Harcourt Butler Technical University, Kanpur

Department of Electrical Engineering

School of Engineering

B.Tech. Course Structure & Syllabi as per the B.Tech. Ordinance 2017-18

SEMESTER I

Sr. No.	Course Type	Subject Code	Course Title	Credits (L-T-P)	Sessional Marks				ESE	Total
					MSE	TA	Lab.	Total		
1.	BSC	BPH-101	Physics	4 (3-0-2)	15	20	15	50	50	100
2.	BSC	BMA-101	Mathematics-I	4 (3-1-0)	30	20	-	50	50	100
3.	ESC	EEE-101	Electrical Engineering	4 (3-0-2)	15	20	15	50	50	100
4.	ESC	EME-101	Engineering Mechanics	3 (3-0-0)	30	20	-	50	50	100
5.	HSMC	HHS-103	Professional Communication	3 (2-0-2)	15	20	15	50	50	100
6.	HSMC	HHS-101	English Language & Composition	2(2-0-0)	30	20	-	50	50	100
Total Credits				**20**						

SEMESTER II

Sr. No.	Course Type	Subject Code	Course Title	Credits (L-T-P)	Sessional Marks				ESE	Total marks
					MSE	TA	Lab.	Total		
1.	BSC	BCY-102	Engineering Chemistry	4 (3-0-2)	15	20	15	50	50	100
2.	BSC	BMA-102	Mathematics-II	4 (3-1-0)	30	20	-	50	50	100
3.	ESC	EET-102	Electronics & Instrumentation Engineering	3 (3-0-0)	30	20	-	50	50	100
4.	ESC	ECE-102	Engineering Graphics	3 (0-0-6)	30	20	-	50	50	100
5.	ESC	ECS-102	Computer Concept & C Programming	4 (3-0-2)	15	20	15	50	50	100
6.	ESC	EWS-102	Workshop Practice	2 (0-0-4)	-	20	30	50	50	100
7.	MC (Non-credit)	ECE-104	Environment & Ecology	0 (2-0-0)	30	20	-	50	50	100
Total Credits				**20**						

BSC- Basic Science Course; ESC-Engineering Science Course; PCC-Programme Core course; PEC-Programme Elective Course; OEC-Open Elective Course; MC-Mandatory Course; HSMC-Humanities, Social Science & Management Course.

SEMESTER III

Sr. No.	Course Type	Subject Code	Course Title	Credits (L-T-P)	Sessional Marks				ESE	Total
					MSE	TA	Lab.	Total		
1.	BSC	BMA-201	Mathematics-III	4 (3-1-0)	30	20	-	50	50	100
2.	ESC	EET-201	SSDC	5 (3-1-2)	15	20	15	50	50	100
3.	ESC	EET-203	Digital Electronics	5 (3-1-2)	15	20	15	50	50	100
4.	PCC	EEE-201	Basic System Analysis	5 (3-1-2)	15	20	15	50	50	100
5.	HSMC	HHS-201	Engineering Economics and Management	3 (3-0-0)	30	20	-	50	50	100
6.	MC (Non-credit)	HHS-205	Indian Constitution	0 (2-0-0)	30	20	-	50	50	100
Total Credits				**22**						

SEMESTER IV

Sr. No.	Course Type	Subject Code	Course Title	Credits (L-T-P)	Sessional Marks				ESE	Total
					MSE	TA	Lab.	Total		
1.	BSC	BMA-206	CONM	4 (3-1-0)	30	20	-	50	50	100
2.	PCC	EEE-202	Electrical Machines-I	5 (3-1-2)	15	20	15	50	50	100
3.	PCC	EEE-204	Electrical Measurement and Measuring Instruments	5 (3-1-2)	15	20	15	50	50	100
4.	PCC	EEE-206	Electrical Circuit Analysis	5 (3-1-2)	15	20	15	50	50	100
5.	HSMC	HHS-204	Organizational Behavior	3 (3-0-0)	30	20	-	50	50	100
6.	MC (Non-credit)	ECS-202	Cyber Security	0 (2-0-0)	30	20	-	50	50	100
Total Credits				**22**						

SEMESTER V

Sr. No.	Course Type	Subject Code	Course Title	Credits (L-T-P)	Sessional Marks				ESM	Total
					MSE	TA	Lab.	Total		
1.	PCC	EEE-301	Electrical Machines-II	5 (3-1-2)	15	20	15	50	50	100
2.	PCC	EEE-303	Control System	5 (3-1-2)	15	20	15	50	50	100
3.	PCC	EEE-305	Power System-I	4 (3-1-0)	30	20	-	50	50	100
4.	PCC	EEE-307	Microprocessors	5 (3-1-2)	15	20	15	50	50	100
5.	OEC	BMA-341	Operation Research	3 (3-0-0)	30	20	-	50	50	100
Total Credits				**22**						

SEMESTER VI

Sr. No.	Course Type	Subject Code	Course Title	Credits (L-T-P)	Sessional Marks				ESE	Total
					MSE	TA	Lab.	Total		
1.	PCC	EEE-302	Power System-II	5 (3-2-0)	30	20	-	50	50	100
2.	PCC	EEE-304	Power Electronics	6 (3-2-2)	15	20	15	50	50	100
3.	PCC	EEE-306	Power Station Practice	4 (3-1-0)	30	20	-	50	50	100
4.	PCC	EET-310	Electromagnetic Field Theory	4 (3-1-0)	30	20	-	50	50	100
5.	OEC	HHS-342	Entrepreneurship Development	3 (3-0-0)	30	20	-	50	50	100
Total Credits				**22**						

SEMESTER VII

Sr. No.	Course Type	Subject Code	Course Title	Credits (L-T-P)	Sessional Marks				ESE	Total
					MSE	TA	Lab.	Total		
1.	PCC	EEE-401	Electric Drives	5 (3-1-2)	15	20	15	50	50	100
2.	PEC	PEC-I	PEC-I	3 (3-0-0)	30	20	-	50	50	100
3.	PEC	PEC-II	PEC-II	3 (3-0-0)	30	20	-	50	50	100
4.	OEC	OEC-I	OEC-I	3 (3-0-0)	30	20	-	50	50	100
5.	Industrial Training	EEE-461	Industrial Training	2 (0-0-4)	-	50	-	50	50	100
6.	Seminar	EEE-471	Seminar	2 (0-0-4)	-	50	-	50	50	100
7.	Project	EEE-497	Project	4 (0-0-8)	-	50	-	50	50	100
Total Credits				**22**						

SEMESTER VIII

Sr. No.	Course Type	Subject Code	Course Title	Credits (L-T-P)	Sessional Marks				ESE	Total
					MSE	TA	Lab.	Total		
1.	PEC	PEC-III	PEC-III	4 (3-1-0)	30	20	-	50	50	100
2.	PEC	PEC-IV	PEC-IV	4 (3-1-0)	30	20	-	50	50	100
3.	OEC	OEC-II	OEC-II	4 (3-1-0)	30	20	-	50	50	100
4.	Project	EEE-498	Project	10 (0-0-20)	-	50	-	50	50	100
Total Credits				**22**						

List of Programme Electives:

Programme Elective-I

Sl. No.	Course Code	Course Name	Credits
1.	EEE-411	Instrumentation and Process Control	3 (3-0-0)
2.	EEE-413	HVDC Transmission Systems	3 (3-0-0)
3.	EEE-415	Special Topics in Control Systems	3 (3-0-0)
4.	EEE-417	Electrical Energy Conservation and Auditing	3 (3-0-0)
5.	EEE-419	Power System Design	3 (3-0-0)
6.	EEE-421	Advanced Power Electronics	3 (3-0-0)

Programme Elective-II

Sl. No.	Course Code	Course Name	Credits
1.	EEE-423	Advanced Control System	3 (3-0-0)
2.	EEE-425	Special Electrical Machines	3 (3-0-0)
3.	EEE-427	Optimal Control System	3 (3-0-0)
4.	EEE-429	Power System Protection	3 (3-0-0)
5.	EEE-431	Electrical Machine Design	3 (3-0-0)
6.	EEE-433	Real Time Simulation Techniques of Power Electronic Converters	3 (3-0-0)

Programme Elective-III

Sl. No.	Course Code	Course Name	Credits
1.	EEE-440	Neural Network and Fuzzy System	4 (3-1-0)
2.	EEE-442	Power System Security and Analysis	4 (3-1-0)
3.	EEE-444	Applied System Theory	4 (3-1-0)
4.	EEE-446	Power Quality and FACTS	4 (3-1-0)
5.	EEE-448	Wind and Solar Energy Systems	4 (3-1-0)
6.	EEE-450	Modeling and Simulation of Electrical Machines	4 (3-1-0)

Programme Elective-IV

Sl. No.	Course Code	Course Name	Credits
1.	EEE-452	Robotics and Automation	4 (3-1-0)
2.	EEE-454	Power System Dynamics and Control	4 (3-1-0)
3.	EEE-456	Industrial Instrumentation	4 (3-1-0)
4.	EEE-458	Electrical and Electronics Engineering Materials	4 (3-1-0)
5.	EEE-460	Electrical and Hybrid Vehicles	4 (3-1-0)
6.	EEE-462	Advanced Electric Drives	4 (3-1-0)

List of Open Electives:

OEC-I

Sl. No.	Course Code	Course Name	Credits
1.	OEE 433	Non-Conventional Energy Sources	3(3-0-0)
2.	OEE 435	Power Plant Engineering	3(3-0-0)

OEC-II

Sl. No.	Course Code	Course Name	Credits
1.	OEE 444	Industrial Measurements	4(3-1-0)
2.	OEE 446	Industrial Control Systems	4(3-1-0)

I Semester

BSC	PHYSICS(BPH-101)	3L:0T:2P	4 credits

MODULE- 1 (Lectures: 08)
Introductory Mechanics & Theory of Relativity:

Potential energy function *F= -grad(V)*, equipotential surfaces, meaning of gradient, divergence, curl and their physical significance, Conservative and Non-Conservative forces, Curl of a force, Central forces, Examples of Central forces, Conservation of Angular Momentum.

Inertial and Non- Inertial Frames of reference, Galilean transformation, Michelson Morley Experiment, Lorentz Transformation, Length contraction, Time dilation and Evidences for time dilation, Relativistic velocity addition formula, Relativistic variation of mass with velocity, Evidence of mass variation with velocity, Einstein's Mass energy equivalence, Examples from nuclear physics, Relativistic energy momentum relation.

MODULE -2 (Lectures: 08)
Quantum Mechanics-Schrodinger Equation and its Applications:

Dual Nature of matter & Radiation, Heisenberg's uncertainty Principle and their applications, wave group concept, Davisson Germer experiment, Postulates of quantum mechanics, Significance of wave function, Derivation of Schrodinger equation for time independent and time dependent cases.
Application of Schrodinger wave equation for a free particle, Particle in a box (one dimensional and three dimensional), Simple harmonic oscillator (one dimensional).

MODULE – 3 (Lectures: 08)
Electromagnetic Theory:

Ampere's law and Faraday's law of electromagnetic induction, Maxwell's equations, Correction of Ampere's law by Maxwell (concept of displacement current), transformation from integral to differential form, Physical significance of each equation, Poynting theorem, Maxwell's equations in free space, velocity of electromagnetic wave, Transverse character of the wave and orthogonality of **E**, **H** and **v** vectors, Maxwell's equation in dielectric medium and velocity of e.m. wave, Comparison with free space, Maxwell's equations in conducting media, Solution of differential equation in this case, penetration depth, its significance.

MODULE – 4 (Lectures: 09)

Materials of Technological Importance:

Dielectric Materials: Electric field in presence of dielectric medium, concept of electric polarization, different types of polarizations, dielectric in a.c. field, concept of dielectric loss and loss energy.
Semiconducting Materials: Concept of energy bands in solids, carrier concentration and conductivity in intrinsic semiconductors and their temperature dependence, carrier concentration and conductivity in extrinsic semiconductors and their temperature dependence, Hall effect in semiconductors, compound semiconductors.
Nano Materials: Basic principles of nanoscience and technology, preparation, structure and properties of fullerene and carbon nanotubes, applications of nanotechnology.

MODULE: 5 (Lectures: 09)

Statistical Mechanics & Lasers:

Phase space, the probability of distribution, most probable distribution, Maxwell-Boltzmann Statistics, Applications of Maxwell-Boltzmann Statistics, derivation of average velocity, RMS velocity and most probable velocity in the above case, Bose-Einstein Statistics, application to black body radiation, distribution law of energy, Planck's radiation formula and Stefan's law. Fermi – Dirac statics, application in case of free electrons in metals, energy distribution, Fermi energy.

Lasers: Spontaneous and stimulated emission of radiations, Einstein's theory of matter-radiation interaction, Einstein's coefficients and relation between them, Population inversion, components of a laser, different kinds of lasers, Ruby laser, He-Ne laser, properties of laser beams, mono-chromaticity, coherence, directionality, and brightness, applications of lasers

References:

1. Physics, Marcelo Alonso, J. Finn Edwards, Addison Wesley
2. Perspectives of Modern Physics, Arthur Beiser, McGraw Hill
3. Engineering Physics, R. K.Shukla, Pearson Education
4. Electrical Engineering Materials, R.K.Shukla, McGraw Hill
5. Introduction to Electrodynamics, David Griffiths, Cambridge University Press
6. Principles of Engineering Physics, R.K.Shukla, Ira Books
7. Introduction to Solid State Physics, Charles Kittel, Willey

List of Experiments:(Any ten experiments)

1. To determine the energy of band gap of a N-type Ge-semiconductor using four probemethod
2. Verification of Stefan's fourth power law for black body radiation, determination of the exponent of the temperature
3. Study of thermoelectricity: Determination of thermo-power of Copper-constantan thermo-couple
4. To study the variation of magnetic field with distance along the axis of current carrying coil and then to estimate the radius of the coil
5. Study of Carrey Foster's bridge: determination of resistance per unit length of thebridge wire and of a given unknown resistance
6. Determination of specific charge (charge to mass ratio; e/m) for electron
7. Study of tangent galvanometer: determination of reduction factor and horizontalcomponent of earth's magnetic field
8. Determination of the wavelength of sodium light using Newton Rings' method
9. To determine the concentration of sugar solution using half shade polarimeter
10. Determination of wavelength of spectral lines of mercury (for violet, green, yellow-1 and yellow-2) using plane transmission grating
11. Determination of charge sensitivity and ballistic constant of a ballistic galvanometer.
12. To determine the wavelength of spectral lines of hydrogen & hence to determine the value of Rydberg Constant.
13. Draw the V-I characteristic of Light Emitting Diode (LED) and determine the value of Planck's constant

Course Outcome

Module -1 To understand and to apply principle of conservation of momentum. e.g. in rocket propulsion and in many other space applications.

To understand the theory of relativity and to analyse how the physical quantities undergo drastic changes in their original value at very high velocities and also to see how its principles are applicable in particle accelerators, nuclear devices as an alternative sources of energy and for defense purpose.

Module-2 To understand the basics of quantum mechanics, and to apply its principles to learn the phenomena that occur at subatomic dimensions.

Module–3 To understand and to apply Maxwell's equations which forms the basis of electromagnetic theory. This has a wide application in communication systems. All the information propagating in the universe utilises the principle of electromagnetic theory.

Module–4 To study the fundamentals of material science especially dielectric materials, semiconducting materials and nonmaterial and to apply the knowledge to use how dielectrics are used for the storage of charge. infrared detectors, crystal oscillators, manufacture of microphones, headsets loudspeakers, transducers, ultrasound applications, gas ignitors, accelerometers etc.

Semiconductor material technology which has completely changed the scenario by replacing the older vacuum tube technology, are another technologically important materials which are widely used in LEDs, miniaturization of electronic devices and to develop materials with improved efficiency and economy.

Nanotechnology is the most emerging field at present and is extremely important. It has got various applications in many areas including information technology, biomedical, energy-storage, automotive industry, electronics industry, textiles and chemical industries.

Module – 5 To understand the statistical behavior of the constituent particles which give rise to form a material, and to apply the principles of statistical mechanics and to understand the basics of Laser.

BSC	MATHEMATICS-1(BMA-101)	3L:1T:0P	4 credits

Unit I- Functions of One Real Variable:

Successive differentiation, Leibnitz theorem, Mean value theorems, sequences and series, Expansion of functions, Improper integrals and their convergence.

Unit II-Functions of Several Real Variables:

Limit, Continuity, Partial differentiation, Total differential and approximations, Jacobian, Euler's theorem Expansion of functions, Beta and Gamma Functions, Multiple integral, Change of order, Change of variables, Applications to area, volume, mass, surface area etc. Dirichlet's Integral & applications.

Unit III- Vector Calculus:

Point functions, differentiation, Gradient, Directional derivative, Divergence and Curl of a vector and their physical interpretations, Solenoidal &irrotational fields, Integration, Line, Surface and Volume integrals Green's. Stoke's and Gauss Divergence theorems (without proof) and applications.

Unit IV- Matrices and Linear Algebra:

Vector space and subspace, linear dependence, dimensions and basis, Linear transformation and its matrix representation, Elementary transformations, Echelon form, rank & nullity, Consistency of linear system of equations and their solutions, characteristic equation, Cayley Hamilton theorem, Real and complex eigenvalues and eigenvectors, diagonalisation, quadratic forms, complex, orthogonal, and unitary matrices, Application to Cryptography, discrete, Compartmental models and system stability.

Unit V- Optimization:

Engineering applications of optimization, statement and classification of optimization problems, Optimization techniques, single variable optimization, multi variable optimization with no constraint, with equality and inequality constraints, Linear Programming Problems, Graphical method and Simplex method.

Books Recommended:

1. R.K. Jain & S. R. K. lyengar; Advanced Engineering Mathematics, Narosa Publishing House2002.
2. Erwin Kreyszig: Advanced Engineering Mathematics. John Wiley & Sons 8th Edition.
3. Dennis G. Zill& Michael R Cullen; Advanced Engineering Mathematics, Jones &Bartlett Publishers, 2nd Edition.
4. S.S. Rao; Optimization: Theory & application Wiley Eastern Limited.
5. T.M. Apostol, calculus, Vol. I, 2nded., Wiley 1967.
6. T.M. Apostol, Calculus, Vol. II, 2nded**.,** Wiley 1969.
7. Gilbert Strang, Linear Algebra & its applications, Nelson Engineering 2007.
8. Calculus & Analytic Geometry, Thomas and Finny.

Objective / Outcomes, Mathematics-I

Calculus is one of the most intellectual achievement in the field of mathematics. It is a collection of fascinating and exciting ideas rather than a technical tool. In particular differential calculus i.e. derivative is useful to solve a variety of problems that arise in engineering, technology, science and fields including social sciences. The study of convergence of the infinite series as well as improper integral has vital importance in engineering & Technology.

The Study of partial differentiation and its applications be needful to solve such engineering problems improving quantity (functions) depends on more than one parametric (variable).

Some special functions are represented by improper integrals such as beta & gamma functions. Which are very useful to solve concern engineering. Problem. Multiple integrals have been found to be basic application in engineering such as to find areas and volume of various bodies, this is applicable in various fields like, while preparing a machine, or the partsto be fitted in any machine its size and volume etc. are very important.

Matrices have been found to be of great utility in many branches of applied mathematics such as algebraic and differential equations , mechanics theory, electrical circuits, nuclear physics, aerodynamics and astronomy. With the advent of computers, the usage of matrix methods has been greatly facilitated.

The Vector calculus extends the basic concepts of (ordinary) differential calculus to vector function, by introducing derivative of a vector function and the new concepts of gradient, divergence and curl.Vector integral calculus extends the concepts of (ordinary) integral calculus to vector functions. It has applications in fluid flow design of underwater transmission cables, study of satellites. Line integral is useful in the calculation of work done by variable forces along paths in space and the rates at which fluid flow along curve (circulation) and across boundaries (flux).

Optimization theory and methods have been applied in many fields to handle various practical problems. In light of advances in computing systems, optimization techniques have become increasingly important and popular in different engineering applications.

An important application of multivariable differential calculus is finding the maximum and minimum values of functions of several variables. Such as in the study of stability of the equilibrium states of mechanical and physical systems, determination of extrema is of greatest importance.

BSC	Electrical Engineering (EEE-101)	3L:0T:2P	4 credits

Basic Electrical Engineering Detailed contents:

Module I: DC Circuit Analysis and Network Theorems:(9 hours):

Circuit Concepts: Concepts of Network, Active and Passive elements, voltage and current sources, concept of linearity and linear network, unilateral and bilateral elements. R L and Cas linear elements. Source Transformation.

Kirchhoff's Law; loop and nodal methods of analysis; star – delta transformation; Network Theorems: Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem. (Simple Numerical Problems)

Module II: Steady – State Analysis of Single Phase AC Circuits:(8 hours):

AC Fundamentals: Sinusoidal, Square and Triangular waveforms – average and effective values, form and peak factors, concept of phasors, phasor representation of sinusoidally varying voltage and current. Analysis of series, parallel, and series – parallel RLC Circuits: Apparent, Active & Reactive Powers, Power factor, causes and problems of low power factor, power factor improvement. Resonance in Series and Parallel Circuits, Bandwidth and Quality Factor. (Simple Numerical Problems)

Module III: Three Phase AC Circuits:(3 hours)

Three Phase System – its necessity and advantages, meaning of phase sequence and star and delta connections, balanced supply and balanced load, line and phase voltage / current relations, three phase power and its measurement. (Simple Numerical Problems)

Measuring Instruments: (4 hours):

Types of instruments: Construction and Working Principles of PMMC and Moving Iron type Voltmeter & Ammeters, Single Phase Dynamometer Wattmeter and Induction Type Energy Meter, use of Shunts and Multipliers. (Simple Numerical Problems on EnergyMeter, Shunts and Multipliers)

Module IV: Introduction To Power System:(2 hours):

General layout of Electrical Power system and functions of its elements, standard transmission and distribution voltages, concept of grid.

Magnetic Circuit:(3 hours):

Magnetic circuit concepts, analogy between Electric & Magnetic circuits, Magnetic circuits with DC and AC excitations, Magnetic leakage. B-H curve, Hysteresis and Eddy Current looses, Magnetic circuit calculations mutual Coupling.

Single Phase Transformer:(3 hours):

Principle of Operation, Construction, e.m.f. equation, equivalent circuit, Power losses, efficiency, introduction to auto transformer. (Simple Numerical Problems)

Module V (8 hours): Electrical Machines: Principles of electro mechanical energy conversion.

DC Machines: Types of dc machines, e.m.f. equation of generator and torque equation of motor,characteristics and applications of dc motors. (Simple Numerical Problems)

Three Phase Induction Motor:
Types, Principle of Operation, Slip – torque Characteristics, applications. (Simple Numerical Problems)

Single Phase Induction Motor:
Principle of Operation and introduction to methods of starting, applications.

Three Phase Synchronous Machines:
Principle of Operation of alternator and synchronous motor and their applications.

Text Books:

1. V. Del Toro, " Principles of Electrical Engineering" Prentice Hall International
2. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGrawHill, 2010.
3. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
4. L. S. Bobrow, "Fundamentals of Electrical Engineering", OxfordUniversity Press, 2011.
5. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
6. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

Reference Books:

1. Edward Hughes, "Electrical Technology" Longman
2. T.K. Nagsarkar& M.S. Sukhija, "Basic Electrical Engineering" Oxford University Press
3. H. Cotton, " Advanced Electrical Technology" Wheeler Publishing
4. W.H. Hayt& J.E. Kennely, "Engineering Circuit Analysis" Mc - Graw Hill

List of Experiments:

1. Verification of Kirchhoff's laws.
2. Verification of Superposition Theorem.
3. Verification of Thevenin's Theorem.
4. Verification of Maximum Power Transfer Theorem.
5. Measurement of power and power factor in a 1 – Ø ac series inductive circuit and study improvement
of power factor using capacitor.
6. Study of phenomenon of resonance in RLC series circuit and obtain the resonant frequency.
7. Measurement of power in 3-Ø circuit by Two Wattmeter and determination of its power factor.
8. Determination of parameter of ac 1 – Ø series RLC Circuit.
9. Determination of Efficiency by load test of a 1 – Ø Transformer.
10. To study running and speed reversal of a 3 – Ø induction motor and record its speed in both direction.

Note:
a. Department may add any three experiments in the above list.
b. Minimum eight experiments are to be performed out of the above list.

BSC	ENGINEERING MECHANICS(EME-101)	3L:0T:0P	3 credits

Course Objective: To provide the basic fundamentals of forces, moments, stresses and strains.

Course Prerequisite: Fundamental knowledge of intermediate Physics.

Course Syllabus:

Unit I

Two Dimensional Force Systems: Basic concepts, Laws of motion, Principle of Transmissibility of forces, Transfer of a force to parallel position, Resultant of a force system, Simplest Resultant of Two dimensional concurrent and Non-concurrent Force systems, Distributed force system, Free body diagrams, Equilibrium and Equations of Equilibrium, Applications.

Friction: Introduction, Laws of Coulomb Friction, Equilibrium of Bodies involving Dry-friction, Belt friction, Applications.

Unit II

Beam: Introduction, Shear force and Bending Moment, Differential Equations for Equilibrium, Shear force and Bending Moment Diagrams for Statically Determinate Beams.

Trusses: Introduction, Simple Truss and Solution of Simple truss, Method of Joints and Method of Sections.

Unit III

Centroid and Moment of Inertia: Centroid of plane, curve, area, volume and composite bodies, Moment of inertia of plane area, Parallel Axes Theorem, Perpendicular axes theorems, Principal Moment Inertia, Mass Moment of Inertia of Circular Ring, Disc, Cylinder, Sphere and Cone about their Axis of Symmetry.

