R.K.D.F. UNIVERSITY, BHOPAL
B.E.(Electrical & Electronics Engineering)
SECOND YEAR- **Semester – III**
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	**Environmental Engineering**	**EX- 3011**	**4L-0T-0P**	**4**

Course Outcomes:

CO1 Convey a clear idea of the interdisciplinary nature of environmental and health risk assessment. Understand how each discipline of CEE maps into the society and the world market in the realm of environmental issues

CO2 Understand how each discipline of CEE maps into the society and the world market in the realm of environmental issues.

CO3 The ability to apply the fundamental knowledge of science and engineering to assess environmental and health risk.

CO4 Understand what is life-time learning and how does it contribute to advancements of career.

CO5 Ability to understand environmental laws and regulations to develop guidelines, procedures and processes for health and safety issues.

CO6 Understand what are professional ethics and how do ethics affect the outcomes of environmental laws and regulations.

CO7 Understand professionalism, ethics, and environmental laws and regulations.

CO8 Understand about life-long learning, and current global and contemporary issues in environmental and health risk assessment.

Course Contents:

Unit-I

Ecosystem – Principles of ecology, ecosystem concept: Biotic and biotic components of ecosystem, Segments of Environment: Atmosphere, hydrosphere, Lithosphere, biosphere. Biodiversity: Threats and conservation, Food Chain.

Unit –II

Energy General idea about: Natural Resources , current status and types of resources Non Renewable Sources of energy, coal, oil, Gas, Hydrogen, nuclear sources

Unit –III

Air Pollution & Sound Pollution - Air Pollution: Air pollutants, classification, (Primary & secondary Pollutants) Adverse effects of pollutants. Causes of Air pollution Environmental problems, (Global

warming, ozone depletion and acid rain) General idea about forest ecosystem, grassland ecosystem, wetland ecosystems and aquatic Biogeochemical Cycling: Oxygen cycle, Carbon cycle, Nitrogen cycle, Sculpture cycle and water cycle.

Unit –IV

Water Pollution– Water Pollution: Pollutants in water, adverse effects. Treatment of Domestic & Industrial water effluent.

Soil Pollution – Soil Profile, Pollutants in soil, their adverse effects, controlling measures.

Unit –V

Society & Ethics – Impact of waste on society. Solid waste management (Nuclear, Thermal, Plastic, medical, Agriculture, domestic and e-waste). Ethics and moral values, ethical situations, water preservation rain water collection. Environmental Impact Assessment.

References:

1. Harris, CE, Prichard MS, Rabin's MJ, "Engineering Ethics"; Cengage Pub.
2. Rana SVS ; "Essentials of Ecology and Environment"; PHI Pub.
3. Raynold, GW "Ethics in information Technology"; Cengage.
4. Svakumar; Energy Environment & Ethics in society; TMH
5. AK De "Environmental Chemistry"; New Age Int. Publ.
6. BK Sharma, "Environmental Chemistry" ; Goel Publ. House

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SECOND YEAR- **Semester – III**

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	Electromagnetic Fields	EX – 3021	4L-0T-0P	4

Course Outcomes:

CO1 Explain fundamental laws governing electromagnetic fields and evaluate the physical quantities of electromagnetic fields (Field intensity, Flux density etc.) in different media using the fundamental laws.

CO2 Define and recognize different co-ordinate systems to describe the spatial variations of the physical quantities dealt in electromagnetic field theory as they are functions of space and time. Apply different techniques of vector calculus to understand different concepts of electromagnetic field theory.

CO3 Solve Laplace's & Poisson's equations, solution of Laplace's equation.

CO4 Determine the electromagnetic force exerted on charged particles, current elements, working principle of various electric and electromagnetic energy conversion devices are based on this force.

CO5 Design electromagnetic energy storage devices like capacitor, inductor which are frequently used in electrical systems and choose suitable materials required to assemble such electromagnetic energy storage devices..

CO6 Deduce and justify the concepts of electromagnetic waves, means of transporting energy or information, in the form of radio waves, TV signals, radar beams and light rays.

CO7 Generalize the concepts of guided structures like transmission line, means of transporting energy or information, commonly used in power distribution and communication.

