	**2.6**	**2.2**	**2.2**	**2.6**

The correlation levels are: “1” – Low Correlation, “2” – Medium Correlation, “3” – High Correlation and “-” indicates there is no correlation.

Course Name: Utlization of Electrical Engineering

Course Code: 103708

Semester: 7th

L T P

Credits:03 **3 0 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Understand basic principles of electric heating and welding.
CO 2	Determine the lighting requirements for flood lighting, household and industrial needs.
CO 3	Calculate heat developed in induction furnace.
CO 4	Evaluate speed time curves for traction.
CO 5	Determine the Principle of air conditioning, vapour pressure, refrigeration cycle, eco-friendly refrigerants

Course Content

Course Objective

This subject assumes importance in view of the fact that an electrical technician has to work in a wide spectrum of activities wherein he has to make selection from alternative schemes making technical and economical considerations; e.g. to plan and design an electrical layout using basic principles and handbooks, to select equipment, processes and components in different situations. The contents have been designed keeping the above objectives in view. Besides giving him basic knowledge in the topics concerned, attempts have been made to ensure that the knowledge acquired is applied in various fields as per his job requirements. To orient the subject matter in the proper direction, visits to industrial establishments are recommended in order to familiarize the students with the new developments in different areas

1. Illumination:

1.1 Nature of light, visibility spectrum curve of relative sensitivity of human eye and wave length of light 1.2Definition: Luminous flux, solid angle, luminous intensity, illumination, luminous efficiency, depreciation factor, coefficient of utilization, space to height ratio, reflection factor, glare, shadow, lux. 1.3 Laws of illumination – simple numericals

1.4 Different type of lamps, construction and working of incandescent and discharge lamps – their characteristics, fittings required for filament lamp, mercury vapour sodium lamp, fluorescent lamp, halogen lamp, neon lamp, compact filament lamp(CFL).

1.5 Calculation of number of light points for interior illumination, calculation of illumination at different points, considerations involved in simple design problems. Illumination schemes; indoor and outdoor illumination levels

1.6 Main requirements of proper lighting; absence of glare, contrast and shadow

1.7 General ideas about time switches, street lighting, flood lighting.monument lighting and decorative lighting, light characteristics etc.

2. Electric Heating

2.1 Advantages of electrical heating
2.2 Heating methods:
Resistance heating – direct and indirect resistance heating, electric ovens, their temperature range, properties of resistance heating elements, domestic water heaters and other heating appliances, thermostat control circuit
Induction heating; principle of core type and coreless induction furnace, their construction and applications
Electric arc heating; direct and indirect arc heating, construction, working and applications of arc furnace
Dielectric heating, applications in various industrial fields Infra-red heating and its applications (construction and working of two appliances)
Microwave heating and its applications (construction and working of two appliances)
Solar Heating
2.3 Calculation of resistance heating elements (simple problems)

3. Electric Welding:
3.1 Advantages of electric welding
3.2 Welding method
3.2.1 Principles of resistance welding, types – spot, projection, seam and butt welding, welding equipment
3.2.2 Principle of arc production, electric arc welding, characteristics of arc; carbon arc, metal arc, hydrogen arc welding method and their applications. Power supply requirement. Advantages of using coated electrodes, comparison between AC and DC arc welding, welding control circuits, welding of aluminum and copper

4. Electrolytic Processes:
4.1 Need of electro-deposition
4.2 Laws of electrolysis, process of electro-deposition - clearing, operation, deposition of metals, polishing and buffing
4.3 Equipment and accessories for electroplating
4.4 Factors affecting electro-deposition
4.5 Principle of galvanizing and its applications
4.6 Principles of anodizing and its applications
4.7 Electroplating of non-conducting materials
4.8Manufacture of chemicals by electrolytic process

5. Electrical Circuits used in Refrigeration, Air Conditioning and Water Coolers:

5.1. Principle of air conditioning, vapour pressure, refrigeration cycle, eco-friendly refrigerants
5.2 Description of Electrical circuit used in Refrigerator, Air-conditioner, and Water cooler

6. Electric Drives:
6.1 Advantages of electric drives
6.2 Characteristics of different mechanical loads
6.3 Types of motors used as electric drive
6.4 Electric braking Plugging Rheostatic braking Regenerative braking
6.5 General idea about the methods of power transfer by direct coupling by using devices like belt drive, gears, chain drives etc.
6.6 Examples of selection of motors for different types of domestic loads

6.7 Selection of drive for applications such as general workshop, textile mill, paper mill, steel mill, printing press, crane and lift etc. Application of flywheel.
6.8 Specifications of commonly used motors e.g. squirrel cage motors, slip ring induction motors, AC series motors, Fractional kilo Watt(FKW) motors
6.9 Selection of motors for Domestic Appliances

7. Electric Traction:
7.1 Advantages of electric traction
7.2 Different systems of electric traction, DC and AC systems, diesel electric system, types of services – urban, sub-urban, and main line and their speed-time curves
7.3 Different accessories for track electrification; such as overhead catenary wire, conductor rail system, current collector-pentagraph
7.4 Factors affecting scheduled speed
7.5 Electrical block diagram of an electric locomotive with description of various equipment and accessories used.
7.6 Types of motors used for electric traction
7.7 Power supply arrangements
7.8 Starting and braking of electric locomotives
7.9 Introduction to EMU and metro railways
7.10 Train Lighting Scheme

Note: Students should be taken for visits to nearest electrified railway track and railway station to study the electric traction system.