Unit IV

Simple Stress and Strain: Introduction, Normal and Shear stresses, Stress- Strain Diagrams for ductile and brittle material, Elastic Constants, One Dimensional Loading of members of varying cross-sections, Strain energy.

Compound stress and strains: Introduction, state of plane stress, Principal stress and strain, Mohr's stress circle. Theories of Failure.

Unit V

Pure Bending of Beams: Introduction, Simple Bending Theory, Stress in beams of differentcross sections.

Torsion: Introduction to Torsion of circular shaft, combined bending & torsion of solid & hollow shafts.

Textbooks:

1. Engineering Mechanics by R.K.Bansal
2. Strength of Materials by R.K. Rajput

Reference books:

1. Engineering Mechanics by Irving H. Shames, Prentice-Hall
2. Mechanics of Materials by E.P.Popov, PHI
3. Strength of Materials by Ryder
4. Mechanics of Material by Gere & Timoshenko
5. Engineering Mechanics by A. Nelson
6. Engineering Mechanics by U.C. Jindal
7. Engineering Mechanics Statics by J.L. Meriam&L.G.Kraige

Course Outcomes:

Students will be able to:

1. Apply basic principal of mechanics and its application in engineering problems.
2. Determine resultants and apply conditions of static equilibrium to plane force systems
3. Identify and quantify all forces associated with a static framework
4. Generate and sketch shear force and bending moment diagrams
5. Derive and apply stress and strain relationships in single and compound memberssubject to axial force, bending moment and torsion.
6. Stress analysis for two dimensional stress systems.

HSMC	PROFESSIONAL COMMUNICATION(HHS-103)	2L:0T:2P	3 credits

UNIT I Fundamentals of Technical Communication:
Process of communication, language as a tool of communication, levels of communication , flow of communication, barriers to communication, communication across cultures; Technical Communication: meaning, significance, characteristics, difference between technical and general communication.

UNIT II Elements of Written Communication:
Words and phrases, word formation, synonyms and antonyms, homophones, one word substitution, sentence construction, paragraph construction,

UNIT III Forms of Technical Communication:

(A) business letters, job application letter and resume, business letters: sales & credit letters, letters of enquiry, letters of quotation, order, claim and adjustment letters, official letters: D.O. letters, government letters, letters to authorities, etc. ,

(B) Technical Reports: general format of a report, formal and informal reports, memo report, progress report, status report, survey report, trip report, complaint report, , Joining Report
,laboratory report, research papers, dissertations and theses. E-mail writingTechnical Proposals: purpose, characteristics, types, structure

UNIT IV Presentation Strategies:
Defining the subject, scope and purpose, analysing audience & locale, collecting materials, preparing outlines, organising the contents, visual aids, nuances of delivery, extemporaneous,manuscripts, impromptu, non- verbal strategies.

UNIT V Value-based Text Reading:

(A) Study of the following essays from the text book with emphasis on writing skills:
1. Man and Nature by J. Bronowski
2. The Language of Literature and Science by Aldous Huxley
3. The Aims of Science & The Humanities by Moody E Prior
4. Gods in this Godless Universe by Bertrand Russell
5. Science and Survival by Barry Commoner

(B) Readings of selected short stories:
1. The Renunciation by Rabindranath Tagore
2. The Lament by Anton P. Chekhov
3. The Barber's Trade Union by Mulk Raj Anand
4. The Eyes Are Not Here by Ruskin Bond

Text Books:

1. 'Improve Your Writing' ed. By V N Arora and Laxmi Chandra, Oxford University Press, New Delhi
2. 'An Anthology of English Short Stories', edited by R P Singh, Oxford University Press.
3. 'Technical Communication- Principles and Practices' by Meenakshi Raman&Sangeeta Sharma, Oxford University Press, New Delhi.

Reference Books:

1. Effective Technical Communication, by Barun K Mitra, Oxford University Press
2. Business Correspondence & Report Writing by R.C. Sharma & Krishna Mohan, Tata McGraw Hill, N.D.
3. Developing Communication Skills by Krishna Mohan &Meera Banerjee, Macmillan

India

4. ‘Technical Communication- Principles and Practices’ by M R S Sharma, Oxford University Press, New Delhi

Course Objectives (COs)

At the end of this course students should be able to:

1. Effectively communicate their ideas in the contemporary global competitive environment.
2. Convey their messages through constructive writing.
3. Draft potent E-Mails, letters, proposals and reports.
4. Present their presentations along with using all nuances of delivery with clarity and thoroughness.
5. Solve problems based on real time situations and articulate them eventually.

PROFESSIONAL COMMUNICATION LABORATORY

Interactive practical sessions with emphasis on oral presentations/ spoken communication:Practical Sessions on:

1. Group Discussions: selected topical issues to be discussed in groups.
2. Mock interviews
3. Communication skills for seminars/conferences/workshops with emphasis on non-verbal skills.
4. Presentation skills for technical papers/project reports/professional reports.
5. Theme presentation/ key note presentation based on correct argumentation methodologies.
6. Argumentative skills
7. Role play
8. Comprehension skills based on reading and listening practice, asking questions.
9. Introduction to International Phonetics Alphabets
10. Audio Visual demonstration of effective communicative strategies & TED Talks

References:

1. Sethi and Dhamija, ‘A Course in Phonetics and Spoken English’, Prentice Hall of India, New Delhi.

2. Joans Daniel, ‘English Pronouncing Dictionary’, Cambridge University Press.

Additional Reference Books

1. R. K. Bansal & J.B. Harrison, Spoken English for India, Orient Longman

2. Excellence in Business Communication, Boeuve&Thill and Courtland

HSMC	ENGLISH LANGUAGE AND COMPOSITION(HHS-101)	2L:0T:0P	2 credits

UNIT I Basic Applied Grammar and Usage:

Sentence structure-1: constituent of a sentence- noun, verb, adjective, preposition, etc.; use of articles, adjectival forms, prepositions, adverbs; verb forms; finite and non-finite verbs, gerund and participles, auxiliary verbs. Tense and mood, Subject- verb concord, pronoun concord.

UNIT II

Sentence Structure-2:

(i) adverb clause, adjective clause, noun-clause; (ii) negation and interrogation; (iii) passive; (iv) exclamatory; (v) transformations; (vi) tense forms; (vii) varieties of sentences; (viii)placement of modifiers

UNIT III Paragraph Writing:

Structure of Paragraph, Topic Sentence, Construction of Paragraph, Technique of Paragraphwriting, Unity, Coherence, Emphasis

UNIT IV Comprehension and Précis Writing

Reading and listening comprehension, improving comprehension skills, précis writing

UNIT V Short Essay Writing

Dimension of essay writing- literary, Scientific, Comparison and Contrast, Narrative, Descriptive, Reflective, Expository, Argumentative and Imaginative

References:

1. Das, B K and A David, 'A Remedial Course in English for Colleges', (Book -1,2,3) Oxford University Press, New Delhi.
2. Sinha, R P, 'Current English Grammar and Usage with Composition', Oxford University Press, New Delhi.
3. Wren, P C & Martin, 'English Grammar and Composition', S Chand & Co Ltd. New Delhi.
4. A. S. Horne, Guide to Pattern and usage in English, Oxford University Press, N.D.
5. M.L. Tickoo& A. E. Subramanian, Intermediate Grammar, usage & composition, Orient Longman

Course Objectives (Cos)

At the end of this course students should be able to:

1. Write professional statements & organizational communications.
2. Develop writing skills by applying different strategies on organisation system.
3. Develop the project reports, their relevance and significance.

II Semester

BSC	ENGINEERING CHEMISTRY(BCY-102)	3L:0T:2P	4 credits

Module I

(i) ***Bonding*****:** CFT, Electronic Spectra and Ligands (strong and weak field), Phosphorescence and Fluorescence, Jablonski diagram, hydrogen bonding and their effect on physical properties, Metallic bonds, Classification and Applications of Liquid crystals, Band Theory of Solids andsuperconductors.
(Lectures: 7-8)

(ii) ***Spectroscopy***: Basic Principles, Instrumentation and Applications of UV-VIS and IR Spectroscopy.

(Lectures: 5-6)

Module II

(i) ***Chemical Kinetics***: Second order reactions. Determination of order, Fast and slow reaction, steady state approximation, Temperature effect, Concept of Activated Complex/Transition State: Energy of activation, Potential energy surface, Theories of reaction rate: Collision and Transition State theories in terms of enzyme catalysis.

(Lectures: 4-5)

Module III

(i) ***Electrochemistry***: Dry and fuel cells, electrochemical cell, Solar cells, Disensitized cell,Photovoltaic cell.

(Lectures: 3-4)

(ii) ***Environmental Chemistry*****:** Air and Water Pollution, analysis of gaseous effluents oxides of Nitrogen, oxides of Sulphur and H_2S, chemical analysis of effluents liquid streams, BOD, COD, control of pollution, Depletion of ozone layer.

(Lectures: 5-6)

Module IV

(ii) ***Stereochemistry*****:** Stereoisomerism of organic compounds containing one & two chiral centers. Enantiomers &Diastereomers, E-Z nomenclature, R-S configuration, Atropisomerism, and Optical isomerism in Allenes, biphenyl and Spiranes, Circular Dichroism.

(Lectures: 5-6)

(i) ***Reaction Mechanism***: Inductive, Electromeric and Mesomeric effects. Study of reaction intermediates (Carbanion, carbocation, carbene, nitrene and benzyne). Mechanism of nucleophilic and electrophilic substitution reactions. Mechanism and application of following reactions:

a) Suzuki-Miyaura Cross coupling reaction
b) Fries and Photo-Fries Rearrangement
c) Wagner- Meerweir Rearrangement
d) Umpolung Reactions
e) Reaction of vision

(Lectures: 4-5)

Module V

(i) ***Polymers***: Introduction and their classifications, types of polymerization, Free radical, anionic and cationic polymerization, Preparation, Rheological properties and uses of some common polymers. Synthetic Polymers (carbon framework, silicon framework, fluorinated polymer), Conducting and Biodegradable polymers.

(Lectures: 4-5)

(ii) ***Water Analysis*****:** Introduction; Hardness of Water- cause, types, units, Disadvantages of using hard water for domestic and industrial purposes, Softening of hard water, Chemical analysis of Water- estimation of free chlorine, total alkalinity, hardness, Numerical based on determination of hardness.

(Lectures: 4-5)

List of Experiments:

1. Determination of alkalinity in given water sample.
   a. Sodium Carbonate & Sodium Bicarbonate
   b. Sodium Carbonate & Sodium Hydroxide
2. Determination of temporary and permanent hardness in water sample using EDTA asstandard solution.
3. Determination of Chloride content of water by Mohr's Method.
4. Determination of Chlorine content in Bleaching powder.
5. Determination of strength of supplied Ferrous Ammonium Sulphate (FAS) solution in using external, internal indicators.
6. Determination of viscosity of a given liquid by Ostwald's viscometer.
7. Determination of surface tension of a given liquid by Stalagmometer.
8. pH determination of given sample.
9. Determination of iron content of water by Mohr's Method.
10. Determination of Dissociation constant of weak acids by conductometric Titration.

Reference Books:

1. Advance Organic Chemistry by Jerry March, Third Edition Wiley Eastern Limited, New Delhi.
2. Organic Chemistry by Morrision& Boyd, Allyn and Bacon, Inc. Boston.
3. Physical Chemistry by Puri, Sharma &Pathania, Peter Atkins & Julio de Paula,ArunBahl, B.S. Bahl&G.D.Tuli.
4. Textbook of Physical Chemistry by S. Glasstone, Macmillan and Co. Ltd., London.
5. Chemical Kinetics and Reaction Dynamics by Puri, Sharma &Pathania.
6. Principles of Polymerization by George Odian.
7. Polymer Science by V. R. Gowarikar, N. V. Vishwanathan and J. Shridhar, Wiley Eastern Ltd., New Delhi.
8. Principles of Instrumental Analysis by Douglas and Skoog, Saunder CollegePublishing Co., New York.
9. Engineering Chemistry by Jain & Jain, Dhanpat Rai Publication Co., New Delhi.
10. Application of Absorption Spectroscopy of Organic Compounds by John R. Dyer, Prentice Hall of India Pvt. Ltd., New Delhi.
11. Spectroscopy of Organic Compounds by P.S. Kalsi, Y.R. Sharma.

Course Outcome:

After studying the course, the student will be able to:

- Interpret UV-Visible and IR–Spectra.
- Describe a reaction rate having various reaction orders.
- Understand different aspects of corrosion (Chemical and electrochemical corrosion, mechanism, factors affecting, protection and practical problems, prevention methods). Thermodynamic overview of electrochemical processes. Reversible and irreversible cells.
- Gain hands-on experience in making different polymers, distinguish between different polymeric structures, classify polymers and analyze the polymerization mechanism. The uses of polymers in different walks of life.
- Knowledge of conductivity polymers, bio-degradable polymers and fiber reinforced plastics.
- Acquire knowledge about water and treatment of municipal water.

Experimental Outcome:

The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to:

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- Design and carry out scientific experiments as well as accurately record and analyzethe results of such experiments
- Communicate the results of scientific work.
- Measure molecular/system properties such as surface tension, viscosity, conductanceof solution.
- Chemical analysis of water-hardness, alkalinity, pH and chloride content.

BSC	MATHEMATICS-II (BMA-102)	3L:1T:0P	4 credits

Unit- I: Ordinary Differential Equations:
First order ordinary differential equations, Existence and uniqueness of solutions of initial value problems, Solution of higher order linear differential equation with constant coefficients, Solution of second order differential equations by changing dependent and independent variables, Cauchy- Euler equations, Methods of diagonalization, undetermined coefficients and variation of parameters: Nonlinear equations, Linear and nonlinear models, Initial value and boundary value problems, Systems of equations. Application of differential equations as mathematical models, Models from population dynamics, Newton's Law of cooling, electric circuit, Oscillation of spring.

Unit-II: Series Solutions of Ordinary Differential Equations & Special Fuctions
Ordinary and singular points of an equation, Power series solutions, Frobenius method, Bessel's and Legendre's equations and their series solutions, Properties of Legendre's polynomials and Bessel's functions, Generating functions, Fourier- Bessel series and Fourier-Legendre series expansions, sturm- Liouville Problem and related theorems.

Unit-III: Laplace Transform:
Laplace transform, Existence conditions and ROC, Inverse Laplace transform, Operational properties, Convolution, Unit step function, Dirac-Delta function, Periodic functions, Applications to solve IVP and BVP: Linear ordinary differential equations, Transfer function and control system analysis.

Unit-IV: Fourier Series and Partial Differential Equations:
Orthogonal functions, Fourier series, existence conditions, Fourier series of even and odd functions, convergence of Fourier series, Fourier half range series, Harmonic analysis, Complex Fourier series and frequency spectrum.
Development of partial differential equations and Solutions, Solution of first order partial differential equations, Solutions of linear higher order partial differential equations with constant coefficients.

Unit-V: Boundary-Value Problems:
Classification of second order partial differential equations, Derivation of heat and wave equations, solutions in rectangular coordinates by separation variable method, solution of Laplace equation, D'Alemberts solution of wave equation, Non-homogeneous equations and boundary conditions, Orthogonal series expansions, Fourier series in two dimensions, Boundary value problems in polar, cylindrical and spherical coordinate systems and their solutions.

Books Recommended:

1. E.A. Coddington, An Introduction to Ordinary Differential Equations, Practice Hall, 1995.
2. I.N. Sneddon, Elements of Partial Differential equations, McGraw-Hill 1957.
3. Dennis G, Zill& Michael R. Cullen; Advanced Engineering Mathematics, Jones & Bartlett Publishers. 2nd Edition.
4. R.K. Jain & S.R.K. Iyengar; Advanced Engineering Mathematics, Narosa Publishing House, 2002.
5. Erwin Kreyszig; Advaced Engineering Mathematics, John Wiley & Sons 8th Edition.

Objective / Outcomes. Mathematics II

All the physical & engineering problems related to rate of change and many practical laws, used in engineering, are expressed mathematically in the form of differential equations so the primary use of differential equations is to serve as a tool for the study of problems regarding change in almost all the branches of engineering & technology.

The solutions of many differential equations arises from physical problems and important differential equations such as Bessel's equation and Legendre equation cannot be

expressedin terms of elementary functions in closed form so in such cases, it is easier to find an approximate solution in the form of the convergent infinite series. The series solutions many reveal important information's about the nature of solution such as passing through the origineven or odd, increasing & decreasing on a given interval and so on.

Laplace transform is a very powerful technique it replaces operations of calculus by operations of algebra. Laplace transform is useful since particular solution can be obtained without first determining the general solution of differential equation. Non-homogeneous equation also can be solved. Solution of mechanical and electrical problems involving discontinuous force function of periodic function are obtained easily.

Fourier series is the simple representation of a complicated periodic functions associated as the periodic phenomenon which occur frequently in many physical and engineering problems.

It is very useful in the study of heat conduction, mechanics, concentration of chemical andpollutants, electrostatics. The Fourier Transform and series and their analytic properties are very commonly used in telecommunications, digital signal processing, electronic design and more.

Several problems in fluid mechanics, solid mechanics, heat transfer, electromagnetic theoryand other areas of physics& engineering are modeled as boundary value problems i.e. partial differential equations with boundary value conditions in the different coordinate systems.

BSC	Electronics & Instrumentation Engineering(EET102)	3L:0T:0P	3 Credits

Unit-I: P-N Junction Diode, V-I Characteristics and its Equivalent Models, Diode Applications as Half Wave Full Wave & Bridge Rectifier and their efficiency, Clippers and clampers, Varacter diode, Zener Diode and its Applications.

Unit-II: Introduction to BJT, FET & MOSFET and their Applications demonstration, Ebers-Moll Model of BJT, Introduction to Operational Amplifier and its Applications demonstration as Adder, Subtractor, Integrator, and Differentiator

Unit-III: Review of Boolean Algebra, Logic Gates, Concept of Universal Gates & Number system, Elaboration of Minimization using K map,

Basic Combinational Circuits: Adder, Subtractor. Sequential Circuits: Flip-Flops, Registers.

Unit-IV: Functional Elements of Instruments, Classification & Characteristics, Types of Errors, Active and Passive Transducers: Thermocouple, LVDT and their Characteristics

Unit-V: Display Devices: LCD, LED, Seven Segment Display, Alphanumeric Display, Strip chart recorder, modern display technique- OLED, AMOLED, PDP, QLED displays .

Electronic Ammeter and Voltmeter, Digital Multi-meter, Digital Storage Oscilloscope (DSO)

Text Books:

1. Malvino, A.P. / “Electronics Principles” / Tata McGraw-Hill.
2. Boylestad, Robert &Nashelsky, Louis / “Electronic Devices & Circuit Theory” / Prentice Hall of India.
3. H.S. Kalsi / “Electronic Instrumentation” / Tata McGraw-Hill
4. Malvino& Leach / “Digital Principles & Applications” / Tata McGraw-Hill.

Reference Books:

1. Sedra, Adel S., Smith, Kenneth C. / “Microelectronic Circuits”/ Oxford University Press.
2. Sawhney AK/ “Electrical and electronic Measurement and Instrumentation”/ Dhanpat Rai& sons.
3. Behzad Razavi/ “Fundamentals of Microelectronics”/ Wiley
4. Lectures of NPTEL

OUTCOMES:

Upon Completion of the course the students will be able:

1. To understand the basic concept of diodes, transistor, and Operational Amplifier.
2. To apply the knowledge in the calculation of the parameters of the diode,transistor, and Operational Amplifier.
3. To design the simple digital circuits.
4. Having the basic knowledge of measurement and applying it in the transducer.
5. To apply the knowledge of measurement with the help of electronic instrumentsand displaying it on electronic devices.

ESC	ENGINEERING GRAPHICS(ECE-102)	0L:0T:6P	3 credits

Unit-I

Lettering and Dimensioning

Introduction, lettering practice, Elements of dimensioning - systems of dimensioning. Geometric Constructions, Free hand sketching, Conic sections, Special curves.

Engineering Scales

Unit-II

Projection of Points and Projection of Lines

Projection of Points: First and Third Angle Projections; Projection of points. Projection of Lines: Projection of straight lines (First angle projection only); Projection of lines inclined to one plane and both planes, true length and true inclinations.

Unit-III

Projection of Solids and Section of Solids

Projection of solids: Classification of solids, Projection of solids in simple position, Projection of solids inclined to one plane. Sections of Solids: Right regular solids andauxiliary views for the true shape of the sections.

Unit-IV

Development of Surfaces

Development of surfaces for various regular solids. Isometric Projection and Perspective Projection

Isometric Projection: Isometric scales, Isometric projections of simple and combination of solids; Perspective Projection: Orthographic representation of a perspective views – Plane figures and simple solids - Visual ray method.

Unit-V

Orthographic Projection Conversion of pictorial view into orthographic Projection.Introduction to auto CAD

Text Book(s)

1. Venugopal K and Prabhu Raja V, “Engineering Graphics”, New AGE International Publishers, 2015.

Reference Books

1. N. D. Bhatt, Engineering Drawing, Charotar publishing House,
2. Natarajan, K. V., A Text book of Engineering Graphics, Dhanalakshmi Publishers,2012.
3. K.L.Narayana, P. Kannaiah&K.VenkataReddy New Age International publishers

Course Objectives:

- To follow basic drawing standards and conventions.
- To develop skills in three-dimensional visualization of engineering components.
- To prepare sectional views of solids.
- To draw the development of surfaces and estimate the sheet metal requirement.
- To develop an understanding of solid modeling using CAD software.

Expected Course Outcome:

- Prepare drawings as per standards.
- Solve specific geometrical problems in plane geometry involving lines, plane figures and special Curves.
- Prepare sectional views of solids.
- Draw isometric drawings of combined solids and simple components.
- Produce orthographic projection of engineering components working from pictorial drawings.
- Prepare solid modeling of machine components using CAD software

ESC	COMPUTER CONCEPTS & 'C' PROGRAMMING (ECS-102)	3L:0T:2P	4 credits

Unit-1:

Introduction to Computers: Computer hardware Components, peripherals and their functions,Number Systems and conversion methods, Concept of an algorithm; termination and correctness. Algorithms to programs: specification, top-down development and stepwise refinement, Introduction to programming environment, use of high level programming language for the systematic development of programs. Introduction to the design and implementation of correct, efficient and maintainable programs, Structured Programming, Trace an algorithm to depict the logic.

Unit-2:

Basic operating System Concepts: Introduction of MS-DOS, WINDOWS, and LINUX Operating Systems, Functional Knowledge of these operating systems, Introduction of basic commands of LINUX and Editors, Managing Files and Directories in LINUX, ProgrammingEnvironment in LINUX, Writing and executing programs in LINUX.

Unit-3:

Programming in C: History, Introduction to C Programming Languages, Structure of C programs, compilation and execution of C programs, Debugging Techniques, Data Types andSizes, Declaration of variables, Modifiers, Identifiers and keywords, Symbolic constants, Storage classes (automatic, external, register and static), Enumerations, command line parameters, Macros, The C Preprocessor.

Unit-4:

Operators: Unary operators, Arithmetic & logical operators, Bit wise operators, Assignment operators and expressions, Conditional expressions, Precedence and order of evaluation. Control statements: if-else, switch, break, and continue, the comma operator, goto statement.Loops: for, while, do-while. Functions: built-in and user-defined, function declaration, definition and function call, and parameter passing: call by value, call by reference, recursivefunctions, Multi-file programs. Arrays: linear arrays, multidimensional arrays, passing arraysto functions, Arrays and strings.

Unit-5:

Structure and Union: definition and differences, self-referential structure. Pointers: value at (*) and address of (&) operator, pointer to pointer, Dynamic Memory Allocation, calloc and malloc functions, array of pointers, function of pointers, structures and pointers. File Handling in C: opening and closing a data file, creating a data file, read and write functions, unformatted data files.

Lab Work:

1. Write C program to find largest of three integers.
2. Write C program to check whether the given string is palindrome or not.
3. Write C program to find whether the given integer is
   (i). aprime number
   (ii). an Armstrong number.
4. Write C program for Pascal triangle.
5. Write C program to find sum and average of n integer using linear array.
6. Write C program to perform addition, multiplication, transpose on matrices.
7. Write C program to find Fibonacci series of iterative method using user-definedfunction.
8. Write C program to find factorial of n by recursion using user-defined functions.
9. Write C program to perform following operations by using user defined functions:
   (i) Concatenation
   (ii) Reverse
   (iii) String Matching
10. Write C program to find sum of n terms of series: n – n*2/2! + n*3/3! - n*4/4! + ...

11. Write C program to interchange two values using (i).Call by value.
(ii). Call by reference
12. Write C program to sort the list of integers using dynamic memory allocation.
13. Write C program to display the mark sheet of a student using structure.
14. Write C program to perform following operations on data files:
(i) Read from data file. (ii) Write to data file.
15. Write C program to copy the content of one file to another file using command lineargument.

Text and References Books:

1. Kernighan, Ritchie, “The C Programming Language”, PHI
2. V. Rajaraman, “Fundamentals of Computers”, PHI
3. Peter Norton’s, “Introduction to Computers”, TMH
4. Gottfried, “Programming in C”, Schaum’s Series, Tata McGraw Hill
5. YashwantKanitkar, “Working with C”, BPB
6. E. Balagurusamy, “Programming in ANSI C”, TMH

Course Outcomes:

1. Identify the parts of the computer system and explain the functioning of its components along with the process of problem solving. (Remember, Understand)
2. Design an algorithmic solution for a given problem and translate it into a program. (Design)
3. Understand different operating systems, related concepts and their functions.(Understand)
4. Use the appropriate control statements to solve the given problem. (Apply)
5. Implement different Operations on arrays and use functions to solve the givenproblem. (Apply)

Understand pointers, structures and unions &Implement file Operations in C programming.(Understand, Apply)

ESC	WORKSHOP PRACTICE(EWS-102)	0L:0T:4P	2credits

Name of Different Shops:

Carpentry Shop:

Practice (I) : To prepare half lap corner joint from given pleces of mango wood. Practice (II): To prepare mortise and tenon joint from given pleces of mango wood.