CO8 Explain Biot-Savart's law,Faraday's Law

Course Contents:

UNIT I

STATIC ELECTRIC FIELDS

Cartesian, cylindrical & spherical co-ordinate systems, scalar & vector fields, gradient, divergence & curl of a vector field, Divergence theorem & Stokes's theorem, concept of vectors. Coulomb's law – Electric field intensity – Field due to different types of charges – Stream lines and sketches of fields – Electric flux density – Gauss law and its application to symmetrical charge distributions – Gauss law applied to differential volume element – Concept of divergence – electric potential – Potential field due to different types of charges – Potential gradient – the dipole – field due to dipole – Energy density in electrostatic field.

UNIT II

CONDUCTORS, DIELECTRICS AND CAPACITANCE

Laplace's & Poisson's equations, solution of Laplace's equation, Electric dipole, dipole moment, potential & electric field intensity due to dipole, Behavior of conductors in an electric field. Conductor & insulator, electric field inside a dielectric, polarization, Boundary value conditions for electric Field, Capacitance & Capacitances of various types of capacitors, Energy stored and energy density in static electric field, Current density, conduction & convection current density ohms law in point form, equation of continuity.

UNIT III

STEADY MAGNETIC FIELDS

Static Magnetic Field, Biot-Savart's law, Magnetic Field intensity due to straight current carrying filament, circular, square and solenoid current carrying wire, Relationship between magnetic flux, flux density & magnetic Field intensity; Ampere's circuital law and its applications, magnetic Field intensity due to infinite sheet and various other configurations, Ampere's circuital law in point form, Magnetic force, moving charge in a magnetic field, Lorentz Force on straight and long current carrying conductors in magnetic field, force between two long & parallel current carrying conductors. Magnetic dipole & dipole moment, a differential current loop as dipole, torque on a current carrying loop in magnetic field, Magnetic Boundary conditions.

UNIT IV

MAXWELLS EQUATIONS AND SCALAR, VECTOR PROPERTIES

Faraday's Law, transformer & motional EMFs, Displacement current, Maxwell's equations as Generalization of circuit equations, Maxwell's equation in free space, Maxwell's equation for harmonically varying Field, static and steady fields, Maxwell's equations in differential & integral form. Scalar magnetic potential and its limitations, Vector magnetic potential and its properties, vector magnetic potential due to different simple configurations; Self and Mutual inductances, determination of self & mutual inductances, self inductance of solenoid, toroid coils, mutual inductance between a straight long wire & a square loop. Energy stored in magnetic Field & energy density,

UNIT V

ELECTRO MAGNETIC WAVES

Uniform plane wave in time domain in free space, Sinusoidally time varying uniform plane wave in free space, Wave equation and solution for material medium, Uniform plane wave in dielectrics and conductors, Pointing Vector theorem, instantaneous, average and complex poynting vector, power loss in a plane conductor, energy storage, Polarization of waves, Reflection by conductors and dielectric – Normal & Oblique incidence, Reflection at surface of a conducting medium, surface impedance, transmission line analogy.

References:

1. Mathew N.O Sadiku; Elements of Electromagnetic; Oxford.
2. P.V. Gupta; Electromagnetic Fields; Dhanpat Rai.
3. N.N. Rao; Element of Engineering Electromagnetic; PHI.
4. William H. Hayt; Engineering Electromagnetic; TMH.
5. John D. Kraus; Electromagnetic; TMH.
6. Jordan Balmian; Electromagnetic wave & Radiating System; PHI.

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SECOND YEAR- **Semester – III**

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	**Electrical Measurement and Measuring Instruments**	**EX- 3031**	**4L-0T-2P**	**6**

UNIT I

Course Outcomes:

CO1 Understand about different instruments that are used for measurement purpose.

CO2 Analyze the Performance characteristics of each instrument.

CO3 Understand about different types of signal generators and recorders.

CO4 Understand how different physical parameters and there co-relation with measuring Instrument.

CO5 Internal and general repairing of instruments and problem solving capacity.

CO6 Perform the experiments on pH-metry, Potentiometry, Conductometry, Colorimetry and chromatography as well as to analyze and interpret the data to address issues related to engineering problems.

CO7 Knlowdege about Dynamometer type wattmeter – induction type energymeter- 1 phase & 3 phase.