RECOMMENDED BOOKS

(i) Partap, H. (1999). *Art and Science of Utilization of Electrical Energy*. Dhanpat Rai & Sons, Delhi.
(ii) Gupta, JB. (1998). *Utilization of Electrical Energy*. Kataria Publications, Ludhiana.
(iii) Sahdev. (2003). *Utilization of Electrical Energy*. Uneek Publication, Jalandhar.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Utlization of Electrical Engineering

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	2	2	2	2	3	2	1	2	2
CO2	2	2	2	2	2	-	3	2	2	-	2	3	2	3	3
CO3	3	3	2	2	2	1	2	2	3	2	3	2	2	2	2
CO4	2	3	2	2	3	-	2	2	2	3	2	3	2	2	3
CO5	2	2	3	3	3	1	3	1	2	3	-	-	3	2	3
AVERAGE	**2.4**	**2.6**	**2.2**	**2.4**	**2.4**	**1**	**2.4**	**1.8**	**2.2**	**2.5**	**2.5**	**2.5**	**2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Estimating & Costing

Course Code: 103709

Semester: 7th

L T P

Credits:03 **3 0 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Understand basic principles of estimating and costing.
CO 2	Apply preliminary cost estimating techniques to prepare building cost plans.
CO 3	Apply estimating techniques to build unit prices.
CO 4	Learn price conforming Tenders to available information.
CO 5	Develop and apply appropriate cost planning bidding strategies that are ethically appropriate.

Course Content

Objective:- To understands the basic concepts of different types of wiring, estimating and costing of material.

1.Introduction

Purpose of estimating and costing, preformed for making estimates, preparation of materials schedule, costing, price list, tender document, net price list, market survey, overhead charges, labour charges, electrical point method and fixed percentage method, contingency, profit, purchase system, enquiries, comparative statements, orders for supply, payment of bills. Tenders – its constituents, finalization, specimen tender.

2. Types of wiring

Cleat, batten, casing capping and conduit wiring, comparison of different wiring systems, selection and design of wiring schemes for particular situation (domestic and Industrial). Selection of wires and cables, wiring accessories and use of protective devices i.e. MCB, ELCB etc. Use of wire-gauge and tables (to be prepared/arranged)

3.Estimating and Costing: Domestic installations;

standard practice as per IS and IE rules. Planning of circuits, sub-circuits and position of different accessories, electrical layout, preparing estimates including cost as per schedule rate pattern and actual market rate (single storey and multi-storey buildings having similar electrical load)

Industrial installations; relevant IE rules and IS standard practices, planning, designing and estimation of installation for single phase motors of different ratings, electrical circuit diagram, starters, preparation of list of materials, estimating and costing exercises on workshop with singe-phase, 3-phase motor load and the light load (3-phase supply system) **Service line connections:** estimate for domestic and Industrial loads (over-head and under ground connections) from pole to energy meter.

4. Estimating the material required for:

Transmission and distribution lines (overhead and underground):Planning and designing of lines with different fixtures, earthing etc. based on unit cost calculations

Substation: Types of substations, substation schemes and components, estimate of 11/0.4 KV pole mounted substation up to 200 KVA rating, earthing of substations, Key Diagram of 66 KV/11KV Substation.

RECOMMENDED BOOKS

1. Gupta, J.B. (2000). *Electrical Installation, Estimating and Costing*. SK Kataria and Sons, New Delhi

2. Bhattacharya, S.K. (1998). *Estimating and Costing*. Tata McGraw Hill, New Delhi

3. Singh, Surjeet. (1999). *Estimating and Costing*. Dhanpat Rai & Co. New Delhi

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Estimating & Costing

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	2	2	2	3	2	3	1	2	2
CO2	2	2	2	2	2	2	3	2	-	2	3	2	2	3	3
CO3	3	3	2	2	2	2	2	2	3	2	-	1	2	2	2
CO4	2	3	2	2	3	2	2	2	-	3	2	3	2	2	3
CO5	2	2	3	3	3	1	3	1	-	2	2	2	3	2	3
AVERAGE	**2.4**	**2.6**	**2.2**	**2.4**	**2.4**	**1.6**	**2.4**	**1.8**	**2.5**	**2.4**	**2.25**	**2.2**	**2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Image Processing

Course Code: 103716

Semester: 7th

L T P

Credits:03 **3 0 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Review the fundamental concepts of a digital image processing system
CO 2	Analyze images in the frequency domain using various transforms.
CO 3	Evaluate the techniques for image enhancement and image restoration.
CO 4	Categorize various compression techniques.
CO 5	Interpret Image compression standards

Course Content

Module:1

Introduction: Digital Image- Steps of Digital Image Processing Systems-Elements of Visual Perception -Connectivity and Relations between Pixels. Simple Operations- Arithmetic, Logical, Geometric Operations. 2D Linear Space Invariant Systems - 2D Convolution - Correlation 2D Random Sequence - 2D Spectrum.

Image Transforms: 2D Orthogonal and Unitary Transforms-Properties and Examples. 2D DFT-FFT – DCT, Histogram Equalization Technique- Point Processing-Spatial Filtering-In Space and Frequency -Nonlinear Filtering-Use of Different Masks.