Instruction : Description and demonstration of different tools, joints along with advanced Carpentry joints, classification and definition of timber, wood seasoning, demonstration of wood working lathe and advanced power tools used in carpentry work, safety precaution during actual working.

Fitting and Bench Working Shop:

Practice (I): To prepare male-female joint form given pieces of mild steel.

Practice (II): To prepare practice work piece involving marking, measuring, sawing, drilling, and tapping operations.

Instruction : Classification and description of different tools used in fitting shop e.g. making and measuring tools, holding and supporting tools, striking tools and cutting tools etc, safety precaution during actual working.

Black Smithy Shop:

Practice (I) : To prepare 'L' shape job form given piece of mild steel rod by hand forging. Practice (II): To prepare a 'Ring' form given piece of mild steel rod by hand forging.

Instruction : Description of various forging processes done in black-smithy work e.g upsetting, drawing down, punching, bending, fulleringetc, classification and description of different tools, equipments used in black smithy shop, safety precaution during actual working.

Welding Shop :

Practice (I) : To prepare simple butt joint and lap joint by electric arc welding form given pieces of mild steel.

Practice (II): To Prepare simple lap joint by oxy-acetylence gas welding and gas flamecutting practice.

Instruction : Concept of welding, classification and explanation of various types of welding with the help of flow chart description of different tools. Equipments required for arc welding and gas welding, demonstration of various types of lames in Oxy-acetylence gas welding, setting of current and selection of electrodes along with different welding joints, safety precaution during actual working.

Sheet metal Shop :

Practice (I) : To prepare a funnel complete withsoldering form given G.I.Sheet..
Practice (II): To fabricate tray/tool box or electric panel box form given G.I. Sheet.

Instruction : Classification and description of different types of tools, equipments used in sheet metal work, different types of metals used in sheet metal shop e.g Galvanized iron, copper, aluminum etc, concept of development of surfaces along with different types of joints in sheet metal work, safety precaution duringactual working.

Machine Shop :

Practice (I) : To prepare a job by plain turning, facing, step turning and chamfering operation form given mild steel rod.

Practice (II): To Prepare a job by taper turning, threading, knurling operations form given mild steel rod.

Instruction : Classification of lathe machines, different parts of lathe machine, tools and equipments used, explanation and demonstration of various operations on lathe machine, tool geometry of single point cutting tool, cutting speed, feed and depth of cut in turning, safety precaution during actual working.

Foundry Shop :

Practice (I) : To prepare a mould of given pattern in Green Sand.

Practice (II): To prepare a mould with two step pulley with runner and riser.

Instruction : Description and use of various foundry tools, shovel, flat rammer, hand rammer, strike off bars, vent wire, trowels, hand riddle etc Types of various molding sands, types of patterns, pattern materials, pattern allowances, safety precaution during actual working.

Course Outcome

- Acquire skills in basic engineering practice
- Identify the hand tools
- Obtain practical skills in the trades.
- Gain measuring skills.

Course Outcome (CO)		Knowled geLevel (KL)
At the end of the course the student should be able to:		
CO1	and practice on machine tools and their operations	
CO2	e on manufacturing of components using workshop trades including fitting, carpentry, foundry, black-smithy and welding work	K3
CO3	y and apply suitable tools for machining processes including plain turning, step turning, taper turning, facing, thread cutting operations	K4
CO4	stand and practice welding and forging operations	K3
CO5	the appropriate tools required for specific operation	K2, K3
CO6	rehend the proper safety measures required to be taken while using different tools.	K1, K2

Note : K1- Remember, K2- Understand, K3- Apply, K4- Analyze, K5- Evaluate,K6-Create

Text and References :

- A course in Workshop Technology, By R. S. Khurmi& J. K. Gupta
- Manufacturing Processes, By B. S. Raghuwanshi
- Elements of Workshop Technology (Vol - I) - By S. K. HajraChudhary, Nirjhar Roy & A. K. (Vol - I) HajraChudhury
- Workshop Technology (part -1 / part-2), By W. A. J. Chapman

MC	ENVIRONMENTAL AND ECOLOGY(ECE-104)	2L:0T:0P	0 credits

Unit-I

Definition, Scope and importance, Need for Public awareness, Environment definition, Ecosystem, Concept of ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Ecological succession, Balanced ecosystem, Human activities, Food shelter, Economic and Social Security.

Effects of Human Activities on Environment: Agriculture, Housing Industry, Mining and Transportation Activities, Basic of Environmental Impact Assessment, Sustainable Development.

Unit-II

Natural Resources: Water Resources – Availability and Quality Aspects, Conservation of water, Water Borne Diseases, Water induced Diseases, Fluoride problems in Drinking Water, Mineral Resources, Forest Wealth, Material Cycles-Carbon, Nitrogen and Sulphur Cycles.

Energy-Different Types of Energy, Electro-magnetic Radiation, Conventional and Non-Conventional Sources, Hydro Electric Fossil Fuel Based, Nuclear, Solar, Biomass, Bio-gas, Hydrogen as an Alternative Future Sources of energy

Unit-III

Environmental Pollution : Water Pollution, Land Pollution, Noise Pollution, Public Health aspects, Air Pollution, Soil Pollution, Marine Pollution, Thermal Pollution, Nuclear Hazards. Solid Waste Management : Cause , effects and control measures of urban and industrial wastes, Role of an Individual in prevention of pollution, Pollution case studies, Disaster management : Floods, earthquake, cyclone and landslides.

Unit-IV

Current Environmental Issue of Importance, Population Growth, Variation among nations, Population explosion, Family welfare Programme, Climate Change and Global Warming-Effects, Urbanization, Automobile Pollution,Acid Rain, Ozone Layer Depletion.

Environmental Protection-Role of Government, Legal Aspects, Initiatives by Non- Government Organizations (NGO), Environmental Education, Value Education, Human Rights, HIV/AIDS, Women and Child Welfare, Case Studies.

Course Objectives:

1. To make students understand and appreciate the unity of life in all itsforms, the implications of the life style on the environment.
2. To understand the various causes for environmental degradation.
3. To understand individual contribution in the environmental pollution.
4. To understand the impact of pollution at the global level and alsoin the local environment.
5. To understand the concept of sustainable development.

Expected Course Outcome:

Student will be able to

1. Understand the need for eco-balance.
2. Acquire basic knowledge about global climate change with a particularreference to the Indian context.
3. Find ways to protect the environment and play pro-active roles.
4. Involve themselves in activities for environment protection.

BMA 201	MATHEMATICS-III	3L:1T:0P	4 credits

Unit – I: Transform Methods:

Fourier integral, conditions of convergence, Fourier sine and cosine integrals, complex form, applications, Fourier transform pairs, existence conditions, operational properties. Applications of Laplace transform and Fourier transform to solve boundary value problems, Discrete and Fast Fourier transforms and its applications.

Development of difference equations as models, operator method, method of undetermined coefficients, Z-transform pairs, ROC. Operational properties, limiting- value theorems, its applications to solve difference equations and BVP, systems of difference equations.

Unit- II: Functions of a Complex Variable and Conformal mapping:

Limit, continuity, differentiability and analyticity, Cauchy-Riemann equations, harmonic functions, complex functions as mappings, liner transformation, inverse transformation, bilinear transformations, conformal mapping, applications.

Unit- III: Integration of Complex Functions:

Contour integrals and evaluations, Cauchy- integral theorem, Cauchy's integral formulae, Liouville's theorem, convergence of power series, Taylor series, Laurent series, zeros and singularities of a complex function, residues and residue theorem, Fundamental theorem of algebra Rouche's theorem, Argument Principle and maximum modules theorem, evaluation of definite and improper integrals.

Unit- IV: Curve- Fitting, Correlation, Regression and Probability:

Curve-fitting, method of least- squares, fitting of straight lines, polynomials, non-linear and exponential curves etc., correlation analysis, linear, non-linear and multi-regression analysis, probability, random variables and probability distributions, expectation, moments and transform methods, Binomial, Poisson and Normal distributions.

Unit- V: Statistical Methods:

Sampling theory (small and large), parameter estimation, confidence intervals, tests of hypotheses and significance; Overview of t-distribution, F-distributions and χ^2-distribution. Z-, t-, F-, and χ^2 tests, goodness of fit test- χ^2test, analysis of variance, non-parametric tests (Simple application). time series analysis, index numbers, quality control charts.

Books Recommended:

1. Dennis G, Zill& Michael R. Cullen; Advanced Engineering Mathematics, Jones & Bartlett Publishers. 2nd Edition.
2. R.K. Jain & S.R.K. Iyengar; advanced Engineering Mathematics, Narosa Publishing House, 2002.
3. Erwin Kreyszig; Advanced Engineering Mathematics, John Wiley & Sons 8th Edition.
4. R.V. Churchill and J.L. Brown, Complex Variables and Applications, McGraw Hill, 1990.
5. J.N. Kapur and H.C. Saxena, Mathematical Statistics, S.Chand. & Co., 2001.
6. H.C. Saxena, Practical Mathematical Statistics, S. chand& Co., 2000.
7. J.H. Mathews and R.W. Howell, Complex analysis for Mathematics and Engineering, 3rd Ed. Narosa, 1998.

Objective / Outcomes, Mathematics-III

Fourier transform is useful in study of frequency response of filter, In the theories of communication engineering, wave propagation, transmission lines and solution of boundary value problems. Discrete and fast fourier transform are used in signal analysis. Fourier transform is also used in electromagnetic field, medical application and in error control coding.

Solution of a discrete system, expressed as a difference equation is obtained using z-transform. Discrete analysis played important role in the development of communication engineering. Basic theory of z-transform help us to obtain the response of output sequence for a discrete system. This will involve the concept of the transfer function.

Complex Analysis is the study of analytic functions. It is an elegant and powerful method useful in the study of heat flow, fluid dynamics and electrostatics. Two-dimensional potential problem can be solved using analytic functions. The other important applications of this theory is to evaluate many real integrals which can not be evaluated by usual methods.

In many engineering problems to establish a linear, quadratic, cubic or exponential relationship between two quantities, it is required two or more unknowns in such a way that these follow whole data, such situations occur in the problems of curve fitting etc. Correlation and regression are the most commonly used techniques for investigating the relationship between two quantitative variables. The theory of probability is the study of such random phenomenon, which are not deterministic. In analyzing and interpreting data that involves an element of "chance" or uncertainty, probability theory plays a vital role in the theory and application of statistics.

probability distribution is the theoretical counterpart of frequency distribution and plays an important role in the theoretical study of populations.

Statistical methods are useful in engineering, medical sciences, industries, banking, and economics. These methods are used to present the data effectively, help in critical analysis of information and summarizing the large data into a simple form using the frequency distribution and graph. In many situations, assumptions are made about the population parameters involved in order to arrive at decisions related to population on the basis of sample information. Quality control and process control use statistics as a tool to manage conformance to specifications of manufacturing processes and their products.

EET 201	Solid States Devices And Circuits	3L:1T:2P	5 credits

Solid State Physics: Diode**,** P-N Junction Diode, Depletion Region, Transition Capacitance, Junction Breakdown Diodes. Diffusion Capacitance, I-V Characteristics and Equation, Models: Piece wise & Small Signal, Effect of Temperature, Switching Characteristics, Special Diodes: Zener, LEDs, Varactors, Photodiodes, Schottky Barrier Diodes.
Transistors: Introduction to Bipolar Junction Transistors, Basic Transistor Operation, Transistor current components.
MOS Field Effect Transistors: Theory and Operation of MOSFET, I-V Characteristics, Biasing, MOSFET circuits at DC, MOSFET as an amplifier and as as a switch, Biasing in MOSFETs
Analysis of Single Stage MOS Amplifier: Small signal Operation and Model, Analysis of Single Stage CS, CG & CD (MOSFET Amplifiers) in Mid-band & High Frequency Region, Analysis of Single Stage CS, CG & CD (MOSFET Amplifiers) in Mid-band and High Frequency region, Frequency Response of the CS Amplifier , Feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc., calculation with practical circuits, concept of stability, gain margin and phase margin.
Classification of Amplifiers: Multistage Amplifiers, Power Amplifiers, Feedback Amplifiers, Basic Concept of Feedback, Effect of Negative Feedback, Simple Analysis, and Stability of Feedback Amplifier.
Oscillators: Condition for Oscillations, Generalized form of Hartley &Colpitts Oscillators, Op-Amp Based RC Phase Shift, Wein Bridge, Crystal Oscillators, Frequency Stability.
Power Supply: Unregulated Power Supply, Ripple Factor, Filters, Rectifier Efficiency. Regulated Power Supply, Regulation, Shunt Regulators, Series Regulators.

LIST OF EXPERIMENTS:
Note: At least 08 experiments are to be performed from the following.

1. Characteristics of Diode: Semiconductor PN Junction Diode, Zener Diode.
2. Diode as a Circuit Element: Rectifiers - Half-wave, Full-wave & Bridge Rectifiers Performance of RC Filters, Clipper and Clamper.
3. I/P and O/P Characteristics of BJT: CE Configuration.
4. Drain and Transfer Characteristics of FET.
5. Switching Characteristics of MOSFET.
6. Biasing of MOSFET in CS configuration.
7. Measurement of h-parameters of FET Amplifier.
8. Op Amp as Adder, Subtractor& Integrator, Instrumentation Amplifier.
9. Realization of fixed frequency Oscillator.
10. Design, Implementation and Testing of Amplifier/ Filter.

Text Books:

1. Millman , J. &Halkias, C. / “Integrated Electronics” / McGraw-Hill International.
2. Sedra, Adel S., Smith, Kenneth C. / “Microelectronic Circuits”/ Oxford University Press.
3. Shilling, D. H. &Belove, Ch. / “Electronic Circuit”/ McGraw-Hill International.

Reference Books:

1. Streetman, B.G. & Banerjee, Sanjay / "Solid-state Electronic Devices" / Prentice Hall (India), Pearson Education
2. Bell, David A. / "Electronic Devices & Circuits"/ Prentice-Hall (India).
3. Millman, J. and Grabel, A. / "Microelectronics"/ McGraw –Hill.
4. Nair, B. Somanathan/ "Electronic Devices & Applications"/ Prentice-Hall (India)
5. Nagrath, I. J. / "Electronics, Analog & Digital"/ Prentice-Hall (India).
6. Neamen, Donald A. / "Electronic circuit Analysis & design" / Tata McGraw Hill
7. Neamen, Donald A. / "Semiconductor physics & Devices" / Tata McGraw Hill
8. Salivahanan, S. & Kumar, Suresh N. &Vallavraj / "Electronic Devices & Circuits" / Tata McGraw-Hill.
9. Schaum's Outlines / "Electronic Devices & Circuits"/ Tata McGraw Hill
10. Lectures of NPTEL, Razavi.

OUTCOMES:

Upon Completion of the course the students will be able to:

1. Understand the basic concept of band formation in semiconductor and working principle of diode, Transistor and MOSFET.
2. Solve the numerical on working of Diode, BJT, MOSFET and broader aspect of the devices.
3. Analyze the concept of feedback and different amplifiers in mid-band and high frequency region.
4. Analyze the principle of regulated DC power supply and oscillator.
5. Implement and test the simple circuits related with characteristics, biasing, amplifiers and oscillators.

EET 203	Digital Electronics	3L:1T:2P	5 credits

Number System: Quantization and implementation of digital number system, Data representations and arithmetic using Floating point & fixed point number system: Signed, Unsigned, Fractional & Integer representation.

Combinational Circuits: Design procedure – Half adder, Full Adder, half-subtractor, Full subtractor, Parallel binary adder, parallel binary subtractor, Fast Adder, Carry Look Ahead adder, Serial Adder/Subtractor, BCD adder, Binary Multiplier, Binary Divider, Multiplexer/ DE multiplexer, decoder, encoder, parity checker, parity generators, code converters, Magnitude Comparator

Sequential Circuits: Latches, Flip-flops -SR, JK, D, T, and Master-Slave , Characteristic table and equation ,Application table , Edge triggering & Level Triggering , Realization of one flip flop using other flip flops, serial adder/subtractor, Asynchronous Ripple or serial counter , Asynchronous Up/Down counter, Synchronous counters, Synchronous Up/Down counters, Programmable counters, Design of Synchronous counters: state diagram, State table ,State minimization , State assignment, Excitation table and maps-Circuit implementation, Modulo–n counter, Registers – shift registers, Universal shift registers, Shift register counters, Ring counter, Shift counters, Sequence generators.

VLSI Design flow: Design entry: Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits

Memory Devices: Classification of memories, ROM organization, PROM, EPROM, EEPROM, EAPROM, RAM – RAM organization, Write operation & Read operation, Memory cycle, Timing wave forms, Memory decoding, memory expansion, Static RAM Cell, Bipolar RAM cell, MOSFET RAM cell, Dynamic RAM cell, Programmable Logic Devices, Programmable Logic Array (PLA), Programmable Array Logic (PAL), Field Programmable Gate Arrays (FPGA), Implementation of combinational logic circuits using ROM, PLA, PAL.

Logic Families: CMOS Logic, CMOS Dynamic Electrical Behavior, Bipolar Logic: Diode Logic, Transistor Logic Inverter, TTL Logic, NMOS, CMOS / TTL Interface, ECL

LIST OF EXPERIMENTS:

Note: At least 08 experiments are to be performed from the following.

1. Input, Output & Transfer Characteristics of CMOS Inverter
2. Minimization and Realization of a Given Function Using Basic Gates (AND, OR, NOR, NAND, EXOR).
3. Function Generation Using Decoders and Multiplexers.
4. Experiments on Priority Encoder Using 74LS148.
5. Applications of Multiplexers.
6. Seven Segment Display Experiments.
7. Four Bit and Eight Bit Adder and Subtractor.
8. Experiments on SR Latch and Master-Slave JK Flip-Flop Using SSI Gates.
9. Design and Testing of Ripple Counters Using ICs
10. Design and Testing of Mod-K Synchronous Counters.
11. Design and Testing of Shift Registers.
12. Simple experiments with HDL (writing simple combination & sequential logic such as adder, flop, counters)

Text Books:

1. Wakerly, John F. / "Digital Design Principles & Practices" / Pearson Education / 3rd Ed.

References Books:

1. Bartee, Thomas C. / "Fundamentals of Digital Computers"/ Tata McGraw-Hill
2. Gopalan, K. "Gopal" / "Introduction to Digital Microelectronic Circuits" / Tata McGraw-Hill
3. Taub, Herbert & Schilling, Donald / "Digital Integrated Electronics"/ Tata McGraw-Hill
4. Millman, Jocob&Taub, Herbert / "Pulse, Digital & Switching Waveforms" / Tata McGraw-Hill
5. Mano, M. Morris / "Digital Design"/ Prentice Hall /
6. Malvino, A.P. & Leach, Donald P. / "Digital Principles & Applications" / Tata McGraw-Hill
7. Mano, M. Morris / "Digital Logic and Computer Design"/ Prentice Hall (India)
8. Tokheim, H. Roger L. / "Digital Electronics Principles & Application"/ Tata McGraw-Hill
9. John. M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.
10. Charles H. Roth. "Fundamentals of Logic Design", Thomson Learning.
11. Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc.
12. Donald D. Givone, "Digital Principles and Design", TMH
13. Lectures of NPTEL

OUTCOMES:

Students will be able to:

1. Analyze different methods used for simplification of Boolean expressions.
2. Design and implement Combinational circuits.
3. Design and implement synchronous and asynchronous sequential circuits.
4. Logic level simulation of logic gates using HDL.
5. Learn about logic families and its interfacing with real world.

PCC	Basic System Analysis (EEE-201)	3L:1T:2P	5 credits

UNIT I

Introduction to continuous time signals and systems: Basic continuous time signals, unit step, unit ramp, unit impulse and periodic signals with their mathematical representation and characteristics. Introduction to various types of systems.

Analogous System: Linear mechanical elements, force-voltage and force-current analogy, modeling of mechanical and electro-mechanical systems: Analysis of first and second order linear systems by classical method.

UNIT II

Fourier Transform Analysis: Exponential form and Trigonometric form of Fourier series, Fourier symmetry, Fourier Integral and Fourier Transform. Transform of common functions and periodic wave forms: Applications of Fourier Transform to network analysis.

UNIT III

Laplace Transform Analysis: Review of Laplace Transform, Laplace Transform of periodic functions, Initial and Final Value Theorems, Inverse Laplace Transform, Convolution Theorem, Superposition Integral, Application of Laplace Transform to analysis of networks, waveform synthesis and Laplace Transform of complex waveforms.

UNIT IV

State – Variable analysis : Introduction, State Space representation of linear systems, Transfer Function and state Variables , State Transition Matrix, Solution of state equations for homogeneous and non-homogeneous systems , Applications of State-Variable technique to the analysis of linear systems

UNIT V

Z-Transform Analysis : Concept of Z-Transform, Z-Transform of common functions, Inverse ZTransform, Initial and Final Value theorems , Applications to solution of difference equations, Pulse Transfer Function

Text Books:

1. David K.Cheng; “Analysis of Linear System”, Narosa Publishing Co.
2. ME Van-Valkenberg; “ Network Analysis”, Prentice Hall of India
3. C.L.Wadhwa, “Network Analysis and Synthesis”, New Age International Publishers,2007.
4. Samarajit Ghosh, “Network Theory: Analysis and Synthesis” Prentice Hall of India, 2008

Reference Books:

1. Choudhary D.Roy, “Network & Systems”, Wiley Eastern Ltd.
2. Donald E.Scott, “Introduction to circuit Analysis” Mc. Graw Hill
3. B.P. Lathi, “Linear Systems & Signals” Oxford University Press, 2008.
4. I.J. Nagrath, S.N. Saran, R. Ranjan and S.Kumar, “Singnals and Systems, “Tata Mc. Graw Hill, 2001

BASIC SYSTEM ANALYSIS LAB

Note: Minimum seven experiments out of the following list:

MATLAB Based Experiments

1. Solution of linear equations for under damped and over damped cases.
2. Determination of eigen values and eigenvectors of a square matrix.
3. Determination of roots of a polynomial.
4. Determination of polynomial using method of least square curve fitting.
5. Determination of polynomial fit, analyzing residuals, exponential fit and error bounds from the given data.
6. Solution of differential equations using 4th order Runge-Kutta method.
7. Solution of differential equation using revised Euler method.
8. Solution of difference equations.

9. Determination of time response of an R-L-C circuit.
10. Department may add any three experiments in the above list.

Text/Reference Books:

1. Almos Gilat, “MATLAB: An Introduction with Applications” Wiley India Ltd., 2004.

HHS-201	ENGINEERING ECONOMICS AND MANAGEMENT	3L:0T:0P	3 credits

UNIT I Introduction to Economics:
Overview: production possibility curve, choices-what, how and for whom, micro- and macro economics, inflation, unemployment, GDP and business cycle; demand and supply, elasticity of demand, consumer surplus and its applications, utility theory.

UNIT II Production and Cost:
Factors of production, production function, law of variable proportion, isoquant analysis, return to scale, economies of scale;
Types of costs: direct and indirect costs, explicit and implicit costs, opportunity cost, economic cost, fixed cost and variable costs, average and marginal costs, short-run and long-run costs, optimal combination of factor-inputs.

UNIT III Market Structure:
Perfectly Competitive Market, Imperfect market: Monopoly, Oligopoly, Monopolistic Market

UNIT IV Fundamentals of Management:
Development of Management Thoughts, Objectives, Functions of Management: Planning, Organising, Directing, Controlling and Coordination.

UNIT V Business Enterprises-
Business Ownership: Sole Proprietorship, Partnership, Company: Promotion, Formation & Development, Cooperative Firms.

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Text books:

1. **Koutsoyiannis, A**., 'Modern Microeconomics', English Language Book Society, Macmillan.

2. **Joseph, L Massod,** "Essential of Management", Prentice Hall, India.

Additional Reference Books:

1. **Armstrong, Michel**, "A Handbook of Management Techniques", Kogan Page Limited

2. **Babcock, D L and Lucy C Morse**, "Managing Engineering and Technology", third edition, Pearson Education, 2006

3. **Pindyck, R S, Rubinfeld, D L &Mehta** , 'Microeconomics', 6 th Edition, Pearson Education India.

4. **Barthwal, R R , Microeconomic Analysis**

5. **Samuelson, Paul A** , 'Economics', 5th edition, McGraw Hill New York.

6. **Henderson, J M and Quadnt, R E** , 'Microeconomic Theory: A Mathematical Approach.', Tata MacGraw Hill, New Delhi,2003

7. **H. Varian,** 'Intermediate Micro Economics'

8. **G. Mankiw,''**Principles of Micro Economics

**Additional references will be provided in class

Course Objectives (COs)

At the end of this course students should be able to:

1. Understanding essential economic principle for solving economic problem with suitable policy alternatives and know how rational consumers can maximize their satisfaction with limited incomes and make best use of their resources.

2. Understand production principles and cost analysis.

3. Gain market knowledge and study the contemporary market situations, market strategy to manage the industries.

4. It gives basic knowledge of management technique.

5. Develop Entrepreneurship skills towards formation of partnership, companies and their functions.

HHS-205	INDIAN CONSTITUTION	2L:0T:0P	0 credits

UNIT – I- Indian Constitution

Sources and Features, Preamble, Fundamental Rights, Fundamental Duties and Directive Principles of State Policy

UNIT-II- Union Executive

President, Vice President, Prime Minister, Council of Ministers, State Executives- Governor, Chief Minister and Council of Ministers

UNIT- III- Union Legislature

Parliament- Composition and Functions, Speaker of Lok Sabha, Amendment Process, State Legislature- Vidhaan Sabha, Panchaayati Raj, Institutions- History, Basic Features and 73rd Amendment

UNIT- IV- Judiciary

Supreme Court, High Courts, Judicial Review and Judicial Activism

UNIT-V- Election Commission

Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the Welfare of SC/ST/OBC and Women.