CO8 Acquire the Principle of operation and construction of PMMC, MI, Dynamometer.

Course Contents:

MEASUREMENT OF R,L,C

Functional elements of an instrument – static and dynamic characteristics – Errors in measurement. Measurement of R, L, C – Wheatstone, Kelvin's double, Maxwell, Anderson and Schering bridges. Measurement of high resistance – Megger – loss of charge method.

UNIT II

MEASURING INSTRUMENTS

Principle of operation and construction of PMMC, MI, Dynamometer, Induction, Thermal and Rectifier type instruments – Measurement of voltage and current – use of ammeter shunts and voltmeter multiplier – Use of CT and PT for extending instrument ranges.

UNIT III

MEASUREMENT OF POWER AND ENERGY

Dynamometer type wattmeter – induction type energy meter- 1 phase & 3 phase – errors and compensation – energy meter calibration by direct and phantom loading – Maximum demand indicator – Measurement of reactive power – Trivector meter.

UNIT IV

MEASUREMENT OF FREQUENCY,POWER FACTOR AND PHASE SEQUENCE

Frequency meters – Power factor meter - 1 phase & 3 phase – Synchroscope – Phase sequence indicator. Magnetic tape recorders – Stripchart recorder – X-Y recorder – Cathode Ray Oscilloscope – block diagram – CRT – Dual Trace oscilloscope.

UNIT V

ELECTRONIC INSTRUMENTS

Electronic voltmeters – Digital voltmeter – Multimeter – Signal generator – Function generator. Classification of transducers – resistive, capacitive and inductive – piezoelectric transducer – strain gauges – LVDT – thermoelectric – piezoelectric. Transducers for measurement of displacement – temperature – pressure – velocity.

LIST OF EXPERIMENTS (EXPANDABLE):

1. Measurement of low resistance using Kelvin's Double bridge
2. Measurement of medium resistance using Wheatstone's bridge
3. Measurement of high resistance by loss of charge method
4. Measurement of Insulation resistance using Megger
5. Measurement of earth resistance by fall of potential method and verification by using earth tester
6. Measurement of power in a single phase ac circuit by 3 voltmeter/ 3 Ammeter method
7. Calibration of a dynamometer type of wattmeter with respect to a standard/Sub Standard wattmeter
8. Calibration of a induction type single phase energy meter
9. Calibration of a dynamometer type of wattmeter by Phantom Loading method

TEXT BOOKS

1. Golding, EW. & Widdies, FW. *Measurements & Measuring instruments*, Sir Issar Pitman & sons (P)Ltd. 1998.
2. A.K. Sawhney; Electrical & Electronic Measurements & Instrument; Dhanpat Rai & Sons Pub.
3. Albert D Half ride & William D Cooper, *Modern Electronic instrumentation and measurement techniques*, Prentice Hall of India Pvt Ltd. 1998.

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SECOND YEAR- **Semester – III**
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	**Network Analysis**	EX – 3041	**3L-1T-2P**	**6**

Course Outcomes:

CO1 Introduction to LLBP circuit elements R,L,C

CO2 Select a suitable measuring instrument for a given electrical machine.

CO3 Conduct experimental investigation and gain knowledge of Filter circuit.

CO4 Solve the Laplace Transform and Inverse Laplace Transform.

CO5 Analyze the response of Step, Ramp, Impulse, Sinusoidal, Cosinusoidal, Exponential, and Gate signals.

CO6 Perform the experiments on Network Theorems – Thevenins & Norton's theorem, superposition, reciprocity, compensation, maximum power transfer and Millman's theorem

CO7 Solve the two port network analysis.

CO8 Concept of phasor & vector, impedance & admittance. Node & mesh analysis of RL,RC and RLC networks with sinusoidal and other driving sources.

Course Contents:

UNIT I

Introduction to DC and AC circuits, Active and passive two terminal elements. Ohms law, Voltage-Current relations for resistor, inductor, capacitor. Introduction to LLBP circuit elements R,L,C and their characteristics in terms of Linearity & time dependent nature, KCL and KVL analysis dual networks analysis of magnetically coupled circuits Dot convention, coupling co-efficient, Tuned circuits. Series & parallel resonance voltage & current sources, controlled sources

UNIT II

Network topology, concept of Network graph, Tree, Tree branch & link, Incidence matrix, cut set and tie set matrices. Network Theorems – Thevenins & Norton's theorem, superposition, reciprocity, compensation, maximum power transfer and Millman's theorem, problems with controlled sources.