Module:2

Image Restoration: Image Observation And Degradation Model, Circulant And Block Circulant Matrices and Its Application In Degradation Model - Algebraic Approach to Restoration- Inverse By Wiener Filtering – Generalized Inverse-SVD And Interactive Methods - Blind Deconvolution-Image Reconstruction From Projections.

Image Compression: Redundancy and Compression Models -Loss Less and Lossy. Loss Less-Variable-Length, Huffman, Arithmetic Coding - Bit-Plane Coding, Loss Less Predictive Coding Lossy Transform (DCT) Based Coding, JPEG Standard - Sub Band Coding.

Module:3

Image Segmentation: Edge Detection - Line Detection - Curve Detection - Edge Linking and Boundary Extraction,

Boundary Representation, Region Representation and Segmentation, Morphology-Dilation, Erosion, Opening and Closing. Hit and Miss Algorithms Feature Analysis

Module:4

Colour and multispectral image processing: Colour Image-Processing Fundamentals, RGB Models, HSI Models, Relationship Between Different Models.

REFERENCES:

(i) Rafael C.Gonzales, Richard E. Woods. (2000). *Digital Image Processing*. Pearson Education.
(ii) Sonka, Hlavac. (1998). *Digital Image Processing and Computer*. Vision Boyle Cengage Learning

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Image Processing

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	2	2	2	1	-	3	1	2	2
CO2	2	2	2	2	2	2	3	2	1	2	2	2	2	3	3
CO3	3	3	2	2	2	2	2	2	-	2	3	2	2	2	2
CO4	2	3	2	2	3	2	2	2	3	-	2	3	2	2	3
CO5	2	2	3	3	3	1	3	1	-	3	2	1	3	2	3
AVERAGE	**2.4**	**2.6**	**2.2**	**2.4**	**2.4**	**1.6**	**2.4**	**1.8**	**2**	**2**	**2.25**	**2.2**	**2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Electrical Materials

Course Code: 103710

Semester: 7th

	L T P
Credits:03	**3 0 0**

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Review the fundamental concepts of materials into conducting, semi conducting and insulating materials
CO 2	Apply preliminary cost estimating techniques to prepare building cost plans.
CO 3	Apply estimating techniques to build unit prices.
CO 4	Learn price conforming Tenders to available information.
CO 5	Develop and apply appropriate cost planning bidding strategies that are ethically appropriate.

Course Content

Course Objective :
Students of Electrical Engineering will be involved in maintenance, repair and production of electrical equipment and systems. In addition, he may be required to procure, inspect and test electrical and electronic engineering materials. Knowledge of various types of materials will be needed in order to execute the above mentioned functions. He may also have to decide for an alternative when a particular material is either not readily available in the market or its cost becomes prohibitive.

1. Classification Classifications of materials into conducting, semi conducting and insulating materials through a brief reference to their atomic structure and energy bands

2. Conducting Material
2.1 Introduction

2.2 Resistance and factors affecting it such as alloying and temperature etc

2.3 Classification of conducting material as low resistivity and high resistivity materials, Low resistance materials

2.3.1 Copper: General properties as conductor: Resistivity, temperature coefficient, density, mechanical properties of hard-drawn and annealed copper, corrosion, contact resistance. Applications in the field of electrical engineering.

2.3.2 Aluminium: General properties as conductor: Resistivity, temperature coefficient, density, mechanical properties of hard and annealed aluminium, solder ability, contact resistance. Applications in the field of electrical engineering.
2.3.3 Steel:
General properties as conductor: Resistivity, corrosion, temperature coefficient, density, mechanical properties, solderability, Applications in the field of electrical engineering.
2.3.4 Introduction to bundle conductors and its applications.
2.3.5 Low resistivity copper alloys: Brass, Bronze (cadmium and Beryllium), their practical applications with reasons for the same
2.4 Applications of special metals e.g. Silver, Gold, Platinum etc.

2.5 High resistivity materials and their applications e.g., manganin, constantin, Nichrome, mercury, platinum, carbon and tungsten

2.6 Superconductors and their applications

3. Review of Semi-conducting Materials Semi-conductors and their properties, Materials used for electronic components like resistors, capacitors, diodes, transistors and inductors etc.
4. Insulating materials; General Properties:
4.1 Electrical Properties:
Volume resistivity, surface resistance, dielectric loss, dielectric strength (breakdown voltage) dielectric constant
4.2 Physical Properties:
Hygroscopicity, tensile and compressive strength, abrasive resistance, brittleness
4.3 Thermal Properties:
Heat resistance, classification according to permissible temperature rise. Effect of overloading on the life of an electrical appliance, increase in rating with the use of insulating materials having higher thermal stability, Thermal conductivity, Electro-thermal breakdown in solid dielectrics
4.4 Chemical Properties:
Solubility, chemical resistance, weatherability
4.5 Mechanical properties, mechanical structure, tensile structure
5. Insulating Materials and their applications:
5.1 Plastics
5.1.1 Definition and classification
5.1.2 Thermosetting materials: Phenol-formaldehyde resins (i.e. Bakelite) amino resins (urea-formaldehyde and Malamine-formaldehyde), epoxy resins - their important properties and applications.
5.1.3 Thermo-plastic materials:
Polyvinyl chloride (PVC), polyethelene, silicons, their important properties and applications
5.2 Natural insulating materials, properties and their applications
- Mica and Mica products
- Asbestos and asbestos products
5. Ceramic materials (porcelain and steatite)
6. Glass and glass products