Reference Books:

1. Indian Constitution : D.D Basu
2. Indian Administration: Avasthi and Avasti

Additional Reference Books

1. The Indian Constitution: Corner Stone of a Nation, G. Austin, Oxford University Press.
2. Indian Politics: Contemporary Issues and Concerns, M. P. Singh and RekhaSaxena, Prentice Hall of India, Delhi

Course Objectives (COs)

At the end of this course students should be able to:

1. Configure the preambles & fundamental rights.
2. Actuate the governance & functioning of constitutional functionaries.
3. Describe the functions of legislative bodies.
4. Decipher the judiciary system & its role in governance.
5. Develop a democratic process through electoral mechanism into system.

BSC	COMPUTER ORIENTED NUMERICAL METHODS (BMA-206)	3L:1T:0P	4 credits

UNIT I: Nonlinear Equations and Simultaneous Linear Equations:
Roots of nonlinear equation, Methods of solution, Order of convergence of iterative methods, Simple roots: Bisection, False position, secant, Newton-Raphson, Chebyshev, Iteration and multi point iteration methods, Multiple roots: Newton-Raphson and Chebyshev, Complex roots: Newton-Raphson and Muller's method, a system of nonlinear equations: Newton-Raphson and Iteration methods, Polynomial equations: Bairstow's method, convergence analysis of above methods.
Linear systems: Introduction, Direct methods, Operation count, Pivoting, III conditioned linear systems & condition number, Iteration methods: Jacobi, Gauss-Seidel, SOR methods, convergence conditions. Special system of
equations: Thomas algorithm. Eigen value problems: Given's and Power methods.

UNIT II: Interpolation, Differentiation and Integration:
Curve fitting: Polynomial interpolation, error, Existence and Uniqueness, Truncation error bounds, difference operators, Newton forward and backward difference interpolations, Lagrange, Newton divided difference and Iterated interpolations, stirling and Bessel's interpolations, Spline interpolation, Least squares and Chebyshev approximations. Numerical Differentiation: Methods based on interpolation, Error analysis. Numerical
Integration: Methods based on interpolations (Trapezoidal, Simpson's 1/3, simpson's 3/8 rule), Gauss
quadrature methods, Romberg integration, Error bounds and estimates.

UNIT III: Numerical Solution of Ordinary Differential Equations:
Initial-value problems, Single step methods: Taylor's, Picard's, Euler's, Modified Euler's method and Runge-Kutta method (fourth Order), Error estimates, Multi-step methods: Adam's-Bashforth and Milne's methods, convergence and stability analysis, Simultaneous and Higher order equations: RK Fourth order method.

UNIT IV: Initial & Boundary Value Problems and Iterative Solvers:
BVP: Shooting method and Finite difference methods for Ordinary Differential Equations, Solution of Partial differential equation; solution of Laplace, Poisson equations: Standard 5-point and diagonal 5- point formulae, Jacobi method, Gauss Seidel method (Liebmann's iterative method) Relaxation method. Solution of heat equation: Crank – Nicolson method, Solution of wave equation.

UNIT V: Finite Element Method:
Basic concepts, variational formulation and functional, base functions, approximations weighted residual methods: Ritz method, Galerkin method, Least squares method, collocationmethod, Finite element and solution of simple problems and time dependent problems.

Books Recommended:

1. M.K.Jain, S.R.K. Iyengar&R.K.Jain, Numerical methods for Scientific and Engineering Computation, N age International Publication.
2. S.S Sastry, Intoductory Methods of Numerical Analysis, Eastern Economy Edition.
3. S. Rajasekaran, Numerical Method in Science and Engineering, Wheeler Publishing House.
4. B.S. Grewal, Numerical Method in Engineering & Science, Khanna Publishers.

Objective / Outcomes, CONM

Using Mathematical Modeling, most of the problems in Engineering, physical and Economical sciences canbe formulated in terms of systems of linear or non-linear equations, ordinary or partial differential equations or integral equations. In majority of the cases, the solutions to these problems in analytical form are difficult or not amenable for direct interpretation. In all such problems, Numerical Analysis provides approximate solutions to the desired degree of accuracy.

Numerical Methods provide easier computational process to solve various mathematical problems like Interpolation,
Differentiation, Integration, ODE & PDE and Initial & Boundary value problems. Analytical solutions can be obtained only for selected class of ODE and PDE. For certain problems, analytical solutions cannot be obtained. However numerical solutions can be obtained to the desired degree of accuracy
using computers.

In civil engineering, numerical methods are used routinely in structural analysis to determine the member forces and moments in structural systems, prior to design. They are most useful in analyzing civil engineering problems with complicated geometries, material properties andloading conditions.

Finite element method has been extensively used in the field of structural mechanics, it has been successfully applied to solve several other types of engineering problems like heat conduction, fluid dynamics, electric and magnetic field. The general applicability of the method is to find the solution of complicated boundary value and other problems.

PCC	Electrical Machines-I(EEE-202)	3L: 1T: 2P	5 Credits

Course Outcomes:

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

COs	Course Outcomes	Bloom's Level
CO1	Able to know about electrical machines	Remembering, Understanding
CO2	Able to understand and apply concepts of DC machines	Understanding, Applying
CO3	Able to understand and apply electromagnetic energy conversion principles	Understanding, Applying
CO4	Exhibit the knowledge of armature reaction, commutation, interpoles, windings, singly and double excited systems	Understanding, Analysing, Applying
CO5	Calculate emf, torque, current, losses etc.	Understanding, Analysing
CO6	Demonstrate fundamental understanding of transformers	Analysing, Evaluating

Syllabus

Module-I: Principles of Electro-mechanical Energy Conversion

Introduction, Flow of Energy in Electromechanical Devices, Energy in magnetic systems (defining energy & Co-energy), Singly Excited Systems; determination of mechanical force, mechanical energy, torque equation, Doubly excited Systems; Energy stored in magnetic field, electromagnetic torque, Generated emf in machines; torque in machines with cylindrical air gap

[8L]

Module-II: D.C. Machines

Construction of DC Machines, Armature winding, emf and torque equation, Armature Reaction, Commutation, Inter-poles and Compensating Windings, Performance Characteristics of D.C. generators, Voltage build in DC shunt generators

[6L]

Module–III: D.C. Machines (Continued)

Performance Characteristics of D.C. motors, starting of D.C. motors; 3-point and 4-point starters, Speed control of D.C. Motors: Field Control, armature control and Voltage Control (Ward Leonard method); Losses, Efficiency and Testing of D.C. machines (Hopkinson's and Swinburn's Test)

[9L]

Module-IV: Single Phase Transformer

Phasor diagram, efficiency and voltage regulation, all day efficiency. Testing of Transformers: O.C. and S.C. tests, Sumpner's test, Polarity test. Auto Transformer: Single phase and three phase auto transformers, volt-ampere relation, efficiency, Merits & demerits and applications

[8L]

Module-V: Three Phase Transformers

Construction, three phase transformer, Phasor groups and their connections, open delta connection, three phase to 2 phase, 6 phase or 12 phase connections, and their applications, parallel operation and load sharing of single phase and three phase transformers, excitation phenomenon and

harmonics in transformers, three winding transformers

[9L]

List of Experiments:

(Note: At least eight experiments must be performed in a semester.)

1. To obtain magnetization characteristics of a D.C. shunt generator.
2. To obtain load characteristics of a D.C. shunt generator and compound generator (a) Cumulatively compounded (b) Differentially compounded.
3. To obtain efficiency of a DC shunt machine using Swinburn's test.
4. To perform Hopkinson's test and determine losses and efficiency of DC machine.
5. To obtain speed-torque characteristics of a dc shunt motor.
6. To obtain speed control of dc shunt motor using (a) armature resistance control (b) fieldcontrol.
7. To obtain speed control of dc separately excited motor using Conventional Ward-Leonard/Static Ward – Leonard method.
8. To study polarity and ratio test of single phase and 3-phase transformers.
9. To obtain equivalent circuit, efficiency and voltage regulation of a single phasetransformer using O.C. and S.C. tests.
10. To obtain efficiency and voltage regulation of a single phase transformer by Sumpner'stest.
11. To obtain 3-phase to 2-phase conversion by Scott connection.
12. To determine excitation phenomenon (B.H. loop) of single phase transformer usingC.R.O.

Text Books:

1. J. Nagrath & D. P. Kothari," Electrical Machines", Tata McGraw Hill
2. Ashfaq Husain, "Electrical Machines", Dhanpat Rai & Sons
3. Fitggerald E. A., C. Kingsley Jr and Umans, "Electric Machinery", 6th Edition McGraw Hill, International Student Edition
4. B.R. Gupta & Vandana Singhal, "Fundamentals of Electrical Machines", New AgeInternational

Reference Books:

1. Irving L. Kosow, "Electric Machine and Tranformers", Prentice Hall of India
2. M.G. Say, "The Performance and Design of AC machines", Pit man & Sons
3. Bhag S. Guru and Huseyin R. Hizirogulu, "Electric Machinery and Transformers" OxfordUniversity Press, 2001

PCC	Electrical Circuit Analysis(EEE-206)	3L: 1T: 2P	5 Credits

Course Outcomes:

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

COs	Course Outcomes	Bloom's Level
CO1	Able to know and analyse electrical circuits	Remembering, Understanding
CO2	Able to understand and apply concepts of graph theory and network theorems	Understanding, Applying
CO3	Able to understand and apply knowledge of series and parallel circuits, resonance, network synthesis	Understanding, Applying
CO4	Exhibit the knowledge of Laplace Transform, Dual Networks and Filters	Understanding, Analysing, Applying
CO5	Calculate circuit properties and do circuit analysis	Understanding, Analysing
CO6	Demonstrate fundamental understanding of circuit	Analysing, Evaluating

Syllabus

Module I: Graph theory

Graph of a Network, definitions: Tree, Co-tree, Link, Basic loop and Cut set, Incidence matrix, Cut set matrix, Tie set matrix, Loop and node equation based analysis, Concept of duality and dual networks **[6L]**

Module II: Network Theorems

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 **[8L]**

Module III: Electrical Circuit Analysis using Laplace Transforms

Solution of first and second order 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, Transfer function representation, Poles and Zeros, Frequency response (Magnitude and phase plots), Series and Parallel resonances **[10L]**

Module IV: Two Port Network and Network Functions

Two port networks, Terminal pairs, relationship of two port variables, Impedance parameters, Admittance parameters, Transmission parameters and Hybrid parameters, Interconnections of two port networks **[6L]**

Module V: Network Synthesis

Positive Real Function: Definition and properties, Properties of L-C, R-C and R-L driving point functions, Synthesis of L-C, R-C and R-L driving point immittance functions using Foster and Cauer first and second forms
Filter: Passive and active filter fundamentals, Low pass, High pass (Constant K-type) Filters, Introduction to Active filters **[10L]**

Text Books:

1. M. E. Van Valkenberg, “Network Analysis, PHI, 2006.
2. D. Roy Choudhary, “Networks and Systems”, New Age International Publications, 1998.
3. W. H. Hayt and J. E.Kemmerly”, Engineering Circuit Analysis, McGraw Hill Edu., 2013.

Reference Books:

1. C. K. Alexander and M. N. O., Sadiku, Electric Circuits”, McGraw Hill Education, 2004.
2. K. V. V. Murthy and M.S. Kanaih, “Basic Circuit Analysis”, Jaico Publications, 1999.
3. Peikari – Fundamentals of Network Analysis & Synthesis, Wiley.
4. V. Atre, “Network Theory and Filter design”, TMH

PCC	Electrical Measurement and Measuring Instruments (EEE-204)	3L: 1T: 2P	5 Credits

Course Outcomes:

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

COs	Course Outcomes	Bloom's Level
CO1	Able to know and analyse principles of measurements	Remembering, Understanding
CO2	Able to understand and apply concepts of analog instruments and digital measurements	Understanding, Applying
CO3	Able to understand and apply knowledge of CRO	Understanding, Applying
CO4	Exhibit the knowledge of magnetic measurement and instrument transformers	Understanding, Analysing, Applying
CO5	Calculate measurement errors and do error analysis	Understanding, Analysing
CO6	Demonstrate fundamental understanding of measurement bridges	Analysing, Evaluating

Syllabus

Module-I: Principles of Measurement and Error Analysis

Methods of measurement, Measurement system, Classification of instrument system, Characteristics of instruments and measurement systems, Errors in measurement and itsanalysis

Module-II: Analog Instruments

Classification, Principle of operation of Permanent Magnet Moving Coil and Moving Iron Instruments, Voltmeters and Ammeters, Errors in Voltmeters and Ammeters, Electrodynamometer type Instruments, Power measurement.

Module-III: Digital Measurements and Cathode Ray Oscilloscopes (CROs)

Digital Measurement of Electrical Quantities, Block Diagram study of Digital Voltmeter, Frequency Meter, Basic CRO Circuit (Block Diagram), Cathode Ray Tube (CRT) and its Components, Applications of CRO in measurements of Phase and Frequency, Dual-Traceand Dual-Beam Oscilloscopes

Module-IV: Potentiometers and Bridges

D.C. and A.C. Potentiometers, D.C. and A.C. Bridges, Measurement of Inductance, Capacitance and Quality factor, Measurement of Low, Medium, and High Resistances

Module V: Instrument Transformers and Magnetic Measurements

Principle of operation of Current Transformer and Potential Transformer, Error Analyses, Magnetic measurements, Ballistic Galvanometer, Flux meter, Advantages and Applications

List of Experiments

(Note: At least eight experiments must be performed in a semester.)

1. Measurement of Inductance by Maxwell Inductance Capacitance Bridge.
2. Measurement of Inductance by Anderson Bridge.
3. Measurement of Capacitance by Schering Bridge.
4. Measurement of Capacitance by Wien's Bridge.
5. Calibration of AC Voltmeters and Ammeters.
6. Measurement of Resistance with the help of Ammeter-Voltmeter method.
7. Measurement of Low Resistance by Kelvin's Double Bridge.
8. Measurement of High Resistance and Insulation Resistance using Megger.
9. Measurements of Phase and Frequency using CRO.
10. Study of the Digital Storage Oscilloscope (DSO) and Measurements of Phase and Frequency.

Text Books:

1. Sawhney A. K., "Electrical and Electronic Measurements & Instrumentation", Dhanpat Rai & Sons.
2. Golding E. W. & F. C. Widdis, "Electrical measurement & measuring instruments" A. H. Wheeler & Co.Pvt Ltd. India.
3. Helfrick A. D. & W. D. Cooper, "Electronic Instruments & Measurement Technique"Prentice Hall of India.

Reference Books:

1. David A. Bell, "Electronic Instrumentation & Measurement" Prentice Hall of India.
2. M. B. Stout, "Basic Electrical measurement" Prentice Hall of India.
3. H. S. Kalsi, "Electronic Instrumentation" Tata Mc-Graw Hill.

HSMC	Organizational Behaviour(HHS-204)	3L:0T:0P	3 credits

Unit 1: Introduction to organizations
What is an organization, components of organization, nature and variety of organizations (in terms of objectives, structure etc.), models of analyzing organizational phenomena, organizational and business variables, organizations in the Indian context, institutions and structures.

Unit 2: Dimensions of Individual Behavior
Individual Behavior, Dimensions of individual behavior: Perceptions, Learning, Motivation, Personality, Commitment, Attitudes, Values & Ethics, Stress Management

Unit 3: Dimensions of Interpersonal Behavior
Transactional Analysis, Interpersonal communication, Listening, Feedback, Counseling,

Unit 4: Group Behavior
Leadership, Communication, Group: Formal Vs Informal Groups, Group Decision making, Team: Team building, team problem solving.

Unit 5: Organizational Dimensions
Organizational Structure: Elements of Organizational Structure, Dimensions of Organizational Structure, Organizational change, Organizational Development, Power, Authority, Politics

Note: *Integrating cases (s). Case method and lectures should be supplemented with a varietyof other methodologies such as feedback on questionnaires and tests, role plays, and behavior simulation exercise.*

References:

1. Luthans Fred., "Organizational Behavior", McGraw Hill, 1998
2. Pareek, Udai, "Understanding Organizational Behavior, Oxford university press Additional Reference Books
3. Robbins (4th ed.), "Essentials of organizational behavior", Prentice Hall of India Pv1. Ltd., New Delhi, 1995
4. Keith Davis, "OrganisationalBehaviour,
5. Hersey and Blanchard (6th ed.). "Management of organizational behavior L utilising human resources", Prentice Hall of India Pv1. Ltd., New Delhi, 1996.
6. Nancy J. Adler, “International OrganisationalBehaviour’, Cengage Learning
7. Nelson Quick, ‘Organizational Behaviour Function Learning’Fifth Edition

Course Objectives (COs)
At the end of this course students should be able to:

1. Apply organizational objectives, components and models in Indian context for better results for attaining organizational goals.
2. Demonstrate individual behavioural dimensions, learning theories, perceptual process, values & ethics with motivational techniques in stressed situations.
3. Identify mechanism for, conducive survival of individual in an organization with interpersonal understanding.
4. Ascertain group, group behaviour, Team & Team building with its key role in organization.
5. Demonstrate organisational structure, organisational change, organisational development for achieving higher productivity and accomplishing goals of organisation.

ECS-201/202	CYBER SECURITY	2L:0T:0P	0 credits

Unit-1:
Introduction to information systems, Types of information systems, Development of Information systems, Introduction to information security, Need for Information security, Threats of Information Systems, Information Assurance, Cyber Security and Security Risk Analysis.

Unit-2
Application security (Database, E-mail and Internet), Data Security Considerations-Backups, Archival Storage and Disposal of Data, Security Technology- Firewall and VPNs, Intrusion Detection, Access Control, Security Threats- Viruses, Worms, Trojan Horse, Bombs, Trapdoors, Spoofs, E-mail viruses, Macro viruses, Malicious Software, Network and Denial of Services Attack, Security Threats to E-Commerce – Electronic Payment System, e-Cash, Credit/Debit Cards, Digital Signature, public Key Cryptography.

Unit-3
Developing Secure Information Systems, Application Development Security, Information Security Governance & Risk Management, Security Architecture & Design, Security Issues in Hardware, Data Storage & Downloadable devices, Physical Security of IT Assets, Access Control, CCTV and intrusion Detection Systems, Backup Security Measures.

Unit-4
Security Policies, why Policies should be developed, WWW Policies, Email Security Policies, Policy Review Process- Corporate policies- Sample Security Policies, Publishing and Notification requirement of the Policies.Information Security Standards- ISO, IT Act, Copyright Act, Patent Law, IPR. Cyber Laws in India: IT Act 2000 Provisions, Intellectual Property Law: Copy Right Law, Software License, Semiconductor Law and Pattern Law.

Text and Reference Books:

1. Charles, P., and Shari Lawrence P fleeger, "*Analyzing Computer Security"*. Pearson Education India.
2. V.K. Pachghare, "*Cryptography and information security",* PHI Learning Pvt. Ltd., Delhi India.
3. Dr Surya Prakash Tripathi, RitendraGoyal, and Praveen Kumar Shukla, "Introduction to Information Security and Cyber Law", Willey Dream tech Press.
4. Schou, Shoemaker, "Information Assurance for the Enterprise", Tata McGraw Hill.
5. Chander Harish, "Cyber Laws and their Protection", PHI Learning Private Limited, Delhi, India.

Course Outcomes:

1. Understand information, information systems, information security, Cyber Security and Security Risk Analysis. (Understand)
2. Understand and apply application security, data security, security technology, security threats from malicious software. (Understand, Apply)
3. Understand the concepts of security threats to e-commerce applications such as electronic payment system, e-Cash, Credit/Debit Cards etc. (Understand)
4. Understand and apply Information Security Governance & Risk Management, Security of IT Assets and Intrusion Detection Systems. (Understand, Apply)
5. Understand various types of Security Policies, Cyber Ethics, IT Act, IPR and Cyber Laws in India. (Understand).

EEE - 303	Control System	3L: 1T: 2P	5 Credits	Course Type: PCC

Course Outcomes:

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

COs	Course Outcomes	Bloom's Level
CO1	Explain the needs and effects of control system	Remembering, Understanding
CO2	Obtain mathematical model of a given control system in transfer functions and state space, and apply the same	Applying, Analysing
CO3	Identify and also justify the type of a given control system from its model, characteristics and responses	Analysing, Evaluating
CO4	Understand Time - response analysis and time-domain analysis	Understanding
CO5	Understand Frequency - response analysis	Understanding
CO6	Analyze the system"s stability and performance in terms of the key characteristics and practical implementation, compensation.	Analysing, Creating

Syllabus

Module 1: Basic Concepts (7 Lectures): Systems - Types of control systems, Notion of feedback, Open and Closed loop systems, Fundamental control actions (ON/OFF, Hysteresis control), Servomechanism, Physical examples, Reduction of parameter variation and effects of disturbance by using negative feedback, Digital Control vs. Analog Control.

Module 2: Control System Components and Modelling (8 Lectures): Servo Motors and actuators (control valves, solenoids), Stepper Motor , Modelling and representations of control systems: Ordinary differential equations, Transfer functions, Block diagrams, Signal flow graphs, Brief introduction of State-space representations.

Module 3: Time - Response Analysis (9 Lectures): Test Signals, Time response of first order and second order systems, Time domain specifications, Steady state errors and error constants, Effect of addition of Poles and Zeros, Dominant poles and zeros of Transfer function, PID Controllers - Derivative error, derivative output, integral error, Design specifications of second order systems, Design considerations for higher order systems, Performance indices.

Module 4: Time - Domain Analysis and Stability(7 Lectures): Review of State variable technique, conversion of State variable model to Transfer Function model and vice-versa, Diagonalization, Controllability and Observability and their Testing, Solution of state equations, Stability: Concept, Algebraic criteria and conditions, Characteristic equation, Routh-Hurwitz criteria and limitations, Root locus concept and construction.

Module 5: Frequency - Domain Analysis and Stability (9 Lectures): Frequency responses and Frequency domain specifications - Concepts of gain margin and phase margin, Correlation between time and frequency responses, Nyquist stability criterion, Nyquist plot, Bode plots, Nichol"s chart, Concepts of Lead, Lag and Lead-lag compensators and their implementation.

Control System Laboratory

Note: The minimum of 08 experiments are to be performed from the following. Hardware based experiments

1. To determine response of first order and second order systems for step input for various values of constant

"K" using linear simulator unit and compare theoretical and practical results.

2. To study P, PI and PID temperature controller for an oven and compare their performance.
3. To study and calibrate temperature using resistance temperature detector (RTD)
4. To study DC position control system
5. To determine speed-torque characteristics of an ac servomotor.
6. To study Solar and Wind Energy Systems on FESTO set up LabVolt Series 8960 - 2A
7. To study Industrial Training Control System on FESTO set up LabVolt Series 3103 - 40

Software based experiments (Use MATLAB)

1. To determine time domain response of a second order system for step input and obtain performance parameters.
2. To convert transfer function of a system into state space form and vice-versa.
3. To plot root locus diagram of an open loop transfer function and determine range of gain „k' fir stability.
4. To plot a Bode diagram of an open loop transfer function.
5. To draw a Nyquist plot of an open loop transfer functions and examine the stability of the closed loop system.

Text Books

1. B.C. Kuo, and F.Golnaraghi, Automatic Control Systems, 9th Edition. Wiley India Pvt limited 2014. (Student edition)
2. Yaduvir Singh & S. Janardhanan, "Modern Control Engineering", Cengage Learning
3. I J Nagrath and M Gopal, Control Systems engineering, 5th Edition, New Age International, 2007

Reference Books

1. Katsuhiko Ogata, Modern Control Engineering, 5th edition, PHI, 2010
2. Norman S. Nise, Control Systems Engineering, 6th edition, John Wiley, 2010. (Indian edition)
3. M Gopal, Control Systems-Principles and Design, 4th Edition, McGraw Hill India, 2012

EEE - 307	Microprocessors	3L: 1T: 2P	5 Credits	Course Type: PCC

Course Outcomes:

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

COs	Course Outcomes	Bloom's Level
CO1	Students will understand the Fundamentals of Microprocessor Architecture.	Knowledge
CO2	Students will understand the 8-bit microprocessor.	Knowledge Comprehension
CO3	Students will understand the 16-bit microprocessor.	Knowledge Comprehension Analysis
CO4	Students will demonstrate the ability to do assembly language programming.	Synthesis Evaluation
CO5	Do interfacing design of peripherals like 8237 DMA controller, 8255-Programmable peripheral interface, 8253/8254 Programmable timer/counter. 8259 programmable Interrupt Controller etc.	Application Synthesis Evaluation

Module 1: Fundamentals of Microprocessors: (6Hours)

Microprocessor and Microprocessor Development Systems: Evolution of Microprocessor, Microprocessor architecture and its operations, memory, inputs-outputs (I/Os), data transfer schemes interfacing devices, architecture advancements of microprocessors, typical microprocessor development system.
Fundamentals of Microprocessor Architecture: 8-bitMicroprocessor architecture, Internal Block Diagram, CPU, ALU, address, data and control bus, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory.

Module 2 :8 Bit Microprocessor (7 Hours)

8085 microprocessor: pin configuration, internal architecture. Timing & Signals, ALU, machine cycles, Buses and CPU Timings, Bus size and signals, machine cycle timing diagram, instruction timing, processor timing. Instruction Set of 8085, Addressing Modes; Register addressing, direct addressing; register indirect addressing, immediate addressing, and implicit addressing. Instruction format, op-codes, mnemonics, no. of bytes, no. 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.