UNIT III

Transient analysis Transients in RL, RC & RLC Circuits initial conditions, time constants. Network driven by constant driving sources & their solutions. Steady state analysis - Concept of phasor & vector, impedance & admittance. Node & mesh analysis of RL,RC and RLC networks with sinusoidal and other driving sources.

UNIT IV

Frequency domain analysis – Laplace transform solution of Integro differential equations. Transform of Waveform – synthesized with step ramp, Gate and sinusoidal functions. Initial & final value theorem. Network Theorems in transform domain. Concept of signal spectra, Fourier series co-efficient of a periodic waveform. Waveform symmetries. Trigonometric and Exponential form of Fourier series, steady state response to periodic signals.

UNIT V

Network function & Two port networks – concept of complex frequency, port. Network functions of one port & two ports, poles and zeros network of different kinds. Two port parameters – Z,Y, chain parameters relationship between parameters. Interconnection of two ports. Terminated two port network.

List of experiments (Expandable):

1. To Verify Thevenin Theorem.
2. To Verify Superposition Theorem.
3. To Verify Reciprocity Theorem.
4. To Verify Maximum Power Transfer Theorem.
5. To Verify Millman's Theorem.

References:

1. M.E. Van Valkenburg, Network Analysis, (PHI)
2. F.F.Kuo, Network Analysis.
3. Mittal GK; Network Analysis; Khanna Publisher
4. Mesereau and Jackson; Circuit Analysis- A system Approach; Pearson.
5. Sudhakar & Pillai; Circuit & Networks- Analysis and Synthesis; TMH
6. Hayt W.H. & J.E. Kemmerly; Engineering Circuit Analysis; TMH
7. Decarlo lin; Linear circuit Analysis; Oxford
8. William D Stanley : Network Analysis with Applications, Pearson Education
9. Roy Choudhary D; Network and systems; New Age Pub
10. Charles K. Alexander & Matthew N.O. Sadiku: Electrical Circuits :TMH
11. Chakraborti :Circuit theory: Dhanpat Rai
12. B.Chattopadhyay & P.C.Rakshit; Fundamental of Electrical circuit theory; S Chand
13. Nilson & Riedel , Electric circuits ;Pearson

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Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	**Value Education**	**EX - 3051**	**4L-0T-2P**	**6**

Course Outcomes:

CO1 To teach and inculcate the importance of value based living

CO2 To give students a deeper understanding about the purpose of life.

CO3 To teach and inculcate the essential qualities to become a good leader.

CO4 understand the importance of value based living

CO5 understand and start applying the essential steps to become good leaders.

CO6 emerge as responsible citizens with clear conviction to practice values and ethics in life.

CO7 To teach the students on being tolerant and to adjust with family, friends and society through case studies.

CO8 To motivate students to prove that the character building is important for value based living through Debates / Testimonies.

Course Contents:

Chapter 1

Concepts of Values-Definition and Types of values –The need for Education in values-Challenges for Value adoption-Character development-Vision of a better world

Chapter 2

Inculcation of values

Classification of values- Personal Values-Family Values-Social Values-Spiritual values-Benefits of value adoption

Chapter3

Values for Professional Excellence

Definition-Purpose-implementation-situations to adopt-reflectionquestions-quotable quotes of Active listening- Decision making-Determination-Perseverance-Discipline-Responsibility

Chapter 4

Business ethics

Ethics and Entrepreneurship- Professional Ethics –Ethical choices- Resolving Ethical Dilemmas- Leadership and Social Responsibility- Corporate Social Responsibility

Chapter 5

Quality of Life Dealing with change-Trends, Organizations and the Individual-Self and the world-Quality from within-Relating to others-The dynamics of personal powers

Chapter 6

Exploring the self True Identity-Anatomy of the self-The cyclic processes within the self-States of the awareness-Innate and Acquired qualities-Empowering the self

Chapter 7

Understanding Self-Esteem
Know self-esteem-Understanding the self-Components of self-esteem**-Association with self-esteem-Levels of self-esteem-Reflection exercises**