7. Cotton
8. Silk
9. Jute
10. Paper (dry and impregnated)
11. Rubber, Bitumen
- Mineral and insulating oil for transformers switchgear capacitors, high voltage insulated cables, insulating varnishes for coating and impregnation
Enamels for winding wires
Glass fibre sleeves
12. Gaseous materials; Air, Hydrogen, Nitrogen, SF_6 their properties and applications

6. Magnetic Materials:
6.1 Introduction - ferromagnetic materials, permeability, B-H curve, magnetic saturation, hysteresis loop including coercive force and residual magnetism, concept of eddy current and hysteresis loss, curie temperature, magnetostriction effect.
6.2 Soft Magnetic Materials:
6.2.1 Alloyed steels with silicon: High silicon, alloy steel for transformers, low silicon alloy steel for electric rotating machines
6.2.2 Cold rolled grain oriented steels for transformer, Non-oriented steels for rotating machine
6.2.3 Nickel-iron alloys
6.2.4 Soft Ferrites
6.3 Hard magnetic materials: Tungsten steel, chrome steel, hard ferrites and cobalt steel, their applications

7. Special Materials: Thermocouple, bimetals, leads soldering and fuses material, mention their applications.

8.**Introduction of various engineering materials** necessary for fabrication of electrical machines such as motors, generators, transformers etc

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Electrical Materials

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	3	2	3	2	1	2	2	2	3	2	1	1	2	2
CO2	2	2	2	2	2	2	3	2	-	3	2	2	-	3	3
CO3	-	3	2	2	2	2	2	2	3	3	2	-	2	2	2
CO4	2	3	2	2	3	2	2	2	-	2	3	3	-	2	3
CO5	2	2	3	3	3	1	3	1	2	1	2	1	3	2	3
AVERAGE	**2**	**2.6**	**2.2**	**2.4**	**2.4**	**1.6**	**2.4**	**1.8**	**2.33**	**2.4**	**2.2**	**1.75**	**2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Computer Aided Power System Analysis

Course Code: A103801

Semester: 8th

	L T P
Credits:03	3 0 0

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Review the fundamental concepts of materials into conducting, semi conducting and insulating materials
CO 2	Apply preliminary cost estimating techniques to prepare building cost plans.
CO 3	Apply estimating techniques to build unit prices.
CO 4	Learn price conforming Tenders to available information.
CO 5	Develop and apply appropriate cost planning bidding strategies that are ethically appropriate.

Course Content

1. SYSTEM MODELLING: System modeling of synchronous machines, transformers, loads etc, per unit impedance, single line diagram of electrical networks, single phase impedance diagrams corresponding to single line diagram. Formation of impedance and admittance matrices for the electrical networks.

2. LOAD FLOW STUDIES: Data for the load flow studies, Swing Bus, Formulation of simultaneous equations, Iterative solutions by the Gauss-Seidal Method & by Newton Raphson Method.

3. FAULT ANALYSIS: Transients on transmission line, short circuit of synchronous machine, selection of circuit breakers, Algorithm for short circuit studies, Symmetrical Component transformation, construction of sequence networks of power systems. Symmetrical Analysis of Unsymmetrical LG, LL, LLG faults using symmetrical components.

4. POWER SYSTEM STABILITY: Steady state stability, Dynamics of a synchronous machine, Power angle equations, Transient Stability, equal area criterion, Numerical solution of swing equation, factors effecting transient Stability.

Books :

(i) Elgerd,O.I. (1999). *Electric Energy Systems Theory*. TMH
(ii) Nagrath,I.J. Kothari, D.P. (1998). *Modern Power System Analysis*. TMH
(iii) Stevenson, W.D. (2001). *Elements of Power System Analysis*. McGraw Hill

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Computer Aided Power System Analysis

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	3	3	1	2	2	3	1	2	1	1	2	2
CO2	2	2	2	2	2	2	3	2	-	3	-	2	2	3	3
CO3	3	3	2	2	2	2	2	2	2	2	2	1	2	2	2
CO4	2	3	2	2	3	2	2	2	1	2	1	1	2	2	3
CO5	2	2	3	3	3	1	3	1	1	3	3	-	3	2	3
AVERAGE	**2.2**	**2.6**	**2.2**	**2.4**	**2.6**	**1.6**	**2.4**	**1.8**	**1.7**	**2.2**	**2**	**1.2**	**2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Advanced Electric Drives

Course Code: 103812

Semester: 8th

L T P

Credits:03 3 0 0

Course Outcomes: On completion of this course, the successful students should be able:

CO	Statement
CO 1	Design controllers for closed-loop operation of a separately excited DC motor drive with symmetrical optimization technique
CO 2	Implement sine-triangle and Space Vector PWM techniques on analog and digital platforms
CO 3	Understand the power circuit topologies and the sine triangle PWM technique for 3-level NPC, FC, HB inverters
CO 4	Understand and simulate the behavior of high performance induction Motor drives using the principles of Vector Control and DTC
CO 5	Understand and apply the concept of vector control to PMSM drives

Course Content

DC Motor Drive and its Operational Strategies: Dynamic model of machine with armature voltage control only and converters with continuous conduction only; Closed loop control using single (speed) and two loops (speed, current), Implementation using circulating current type three phase dual converter and four quadrant transistorized chopper.