Module3: 16-bit Microprocessors (8 Hours):

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, data transfer, arithmetic , logic string, branch control transfer, processor control, Interrupts, Hardware and software interrupts, responses and types.

Module 4: Instruction Set and Programming (9 Hours)

Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, 8085 and 8086 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs.

Module 5: Peripheral Interfacing: (10 Hours)

I/O programming: Programmed I/O, Interrupt Driven I/O, DMA I/O interface: serial and parallel communication, memory I/O mapped I/Os. Peripheral Devices: 8237 DMA controller, 8255-Programmable peripheral interface,

8253/8254 Programmable timer/counter. 8259 programmable Interrupt Controller.

Text Books:

1. R. S. Gaonkar, “, Microprocessor Architecture: Programming and Applications with the 8085”, Penram International Publishing, 1996.
2. D. V. Hall, “Microprocessors & Interfacing”, McGraw Hill Higher Education, 1991. 3.Brey, Barry B. / “INTEL microprocessors” / Prentice Hall (India) .
3. Liu and Gibson G.A. / “Microcomputer Systems: The 8086/8088 Family” / Prentice Hall (India).
4. D. A. Patterson and J. H. Hennessy, "Computer Organization and Design: The Hardware/Software interface”, Morgan Kaufman Publishers, 2013.

Reference Books:

1. Ray, A.K. & Bhurchandi, K.M./ “Advanced Microprocessors and Peripherals: Architecture, Programming and Interfacing”/ Tata McGraw Hill.
2. Singh, B.P. / “Advanced Microprocessors and Microcontrollers” / New Age International
3. Ayala, Kenneth J. / “The 8086 Microprocessor Programming & Interfacing the PC”/Pen ram International Publishing (India) Limited.

Web Reference:

1. Video/Web contents on NPTEL

List of Experiments:

1. To study 8085 based microprocessor system
2. To study 8086 based microprocessor system
3. To perform mathematical operations like addition, subtraction, multiplication and division on 8-bit processor 8085
4. To perform mathematical operations like addition, subtraction, multiplication and division on 16-bit processor 8086
5. To develop and run a program for finding out the largest/smallest number from a given set of numbers.
6. To develop and run a program for finding out the smallest number from a given set of numbers.
7. To develop and run a program for arranging in ascending order of a set of numbers
8. To develop and run a program for arranging in descending order of a set of numbers
9. To perform conversion of temperature from 0F to 0C and vice-versa
10. To perform mathematical operations like addition, subtraction, multiplication and division on 8-bit processor 8085
11. To perform mathematical operations like addition, subtraction, multiplication and division on 16-bit processor 8086
12. To obtain interfacing with PPI 8255 in I/O mode and BSR mode.
13. To obtain interfacing with 8253 and generation of square wave.
14. Understanding of Debug command on Advanced Microprocessors.
15. Microcontroller based mini project.

EEE - 301	Electrical Machines - II	3L: 1T: 2P	5 Credits	Course Type: PCC

Course Outcomes:

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

COs	Course Outcomes	Bloom's Level
CO1	Understand the basics and needs of electrical machines	Remembering, Understanding
CO2	Able to solve problems of electrical machines	Applying, Analysing
CO3	Understand and analyse the basic operation of synchronous machine	Understanding, Analysing, Evaluating
CO4	Understand and analyse the basic operation of induction machine	Understanding, Analysing, Evaluating
CO5	Understand and analyze the basic operation of single phase induction motor and to understand basic operation of universal motor	Understanding, Analysing, Evaluating
CO6	Able to learn electrical machine and implement its concepts for life long	Remembering, Understanding, Analysing, Creating

Syllabus:

Module 1: Synchronous Machine I (10 Lectures):

Constructional features, EMF Equation, Winding coefficients, equivalent circuit and phasor diagram, Armature reaction, O. C. & S. C. tests, Voltage Regulation using Synchronous Impedance Method, MMF Method, Potier"s Triangle Method, Parallel Operation of synchronous generators, operation on infinite bus, synchronizing power and torque co-efficient

Module 2: Synchronous Machine II (7 Lectures):
Two Reaction Theory, Power flow equations of cylindrical and salient pole machines, operating characteristics Synchronous Motor: Starting methods, Effect of varying field current at different loads, V- Curves, Hunting & damping, synchronous condenser

Module 3: Three phase Induction Machine I (9 Lectures):
Constructional features, Rotating magnetic field, Principle of operation Phasor diagram, equivalent circuit, torque and power equations, Torque- slip characteristics, no load & blocked rotor tests, efficiency, Induction generator & its applications.

Module 4: Three phase Induction Machine II (7 Lectures):
Starting, Deep bar and double cage rotors, Cogging & Crawling, Speed Control (with and without emf injection in rotor circuit.)

Module 5: Single phase Induction Motor (7 Lectures):
Double revolving field theory, Equivalent circuit, No load and blocked rotor tests, Starting methods, Universal motor

Electrical Machines - II Laboratory

Note: The minimum of 08 experiments are to be performed from the following. Hardware based experiments

1. To perform no load and blocked rotor tests on a three phase squirrel cage induction motor and determine equivalent circuit.
2. To perform load test on a three phase induction motor and draw: (i) Torque -speed characteristics (ii) Power factor -line current characteristics
3. To perform no load and blocked rotor tests on a single phase induction motor and determine equivalent circuit.

4. To study speed control of three phase induction motor by keeping V/f ratio constant
5. To study speed control of three phase induction motor by varying supply voltage.
6. To perform open circuit and short circuit tests on a three phase alternator and determine voltage regulation at full load and at unity, 0.8 lagging and leading power factors by (i) EMF method (ii) MMF method.
7. To determine V-curves and inverted V-curves of a three phase synchronous motor.
8. To determine X_d and X_q of a three phase salient pole synchronous machine using the slip test and draw the power-angle curve.
9. To study synchronization of an alternator with the infinite bus by using (i)dark lamp method (ii) two bright and one dark lamp method

Software based experiments (Develop Computer Program in „C" language or use MATLAB or other commercial software)

1. To determine speed-torque characteristics of three phase slip ring induction motor and study the effect of including resistance, or capacitance in the rotor circuit.
2. To determine speed-torque characteristics of single phase induction motor and study the effect of voltage variation.
3. To determine speed-torque characteristics of a three phase induction motor by (i) keeping v/f ratio constant (ii) increasing frequency at the rated voltage.
4. Draw O.C. and S.C. characteristics of a three phase alternator from the experimental data and determine voltage regulation at full load, and unity, 0.8 lagging and leading power factors.
5. To determine steady state performance of a three phase induction motor using equivalent circuit.

Text Books:

1. D.P.Kothari & I.J.Nagrath, "Electric Machines", Tata Mc Graw Hill
2. P.S.Bimbhra, "Electrical Machinery", Khanna Publisher
3. Ashfaq Hussain"Electric Machines" Dhanpat Rai & Company

Reference Books:

1. Fitzerald,A.E.,Kingsley and S.D.Umans"Electric Machinery", MC Graw Hill.
2. P.S. Bimbhra, " Generalized Theory of Electrical Machines", Khanna Publishers
3. M.G.Say, "Alternating Current Machines", Pitman & Sons

EEE - 305	Power System - I	3L: 1T: 0P	4 Credits	Course Type: PCC

Course Outcomes:

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

COs	Course Outcomes	Bloom's Level
CO1	Able to know about various components of power system and supply system	Remembering, Understanding
CO2	Able to calculate inductance and capacitance of various configurations of transmission lines	Understanding, Applying, Analysing
CO3	Evaluating various aspects of insulators used in power system network	Analysing, Evaluating
CO4	Understand various aspects of corona and interference, and their effects on transmission line performance	Understanding, Analysing,
CO5	Able to do mechanical and electrical design calculations of transmission line	Understanding, Analysing, Applying
CO6	Able to identify various aspects of grounding and familiarization with EHVAC, HVDC systems	Remembering, Understanding

Syllabus:

Module 1: Power System Components (8 Lectures):

Single line Diagram of Power system, Brief description of power system Elements: Synchronous machine, transformer, transmission line, bus bar, circuit breaker and isolator, Supply System, Different kinds of supply system and their comparison, choice of transmission voltage, Transmission Lines: Configurations, types of conductors, resistance of line, skin effect, Kelvin"s law, Proximity effect

Module 2: Over Head Transmission Lines (8 Lectures):
Calculation of inductance and capacitance of single phase, three phase, single circuit and double circuit transmission lines, Representation and performance of short, medium and long transmission lines, Ferranti effect, Surge impedance loading

Module 3: Corona and Interference (8 Lectures):
Phenomenon of corona, corona formation, calculation of potential gradient, corona loss, factors affecting corona, methods of reducing corona and interference, Electrostatic and electromagnetic interference with communication lines. Overhead line Insulators: Type of insulators and their applications, potential distribution over a string of insulators, methods of equalizing the potential, string efficiency

Module 4: Mechanical Design of transmission line (8 Lectures):

Catenary curve, calculation of sag & tension, effects of wind and ice loading, sag template, vibration dampers Insulated cables: Type of cables and their construction, dielectric stress, grading of cables, insulation resistance, capacitance of single phase and three phase cables, dielectric loss, heating of cables

Module 5: Neutral grounding and electrical design of transmission line (8 Lectures):

Necessity of neutral grounding, various methods of neutral grounding, earthing transformer, grounding practices

Electrical Design of Transmission Line: Design consideration of EHV transmission lines, choice of voltage, number of circuits, conductor configuration, insulation design, selection of ground wires, EHV AC and HVDC Transmission: Introduction to EHV AC and HVDC transmission and their comparison, use of bundle conductors, kinds of DC links, and incorporation of HVDC into AC system

Text Books

1. W. D. Stevenson, “Element of Power System Analysis”, McGraw Hill,
2. C. L. Wadhwa, “Electrical Power Systems” New age international Ltd. Third Edition
3. Asfaq Hussain, “'Power System”, CBS Publishers and Distributors,
4. B. R. Gupta, “Power System Analysis and Design” Third Edition, S. Chand & Co.

Reference Books

1. M. V. Deshpandey, “Elements of Power System Design”, Tata McGraw Hill,
2. Soni, Gupta & Bhatnagar, “A Course in Electrical Power”, Dhanpat Rai & Sons,
3. S. L. Uppal, “Electric Power”, Khanna Publishers

BMA - 341	Operation Research	3L: 0T: 0P	3 Credits	Course Type: OEC(Math)

UNIT I:

Linear Programming Problems (LPP) OR model, Formulation of LPP. model, Graphical LPP solution and sensitivity analysis, simplex method, M-method, Two-phase method, Special cases in simplex method application, Duality theory, Dual simplex method, Revised simplex method, Degeneracy, Sensitivity analysis, Various industrial application of LP.

UNIT II:

Transportation Models, Assignment Models and Integer Programming: Formulation and Optimal solution of transportation models, Assignment models, Transshipment models, Degeneracy in TP model, Industrial application, Formulation and Solution of integer linear programming problems; Cutting- plane algorithm, Branch and Bound algorithm, 0-1 ILPP, applications, Knapsack problem, facility-location problem.

UNIT III:

Sequencing and Scheduling Model: Sequencing problems- Travelling salesman problem, Machine-scheduling problem (Job shop), Network based planning models, Objectives of CPM and PERT, Characteristics of CPM/PERT projects, Network diagram, Terminology, Critical path, Project duration, PERT Network, Activity time, Probabilities of project completion, Optimal crashing of project activities.

UNIT IV:

Replacement and Inventory mod Replacement Problems: Optimal age of equipment replacement, capital equipment discounting cost, Replacement of items that fail, Individual and group replacement policies. Inventory Models: Deterministic inventory models, Classic EOQ model, EOQ with price breaks, Multiterm, stochastic inventory models under probabilistic demand and lead times.

UNIT V:

Dynamic Programming and Genetic Algorithms: Dynamic programming: Bellman's principle of optimality, computations in DP, Forward and Backward recursions, Dynamic Programming formulations, Investment problem, General allocation problem, Storage coach problem, Production scheduling.
Genetic Algorithms: Working principles, similarities and differences between Gas and Traditional methods, Gas for constrained optimization, Applications of Gas to solve simple problems.

Text Books Recommended:

1. S.S. Rao, "Optimization: Theory and Applications" Willey Eastern Limited.
2. H.A. Taha, " Operations Research- AN Introduction", Macmillan.
3. Hiller, F.S., G.J. Lieberman, "Introduction to Operations Research", Hoiden-Day.
4. Kalyanmoy Deb, "Optimizaton for Engineering Design: Algorithms & Examples " Prentice- Hall of India
5. B.E. Gillet, Introduction Operations Research- A Computer Oriented Algorithmic Approach, McGraw Hill 1989.

EEE - 302	Power System - II	3L: 2T: 0P	5 Credits	Course Type: PCC

Course Outcomes:

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

COs	Course Outcomes	Bloom's Level
CO1	Understanding basics and needs of representation of power system components	Remembering, Understanding
CO2	Able to solve problems of faults analyses, stability analyses of power system	Applying, Analysing
CO3	Understanding basic concepts of load flow	Understanding, Analysing, Evaluating
CO4	Understanding and analyse the basiccomponents of power system stability	Understanding,Analysing, Evaluating
CO5	Handling problems of fault analysis usingcomputer	Understanding, Analysing, Evaluating
CO6	Able to learn power system and itsconcepts for life long	Remembering, Understanding, Analysing, Creating

Module 1: Representation of Power System Components and Symmetricalanalysis (10 Lectures):

Representation of Power System Components:
Synchronous machines, Transformers, Transmission lines, One line diagram, Impedance and reactance diagram, per unit System
Symmetrical fault analysis:
Transient in R-L series circuit, calculation of 3-phase short circuit current and reactance of synchronous machine, internal voltage of loaded machines under transient conditions

Module 2: Symmetrical components and Unsymmetrical faults (10 Lectures):
Symmetrical components:

Symmetrical Components of unbalanced phasors, power in terms ofsymmetrical components, sequence impedances and sequence networks Unsymmetrical faults:
Analysis of single line to ground fault, line-to-line fault and DoubleLine to ground fault on an unloaded generators and power system networkwith and without fault impedance

Module 3: Building of Z_{bus} and introduction to computer method for fault analysis (10 Lectures):
Formation of Z_{bus} using singular transformation and Z_{bus} building algorithm, Introduction to computer method for short circuit calculations

Module 4: Load Flow (10 Lectures):
Introduction, bus classifications, nodal admittance matrix (Y_{bus}), Development of load flow equations, Load flow solution using Gauss Siedel and Newton-Raphson method

Module 5: Power System Stability (10 Lectures):
Stability and Stability limit, Steady state stability study, Derivation ofSwing equation, Transient stability studies by equal area criterion and step-by-step method, Factors affecting steady state and transient stability and methods of improvement

Text Books:

1. W. D. Stevenson, Jr. “Elements of Power System Analysis”, Mc Graw Hill
2. C. L. Wadhwa, “Electrical Power System”, New Age International
3. I. J. Nagrath and D. P. Kothari, "Power System Enginerring", TMH

Reference Books:

1. Chakraborthy, Soni,Gupta & Bhatnagar, “Power System Engineering”, Dhanpat Rai & Co.
2. T.K Nagsarkar & M.S. Sukhija, “Power System Analysis” Oxford University Press,2007.

EEE- 304	Power Electronics	3L:2T:2P	6 credits

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

COs	Course Outcomes	Bloom's Level
CO1	Demonstrate the ability to Understand the differences between signal level and power level devices.	Knowledge (1) Comprehension (2)
CO2	Describe basic operation and compare performance of various power semiconductor devices, passive components and switching circuits	Knowledge (1) Comprehension (2)
CO3	Design and Analyze power converter circuits and learn to select suitable power electronic devices by assessing the requirements of application fields.	Knowledge (1) Analysis (4) Application (3)
CO4	Formulate and analyze a power electronic design at the system level and assess the performance.	Knowledge (1) Analysis (4)
CO5	Identify the critical areas in application levels and derive typical alternative solutions, select suitable power converters to control Electrical Motors and other industry grade apparatus.	Synthesis (5) Evaluation (6)

Module 1: Fundamentals of Power Electronics and Power Semiconductor Devices : (10 Hours)

Concept of power electronics, application of power electronics, types of power electronic circuits and devices, Thyristor V- I characteristics, two transistor model and methods of turn-on, Operation and steady state characteristics of Power MOSFET, IGBT, GTO, MCT and TRIAC, Protection of thyristor, series and parallel operation of thyristors, commutation techniques of thyristor.

Module 2 : Phase Controlled Converters: (10 Hours)

Single phase half wave controlled rectifier with resistive, inductive and RLE loads, Single phase fully controlled and half controlled converters, effect of freewheeling diode and source inductance on the performance of converters. Three phase half wave converters, Three phase fully controlled and half controlled bridge converters, input current harmonics and power factors, techniques of power factor improvement and input harmonic spectrum, dual converters.

Module3: DC-DC Converters: (8 Hours)

Principle of operation, Power circuit of step down and step up choppers, relation between duty ratio and average output voltage, control strategies, types of choppers circuits based on quadrant of operation, performance parameters.

Module 4: AC Controllers: (8 Hours)

Principle of on-off and phase control, single phase AC voltage controllers with R and R-L loads, sequential controller, three phase AC voltage controllers, principle of operation of cycloconverters, single phase to single

phase step up and step down cycloconverters, three phase to single phase cycloconverters, three phase to three phase cycloconverters.

Module 5: Inverters: (10 Hours)

Principle of operation of single-phase voltage source inverter with R and R-L loads, switch states, pole voltage and instantaneous output voltage, square wave operation of the inverter, power circuit of a three-phase voltage source inverter, switch states, pole voltage and instantaneous output voltages, average output voltages over a sub-cycle, methods of voltage control and harmonic reduction of inverters, three-phase sinusoidal modulation, brief idea of multi level inverters, current source inverters.

Text Books:

1. M.H. Rashid,"Power Electronics: Circuits, Devices & Applications", Prentice Hall of India Ltd. 3rd Edition,2004.
2. M.D. Singh and K.B.Khanchandani, "Power Electronics"Tata MC Graw Hill, 2005.
3. V.R. Moorthy, " Power Electronics : Devices, Circuits and Industrial Applications" Oxford University Press,2007.
4. P.S. Bimbhra, "Power Electronics" Khanna Publishers Delhi, 2010.

Reference Books:

1. Chakrabarti & Rai, "Fundamentals of Power Electronics &Drives" Dhanpat Rai & Sons.
2. Ned Mohan, T.M.Undeland and W.P.Robbins, "Power Electronics:Converters, Applications andDesign", Wiley India Ltd,2008
3. S.N.Singh, "A Text Book of Power Electronics" Dhanpat Rai & Sons.
4. M.S. Jamil Asghar, "Power Electronics" Prentice Hall of India Ltd., 2004
5. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business
6. Media, 2007.
7. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.

Web Reference:

1. Video/Web contents on NPTEL

List of Experiments:

1. To study V-I characteristics of SCR and measure latching and holding currents.
2. To study characteristics of MOSFET, IGBT, TRIAC
3. To study characteristics of IGBT
4. To study characteristics of TRIAC
5. To study single-phase half wave controlled rectified with (i) resistive load (ii) inductive load with and without freewheeling diode.
6. To study single phase (i) fully controlled (ii) half controlled bridge rectifiers with resistive and inductive loads.
7. To study single-phase ac voltage regulator with resistive and inductive loads
8. To study operation of IGBT/MOSFET chopper circuit

9. To study MOSFET/IGBT based single-phase bridge inverter.
10. To study MOSFET/IGBT based single-phase series-resonant inverter.

Software based experiments (MATLAB)

11. To obtain simulation of single phase half controlled rectifier and draw load voltage and load currentwaveform for inductive load.
12. To obtain simulation of single phase fully controlled bridge rectifier and draw load voltage and loadcurrent waveform for inductive load.
13. To obtain simulation of single phase full wave ac voltage controller and draw load voltage and loadcurrent waveforms for inductive load.
14. To obtain simulation of step down dc chopper with L-C output filter for inductive load and determinesteady-state values of output voltage ripples in output voltage and load current.
15. To obtain simulation of single phase square wave bridge inverter with R and RL loads

EEE - 306	Power Station Practice	3L: 1T: 0P	4 Credits	Course Type: PCC

Course Outcomes:

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

COs	Course Outcomes	Bloom's Level
CO1	Able to know about various componentsof power plants	Remembering, Understanding
CO2	Able to calculate capital costs, operation costs, various factors, tariffs, power factor corrections,power output and power plant economics	Understanding, Applying, Analysing
CO3	Evaluating various aspects of powerplants , sub-stations, power factor corrections and power plant economics	Analysing, valuating
CO4	Understand various aspects of powerplant economics and their affects on power plant performance	Understanding, Analysing,
CO5	Able to do basic mechanical andelectrical design calculations of some devices of power plants	Understanding, Analysing, Applying
CO6	Able to identify various aspects ofnon-conventional energy resources	Remembering, Understanding

Syllabus:

Module 1: Introduction, Thermal Power Plant and Hydro Electric Plants (8Lectures):

Introduction, Electric energy demand and growth in India, Electric energy sources
Thermal Power Plant: Site selection, general layout and operation of plant, detailed description and use of different parts
Hydro Electric Plants: Classifications, location and site selection, detailed description of various components, general layout and operationof Plants, brief description of impulse, reaction, Kaplan and Francis turbines, advantages & disadvantages, hydro-potential in India

Module 2: Nuclear Power Plant, Gas Turbine Plant and Diesel Power Plant (7Lectures):

Nuclear Power Plant: Location, site selection, general layout and operation of plant. Brief description of different types of reactors Moderator material, fissile materials, control of nuclear reactors,disposal of nuclear waste material, shielding
Gas Turbine Plant: Operational principle of gas turbine plant & its efficiency, fuels, open and closed-cycle plants, regeneration, intercooling and reheating, role and applications

Diesel Plants: Diesel plant layout, components & their functions, itsperformance, role and applications

Module 3: Power Plant Economics and Tariffs (7 Lectures):

Power Plant Economics and Tariffs: Load curve, load duration curve,different factors related to plants and consumers, Cost of electricalenergy, depreciation, generation cost, effect of Load factor on unit cost. Fixed and operating cost of different plants, role of load diversity inpower

system economy.
Objectives and forms of Tariff; Causes and effects of low power factor, advantages of power factor improvement, different methods for power factorimprovements.

Module 4: Sub-stations Layout and Economic Operation of Power Systems (4Lectures):

Types of substations, bus-bar arrangements, typical layout of substation. Economic Operation of Power Systems: Characteristics of steam and hydro-plants, Constraints in operation, Economic load scheduling of thermalplants, Penalty factor, loss coefficients

Module 5: Non Conventional Energy Sources (14 Lectures):

Power Crisis, future energy demand, role of Private sectors in energy management MHD generation: Working principle, open and closed cycles, MHD systems, advantages, parameters governing power output Solar power plant: Conversion of solar heat to electricity, Solar energy collectors, Photovoltaic cell, power generation, future prospects of solarenergy use.
Wind Energy: Windmills, power output with combined operation of wind turbine generation and isolated generating system, technical choices& economic size Geothermal Energy: Earth energy, heat extraction, vapor turbine cycle, difficulties & disadvantages
Tidal energy: Tidal phenomenon, tidal barrage, tidal power Schemes Ocean Thermal Energy: Introduction, energy conversion, problems

Text Books

1. B.R. Gupta,"Generation of Electrical Energy", S. Chand Publication
2. Soni, Gupta & Bhatnagar, "A text book on Power System Engg.", Dhanpat Rai & Co.
3. P.S.R. Murthy, "Operation and control of Power System" BS Publications, Hyderabad

Reference Books

1. W. D. Stevenson, "Elements of Power System Analysis", McGraw Hill
2. S. L. Uppal, "Electrical Power", Khanna Publishers

EET - 310	Electromagnetic Field Theory	3L: 1T: 0P	4 Credits	Course Type:PCC

Review of: Vector Analysis, Static Electric Fields, Solution of Electrostatic Problems

Review of: Steady Electric Currents, Static Magnetic Fields

Time Varying Fields: Faraday's Law of Electromagnetic Induction, Maxwell's Equations. Potential Functions, Electromagnetic Boundary Conditions, Wave Equations & Their Solutions, Time Harmonic Fields

Plane Electromagnetic Waves: Plane Waves in Lossless &Lossy Media, Group Velocity, Poynting Vector &Poynting Theorem, Refractions and Reflections at Normal and Oblique Incidence at Plane Conducting and Plane Dielectric Boundary

Transmission Lines: Transverse Electromagnetic Wave Along a Parallel Plate Transmission Line, Transmission-Line Equation, Wave Characteristics on Finite Transmission Lines, Transient on Transmission Lines Transmission Line as circuit element, Transmission Line Impedance Matching, Smith Chart, Introduction to Wave Guides

TEXT BOOKS:

1. William H Hayt and Jr John A Buck, "Engineering Electromagnetics" , Tata McGraw- Hill Publishing Company Ltd, New Delhi, 2008
2. David K Cheng, "Field and Wave Electromagnetics", Pearson Education.
3. Sadiku M H, "Principles of Electromagnetics", Oxford University Press Inc, New Delhi, 2009

REFERENCE BOOKS:

1. John D Kraus and Daniel A Fleisch, "Electromagnetics with Applications", McGraw Hill Book Co.
2. Karl E Longman and Sava V Savov, "Fundamentals of Electromagnetics", Prentice Hall of India.
3. AshutoshPramanik, "Electromagnetism", Prentice Hall of India.
4. Harington, R. F. / "Time Harmonic EM Fields" / McGraw Hills
5. Schaum's Outlines / "Electromagnetics" / Tata McGraw-Hill /.
6. Collin, R. E. / "Antennas and Radio Wave Propagation"/ Tata McGraw-Hill.