Chapter 8

Principles of living
Be introspective-Be an observer-Being optimistic-Appreciate differences-Don't compare yourself with others- Live at present

Chapter 9

Practical Meditation
Why meditate?-Soul consciousness-The supreme-Karma-Timeless dimension-The eight powers

Chapter 10

Exercises for Practice
Quiet reflection- Practice introversion-Being an observer-Stand back and observe -Self awareness (Soul consciousness)-Experiencing Body free stage-Reflect on original qualities-Visualize the Divine-Think attributes of the Supreme-Developing a living relationship-Surrender to God-Create Good wishes for all-Visualization in Meditation: Orbs of Light- The forest-The Balloon.

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Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	**ELECTRICAL WORKSHOP**	EX – 3061	**0L-0T-2P**	**2**

Course Outcomes:

Impart a basic knowledge of electrical quantities such as current, voltage, power, energy and frequency to understand the impact of technology in a global and societal context. 1. Provide working knowledge for the analysis of basic DC and AC circuits used in electrical and electronic devices.

LIST OF EXPERIMENTS

1. INTRODUCTION OF TOOLS, ELECTRICAL MATERIALS, SYMBOLS AND ABBREVIATIONS.

2. TO STUDY STAIR CASE WIRING.

3. TO STUDY HOUSE WIRING i.e, BATTEN, CLEAT, CASING-CAPING AND CONDUIT WIRINGS.

4. TO STUDY FLUORESCENT TUBE LIGHT.

5. TO STUDY CIRCUIT OF SMPS.

6.TO STUDY MOVING IRON, MOVING COIL, ELECTRODYNAMIC AND INDUCTION TYPE METER.

7. TO STUDY CIRCUIT AND WORKING OF UPS.
8. TO STUDY CIRCUIT AND WORKING OF HOME INVERTER.

9. TO STUDY FUSES MCBS AND IMPORTANCE OF EARTHING.

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Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	Engineering Mathematics-III	BE.- 4011	3L-1T-0P	4

Course Outcomes:

CO1 **Find** Laplace Transform of periodic functions, Dirac delta function and solve differential equations, integral equations and integro- differential equations and can analyze the solution. **Expand** the function in Fourier series and half range. Also Find Fourier transform and Fourier Integral and solve Integral equations.

CO2 **Analyse** solutions of partial differential equations and solve the initial value and boundary value problems. Extremis the functional and also solve Isoperimetric problems.

CO3 **Understand** Principle of operation and characteristics, biasing arrangements of Field effect transistors and MOSFETs and types of oscillator.

CO4 **Evaluate** conversion of numbers from one code to other code, logic gates and truth table of digital circuits.

Course Contents:

Unit-I

Fourier series: Introduction of Fourier series, Fourier series for Discontinuous functions, and Fourier series for even and odd function. Laplace Transform: Introduction of Laplace Transform, Laplace Transform of elementary functions, properties of Laplace Transform, Change of scale property, second shifting property, Laplace transform of the derivative, Inverse Laplace transform & its properties, Convolution theorem, Applications of L.T. to solve the ordinary differential equations.

Unit- II

Difference Operators, Interpolation (Newton Forward & Backward Formulae, Central Interpolation Formulae, Lagrange's and divided difference formulae), Numerical Differentiation and Numerical Integration.

Unit –III

Errors & Approximations, Solution of Algebraic & Trancedental Equations (Regula Falsi, Newton-Raphson, Iterative, Secant Method), Solution of simultaneous linear equations by Gauss Elimination, Gauss Jordan, Crout's methods , Jacobi's and Gauss-Siedel Iterative methods.

Unit –IV

Solution of Ordinary Differential Equations (Taylor's Series, Picard's Method, Modified Euler's Method, Runge-Kutta Method, Milne's Predictor & Corrector method), Correlation and Regression, Curve Fitting (Method of Least Square). **Society & Ethics –** Impact of waste on society. Solid waste management (Nuclear, Thermal, Plastic, medical, Agriculture, domestic and e-waste). Ethics and moral values, ethical situations, water preservation rain water collection. Environmental Impact Assessment.