Modelling and Control of DC Drives: State feedback control and sliding mode control of separately–excited DC machine, Modelling and control of separately–excited DC machine in field weakening region and discontinuous converter conduction mode, Control of DC series machine.

Open-loop Dynamic Performance of AC & DC Drives: Starting & reversal time, Energy consumption & energy savings principle. Drives Application Engineering for Fan, Pump, Compressor, Lift-Elevator, Kiln, Winder-Un-Winder, Traction application. Synchronization and master-slave configuration.

AC Drives and its Operational Strategies: Variable frequency operation of three–phase symmetrical induction machine, Scalar control methods for constant power an constant torque modes, Vector control of induction machine, Methods of field sensing and estimation, Field orientation methods: Implementation of IRFO scheme using current controlled PWM, VSI and implementation of DSFO scheme using CSI, Performance of vector controlled permanent magnet machine.

CONTROL AND ESTIMATION OF AC DRIVES: Introduction to speed control of Switched Reluctance Machine, Induction motor drive, basic of Scalar & Vector control V/f Control, Sensorless vector control, Field Oriented Control, Direct torque control and flux observation, Speed control of wound rotor induction motors: Converter based static rotor resistance control, Static scherbius drive using line commutated converter cascade, Analysis and estimation of harmonics and power factor, Vector control of wound rotor induction machine using self-commutated converter cascade and improvement in power factor, Variable speed constant frequency (VSCF) generation.

CONTROL OF PERMANENT MAGNET MACHINE: Power Electronics Control of Permanent magnet synchronous machine, Brushless DC machine, Surface permanent magnet machine and interior.

COMPATIBILITY OF MOTOR & DRIVES: Effects of drives on motor - dV/dt, THD, Common Mode Voltage, Shaft Voltage and Bearing Current, Sound & Vibration

Recommended Books

(i) Mohan, N. (2001*). Electric Drives: An Integrative Approach*, MNPERE.
(ii) Mohan, N. (2001). *Advanced Electric Drives: Analysis, Control, and Modeling Using Simulink*, MNPERE .
(iii) Krishnan, R. (2001). *Electric Motor & Drives: Modeling, Analysis & Control*, PHI Pvt. Ltd.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Advanced Electric Drives

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	3	3	1	2	2	2	2	1	3	1	2	2
CO2	2	2	2	2	2	2	3	2	3	2	3	2	2	3	3
CO3	3	3	2	2	2	2	2	2	3	2	-	3	2	2	2
CO4	2	3	2	2	3	2	2	2	2	1	3	2	2	2	3
CO5	2	2	3	3	3	1	3	1	2	-	3	-	3	2	3
AVERAGE	**2.2**	**2.6**	**2.2**	**2.4**	**2.6**	**1.6**	**2.4**	**1.8**	**2.4**	**1.75**	**2.5**	**2.5**	**2**	**2.2**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Electromagnetic Waves

Course Code: 103813

Semester: 8th

L T P

Credits:03 3 0 0

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Understand the basic mathematical concepts related to electromagnetic vector fields. .
CO 2	Apply the principles of electrostatics to the solutions of problems relating to electric field and electric potential, boundary conditions and electric energy density
CO 3	Apply the principles of magneto statics to the solutions of problems relating to magnetic field and magnetic potential, boundary conditions and magnetic energy density.
CO 4	Understand the concepts related to Faraday's law, induced e.m.f and Maxwell's equations.
CO 5	Apply Maxwell's equations to solutions of problems relating to transmission lines and uniform plane wave propagation.

Course Content

Vector Analysis: Review of vector algebra, Review of cartesian, Cylindrical and spherical coordinate systems, Introduction to del ∇ (operator, Use of del operator as gradient, divergence,curl).

Electrostatic fields: Introduction to coulomb's law, Gaussian law and its applications in determination of field of spherical and cylindrical geometries, Laplace's and poission's equation in various coordinate systems. Effect of dielectric on capacitance, Boundary conditions at electric interfaces, Method of images and its applications.

Magnetostatics: Introduction to ampere's law, Magnetic vector potential, Magnetic forces, Boundary conditions at magnetic interfaces.

Time Varying Fields and Maxwell's Equations: Continuity of charge, Concept of displacement current, Maxwell's equation in integral and differential form: for static fields, for time varying fields, for free space, for good conductors, for harmonically varying fields, Poynting theorem: Energy stored and radiated power, Complex poynting vector, Properties of conductor and dielectrics, Wave equations for free space, Wave equations for conductors.

Uniform Plane Waves: Introduction, Uniform plane wave propagation: Wave equations, Transverse nature of uniform plane waves, Perpendicular relation between E and H , EM waves in charge free, Current free dielectric, Reflection by ideal conductor: Normal incidence, reflection and transmission with normal incidence at another dielectric, Plane wave in lossy dielectric, Wave impedance and propagation constant, Depth of penetration, Surface impedance and surface resistance, Application of EM propagation through Transmission Lines and Rectangular Waveguides.