COURSE OUTCOMES:

Upon completion of the course, the students should be able to

1. Analyze field potentials due to static changes and static magnetic fields.
2. Explain how materials affect electric and magnetic fields.
3. Analyze Maxwell's equation in different forms (differential and integral) and apply them to diverse engineering problems.
4. Examine the phenomena of wave propagation in different media and its interfaces.
5. Have knowledge about different parameters and properties of transmission line.

HHS - 342	Entrepreneurship Development	3L: 0T: 0P	3 Credits	Course Type: HSMC

UNIT I Entrepreneurship: Definition, requirements to be an entrepreneur, entrepreneur and intrapreneur, entrepreneur and manager, growth of entrepreneurship in India, women entrepreneurship, rural and urban entrepreneurship.

Entrepreneurial Motivation: motivating factors, motivation theories-Maslow's Need Hierarchy Theory, McClelland's Acquired Need Theory, government's policy actions towards entrepreneurial motivation, entrepreneurship development programmes.

UNIT II Business Enterprises and Ownership Structure: Small scale, medium scale and large scale enterprises, role of small enterprises in economic development; proprietorship, partnership, companies and co-operatives firms: their formation, capital structure and source of finance.

UNIT III Project Management: Identification and selection of projects; project report: contents and formulation, concept of project evaluation, methods of project evaluation: internal rate of return method and net present value method.

UNIT IV Management of Enterprises: Strategy & policy, introduction to human resource management, marketing strategies, financial management & strategies: raising and managing capital, shares, debentures and bonds, cost of capital; break- even analysis.

UNIT V Institutional Support and Policies: Institutional support towards the development of entrepreneurship in India: Institutional framework, venture capitalist; technical consultancy organizations (TCOs), government policies for small scale enterprises.

References:

1. Khanka, S S. 'Entrepreneurial Development', S Chand & Company Ltd. New Delhi
2. Desai, Vasant, ' Project Management and Entrepreneurship', Himalayan Publishing House, Mumbai, 2002.

Additional Reference Books

1. Gupta and Srinivasan, 'Entrepreneurial Development', S Chand & Sons, New Delhi.
2. Ram Chandran, 'Entrepreneurial Development', Tata McGraw Hill, New Delhi
3. Saini, J. S. 'Entrepreneurial Development Programmes and Practices', Deep & Deep Publications (P), Ltd
4. Holt, Davis, 'Entrepreneurship : New Venture Creations, PHI

Course Objectives (COs)

At the end of this course students should be able to:

1. Describe what it takes an Entrepreneur; describe multiple ways to become an entrepreneur; including, entrepreneur, and manager, woman entrepreneur rural & urban: highlights motives to become entrepreneur.
2. Apply the beginner concept, ownership and various forms with focus on small scale enterprises.
3. Identify opportunities using identification; project conceptualization, formulation & evaluation.
4. Identify potential contribution of human resources, marketing, financial and strategic management with fund, opportunities

5. Decipher the role of Institution support and policy framework of Government for enterprises in India.

EEE-401	Electrical Drives	3L:1T:2P	5 Credits	Course Type: PEC

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

COs	Course Outcomes	Bloom's Level
CO1	Understand the Fundamentals of Electric Drive	Knowledge, Comprehension
CO2	Understand the characteristics of dc motors and inductionmotors.	Knowledge, Comprehension Analysis
CO3	Understand the principles of speed-control of dc motors.	Knowledge, Application, Analysis
CO4	Understand the principles of speed-control of induction motors.	Knowledge, Application Analysis
CO5	Design and Analyse power electronic converters used for speed control of DC and AC motors.	Application, Analysis, Synthesis, Evaluation

Module 1: Fundamentals of Electric Drives: (6 hours)

Electric Drives and its parts, advantages of electric drives, Classification of electric drives, Speed- torque conventions and multi-quadrant operations, Constant torque and constant power operation, Types of load, Load torque: components, nature and classification.

Module 2: Dynamics of Electric Drives: (7 hours)

Dynamics of motor-load combination; Steady state stability of Electric Drive; Transientstability of electric Drive, Selection of Motor Power rating: Thermal model of motor for heatingand cooling, classes of motor duty, determination of motor power rating for continuous duty,short time duty and intermittent duty, Load equalization

Module 3: Converters & Chopper Fed DC Drives: (8 hours)

Single phase and three phase controlled converter fed separately excited dc motor drives, Choppercontrol of separately excited dc motor and dc series motor drive, duty ratio control, chopper feddc motor for speed control, armature current waveform and ripple. Control structure of DCdrive, closed loop control of DC Motor drive, inner current loop and outer speed loop.

Module 4: Induction Motor Drives Fundamental: (8 hours)

Review of three-phase voltage source inverter, generation of three-phase PWM signals,sinusoidal modulation, constant V/f control of induction motor, steady-state performanceanalysis based on equivalent circuit, speed drop with loading, slip regulation.

Module 5: Power Electronic Control of AC Drives: (11 hours)

Three Phase induction Motor Drive, Static Voltage control scheme, static frequency controlscheme (and cyclo-converter base), static rotor resistance and slip power recovery controlschemes. Three Phase Synchronous motor: Self-controlled scheme.

Text / References:

1. G. K. Dubey, “Power Semiconductor Controlled Drives”, Prentice Hall, 1989.
2. R. Krishnan, “Electric Motor Drives: Modeling, Analysis and Control”, Prentice Hall,2001.
3. S. K. Pillai, “A First Course on Electric Drives”, New Age International.

Reference Books:

4. W. Leonhard, “Control of Electric Drives”, Springer Science & Business Media, 2001.
5. M.Chilkin, “Electric Drives”, Mir Publishers, Moscow.

6. Mohammed A. El-Sharkawi, “Fundamentals of Electric Drives”, Thomson Asia, Pvt. Ltd.Singapore.
7. N.K. De and Prashant K.Sen, “Electric Drives”, Prentice Hall of India Ltd.
8. V.Subrahmanyam, “Electric Drives: Concepts and Applications”, Tata McGraw Hill.

Web Reference:

1. Video/Web contents on NPTEL

List of Experiments:

Note: - Minimum 10 experiments are to be performed.

Hardware/Real Time Simulation Based Experiments:

1. To study speed control of separately excited dc motor by varying armature voltage usingsingle-phase fully controlled bridge converter.
2. To study speed control of separately excited dc motor by varying armature voltage usingsingle phase half controlled bridge converter.
3. To study speed control of separately excited dc motor using MOSFET/IGBT chopper
4. To study closed loop control of separately excited dc motor
5. To study speed control of single phase induction motor using single phase ac voltagecontroller.
6. To study speed control of three phase induction motor using three phase ac voltagecontroller.
7. To study speed control of three phase induction motor using three phase voltage sourceinverter.
8. To study speed control of three phase slip ring induction motor using static rotorresistance control using rectifier.
9. To study speed control of three phase slip ring induction motor using static scherbius slippower recovery control scheme.

Software based experiments (MATLAB)

10. To study starting transient response of separately excited dc motor
11. To study speed control of separately excited dc motor using single phase fully / halfcontrolled bridge converter in discontinuous and continuous current modes.
12. To study speed control of separately excited dc motor using chopper control in motoringand braking modes.
13. To study starting transient response of three phase induction motor
14. To study speed control of three phase induction motor using constant V/F control
15. To study speed control of three phase induction motor using Voltage and frequencycontrol.

List of Programme Electives-I

EEE-411	Instrumentation and Process Control	3L: 0T: 0P	3 Credits	Course Type: PEC

Course Outcomes:

COs	Course Outcomes	Bloom's Level
CO1	Able to know about Electrical Transducers	Remembering, Understanding
CO2	Able to understand and apply Telemetry and Data Acquisition system	Understanding, Applying
CO3	Able to understand and apply Display devices and Recorders	Understanding, Applying
CO4	Exhibit the knowledge of different Control modes and their application in controlling various processes	Understanding, Analysing, Applying
CO5	Develop the mathematical model of various Chemical processes.	Understanding, Analysing
CO6	Demonstrate fundamental understanding of Process Control	Analysing, Evaluating

Syllabus

Module 1: Electrical Transducers (10 Lectures)

Definition, Advantages, Classification, Characteristics, Factors affecting the choice of transducers, Strain Gauges, LVDT, Capacitive, Piezoelectric, Thermocouples, Hall Effect Transducers.

Module-II: Telemetry and Data Acquisition System (8 Lectures)

General Telemetry system, Land line & Radio Frequency Telemetering system, Transmission Channels and media, Analog Data Acquisition system, Digital Data Acquisition System.

Module-III: Display Devices and Recorders (8 Lectures)

Display Devices, X-Y Recorders, Magnetic Tape Recorders, Spectrum Analyzer, Recent Developments: Smart Sensors, Smart Transmitters.

Module IV: Control Modes (6 Lectures)

Characteristics and comparison of on-off, Proportional (P), Integral (I), Derivative (D), PI, PD,PID, Tuning of controllers: Ziegler-Nichols, Cohen-Coon methods.

Module V: Process Control (8 Lectures)

Principle, Elements of Process Control system, Definition of Process Variables, Mathematical Modeling, Lumped and Distributed Parameters, Analogies: Thermal, Electrical and Chemical systems, Modeling of Heat Exchanger, Introduction to Actuators and Control Valves.

Text Books / Reference Books:

1. Sawhney A. K., "Advanced Measurements & Instrumentation", Dhanpat Rai & Sons.
2. Yaduvir Singh & S. Janardhanan, "Modern Control Engineering", Cengage Learning.
3. Nakra B. C. & K. Chaudhary, "Instrumentation, Measurement and Analysis", Tata Mc GrawHill 2nd Edition.
4. Johnson C. D., Process Control Instrumentation Technology, Prentice Hall of India PrivateLimited (1992)
5. Stephanopoulos G., Chemical Process Control, Prentice Hall of India Private Limited (1983)
6. Harriot P., Process Control, Tata McGraw Hill (1982)
7. E.O. Decblin, "Measurement System – Application & design", Mc Graw Hill.
8. W.D. Cooper and A.P. Beltried, "Electronics Instrumentation and Measurement Techniques"Prentice Hall International
9. Liptak B.G., Instrument Engineers Handbook, Butterworth, Heinemann (2002)
10. Seborg D.E. and Edgar T., Process Dynamics and Control, John Wiley and Sons (1989)

EEE-413	HVDC Transmission Systems	3L: 0T: 0P	3 Credits	Course Type: PEC

Course Outcomes:

1. Advantages of DC transmission over AC transmission.
2. Operation of Line Commutated Converters and Voltage Source Converters.
3. Control strategies used in HVDC transmission system.
4. Improvement of power system stability using an HVDC system.
5. Implementation of converters in HVDC Transmission.

Module 1: DC Transmission Technology (4 hours)

Comparison of AC and dc Transmission (Economics, Technical Performance and Reliability). Application of DC Transmission. Types of HVDC Systems. Components of a HVDC system. Line Commutated Converter and Voltage Source Converter based systems.

Module 2: Analysis of Line Commutated and Voltage Source Converters (10 hours)

Line Commutated Converters (LCCs): Six pulse converter, Analysis neglecting commutation overlap, harmonics, Twelve Pulse Converters. Inverter Operation. Effect of Commutation Overlap. Expressions for average dc voltage, AC current and reactive power absorbed by the converters. Effect of Commutation Failure, Misfire and Current Extinction in LCC links.

Voltage Source Converters (VSCs): Two and Three-level VSCs. PWM schemes: Selective Harmonic Elimination, Sinusoidal Pulse Width Modulation. Analysis of a six pulse converter. Equations in the rotating frame. Real and Reactive power control using a VSC.

Module 3: Control of HVDC Converters: (10 hours)

Principles of Link Control in a LCCHVdc system. Control Hierarchy, Firing Angle Controls – Phase-Locked Loop, Current and Extinction Angle Control, Starting and Stopping of a Link. Higher level Controllers Power control, Frequency Control, Stability Controllers. Reactive Power Control. Principles of Link Control in a VSC HVdc system: Power flow and dc Voltage Control. Reactive Power Control/AC voltage regulation.

Module 3:Components of HVDC Systems: (8 hours)

Smoothing Reactors, Reactive Power Sources and Filters in LCC HVdc systems DC line: Corona Effects. Insulators, Transient Over-voltages. dc line faults in LCC systems. dc line faults in VSC systems. dc breakers. Monopolar Operation. Ground Electrodes.

Module 4: Stability Enhancement using HVDC Control (4 hours)

Basic Concepts: Power System Angular, Voltage and Frequency Stability. Power
Modulation: basic principles – synchronous and asynchronous links. Voltage Stability Problem in AC/dc systems.

Module 5: MTDC Links (4 hours)

Multi-Terminal and Multi-Infeed Systems. Series and Parallel MTdc systems using LCCs. MTDC systems using VSCs. Modern Trends in HVDC Technology. Introduction to Modular Multi-level Converters.

Text / References:

1. K. R. Padiyar, “HVDC Power Transmission Systems”, New Age InternationalPublishers, 2011.
2. J. Arrillaga, “High Voltage Direct Current Transmission”, Peter Peregrinus Ltd., 1983.
3. E. W. Kimbark, “Direct Current Transmission”, Vol.1, Wiley-Interscience, 1971.

EEE-415	Special Topics in Control Systems	3L: 0T: 0P	3 Credits	Course Type: PEC

Course Objectives:

1. To study the importance of Reduced-order modelling, Some Frequency and Time-domainmethods of MOR.
2. To understand the fundamentals of Neural Networks, Back propagation algorithm, learningmethods.
3. To study the basics of Fuzzy logic, Fuzzification and Defuzzification methods.
4. To study the concept of Optimal and Adaptive Control, Classification of Adaptive control,Riccati equation and its solution.
5. To study the Nonlinear Phase plane and Describing function methods of analysis of Systems,Design of Nonlinear Control systems.

Course Outcomes:

COs	Course Outcomes	Bloom's Level
CO1	Able to know about types of control systems	Remembering, Understanding
CO2	Able to understand the concept of reduced order modeling	Understanding, Applying, Analysing
CO3	Evaluating various aspects of neural networks	Analysing, Evaluating
CO4	Understand various aspects of fuzzy logic	Understanding, Analysing
CO5	Able to do basic calculations of optimal control system	Understanding, Analysing, Applying
CO6	Able to understand working of non-linear system	Remembering, Understanding

Syllabus:

Module 1: Introduction to Reduced Order Modeling (8 Lectures):

Model Order Reduction: Importance of Reduced-order models, Frequency domain Classical techniques, Introduction to Time domain techniques.

Module 2: Introduction to Neural Networks and its Applications (8 Lectures):

Introduction, Neuron model, Activation functions, Perceptrons, Multilayer networks, Back propagation algorithm, Recurrent Neural Networks, Supervised and Unsupervised Learning,Prediction using Neural Networks.

Module 3: Introduction to Fuzzy Control Systems and its Applications (8 Lectures):

Basics of Set Theory and Fuzzy Arithmetic, Crisp Sets versus Fuzzy Sets, Operation, Relation and composition of sets, Fuzzification and Defuzzification methods, Fuzzy Logic Controllers andits applications.

Module 4: Optimal and Adaptive Control (8 Lectures):

Formulation of Optimal Control Problem, Performance Indices, Euler-Lagrange Equation, Linear Quadratic Regulator, Model Reference Adaptive Control and Self-Tuning Regulators, Riccati Equation and its Solution.

Module 5: Analysis of Non-linear Systems (8 Lectures):

Introduction, Phase-plane and Describing function methods of analysis, Non-linear control system design.

Text Books

1. H. K. Khalil: Nonlinear control Systems, Prentice Hall, NJ, 1996
2. D.E. Kirk: Optimal Control Theory: An introduction, Prentice Hall, NJ, 1970
3. Simon Haykin: Neural networks - A comprehensive foundation
4. Vijaylaxmi and Pai: Fuzzy Logic, Neural Netwroks and Genetic Algorithms, PHI

Reference Book

1. T. J. Ross: Fuzzy logic: With Engineering applications
2. J. J. E. Slotine: Applied Nonlinear Control
3. M. S. Mahmoud and M. G. Singh: Large scale systems modelling
4. G. Obinata and B. D. O. Anderson: Model reduction for control system design

EEE-417	Electrical Energy Conservation and Auditing	3L:0T:0P	3Credits	Course Type: PEC

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

COs	Course Outcomes	Bloom's Level
CO1	Understand the energy scenario and importance of Electrical energy conservation.	Remembering, Understanding
CO2	Understand the concepts of energy management.	Applying, Analyzing
CO3	Analyze the Electricity tariff, load management related to Electrical systems.	Analyzing, Evaluating
CO4	Understand the methods of improving energy efficiency in different Electrical systems.	Understanding, Evaluating
CO5	Understand the concepts of different energy efficient devices.	Understanding, Analyzing, Creating

Syllabus:

Module -1: Energy Scenario (8 Hours):

Primary energy sources, energy needs of growing economy, energy sector reforms, restructuring of the energy supply sector, Introduction and Motivation for Energy Conservation, Principles of Energy Conservation, Energy Conservation in Industries, Energy Conservation in Electrical Generation, Transmission and Distribution, Energy Conservation in Household and Commercial Sectors, Transport, Agriculture etc., Energy conservation Acr-2001 and its features.

Module-2: Basics of Electrical Energy and its various forms (8 Hours):

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

Module-3: Energy conservation in Electrical Systems (7 Hours):

Energy saving opportunities in electric motors, Energy conservation by VSD, Energy conservation in electric furnaces, ovens and boilers., lighting techniques – Natural , CFL, LED lighting sources and fittings.

Module-4: Energy Audit (9 Hours):

Aim of Energy Audit, Energy Flow Diagram, Strategy of Energy Audit, Comparison with Standards, Energy Management Team, Considerations in Implementing Energy with Conservation Programmes, impact of renewable energy on energy audit recommendations. Instruments for Energy Audit, Energy Audit of Electrical System.

Module-5: Energy efficiency in Electrical systems (8 Hours):

Electricity billing, energy saving opportunities with energy efficient motors, Distribution and transformer losses, Electric motors: types, losses in induction motors, Motor efficiency, Factors affecting motor performance, energy efficient motors, Case studies of implemented energy cost optimization projects in electrical utilities.

Text Books:

1. S. Sivaganaraju, Electric Energy Generation, Utilisation and Conservation, Pearson Publisher,New Delhi.
2. V. K. Mehta, Electrical Power, Khanna and Khanna Publishers, New Delhi
3. S. C. Tripathy, "Utilization of Electrical Energy and Conservation", McGraw Hill, 1991.
4. Gupta B. R.: Generation of Electrical Energy, Eurasia Publishing House Pvt. Ltd., New Delhi.

Reference Books:

1. S. L. Uppal, Electrical Power, Khanna and Khanna Publishers, New Delhi
2. Paul O Callaghan, Energy Management, Tata Mcgraw Hill, New Delhi
3. Success stories of Energy Conservation by BEE, New Delhi.
4. J. Nanda and Kothari: Recent Trends in Electric Energy Systems, PHI Pvt. Ltd, New Delhi.

EEE-419	Power System Design	3L: 0T: 0P	3 Credits	Course Type: PEC

Course Outcomes:

COs	Course Outcomes	Bloom's Level
CO1	Able to understand concept of power system	Remembering, Understanding
CO2	Able to design transmission Line	Understanding, Remembering, Analysing, Applying
CO3	Demonstrate fundamental understanding of design aspects of substation	Analysing, Evaluating
CO4	Exhibit the knowledge of conductors	Understanding, Remembering, Analysing, Applying
CO5	Exhibit the knowledge of insulator	Understanding, Remembering, Analysing, Applying
CO6	Exhibit the knowledge of poles	Understanding, Remembering, Analysing, Applying

Syllabus:

Module 1: Introduction (8 Lectures):
Introduction, Typical AC electrical power system, Main components of overhead lines, Linesupports, Factors governing height of pole, Conductor materials.

Module 2: Conductor Selection (8 Lectures):
Determination of size of conductor for overhead transmission line, Cross arms, Pole brackets and clamps, Conductors configuration spacing and clearances, Span lengths.

Module 3: Insulators (8 Lectures):
Overhead line insulators, Insulator materials, Types of insulators, Lightning Arrestors, Erection of supports, Fixing of insulators, Conductor erection, Positioning of conductors and attachmentto insulators.

Module 4: Earthing, Testing and Commissioning (8 Lectures):
Earthing of transmission lines, Guarding of overhead lines, Clearances of conductor from ground, Spacing between conductors, Testing and commissioning of overhead distribution line.

Module 5: Design and Estimation of Substation (8 Lectures):
Introduction, Classification, Selection and location, Main Electrical Connections, Graphical symbols for various types of apparatus and circuit elements on substation main connection diagram, Key diagram of typical substations.

Text Books

1. Raina K.B. and Bhattacharya S.K., “Electrical Design, Estimating and Costing”, New Age International, New Delhi, 2010
2. N. Alagappan & S. Ekambaram, “Electrical Estimating & Costing”, TMH, 2006
3. Dr.S. L. Uppal., “Electrical Wiring, Estimating and Costing”, 5th Edition, Khanna Publishers,2003.

Reference Books

1. M.V. Deshpande, “Elements of Electrical Power Station Design”, PHI, 2009
2. J. B. Gupta, “A Course in Electrical Installation Estimating and Costing”, S. K. Kataria andSons, India, 2013
3. ISI, National Electric Code, Bureau of Indian Standard Publications, New Delhi, 2011

EEE-421	Advanced Power Electronics	3L:0T:0P	3 Credits

Module 1: Review of Power Semiconductor Devices (08)

Review of Power diodes and SCR; Modern semiconductor devices: MOSFET, GTO, IGBT, GTO operating characteristics; driving circuits and protection, Comparison of switch ratings and Application area.

Module 2: DC-DC Converters and Power Supplies (09)

Non-isolated converters: Buck, Boost, Buck-boost, Cuk, Sepic, Bipolar and Unipolar modulations, Isolated Converters: Forward, Flyback, Push-pull, half bridge, Full Bridge.

Module 3: DC-AC Inverters (10)

Square wave, PWM, Sinusoidal PWM, Bipolar and Unipolar, Linear and over modulations, three- phase square wave and SPWM**,** Multilevel Inverters.

Module 4: AC-DC Rectifiers (07)

PWM converter, switch mode rectifiers, power factor improvement techniques, multi-pulse converters.

Module 5: AC-AC Conversion (06)

Three-phase ac regulators, Single-phase and three-phase Cyclo-converters; Matrix converters.

Text / References Books:

1. M. H. Rashid, "*Power electronics: circuits, devices, and applications*", PearsonEducation India, 2009.
2. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications andDesign", John Wiley & Sons, 2007.
3. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", SpringerScience & Business Media, 2007.
4. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.
5. Bose B.K., "Power Electronics and Variable Frequency Drives –Technology andApplications", IEEE Press, Standard Publisher Distributors 2001
6. Dubey G. K., Doradla S. R., Joshi A. and Sinha R. M. K., "Thyristorised PowerControllers", New Age International Private Limited, 2008.

Web Reference:

1. Video/Web contents on NPTEL
2. IEEE Journal Papers

List of Programme Elective-II

EEE-423	**Advanced Control System**	**3L: 0T: 0P**	**3 Credits**	**Course Type: PEC**

Course Outcomes:

COs	Course Outcomes	Bloom's Level
CO1	Able to know modelling of control systems	Remembering, Understanding
CO2	Able to found solutions and do stability analyses	Understanding, Applying,
CO3	Demonstrate fundamental understanding of non-linear control systems	Analysing, Evaluating
CO4	Develop the mathematical model of continuous and discrete system, non-linear control systems	Understanding, Analysing, Applying
CO5	Exhibit the knowledge of optimal control	Understanding, Remembering, Analysing, Applying
CO6	Exhibit the knowledge of the adaptive control	Remembering, Understanding

Syllabus

Module 1: State Space Analysis of Continuous System (7 Lectures):

Review of state variable representation of continuous system, State transition matrix, Concept ofControllability and Observability, Design of state observer and controller.

Module 2: Analysis of Discrete System (8 Lectures):

Discrete system and discrete time signals, state variable model and transfer function model of discrete system, conversion of state variable model to transfer function model and vice-versa, modeling of sample-hold circuit, solution of state difference equations, steady state accuracy, stability on the z-plane and Jury stability criterion, bilinear transformation, Routh-Hurwitz criterion on r-th planes.

Module 3: Stability (10 Lectures):

Lyapunov's stability theorems, Methods for generating Lyapunov functions, Popov's criterion.

Non-linear System:

Types of non linearity's, phenomena related to non - linear systems, Analysis of non-linear systems-Linearization method, second order non-linear system on the phase plane, types of phase portraits, singular points, system analysis by phase-plane method, describing function and its applications.

Module 4: Optimal Control (8 Lectures):

Introduction, formation of optimal control problem, Calculus of variations minimization of functions, Pontryagin's Minimum Maximum Principle, Linear Quadratic Problem - Hamilton Jacobi equation, Riccati equation and its solution.

Module 5: Adaptive Control (7 Lectures):

Introduction, Modal reference adaptive control systems, Self tuning regulators, Introduction to neural network, fuzzy logic and genetic algorithms.

Text Books / Reference Books:

1. M. Gopal, “Digital Control and State variable Methods”, Tata Mc Graw Hill
2. Ajit K. Mandal, “Introduction to Control Engineering: Modelling, Analysis and Design” NewAge International.
3. Yaduvir Singh & S. Janardhanan, “Modern Control Engineering”, Cengage Learning
4. S.Rajasekaran & G.A.Vjayalakshmi Pai, “Neural Networks, Fuzzy Logic and GeneticAlogorithms: Synthesis and Applications” Prentice Hall of India.
5. Donald E. Kiv, “Optimal Control Theory: An Introduction” Prentice Hall
6. B.C. Kuo, “Digital Control Systems” Sounders College Publishing
7. C.H.Houpis and G.B.Lamont, “Digital Control Systems: Theory, Hardware, Software”, McGraw Hill.