Unit –V

Concept of Probability: Probability: Binomial, Poisson's, Continuous Distribution: Normal Distribution, Testing of Hypothesis |: Students t-test, Fisher's z-test, Chi-Square Method.

Reference Books :

(i) Higher Engineering Mathematics by BS Grewal, Khanna Publication

(ii) Advance Engineering Mathematics by D.G.Guffy

(iii) Mathematics for Engineers by S.Arumungam, SCITECH Publuication

(iv) Engineering Mathematics by S S Sastri. P.H.I.

(v) Numerical Methods for Scientific and Engg. Computation by MKJain, Iyengar and RK Jain, New Age International Publication

(vi) Mathematical Methods by KV Suryanarayan Rao, SCITECH Publuication

(vii) Pobability and Statistics by Ravichandran, Wiley India

(viii) Mathematical Statistics by George R., Springer

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Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	**ELECTRICAL MACHINE-I**	**EX- 4021**	**3L-1T-2P**	**6**

Course Outcomes:

CO1 Formulate and then analyze the working of any electrical machine using mathematical model Under loaded and unloaded conditions.

CO2 Understand and explain the principle of operation and performance of Induction Machine, Synchronous Machines and Fractional kW Motors

CO3 Analyze the response of Induction Machine, Synchronous Machines and Fractional kW Motors.

CO4 Troubleshoot the operation of Induction Machine, Synchronous Machines and Fractional kW Motors

CO5 Analyze given require specification of electrical machine and select a suitable measuring instrument for a given application

CO6 Select the suitable specification of machine for different purpose

CO7 To expose the students to the concepts of various types of electrical machines and applications of electrical machines in electric power engineering and electric drives. 5. To analyze power

CO8 Requirements, power capability, efficiency, operating characteristics, control requirements and electrical demands of these machines

Course Contents:

UNIT I

ELECTRO MAGNETIC INDUCTION & BASIC CONCEPTS IN ROTATING MACHINES
Introduction to magnetic circuits – Magnetically induced e.m.f and force – AC operation of magnetic circuits –Hysteresis and Eddy current losses. Energy in magnetic systems – Field energy & mechanical force – Single and Multiple excited systems. MMF of distributed windings – Magnetic fields in rotating machines – Generated voltages – Torque.

UNIT II

DC GENERATORS
Constructional features of DC machine – Principle of operation of DC generator – EMF equation – Types of excitation – No load and load characteristics of DC generators – commutation – armature reaction – Parallel operation of DC generators.

UNIT III

DC MOTORS
Principle of operation of DC motors-Back emf – Torque equation –Types of DC motors-Speed – Torque characteristics of DC motors – Starting of DC motors: 2 point starter, 3 point starter, 4 point starter – Speed control – Losses and efficiency –Applications

UNIT IV

TRANSFORMERS
Principle of operation – Constructional features of single phase and three phase transformers – EMF equation – Transformer on No load and Load –Phasor diagram --equivalent circuit – Regulation - three phase transformer connections-parallel operation of single phase and three phase transformer- Auto transformers

UNIT V

SINGLE PHASE INDUCTION MOTOR
Single phase induction motors – Double revolving field theory – Torque – Speed characteristics – Equivalent circuit – No load and Blocked rotor test - Performance analysis – Starting methods of Single phase motors – Special motors: shaded pole motor, reluctance motor, repulsion motor, linear induction motor.

Text Books:
1. Electrical Machines by Nagrath and Kothari (TMH).
2. A.C. Machines by Langs dorf (McGraw-Hill)
3. Electrical Machines by Dr.P.S.Bimbhra (Khanna).
4. Electrical Machines by Ashfaq Hussain. (Dhanpat Rai).
List of Experiments (expandable)

Experiments can cover any of the above topics, following is a suggestive list:

1. Perform turn ratio and polarity test on 1-phase transformer
2. Perform load test on a 1-phase transformer and plot its load characteristic
3. Perform OC and SC tests on a 1-phase transformer and determine its equivalent circuit. Also find its Efficiency and regulation at different load and power factor.
4. Perform OC and SC tests on a 3-phase transformer and determine its equivalent circuit. Also find its Efficiency and regulation at different load and power factor.
5. Perform Sumpner's test on two 1-phase transformer and determine its efficiency at various load.
6. Perform No-load and block rotor test on a 3- phase IM and determine its equivalent circuit.
7. Perform load test on a 3- phase IM and plot its performance characteristics.
8. Study various types of starters used for 3- IMs.
9. Perform No-load and block rotor test on a 1- phase IM and determine its equivalent circuit.