Text Books / Reference Books

1. Edward C. Jordan and Keith G. Balmain, (2003) *Electromagnetic Waves and Radiation System*, Prentice Hall of India. Pvt. Ltd.
2. Kraus/ Fleisch,(1999) *Electromagnetics*, Tata McGraw Hill.
3. Fraser,W. (2003) *Telecommunications*, CBS Publication and Distributor.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Electromagnetic Waves

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	1	2	2	2	1	2	-	1	2	2
CO2	2	3	2	2	2	2	3	2	2	1	2	3	2	3	3
CO3	3	3	2	2	2	2	2	2	-	3	2	1	3	2	2
CO4	2	3	2	2	3	2	2	2	-	3	3	-	2	3	3
CO5	2	2	3	3	3	1	3	1	3	-	3	2	3	2	3
AVERAGE	**2.4**	**2.8**	**2.2**	**2.4**	**2.6**	**1.6**	**2.4**	**1.8**	**2.33**	**2**	**2.4**	**2**	**2.2**	**2.4**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Digital Signal Processing

Course Code: 103814

Semester: 8th

Credits:03

L T P
3 0 0

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Interpret, represent and process discrete/digital signals and systems
CO 2	Thorough understanding of frequency domain analysis of discrete time signals.
CO 3	Ability to design & analyze DSP systems like FIR and IIR Filter etc
CO 4	Practical implementation issues such as computational complexity, hardware resource limitations as well as cost of DSP systems or DSP Processors.
CO 5	Understanding of spectral analysis of the signals

1. Introduction

Basic elements of DSP system, Advantages and disadvantage of DSP over analog processing, Application of Digital signal processing.

2. Discrete Time Signal and Systems

Elementary discrete time signals, Manipulation of discrete time signals, Classification of discrete time LTI system using convolution sum method, properties of LTI system, Analysis of LTI system using Difference equqtion.

3. Z-Transform

Direct Z-Transform and importance of ROC, properties of Z-Transform, Inverse Ztransform methods, system function of LTI systems in Z-domain, Relationship between Z transform and Fourier transform, one sided Z –Transform.

4. Discrete Fourier Transform

Frequency domain sampling and reconstruction of discrete time signal, DFT as linear transformation, properties of DFT, use of DFT in linear filtering, Fast fourier transform (FFT), decimation in time, decimation in frequency algorithm, Goertzel algorithm.

5. Implementation of Discrete Time System

Structures for realisation of discrete time system, Direct form, cascade form, parallel form and lattice form structures for FIR and IIR systems, Representation of numbers, errors resulting for rounding and truncation.

6. Application in DSP

Digital Audio and instrumentation-Digital Audio, Digital Control, Digital frequency oscillator. Telecommunication- Touch tone generator, DTMF detection using Goertzel algorithm.

7. Design of Digital Filters

Fundamentals of filter design, Design of FIR filter using Window method, Design of IIR filter by Impulse invariance, bilinear transformation and matched Z transform technique, Analog and digital domain frequency transformation.

Recommended Text book:

(i) John G. Proakis and Dimitris G. Manolakis. (2001). *Digital Signal Processing Principles, Algorithm and Application*. Prentice Hall India Pvt. Ltd.
(ii) Emmanuel C. Ifeachor and Barrie W. Jervis. (1999). *Digital signal processing*. Pearson Education.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Digital Signal Processing

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	1	2	2	2	1	2	3	1	2	2
CO2	3	3	2	2	2	2	3	2	-	2	3	2	2	3	3
CO3	3	3	2	2	2	2	2	2	1	3	2	1	3	2	2
CO4	2	3	2	2	3	2	2	2	2	-	3	1	2	3	3
CO5	2	2	3	3	3	1	3	1	-	-	1	3	3	2	3
AVERAGE	**2.6**	**2.8**	**2.2**	**2.4**	**2.6**	**1.6**	**2.4**	**1.8**	**1.66**	**2**	**2.2**	**2**	**2.2**	**2.4**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Extra High Voltage Engineering

Course Code: 103802

Semester: 8th

Credits:03

L T P
3 0 0

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Understand the use of bundled conductors, corona characteristics of smooth bundled conductors with different configurations
CO 2	Design the insulation of HV power equipment.
CO 3	Estimate electric field intensity of different electrode configurations.
CO 4	Understand the testing methods of high voltage equipment
CO 5	Understand the Breakdown mechanism of Gas, Liquid and solid insulation

Course Content

E.H.V. Transmission and Corona Loss: Need for EHV Transmission. Use of bundled conductors, corona characteristics of smooth bundled conductors with different configurations, Corona loss. Factors affecting the corona loss. Radio interference due to corona. Shunt and series compensation in EHV lines. Tuned power lines. Insulation Co-ordination.

HVDC Transmission: Advantages, disadvantages and economics of HVDC Transmission system. Types of D.C. links, converter station equipment, their characteristics. **Insulating materials used in**

H.V. Engg.: Applications of insulating materials used in power transformers rotating machines, circuit breakers, cables, power capacitors. Conduction and breakdown in Gases, Liquids & Solid

Dielectrics:

Solids - Intrinsic, electromechanical and thermal breakdown composite dielectrics, solid Dielectrics used in practice.

Liquids:- Conduction and breakdown in pure and commercial liquids, suspended particle theory, cavitation and bubble theory, stressed oil volume theory, Liquids used in practice.

Gases:- Ionization process, Townsend‟s current growth equations, Ist and 2nd ionization coefficients. Townsend‟s criterion for breakdown. Streamer theory of breakdown, Pashen‟s law of Gases. Gases used in practice.