EEE-425	Special Electrical Machines	3L:0T:0P	3 Credits	Course Type: PEC

Module-I: Special AC Machines

Constructional aspects, design and analysis of reluctance, shaded pole, hysteresis, printed circuit, and claw motors, Servomotors and A.C. Tacho-generators.

Module-II: Devices

Introduction of permanent magnet materials, angled field and axial field devices, cross-field machines, special forms of rotating amplifiers, electromagnetic clutches, coupling and brakes, eddy current devices.

Module-III: Linear Machines

Linear devices and actuators, Linear electric machines: Classification, application, constructional aspects, design and method of analysis of various types, Goodness factor.

Module-IV: Linear Electric Motors

Transverse-edge, entry-end, exit end, short primary, short secondary effects in linear electric motors, Force, energy and power LEMs for low speed medium speed and high speed applications. Electromagnetic levitation and guidance schemes-attraction, repulsion.

Module-V: Advanced Motors and Drive Systems

Principle, construction, operation and drive application of Square wave Permanent Magnet (PM) brushless motor drives, sine wave PM brushless motor drives, PM and synchronous reluctance based motors, switched reluctance motors, Energy efficient motors.

Reference Books

1. B.K. Bose, Power Electronics and variable frequency drives, Prentice Hall, New Jersey.
2. T.J.E. Miller, Brushless permanent magnet and reluctance motor drives, Oxford University Press, UK.
3. S.A. Nasar, Linear induction motor, John Wiley, New York.
4. J. C. Andreas, Energy Efficient Motors, Marcel Dekker.
5. J.M.P. Murphy, Power Electronics control of AC Drives, Pergamon Press.

EEE-427	Optimal Control System	3L: 0T: 0P	3 Credits	Course Type: PEC

Course Outcomes:

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

COs	Course Outcomes	Bloom's Level
CO1	Able to know about types of optimal control systems	Remembering, Understanding
CO2	Able to do design of optimal control of continuous time systems	Understanding, Applying, Analysing
CO3	Able to do design of optimal control of discrete time systems	Analysing, Evaluating
CO4	Understand various aspects of dynamic programming	Understanding, Analysing
CO5	Able to do basic calculations of time domain and frequency domain system	Understanding, Analysing, Applying
CO6	Able to robustness, multivariable frequency domain techniques and optimisation	Remembering, Understanding

Syllabus:

Module 1: Introduction (7 Lectures):

Problem formulation, State variable representation, Static optimization, Optimization without constraints, Optimization with equality constraints.

Module 2: Optimal Control of Continuous-Time System (9 Lectures):

Calculus of variations, functional of a single function, functional involving several functions, Continuous-time Linear Quadratic Regulator (LQR), Steady state closed-loop control, and tracking problem.

Module 3: Optimal Control of Discrete-time System (8 Lectures):

Solution of the general Discrete-time Optimization problem, Discrete-time LQR, Digital Control of Continuous-time systems, Frequency domain results.

Module 4: Dynamic Programming (8 Lectures):

Bellman's principle of optimality, Computational procedure for solving control problems, Hamilton-Jacobi-Bellman equation, Linear regulator problems.

Module 5: Robustness and Multivariable Frequency-domain Techniques (8 Lectures):

Robust output-feedback design, Observers and Kalman filter, Linear Quadratic Gaussian (LQG),Loop-transfer recovery (LTR).

Text Books

1. Sage, "Optimal System Control," Prentice-Hall, Englewood Cliffs, New Jersey, 1968
2. Kirk, "Optimal Control Theory- An Introduction," Dover Publications, 2012
3. Frank L. Lewis, D. L. Vrabie, V. A. Syrmos, "Optimal Control," New York: Wiley, 3rdEdition, 1986

Reference Book

1. Lawrence C. Evans, "An Introduction to Mathematical Optimal Control Theory," Universityof California, Berkeley 2010
2. Richard Weber, "Optimization and Control," University of Cambridge, 2010
3. Brian D. O. Anderson and John B. Moore, "Optimal Control: Linear Quadratic Methods,"Dover Publications Inc., 2007

EEE-429	Power System Protection	3L:0T:0P	3 Credits	Course Type: PEC

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

COs	Course Outcomes	Bloom's Level
CO1	Understand the different components of a protection system.	Remembering, Understanding
CO2	Evaluate fault current due to different types of fault in a network.	Applying, Evaluating
CO3	Understand the protection schemes for different power system components.	Understanding, Analyzing,
CO4	Understand the basic principles of Modeling and simulation of protection system.	Understanding, Analyzing, Evaluating
CO5	Understand various system protection schemes, and the use of wide-area measurements.	Understanding, Analyzing, Creating

Syllabus:

Module-1: Introduction and components of a Protection system (9 Hours):
Introduction to desirable attributes of protection, Protection paradigms for system protection, trip circuit of a circuit breaker, CTs &PTs: Current transformer construction, measurement and protective CTs. Type of potential transformers, Functional characteristics of a relay, zone of protection, primary and backup protection, and circuit brakers.

Module 2: Faults and Over-Current Protection (7 hours):
Review of Fault Analysis, Sequence Networks. Introduction to Overcurrent Protection and Overcurrent Relay co-ordination.

Module 3: **Equipment Protection Schemes (7 hours):**
Directional, Distance, Differential protection. Transformer and Generator protection. Bus bar Protection, Bus Bar arrangement schemes.

Module 4: **Modeling and Simulation of Protection Schemes (8 hours):**
Computer aided protection, CT/PT modeling and standards, Relay Testing, Pilot Relaying Schemes: Introduction, Wire Pilot Protection, and Carrier Current Protection.

Module 5: **System Protection (9 hours):**
Effect of Power Swings on Distance Relaying. System Protection Schemes, Phasor Measurement Units and Wide-Area Measurement Systems (WAMS). Application of WAMS for improving protection systems, Modern Trends in Power System Protection: Introduction, gas insulated substation/switchgear (GIS).

Text Books / Reference Books:

1. Ram B. and D. N. Vishwakarma, Power System Protection and Switchgear, Mc. Graw Hill
2. Y. G.Paithankar and S. R. Bhide, "Fundamentals of power system protection", Prentice Hall, India, 2010.
3. G. Phadke and J. S. Thorp, "Synchronized Phasor Measurements and their Applications", Springer, 2008.
4. Reimert, "Protective Relaying for Power Generation Systems", Taylor and Francis, 2006.
5. Ravindranath and M. Chander, Power system Protection and Switchgear, Wiley Eastern Ltd.
6. Sunil S. Rao.: Power System Protection and Switch Gear, Khanna Publishers

EEE-431	Electrical Machine Design	3L: 0T: 0P	3 Credits	Course Type: PEC

Course Outcomes:

COs	Course Outcomes	Bloom's Level
CO1	Able to understand concept of design	Remembering, Understanding
CO2	Able to design using CAD	Understanding, Remembering, Applying, Analysing
CO3	Demonstrate fundamental understanding of application aspects of electrical engineering	Analysing, Evaluating
CO4	Exhibit the knowledge of design of transformer	Understanding, Applying, Remembering, Analysing,
CO5	Exhibit the knowledge of design of three phase inductionmotor	Understanding, Applying, Remembering, Analysing,
CO6	Exhibit the knowledge of three phase synchronous machine	Understanding, remembering, Analysing, Applying

Syllabus

Module 1: Basic Considerations (6 Lectures):

Basic concept of design, Classification of insulating material, Calculations of total mmf andmagnetising current.

Module 2: Transformer Design (8 Lectures):

Output equation, Design of core, yoke and windings, overall dimensions.

Module 3: Design of Rotating Machine - I (10 Lectures):

Output equations of rotating machines, specific electric and magnetic loadings, factors affectingsize of rotating machines, Core and armature design of three phase AC machines.

Module 4: Design of Rotating Machine - II (8 Lectures):

Rotor design of three-phase induction motors, Design of field system of synchronous machines.

Module 5: Computer Aided Design (8 Lectures):

Philosophy of computer aided design, advantages and limitations, Flow charts and computerprograms for the design of transformer.

Text Books / Reference Books:

1. Sawhney, "A Course in Electrical Machine Design" Dhanpat Rai & Sons
2. K.G. Upadhyay," Conventional and Computer Aided Design of Electrical Machines" GalgotiaPublications
3. M.G. Say, "The Performance and Design of AC Machines" Pitman & Sons
4. A.E. Clayton and N.N. Hancock, "The Performance and Design of D. C. Machines" Pitman &Sons
5. S.K. Sen, "Principle of Electrical Machine Design with Computer Programming" Oxford andIBM Publications

EEE-433	Real Time Simulation Techniques of Power Electronic Converters	3L: 0T: 0P	3 Credits	Course Type: PEC

Course Outcomes:

COs	Course Outcomes	Bloom's Level
CO1	Understand the basic concepts of real time simulation	Knowledge, Analysis Comprehension
CO2	Understand and perform real time simulation of Rectifier	Knowledge, Synthesis Application, Analysis,
CO3	Understand and perform real time simulation of Chopper	Knowledge, Application, Analysis, Synthesis
CO4	Understand and perform real time simulation of Inverter	Knowledge, Analysis, Application, Synthesis
CO5	Understand and perform real time simulation of MultilevelInverter	Knowledge, Application, Analysis, Synthesis

Module 1: Introduction of OPAL-RT Simulator (8 Hours)

Basic concept of Real-Time Simulations, Introduction, and Simulation: Variable Vs Fixed step, How to choose a Time step for an Application, difference between Offline simulation and Real time simulation, RT Lab/Real Time Simulator, Opal-RT Internal architecture.

Module 2: Rectifier Simulation (8 Hours)

Simulation of single phase uncontrolled rectifiers in real time environment, Simulation of single phase controlled rectifiers in real time environment, Simulation of three phase uncontrolled rectifiers in real time environment, Simulation of three phase controlled rectifiers in real time environment.

Module 3: Chopper Simulation (6 Hours)

Simulation of buck chopper in real time environment, Simulation of boost chopper in real time environment, Simulation of buck-boost chopper in real time environment.

Module 4: Inverter Simulation (8 Hours)

Simulation of single-phase voltage source inverter with R and R- L loads in real time environment, Simulation of three-phase VSI Inverter in real time environment, Implementation of three-phase sinusoidal modulation in real time environment.

Module 5: **Simulation of Multilevel Inverters (10 Hours)**

Simulation of NPC Multilevel Inverters in real time environment, Simulation of FC MultilevelInverters in real time environment, Simulation of CHB Multilevel Inverters in real time environment.

Text / References:

1. OPAL-RT Manuals
2. M. H. Rashid, "*Power electronics: circuits, devices, and applications*", PearsonEducation India, 2009.
3. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", SpringerScience & Business Media, 2007.
4. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.
5. Bose B.K., "Power Electronics and Variable Frequency Drives –Technology andApplications", IEEE Press, Standard Publisher Distributors 2001

6. Dubey G. K., Doradla S. R., Joshi A. and Sinha R. M. K., “Thyristorised PowerControllers”, New Age International Private Limited, 2008.

Web Reference: Video/Web contents on NPTEL:

List of Programme Electives-III

EEE-440	**Neural Network and Fuzzy System**	**3L: 1T: 0P**	**4 Credits**	**Course Type: PEC**

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

COs	Course Outcomes	Bloom's Level
CO1	Able to know about artificial intelligence	Remembering, Understanding
CO2	Able to understand and apply knowledge representation	Understanding, Applying,
CO3	Demonstrate fundamental understanding of smart control	Analysing, Evaluating
CO4	Develop the mathematical model of artificial intelligent techniques	Understanding, Analysing,
CO5	Exhibit the knowledge of machine intelligence and real time control	Understanding, Analysing, Applying
CO6	Exhibit the knowledge of the working on state-of-art controllers	Remembering, Understanding

Syllabus

Module 1: Introduction & Architecture of Neural Networks (8 Lectures):
Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks, Various learning techniques; perception and convergence rule, Auto-associative and hetero-associative memory.

Module 2: Back Propagation Algorithm (8 Lectures):
Architecture: perceptron model, solution, single layer artificial neural network, multilayer perception model; back propagation learning methods, effect of learning rule co-efficient ;back propagation algorithm, factors affecting back propagation training, applications.

Module 3: Introduction to Fuzzy Logic (8 Lectures):
Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.

Module 4: Fuzzy Membership, Rules (8 Lectures):
Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications and Defuzzifications, Fuzzy Controller, Industrial applications.

Module 5: Fuzzy Neural Networks (8 Lectures):
Type of fuzzy numbers, fuzzy neutron, fuzzy back propagation (BP), architecture, learning in fuzzy BP, inference by fuzzy BP, applications.

Text Books:

1. Kumar Satish, "Neural Networks" Tata Mc Graw Hill
2. Yaduvir Singh & S. Janardhanan, "Modern Control Engineering", Cengage Learning
3. S. Rajsekaran & G.A. Vijayalakshmi Pai, "Neural Networks,Fuzzy Logic and GeneticAlgorithm:Synthesis and Applications" Prentice Hall of India

Reference Books:

1. Siman Haykin,"Neural Netowrks"Prentice Hall of India
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications" Wiley India

EEE-442	Power System Security and Analysis	3L: 1T: 0P	4 Credits	Course Type: PEC

At the end of this course, students will have the ability to demonstrate and implement the:

1. Power transmission in uncompensated AC transmission lines
2. Reactive power flow and voltage control problems
3. Voltage stability
4. Power system security
5. Voltage control and improvement of voltage stability in power transmission system

Module-I: Power Transmission in Uncompensated AC Transmission Lines:
Electrical parameters of transmission lines and representation by line equation, concept of power in AC transmission systems, Power flow in a two terminal power transmission network, Power circle diagram, Surge impedance loading, Operation of transmission lines under no-load conditions, heavy loading conditions, voltage regulation and its relation with reactive power, Maximum power transfer in an uncompensated line load ability.

Module-II: Reactive Power Flow and Voltage Control Problems:

Reactive power voltage, Coupling concept, Governing effects on reactive power flow, Real and reactive power, Static and transient stability, concept of dynamic stability, Relation between V-Q at a node, Reactive power requirement, Operation aspects, Basic principle system voltage control, reactive power flow constants, Effect of transformer tap changing and generator excitation adjustment in the post disturbance period, The practical aspects of reactive power flowproblems leading to voltage collapse in EHV lines

Module-III: Voltage Stability:

Reactive power and voltage collapse and changes in the power system contributing to voltage collapse, Concept of stability of transmission system, Relation between voltage stability and rotor angle stability. Stability margin, Definition and classification of voltage stability, Mechanism of voltage collapse, Analysis of power system voltage stability, Voltage collapse and its Modeling, Voltage security and transient voltage analysis, Power transfer and voltage limits, Voltage stability indicators.

Module-IV: Power System Security:

Introduction, Power system security analysis, planning, operation & control and its assessment, Computation of voltage stability limits, Transfer capacity, Stability margin, Computation of voltage collapse time, Minimum singular value, Various methods of collapse point, Contingency analysis

Module-V: Voltage Control and Improvement of Voltage Stability in Power Transmission System:
Introduction, Role of transformer in voltage control of a power system its modeling under various cases, Quantitative methods to determine the tap setting for voltage control using OLTC at a load bus and its effect on voltage stability, Practical aspects of voltage instability due to OLTC operation, Voltage stability improvement methods, Series, shunt and series-shunt compensation, Use of various FACTS devices for these compensation

Reference Books:

1. Power System Analysis Operation and Control by Abhijit Chakrabarti and Sunita Halder, PHILearning
2. Reactive Power Control and Voltage Stability in Power Transmission Systems by AbhijitChakrabarti, D. P. Kothari, A.K. Mukhopadhyay and Abhinandan De, PHI Learning
3. Power System Stability and Control by Prabha Kundur, Tata McGraw Hill
4. Power System Stability by E W Kimbark, Wiley

EEE-444	Applied System Theory	3L: 1T: 0P	4 Credits	Course Type: PEC

Course Outcomes:

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

COs	Course Outcomes	Bloom's Level
CO1	Able to know about various components of digital control systems and controllers	Remembering, Understanding
CO2	Able to calculate Eigen values, Eigen vectors, and controller parameters	Understanding, Applying, Analysing
CO3	Evaluating various aspects of stability, controllability, observability	Analysing, Evaluating
CO4	Understand various aspects of digital control systems and observers	Understanding, Analysing,
CO5	Able to do basic calculations of describing functions, Lyapunov functions	Understanding, Analysing, Applying
CO6	Able to identify various aspects of non-linear control systems	Remembering, Understanding

Syllabus

Module 1: Introduction (7 Lectures)

Vector spaces, Linear subspaces, Eigenvalues and eigenvectors, Matrix inversion formula, Invariant subspaces, Vector norms and Matrix norms, Singular value decomposition (SVD), Semi-definite matrices.

Module 2: Models of Digital Control Systems and Controllers (10 Lectures)

Introduction, Advantages of Digital control over Analog control and implementation problems, Discrete-time signals, Solution of Difference-Equations, Stability in the z-plane and Jury stability criterion, Discretization methods: Forward and backward difference method, bilinear transformation, System with dead time and dead-beat controllers.

Module 3: Digital Control System Analysis using State Variable Methods (6 Lectures)

State-space representation of Discrete-time systems, State-variable and Transfer-function models, Conversions of State-variable model to Transfer-function model and vice-versa, Diagonalization, Concepts of Controllability and Observability.

Module 4: Design of Controllers and Observers (7 Lectures):

Linear systems, Similarity transformations, Canonical forms, State-space realization of transfer matrices, Design of Pole placement and Observer-based Controllers.

Module 5: Non-linear Systems (10 Lectures):

Introduction, Common physical non-linearities, Phenomenon related to non-linear systems, Phase-plane and describing function methods of analysis, Lyapunov stability for Continuous and Discrete-time systems, Methods for constructing Lyapunov functions.

Text Books / Reference Books:

1. Ben Noble, Applied linear algebra, Pearson, J edition, 1987.
2. Chin-Tsong Chen; Linear system theory and design, Oxford Univ. PI' (Sd), 4 edition, 2012.
3. M. Gopal, State space and Digital Control System", Wiley Eastern Ltd.
4. K. Ogata, Discrete-Time Control Systems. Prentice-Hall, 1987.
5. B. C. Kuo, Digital Control System. Oxford University Press, second edition, 1992.
6. H. K. Khalil: Nonlinear control Systems, Prentice Hall, NJ, 1996.
7. J. J. E. Slotine, Applied Nonlinear Control

EEE-446	Power Quality and FACTS	3L:1T:0P	4 Credits	Course Type: PEC

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

COs	Course Outcomes	Bloom's Level
CO1	Understand the basic concepts of power quality.	Remembering, Understanding
CO2	Understand the working principles of devices to improve power quality.	Understanding, Analyzing
CO3	Understand the characteristics of ac transmission and the effect of shunt and series reactive compensation.	Understanding, Analyzing, Evaluating
CO4	Understand the working principles of FACTS devices and their operating characteristics.	Understanding, Analysing, Evaluating
CO5	Understand the various applications of FACTS.	Understanding, Analyzing, Creating

Syllabus

Module-1: Introduction to Power Quality (7 Hours):

Definition of Power Quality, Power Quality Issues, Voltage Sags, Swells, Interruptions, Power Quality v/s Equipment Immunity, Electric Power Quality Standards. Common Power Frequency Disturbances, Isolation Transformers, Voltage Regulators, Static Uninterruptible Power Source Systems.

Module-2: Effects of harmonics on Power System devices (7 Hours):

Definition of Harmonics, Causes of Voltage and Current Harmonics, Individual and Total Harmonic Distortion, Effect of Harmonics on Power System Devices, Guidelines for Harmonic Voltage and Current Limitation, Harmonic Current Mitigation.

Module-3: Power Quality measuring devices (8 Hours):

Power Quality Measurement Devices, Harmonic Analyzers, Transient-Disturbance Analyzers, Oscilloscopes, Data Loggers and Chart Recorders, True RMS Meters, Power QualityMeasurements.

Module-4: Types of FACTS (9 Hours):

The emergence of Flexible Alternating Current Transmission Systems (FACTS), Types of FACTS controller ,Principle, configuration of Shunt compensation ,control and applications of Shunt Static VAR Compensator (SVC) and Static Synchronous compensator (STATCOM).Fundamental of series compensation, principle of operation, Application of Thyristor Controlled Series Capacitor (TCSC) for different problems of power system, TCSC layout, Static Synchronous Series Compensator (SSSC): principle of operation.

Module-5: Application of FACTS (9 Hours):

Application of FACTS devices for power-flow control and stability improvement, Unified Power Flow Controllers (UPFC): Basic operating principles and characteristics, control UPFC installation applications, UPFC model for power flow studies.

Text Books / Reference Books:

1. Hingorani, N.G. and Gyragyi, L., Understanding FACTS :Concepts and Technology ofFlexible AC Transmission System, Standard Publishers and Distributors (2005).
2. K.R. Padiyar, FACTS Controllers in Power Transmission and Distribution, New AgeInternational Publisher, 2007.
3. Ghosh and G. Ledwich, Power Quality Enhancement using Custom Power Devices,Kluwer Academic Publisher, Boston, MA, 2002.
4. Bollen, M.H.J., Power Quality Problems: Voltage Sag and Interruptions, IEEE Press (2007).
5. Kennedy, B., Power Quality Primer, McGraw Hill (2000).
6. IEEE Standard 519-1992, IEEE recommended practices and requirements for harmoniccontrol in electrical power systems, 1992.
7. G. J. Walkileh, "Power Systems Harmonics", Springer Verlag, New York, 2001.

EEE-448	Wind and Solar Energy Systems	3L: 1T: 0P	4 Credits	Course Type: PEC

Syllabus:

Module-1: Power Scenario (06)

Distribution of non-renewable and renewable installed capacity, Renewable energy types: solar, wind, small-hydro, marine, fuel cells, and biomass etc., Modes of operation: Standalone, grid connected and hybrid systems.

Module-2: Wind Energy Systems – I (08)

Introduction, Basic Principles of Wind Energy Conversion, History of Wind Energy, Wind Energy Scenario, The Power in the Wind, Forces on the Blades, Wind Energy Conversion, and Windmills.

Module-3: Wind Energy Systems – II (10)

Power and wind speed characteristics, Fixed speed and Variable speed wind turbines, Synchronous generator, PMSG, Induction generator, Doubly fed synchronous generator, Land vs. offshore wind turbines, Grid connected application, fully rated and partially rated converters control, rectifier-inverter system.

Module-4: Solar Energy Systems – I (08)

Solar Photovoltaic Systems: Introduction, Solar Cell Fundamentals, Solar Cell I-V and P-V Characteristics, Solar Module, and Array Construction, PV model and equations, efficiency, Series and parallel PV modules, partial shading condition, effect of bypass and blocking diodes, local and global maxima.

Module-5: Solar Energy Systems – II (08)

Open and closed loop MPPT methods, Hill-climbing/P&O and Incremental Conductance methods, DC-DC converters for MPPT, charge controller, Design methodology with and without energy storage, Grid connected and standalone PV system, Balance of system, PV string and array sizing, Battery bank, PCU, Inverter etc.

Text Books / Reference Books:

1. Chetan Singh Solanki, Solar Photovoltaics: Fundamental, Technologies and Applications,(2nd edition), PHI Learning Pvt. Ltd., 2011.
2. Chetan Singh Solanki, Solar Photovoltaics: Technology and Systems: A manual forTechnicians, Trainers and Engineers, PHI Learning Pvt. Ltd., 2014.
3. Mukund R. Patel, Wind and Solar Power Systems, CRC Press LLC, 1999.
4. S. N. Bhandra, D. Kastha and S. Banerjee, Wind Electrical Systems, Oxford University Press,2005.
5. M. H. Rashid, Power Electronics Handbook, Academic Press, Florida, 2001.
6. Deb Tanmoy, Electrical Power Generation Conventional and Renewable", Khanna Publisher.
7. Bansal N. K., Non-Conventional Energy Resources, Vikas Publishing House.
8. Saeed S. H. and Sharma D. K., Non-Conventional Energy Resources (2nd Edition), S. K.Kataria & Sons, 2009.
9. Sawhney G. S., Non-Conventional Energy Resources, Prentice Hall of India.
10. Khan B. H., Non-Conventional Energy Resources", Mc-Graw Hill Education (3rd edition).

EEE-450	Modelling and Simulation of Electrical Machines	3L:1T:0P	4 Credits

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

COs	Course Outcomes	Bloom's Level
CO1	Understand the basic concepts of modelling of DC machine.	Knowledge, Comprehension, Analysis
CO2	Understand the dynamic simulation of the speed-controlled DC Motor Drive.	Knowledge, Analysis, Synthesis
CO3	Understand and modelling of AC motor model indifferent reference frame.	Knowledge, Analysis, Synthesis
CO4	Understand modelling and simulation of 1-phase and 3-phase induction motor.	Knowledge, Application, Analysis, Synthesis
CO5	Understand modelling and simulation of synchronous machine.	Knowledge, Analysis, Synthesis

Module 1: Basic Concepts of Modelling (8 Hours)

DC Machine modelling: Mathematical model of separately excited D.C motor –Steady State analysis - Transient State analysis - Sudden application of Inertia Load - Transfer function of Separately excited D.C Motor- Mathematical model of D.C Series motor, Shunt motor- Linearization Techniques for small perturbations.