Generation of High Voltages: D.C., A.C. (Power frequency and High frequency) Impulse voltage and impulse currentGeneration Tripping and contact of Impulse Generator. Test procedures in H.V. Engg. Lab. Testing of cables, insulators, bushings, circuit breakers and transformers.

References:

1. Bagamudre, R.D. (2000). *E.H.V. A.C. Transmission Engg.* New Age International Publishers.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Extra High Voltage Engineering

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	1	2	2	2	3	2	3	1	2	2

CO2	3	3	2	2	2	2	3	2	-	-	2	1	2	3	3
CO3	3	3	2	2	2	2	2	2	3	1	2	1	3	2	2
CO4	2	3	2	2	3	2	2	2	2	1	1	-	2	3	3
CO5	2	2	-	3	3	1	3	1	3	2	1	2	3	2	3
AVERAGE	**2.6**	**2.8**	**2**	**2.4**	**2.6**	**1.6**	**2.4**	**1.8**	**2.5**	**1.75**	**1.6**	**1.75**	**2.2**	**2.4**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Industrial Safety and Environment

Course Code: A105802

Semester: 8th

L T P

Credits:03 3 0 0

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO 1	Understand the General safety rules, principles, maintenance, Inspections of turning machines
CO 2	Design lathe-drilling-boring-milling-grinding-shaping-sawingshearingpresses- forge hammer-flywheels-shafts-couplings-gears-sprockets
CO 3	Understand the Cold working, power presses, point of operation safe guarding, auxiliary mechanisms
CO 4	Understand the Safety in gas furnace operation, cupola, crucibles, ovens, foundry health hazards, work environment, material handling in foundries
CO 5	Understand the Heat treatment operations, electro plating, paint shops, sand and shot blasting, safety in inspection and testing

Course Content

SAFETY IN METAL WORKING MACHINERY AND WOOD WORKING MACHINES

General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines, Wood working machinery, types, safety principles, electrical guards, work area, material handling, inspection, standards and codes- saws, types, hazards.

PRINCIPLES OF MACHINE GUARDING

Guarding during maintenance, Zero Mechanical State (ZMS), Definition, Policy for ZMS – guarding of hazards - point of operation protective devices, machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, fixed guard fencing- guard construction-guard opening. Selection and suitability: lathe-drilling-boring-milling-grinding-shaping-sawingshearingpresses- forge hammer-flywheels-shafts-couplings-gears-sprockets wheels and chains-pulleys and belts-authorized entry to hazardous installations-benefits of good guarding systems.

SAFETY IN WELDING AND GAS CUTTING

Gas welding and oxygen cutting, resistances welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing – explosive welding, selection, care and maintenance of the associated equipment and instruments – safety in generation, distribution and handling of industrial gases-colour coding – flashback arrestor – leak detection-pipe line safety-storage and handling of gas cylinders.

SAFETY IN COLD FORMING AND HOT WORKING OF METALS

Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot-operated presses, power press electric controls, power press set up and die removal, inspection and maintenance-metal sheers-press brakes. Hot working safety in forging, hot rolling mill operation, safe guards in hot rolling mills – hot bending of pipes, hazards and control measures. Safety in gas furnace operation, cupola, crucibles, ovens, foundry health hazards, work environment, material handling in foundries, foundry production cleaning and finishing foundry processes.

SAFETY IN FINISHING, INSPECTION AND TESTING

Heat treatment operations, electro plating, paint shops, sand and shot blasting, safety in inspection and testing, dynamic balancing, hydro testing, valves, boiler drums and headers, pressure vessels, air leak test, steam testing, safety in radiography, personal monitoring devices, radiation hazards, engineering and administrative controls, Indian Boilers Regulation.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Industrial Safety and Environment

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	2	3	3	1	2	2	2	1	2	3	1	2	2
CO2	-	3	2	2	2	2	3	2	2	1	2	1	2	3	3
CO3	2	3	2	2	2	2	2	2	-	2	1	-	3	2	2
CO4	2	3	2	2	3	2	2	2	3	2	1	-	2	3	3
CO5	2	2	3	3	3	1	3	1	3	2	2	1	3	2	3
AVERAGE	**2**	**2.6**	**2.2**	**2.4**	**2.6**	**1.6**	**2.4**	**1.8**	**2.5**	**1.6**	**1.6**	**1.6**	**2.2**	**2.4**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Course Name: Operations Management

Course Code: 105945

Semester: 8th

Credits:03

L	T	P
3	0	0

Course Outcomes: On completion of this course, the successful students should be able:

CO	Statement
CO 1	To Understand the Supply chain strategy-Demand forecasting Sourcing decisions-Inventory management-Risk management-Packaging-Warehousing-Facility location
CO 2	To learn the fundamentals of management and the various theories of management.
CO 3	To learn the functions of management and practice in real world.
CO 4	To understand the functional areas of management-Marketing, Finance, HRM and Operations Management.
CO 5	To prepare students to solve decision making problems and project management problems

Course Content

Supply Chain and Logistics Management:

Introduction-Supply chain strategy-Demand forecastingSourcing decisions-Inventory management-Risk management-Packaging-Warehousing-Facility location and network design-Distribution management-Transportation fundamentals and planningGreen logistics-Reverse logistics-Supply chain sustainability

Quality Toolkit for Managers: Quality Philosophies-Quality Leadership-Quality Awards and ISO 9000-Quality Tools-Quality Function Deployment-Six Sigma-Design for Six Sigma-Lean Management

Pricing and Revenue Management: Price Optimization-Pricing Decision-Price Response with Competition-Price Differentiation and Variable Pricing-Simulation Game–Scenario 1-Simulation Game–Scenario 2-Dynamic Pricing-Markdown Pricing-Revenue Management-Capacity AllocationNetwork Management-Demand Forecasting-Bid Price Approach-Customized Pricing

Operations Strategy: Introduction to Operations Strategy framework-Manufacturing Architecture, Systems and Processes-Service Strategy -Capacity Strategy and anagement-Technology Strategy-Quality

Strategy and Change / Action programs-Purchasing and Supply network strategy-Environmental and Social sustainability strategy

Sales and Operations Planning: Need for Operations planning and control-Demand Forecasting and its dovetailing with operations planning-Capacity planning-Aggregate operations planning, MRP and MPS-Operations scheduling-Distribution planning-Enterprise resource planning-Operations planning Insights from the TOC school of thought

Behavioural Operations Management: The study of Behavioural Operations-Process and PerceptionDynamic Pricing in Revenue Management-Envisioning motivation and Performance in Work DesignIntertemporal choices in Project based organisations -Impulsiveness and Emotions-Sharing the RiskSupply Chain Negotiator-Behaviour Assessment Test on Conflict Management-Kicking the mean Habit-A chain of hands

Operations Research Applications: O.R. tools-Dynamic programming, branch and bound methodScheduling systems-single machine, flow shop, job shop-Vehicle routing problems-Resource constrained project scheduling-Bin packing-Portfolio optimization-Quadratic Programming-Staff transfer problem-Two-stage supply chain distribution problem

Management of Manufacturing Systems: Cellular manufacturing systems-cell formation, operator allocation, sequencing and scheduling-Just-in-time systems-Kanban, CONWIP-Synchronous manufacturing (Theory of Constraints)-Flexible manufacturing systems (FMS)-machine loading and scheduling

Sourcing Management: Introduction to Global Sourcing-Trends in Global Sourcing-Supply Management-Strategic Sourcing-Global Sourcing–Negotiation-Performance Measurement and Evaluation (Concepts and Metalcraft Case)-Sourcing Risk Management (Concepts)-Supplier Evaluation and Selection (Concepts)-Analytical Tools in Sourcing (Total Cost of Ownership (Wire Harness case), Pricing Analyses (Plastic Shield case))-Analytical Tools in Sourcing (Foreign Exchange Currency Management, Learning Curve, Quantity Discount Models)-Integrative Pacific Systems Case (Supplier Scorecard, Sourcing Risk, Supplier Financial Analysis)-Electronic Sourcing-Sustainability and Sourcing (Green Sourcing; Walmart-China Case)

Supply Chain Analytics: Overview on Supply Chain, Analytics and Supply Chain Analytics-Integrated models for Facility Location Selection and Warehouse Location Selection Ex.: AHP integrated along with traditional methods-Application of Simulation and DoE for Manufacturing System design/redesign-Application of tools for aggregate Production Planning and Control and designing Model Curriculum for Management Program (MBA & PGDM) [29] automated dashboards with relevant KPIs for understanding the deviations in planned aggregate output with root-causes-Application of integrated tools for Resource planning & control, Material planning & control and Capacity planning & Control and designing automated dashboards with relevant KPIs for understanding the optimal resources planned and achieved.

Correlation of COs to the Program Outcomes (POs) and Program Specific Outcomes (PSOs) for Operations Management

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	1	2	2	2	3	2	1	1	2	2

CO2	3	-	2	2	2	1	3	2	2	3	-	2	2	3	3
CO3	2	2	2	2	2	1	2	2	2	2	2	-	3	2	2
CO4	2	-	2	2	3	-	2	2	1	3	-	3	2	3	3
CO5	2	2	3	3	3	1	3	1	2	3	3	2	3	2	3
AVERAGE	**2.4**	**2**	**2.2**	**2.4**	**2.6**	**1**	**2.4**	**1.8**	**1.8**	**2.8**	**2.3**	**2**	**2.2**	**2.4**	**2.6**

The correlation levels are: "1" – Low Correlation, "2" – Medium Correlation, "3" – High Correlation and "-" indicates there is no correlation.

Total Number of Course	66
Number of Theory Course	41
Number of Practical Course	25
Total Number of Credits	**169**

Annexure -4

ACADEMIC INSTURCTIONS

Attendance Requirements

A student shall have to attend 75% of the scheduled periods in each course in a semester; otherwise he / she shall not be allowed to appear in that course in the University examination and shall be detained in the course(s). The University may condone attendance shortage in special circumstances (as specified by the Guru Kashi University authorities). A student detained in the course(s) would be allowed to appear in the subsequent university examination(s) only on having completed the attendance in the program, when the program is offered in a regular semester(s) or otherwise as per the rules.

Assessment of a course

Each course shall be assessed out of 100 marks. The distribution of these 100 marks is given in subsequent sub sections (as applicable).

	Internal (40)						**External (60)**	**Total**
Components	**Attendance**	**Assignment**			**MST 1**	**MST2**	**ETE**	
		A1	A2	A3				
Weightage	10	10	10	10	30	30	60	
Average Weightage	05	05			30		40	100

Passing Criteria

The students have to pass both in internal and external examinations. The minimum passing marks to clear in examination is 40% of the total marks.