Module 2: Modelling of DC Machines (8 Hours)

Principles of DC Motor Speed Control, Fundamental Relationship, Field Control, Armature Control, Armature and Field Controls, Four-Quadrant Operation, Phase-Controlled Converters, Single-Phase-Controlled Converter, Three-Phase-Controlled Converter, Control Circuit, Control Modelling of-the Three-Phase Converter, Steady-State Analysis of the Three-Phase Converter- Controlled Motor Drive, Dynamic Simulation of the Speed-Controlled DC Motor Drive, Motor Equations, Speed Feedback, Speed Controller.

Module 3: Reference Frame Theory (8 Hours)

Reference frame theory Real time model of a two phase induction machine-Transformation to obtain constant matrices - three phase to two phase transformation - Power equivalence. Dynamic modelling of three phase Induction Machine Generalized model in arbitrary reference frame - Electromagnetic torque - Derivation of commonly used Induction machine models - Stator reference frame model - Rotor reference frame model Synchronously rotating reference frame model -Equations in flux linkages - per unit model.

Module 4: Small Signal Modeling (8 Hours)

Small Signal Modeling of Three Phase Induction Machine Small signal equations of Induction machine, derivation d-q flux linkage model derivation - control principle of Induction machine. Single phase induction motor; Cross field theory of single - phase induction machine.

Module 5: Modeling of Synchronous Machine (8 Hours)

Synchronous machine inductances–voltage equations in the rotor's dq0 reference frame- electromagnetic torque-current in terms of flux linkages - simulation of three phase synchronous machine- modeling of PM Synchronous motor.

Text Books:

1. R. Krishnan, "Electric Motor Drives - Modelling, Analysis& control", Pearson Publications, First edition, 2002.
2. P. C. Krause, Oleg Wasynczuk, Scott D.Sudhoff, "Analysis of Electrical Machinery and Drive systems", IEEE Press, Second Edition.

Reference Books:

3. P. S. Bimbra, "Generalized Theory of Electrical Machines" Khanna publications, Fifth edition

-1995.
4. Chee Mun Ong –“Dynamic simulation of Electric machinery using MATLAB / Simulink”,Prentice Hall of India Publications

Web Reference:

Video/Web contents on NPTEL

List of Programme Electives-IV

EEE-452	Robotics and Automation	3L: 1T: 0P	4 Credits	Course Type: PEC

Course Outcomes:

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

COs	Course Outcomes	Bloom's Level
CO1	Able to know about robotic system	Remembering, Understanding
CO2	Able to understand and apply dynamics and control	Understanding, Applying,
CO3	Demonstrate fundamental understanding of system stability	Analysing, Evaluating
CO4	Develop the mathematical model of robots	Understanding, Analysing,
CO5	Exhibit the knowledge of nonlinear control, observer based control robust control	Understanding, Analysing, Applying
CO6	Exhibit the knowledge of the robotic system design	Remembering, Understanding

Syllabus

Module 1: Introduction and Overview of Robotic Systems and their Dynamics (8 Lectures): Forward and inverse dynamics, Properties of the dynamic model and case studies, Introduction to nonlinear systems and control schemes.

Module 2: System Stability and Types of Stability (8 Lectures):

Lyapunov stability analysis, both direct and indirect methods. Lemmas and theorems related to stability analysis.

Module 3: Joint Space and Task Space Control Schemes (8 Lectures):

Position control, velocity control, trajectory control and force control.

Module 4: Nonlinear Control Schemes (8 Lectures):

Proportional and derivative control with gravity compensation, computed torque control, slidingmode control, adaptive control, and observer based control, robust control and optimal control.

Module 5: Nonlinear Observer Schemes (8 Lectures):

Design based on acceleration, velocity and position feedback, Numerical simulations usingsoftware packages namely MATLAB.

Text Books

1. R Kelly, D. Santibanez, LP Victor and Julio Antonio, Control of Robot Manipulators in JointSpace, Springer, 2005.
2. A Sabanovic and K Ohnishi, Motion Control Systems, John Wiley & Sons (Asia), 2011.
3. Yaduvir Singh & S. Janardhanan, “Modern Control Engineering”, Cengage Learning.

Reference Books

1. R M Murray, Z. Li and SS Sastry, A Mathematical Introduction to Robotic Manipulation,CRC Press, 1994.
2. J J Craig, Introduction to Robotics: Mechanics and Controlll, Prentice Hall, 2004.
3. J J E Slotine and W Li, Applied Nonlinear Control, Prentice Hall, 1991.
4. Sebastian Thrun, Wolfram Burgard, Dieter Fox, Probabilistic Robotics, MIT Press, 2005.

EEE-454	Power System Dynamicsand Control	3L: 1T: 0P	4 Credits	Course Type: PEC

Course Outcomes:

1. The problem of power system stability and its impact on the system.
2. Analyze linear dynamical systems and use of numerical integration methods.
3. Model different power system components for the study of stability.
4. Analyze the stability problems.
5. Improve stability.

Module 1: Introduction to Power System Operations (3 hours)

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

Module 2 : Analysis of Linear Dynamical System and Numerical Methods (5 hours) Analysis of dynamical System, Concept of Equilibrium, Small and Large Disturbance Stability. Modal Analysis of Linear System. Analysisusing Numerical Integration Techniques. Issues in Modeling: Slow and Fast Transients, Stiff System.

Module 3: Modeling of Synchronous Machines and Associated Controllers (12 hours)

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

Module 4: Modeling of Other Power System Components (10 hours)

Modeling of Transmission Lines and Loads. Transmission Line Physical Characteristics. Transmission Line Modeling. Load Models - induction machine model. Frequency and Voltage Dependence of Loads. Other Subsystems – HVDC and FACTS controllers, Wind Energy Systems.

Module 5: Stability Analysis (11 hours)

Angular stability analysis in Single Machine Infinite Bus System. Angular Stability in multi- machine systems – Intra-plant, Local and Inter-area modes. Frequency Stability: Centre of Inertia Motion. Load Sharing: Governordroop. Single Machine Load Bus System: Voltage Stability. Introduction to Torsional Oscillations and the SSR phenomenon. Stability Analysis Tools:Transient Stability Programs, Small Signal Analysis Programs.

Module 6: Enhancing System Stability (4 hours)

Planning Measures. Stabilizing Controllers (Power System Stabilizers). Operational Measures- Preventive Control. Emergency Control.

Text/Reference Books

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

EEE-456	Industrial Instrumentation	3L: 1T: 0P	4 Credits	Course Type: PEC

Course Outcomes:

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

COs	Course Outcomes	Bloom's Level
CO1	Able to know about various sensors and transducers,	Remembering, Understanding
	analog and digital systems	
CO2	Able to measure industrial variables	Understanding, Applying, Analysing
CO3	Evaluating various aspects of instrumentation design like amplifier, signal conditioning circuits	Analysing, Evaluating
CO4	Understand various aspects of rectifiers, filters, bridges	Understanding, Analysing
CO5	Able to do basic calculations of measurements and instrumentation	Understanding, Analysing, Applying
CO6	Able to understand working of telemetry and DAS	Remembering, Understanding

Syllabus:

Module 1: Instrumentation Systems and Transducers (8 Lectures):

Role of instrumentation, Elements of instrumentation system, Sensors and transducers, Primary sensing elements, Electrical Transducers: classification, characteristics, desirable properties. Resistive, Inductive, Capacitive, Opto-electronic and Hall-effect type transducers: principle, Characteristics, Advantages and limitations, Industrial applications.

Module 2: Active and Digital Transducers (8 Lectures):

Thermo-electric, Piezo-electric, Photo-electric, Digital Transducers: types, principle, characteristics, Advantages and limitations. Applications of Transducers for instrumentation of common industrial variables: Temperature, Pressure, Flow, Liquid-level, Load / Force, Position, Speed and Acceleration.

Module 3: Electronic Instrumentation (8 Lectures):

Analog Signal Conditioning and Signal conversion, Transducer bridges for resistive and reactive transducers, Instrumentation amplifiers, Precision rectifiers and applications, Active filters: First- order low-pass, Second-order, Features and design.

Module 4: Data Converters and Digital Signal Conditioning (10 Lectures):

Sample and Hold operations, Digital to Analog Converters: R/2R, Binary weighted, BCD to analog types, Analog to Digital Converters: classifications, Capacitor charging type-VFC, PWM type, Dual-slope integrator types, Discrete voltage comparison type-Counter Ramp, Successive Approximation, Flash type, Properties and specifications.

Module 5: Telemetry and Data Acquisition Systems (6 Lectures):

Types of Telemetry Systems: Land line, Wireless, Analog and Digital, Current, Voltage, Position, Frequency Telemetry, Data Acquisition systems-configurations.

Text Books / Reference Books:

1. D. Patranabis –Principles of industrial instrumentation (TMH)
2. Rangan, Sharma, Mani – Instrumentation systems and Devices (TMH)
3. A. K. Sawhney – Instrumentation and Process Control, Dhanpat Rai & Sons

EEE-458	Electrical and Electronics Engineering Materials	3L: 1T: 0P	4 Credits	Course Type: PEC

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

COs	Course Outcomes	Bloom's Level
CO1	Understand the basic crystal structure of materials.	Remembering, Understanding
CO2	Understand the mechanism of conductivity of metals.	Understanding, Analyzing
CO3	Understand the merits and applications of semi-conductor materials and photonic devices.	Understanding, Analyzing, Evaluating, Creating
CO4	Understand the various magnetic properties of materials.	Understanding, Analyzing,
CO5	Understand the applications of Nano materials and modern techniques to study materials.	Remembering, Applying, Creating

Syllabus:

Module –1: Crystal structure of materials (8 Hours):

Crystal Structure of Materials: Bonds in solids, crystal structure, co-ordination number, atomic packing factor, Miller Indices, Bragg's law and x-ray diffraction, structural Imperfections, crystal growth , Energy bands in solids, classification of materials using energy band.

Module-2: Conductivity of metals (8 Hours):

Conductivity of Metals: Electron theory of metals, factors affecting electrical resistance of materials, thermal conductivity of metals, heat developed in current carrying conductors, thermoelectric effect, superconductivity and super conducting materials, Properties and applications of electrical conducting and insulating materials, mechanical properties of metals

Module-3: Semiconductor materials and Photonic devices (8 Hours):

Types of semiconductors, properties of semi-conducting materials, measurement of semiconductor parameters, growth and refining of semiconductor materials, merits of semiconductor materials, preparation of Electronic grade silicon(EGS),Growth of semiconductor crystals from Melt-Czochralski method, Epitaxial growth –Vapour – Phase Epitaxy, refining of semiconductor materials, Microelectronic circuits and ICs, Basic steps in IC fabrication, Photonic devices, Photo-transistor, Photo diode, Light emitting diode.

Module-4: Magnetic and Optical properties of material (8 Hours):

Magnetic Properties of Material, Anti-ferromagnetism and Ferrimagnetic materials or Ferrites ,Application of hysteresis curve, soft and hard magnetic materials and their applications, permanent magnetic materials, basic features of electromagnetic radiation, response of the materials to Electromagnetic radiation ,introduction to optical fibre, merits and application of optical fibre, Light source materials for optical fibre communication.

Module-5: Introduction to modern techniques of material studies and Nano materials (8 Hours):

Brief history of Nano materials, Introduction to modern techniques of material studies and Nano materials: Brief introduction of Differential Scanning of Calorimeters, Transmission Electron Microscopy (TEM), Optical Absorption Spectroscopy, Scanning Electron Microscopy, production and application of Nano materials.

Text Books :

1. R. K. Shukla & A. Singh,"Electrical Engineering Materials" , Tata Mcgraw Hill,New Delhi.
2. R.K. Rajput," Electrical Engg. Materials," Laxmi Publications.

References :

3. Solymar, "Electrical Properties of Materials" Oxford University Press.
4. C.S. Indulkar & S.Triruvagdan "An Introduction to Electrical Engg. Materials, S.Chand & Co.
5. T. K. Basak, "Electrical Engineering Materials" New age International.

EEE-460	Electrical and Hybrid Vehicles	3L: 1T: 0P	4 Credits	Course Type: PEC

Course Outcomes:

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

COs	Course Outcomes	Bloom's Level
CO1	Able to understand need of electric vehicle and hybrid vehicle	Remembering, Understanding
CO2	Able to choose a suitable drive scheme	Understanding, Applying,
CO3	Demonstrate basic schemes of electric vehicle and hybrid vehicle	Analysing, Evaluating
CO4	Develop control of DC and Induction Motor drives	Understanding, Analysing, Applying
CO5	Exhibit the knowledge of Electric Propulsion Unit	Understanding, Remembering, Analysing, Applying
CO6	Exhibit the knowledge of energy storage systems	Remembering, Understanding

Syllabus:

Module 1: Introduction (8 Lectures):

Introduction to electric vehicle and hybrid vehicle, Conventional Vehicles: Basics of vehicleperformance, Vehicle power source characterization, Transmission characteristics.

Module 2: Electric Drive Trains (8 Lectures):

Basic concept, introduction to various electric drive-train topologies, power flow control inelectric drive-train topologies, fuel efficiency analysis.

Module 3: Hybrid Electric Drive Trains (8 Lectures):

Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies, Powerflow control in hybrid drive-train topologies, Fuel efficiency analysis.

Module 4: Electric Propulsion Unit (8 Lectures):

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives.

Module 5: Energy Storage (8 Lectures):

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Hybridization of different energy storage devices.

Text Books

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003

Reference Book

1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004

EEE-462	Advanced Electric Drives	3L:1T:0P	4 Credits	Course Type: PEC

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

COs	Course Outcomes	Bloom's Level
CO1	Understand the operation of power electronic converters for AC drives.	Knowledge, Comprehension Analysis, Synthesis
CO2	Understand the operation and control of induction motor drives.	Knowledge, Application, Analysis
CO3	Understand the operation and control of synchronous motor drives.	Knowledge Application, Analysis
CO4	Understand the operation and control of permanent magnet motor drives.	Knowledge, Application Analysis
CO5	Understand the operation and control of switched reluctance motor drives.	Knowledge, Application, Analysis

Syllabus

Module 1: Power Converters for AC Drives (10 hours)

PWM control of inverter, selected harmonic elimination, space vector modulation, current control of VSI, three level inverter, Different topologies, SVM for 3 level inverter, PWM converter as line side rectifier, current fed inverters with self-commutated devices. Controlof CSI.

Module 2: Induction Motor Drives (10 hours)

Different transformations and reference frame theory, modeling of induction machines,voltage fed inverter control-v/f control, vector control, direct torque and flux control (DTC).

Module 3: Synchronous Motor Drives (8 hours)

Modeling of synchronous machines, open loop v/f control, vector control, direct torquecontrol, CSI fed synchronous motor drives.

Module 4: Permanent Magnet Motor Drives (6 hours)

Introduction to various PM motors, BLDC and PMSM drive configuration, comparison,block diagrams, Speed and torque control in BLDC and PMSM.

Module 5: Switched Reluctance Motor Drives (6 hours)

Evolution of switched reluctance motors; various topologies for SRM drives, closed loopspeed and torque control of SRM.

Text / References:

1. B. K. Bose, “Modern Power Electronics and AC Drives”, Pearson Education, Asia, 2003.
2. P. C. Krause, O. Wasynczuk and S. D. Sudhoff, “Analysis of Electric Machinery and DriveSystems”, John Wiley & Sons, 2013.
3. H. A. Taliyat and S. G. Campbell, “DSP based Electromechanical Motion Control”, CRCpress, 2003.
4. R. Krishnan, “Permanent Magnet Synchronous and Brushless DC motor Drives”, CRCPress, 2009.

Web Reference: Video/Web contents on NPTEL

List of OEC-I

OEE-433	**Non-Conventional Energy Sources**	**3L: 0T: 0P**	**3 Credits**	**Course Type: OEC**

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

COs	Course Outcomes	Bloom's Level
CO1	Able to understand energy, demand and supply issues	Remembering, Understanding
CO2	Able to found energy solutions	Understanding, Applying,
CO3	Demonstrate fundamental understanding of non-conventional resources	Analysing, Evaluating
CO4	Develop the mathematical model of energy systems	Understanding, Analysing, Applying
CO5	Exhibit the knowledge of MHD, Solar and Wind	Understanding, Remembering, Analysing, Applying
CO6	Exhibit the knowledge of Geothermal and OTEC	Remembering, Understanding

Syllabus:

Module 1: Power Situation (7 Lectures):

Power Crisis, future energy demand, role of Private sectors in energy management.

Module 2: MHD generation (7 Lectures):

Working principle, open and closed cycles, MHD systems, advantages, parameters governing power output.

Module 3: Solar Power and Wind Energy (10 Lectures):

Solar power plant: Conversion of solar heat to electricity, Solar energy collectors, Photovoltaic cell, power generation, future prospects of solar energy use, Wind Energy: Windmills, power output with combined operation of wind turbine generation and isolated generating system, technical choices& economic size.

Module 4: Geothermal Energy (8 Lectures):

Earth energy, heat extraction, vapour turbine cycle, difficulties & disadvantages; Tidal energy: Tidal phenomenon, tidal barrage, tidal power Schemes.

Module 5: Ocean Thermal Energy (8 Lectures):Introduction, energy conversion, case studies. Case Studies based on Solar, Wind and GeothermalPower Plants:

Text Books / Reference Books:

1. Sawhney G. S., “Non-Conventional Energy Resources”, Prentice Hall of India.
2. Khan B. H., Non-Conventional Energy Resources, Mc Graw Hill Education 3rd edition.
3. Singal R. K., Non-Conventional Energy Resources, S. K. Kataria & Sons, 2009.
4. Deb Tanmoy, "Electrical Power Generation Conventional and Renewable", Khanna Publisher.
5. Bansal N. K., Non-Conventional Energy Resources, Vikas Publishing House.
6. Saeed S. H. and Sharma D. K., Non-Conventional Energy Resources (2nd Edition), S. K.Kataria & Sons, 2009.

OEE-435	Power Plant Engineering	3L: 0T: 0P	3 Credits	Course Type: OEC

Course Outcomes:

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

COs	Course Outcomes	Bloom's Level
CO1	Able to know about various components of power plants	Remembering, Understanding
CO2	Able to calculate capital costs, operation costs, variousfactors, tariffs, power factor corrections, power output and power plant economics	Understanding, Applying, Analysing
CO3	Evaluating various aspects of power plants , sub-stations, power factor corrections and power plant economics	Analysing, Evaluating
CO4	Understand various aspects of power plant economics and their effects on power plant performance	Understanding, Analysing,
CO5	Able to do basic mechanical and electrical design calculations of some devices of power plants	Understanding, Analysing, Applying
CO6	Able to identify various aspects of non-conventional energy resources	Remembering, Understanding

Syllabus:

Module 1: Introduction, Thermal Power Plant and Hydro Electric Plants (7 Lectures): Introduction, Electric energy demand and growth in India, Electric energy sources; **Thermal Power Plant:** general layout and operation of plant; **Hydro Electric Plants:** general layout andoperation of Plants.

Module 2: Nuclear Power Plant, Gas Turbine Plant and Diesel Power Plant (7 Lectures): Nuclear Power Plant: general layout and operation of plant; Gas Turbine Plant: Operational principle & its efficiency; Diesel Plants: Diesel plant layout, components & their functions.

Module 3: Power Plant Economics and Tariffs (8 Lectures):
Power Plant Economics and Tariffs: Cost of electrical energy, depreciation, generation cost, effect of Load factor on unit cost, Fixed and operating cost of different plants, Objectives and forms of Tariff; Causes and effects of low power factor, advantages of power factor improvement, and different methods for power factor improvements.

Module 4: Sub-stations Layout and Economic Operation of Power Systems (8 Lectures): Types of substations, layout of substation; Economic Operation of Power Systems: Characteristics of steam and hydro-plants, Constraints in operation, Economic load scheduling of thermal plants, Penalty factor.

Module 5: Non-Conventional Energy Sources (10 Lectures): Power Crisis, Role of Private sectors in energy management; **MHD generation:** Working principle, open and closed cycles, advantages; **Solar power plant:** Solar energy collectors, Photovoltaic cell operation; **Wind Energy:** Windmills, power output; **Geothermal Energy:** Earth energy extraction, difficulties & disadvantages; **Tidal Energy:** Tidal phenomenon, tidal power Schemes; **Ocean Thermal Energy:** Introduction, energy conversion.

Text Books

1. B.R. Gupta,"Generation of Electrical Energy", S. Chand Publication.
2. Soni, Gupta & Bhatnagar, "A text book on Power System Engg.", Dhanpat Rai & Co.
3. Sawhney G. S., "Non-Conventional Energy Resources", Prentice Hall of India.

Reference Books

1. W. D. Stevenson, “Elements of Power System Analysis”, McGraw Hill.
2. S. L. Uppal, “Electrical Power”, Khanna Publishers.
3. Khan B. H., “Non-Conventional Energy Resources”, McGraw Hill Education 3rd edition.

List of OEC-II

OEE-444	Industrial Measurements	3L: 1T: 0P	4 Credits	Course Type: OEC

Course Outcomes:

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

COs	Course Outcomes	Bloom's Level
CO1	Able to know about industrial measurements	Remembering, Understanding
CO2	Able to understand and apply knowledge about electrical transducers	Understanding, Applying,
CO3	Demonstrate fundamental understanding of telemetry system	Analysing, Evaluating
CO4	Develop Data Acquisition System	Understanding, Analysing
CO5	Exhibit the knowledge of Display Devices and Recorders	Understanding, Analysing, Applying
CO6	Exhibit the knowledge of computer aided measurements	Remembering, Understanding

Syllabus:

Module 1: Measurement - I (9 Lectures):
Definition, advantages, classification, characteristics, factors affecting the choice of transducers, Potentiometers, Strain gauges, Resistance thermometer, Thermistors, Thermocouples, LVDT, RVDT.

Module 2: Measurement - II (10 Lectures):
Capacitive, Piezoelectric, Hall Effect and Opto-electronic transducers, Measurement of Motion, Force, Pressure, Temperature, Flow and Liquid level.

Module 3: Telemetry (5 Lectures):
General Telemetry System, Land line & Radio frequency Telemetering system, Transmission Channels and Media, Receiver & Transmitter.

Module 4: Signal Conditioning and Data Acquisition System (6 Lectures):
Signal conditioning, Active Filters, Instrumentation amplifiers, logarithmic amplifiers, Isolation Amplifiers, Analog Data Acquisition System and Digital Data Acquisition System.

Module 5: Display Devices and Recorders (10 Lectures):
Display devices, storage oscilloscope, spectrum analyzer, strip chart & X-Y recorders, Magnetic tape & Digital tape recorders. Recent Developments: Computer aided measurements, Fibre optic transducers, Microprocessors, smart sensors, smart transmitters.

Text Books / Reference Books

1. A. K. Sawhney, “Advanced Measurements & Instrumentation”, Dhanpat Rai & Sons
2. B.C. Nakra & K.Chaudhry, “Instrumentation, Measurement and Analysis”, Tata Mc Graw Hill
3. Curtis Johns, “Process Control Instrumentation Technology”, Prentice Hall
4. E.O. Decblin, “Measurement System – Application & design”, Mc Graw Hill.
5. Rajendra Prasad,”Electronic Measurement and Instrumentation Khanna Publisher.
6. M.M.S. Anand, “Electronic Instruments and Instrumentation Technology” PHI Learning.

OEE-446	Industrial Control Systems	3L: 1T: 0P	4 Credits	Course Type: OEC

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

COs	Course Outcomes	Bloom's Level
CO1	Able to understand industrial issues related to the control system	Remembering, Understanding
CO2	Able to control solutions	Understanding, Applying,
CO3	Demonstrate fundamental understanding of optimal control	Analysing, Evaluating
CO4	Exhibit the knowledge of Digital Computer Based ControlSystems	Understanding, Remembering, Analysing,Applying
CO5	Exhibit the knowledge of Microprocessor and Microcontroller Based Control Systems	Understanding, Applying remembering, Analysing
CO6	Exhibit the knowledge of Artificial Intelligence Based Control Systems	Understanding, Remembering, Analysing, Applying

Syllabus

Module 1: Introduction (6 Lectures):

Design specifications of second order systems: Derivative error, derivative output, integral errorand PID compensations, design considerations for higher order systems, performance indices.

Module 2: Optimal Control (9 Lectures):

Introduction, formation of optimal control problem, calculus of variations minimization of functions, constrained optimization, Pontryagin's Minimum Maximum Principle, Linear Quadratic Problem-Hamilton Jacobi equation, Riccati equation and its solution.

Module3: Digital Computer Based Control Systems (10 Lectures):

Digital Computers: General architecture and brief description of elements, instruction execution, instruction format, and instruction set, addressing modes, programming system, higher level languages, Buses and CPU Timings: Bus size and signals, machine cycle timing diagram,instruction timing, processor timing, Controller design.

Module 4: Microprocessor and Microcontroller Based Control Systems (8 Lectures):

Evolution of Microprocessor and Microcontroller, Microprocessor and Microcontroller architecture and its operations, memory, inputs-outputs (I/Os), Data transfer schemes interfacing devices, Controller Design.

Module 5: Artificial Intelligence Based Control Systems (7 Lectures):

Fuzzy Logic, Neural Networks, Genetic Algorithm, AI based Controller Design.

Text Books

1. Uffenbeck, John, Microcomputers and Microprocessors, PHI/ 3rd Edition.
2. Yaduvir Singh & S. Janardhanan, Modern Control Engineering, Cengage Learning.
3. S. Rajsekaran & G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and GeneticAlgorithm: Synthesis and Applications, Prentice Hall of India.

Reference Books

1. Liu and Gibson G.A., "Microcomputer Systems: The 8086/8088 Family" Prentice Hall (India)
2. K. Ogata, "Modern Control Engineering", Prentice Hall of India.
3. B.C. Kuo & Farid Golnaraghi, "Automatic Control System" Wiley India Ltd.