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Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EE	Digital Electronics	EE - 4031	4L-0T-2P	6

Course Outcomes:

CO1 **Convert** different type of codes and number systems which are used in digital communication and computer systems.

CO2 **Employ** the codes and number systems converting circuits and Compare different types of logic families which are the basic unit of different types of logic gates in the domain of economy, performance and efficiency.

CO3 **Analyze** different types of digital electronic circuit using various mapping and logical tools and know the techniques to prepare the most simplified circuit using various mapping and mathematical methods.

CO4 **Design** different types of with and without memory element digital electronic circuits for particular operation, within the realm of economic, performance, efficiency, user friendly and environmental constraints.

Course Contents:

Unit-I

Number Systems and Codes : Digital number systems, base conversion, Binary, Decimal, octal, Hexadecimal, number system with radix r, Gray codes. Alphanumeric codes – ASCII code and EBCDIC codes, Hollerith code, concept of parity, complement's & (r-1)'s, subtraction with complements, signed Binary numbers, Error Detecting &Correcting codes. Basic Theorems & Properties of Boolean Algebra: AND, OR, NOT operators, laws of Boolean Algebra, Demorgon's theorem, Boolean expression & logic diagram. Negative logic, Alternate logic gate representation (concept of bubbled gates) canonical and standard Forms (Minterms & Maxterms), sum of minterms & product of maxterms, conversion between canonical forms. Truth table & maps, 2,3,4,5 and 6 variable maps, Solving digital problems using Maps, Don't care conditions, Tabular minimization. Sum of product & product of sum reduction, Exclusive OR &Exclusive NORcircuits, Parity generator & checkers.

Unit- II

Combinational Circuits : Design procedure, Adders (half and Full), sub tractor (half and full) code

convertors, Analysis of design, Universal building blocks, Implementation of any logic circuit with only NAND gates or with only NOR gates, Binary serial adder, parallel adder, serial/parallel adder, look ahead carry generator, BCD adder, Binary multiplier, Magnitude comparator, Decoder,Demultiplexer, Encoders, priority encoder, Multiplexers & implementation of combinational logic diagram, HDL for combinational circuit.

Unit –III

Sequential Logic Circuit : Latches, SR latch with NAND & NOR gates, D latch, edge triggered flip flop, J-K flip flop, T flip flop, Master slave flip flop, Analysis of clocked sequential circuit, state table, state diagram, state reduction state equations, state assignments, flip flop excitation table &characteristic equations, Design procedure for sequential circuits, Design with state reduction, Applications of flip flop.

Unit –IV

Registers and Counters : Asynchronous and Synchronous counter, counters with MOD numbers, Down counter, UP/DOWN counter, propagation delay in ripple counter, programmable counter, Pre-settable counter, BCD counter, cascading, counter applications, Decoding in counted coding glitches, Ring Counter, Johnson counter, Rotate left & Rotate right counter, Registers – Buffer, Shift left, shift right, shift left/Right registers, parallel in parallel out, serial in seout, parallel in serial out, serial in parallel out registers.

Unit- V

Random Access Memory, Timing waveform, Memory Decoding, Internal Construction, Coincident decoding, Address multiplexing, Read only memory – Combinational circuit Implementation, Type of ROMs, combinational PLDs, Programmable Logic Array (PLA), Programmable Array Logic (PAL), sequential programmable device. Analog to digital conversion Ramp type, dual slope, integration, successive approximation, parallel conversion, parallel/ serial conversion, convertor specifications, Digital to Analog convertors – Binary weighted & R/2R D to A convertors.

List of Practical

1. Verification of all the logic gates.
2. Design of BCD to Excess-3 code converter.
3. Implementation of NAND & NOR as Universal gate.
4. Design of RS, JK, T& D Flip flop.
5. Multiplexer /Demultipexer based boolean function
6. Design of combinational circuit for the (i) Half adder (ii) Full adder (iii) Half subtractor (iv) Full subtractor
7. Design various A-D & D-A convertors.

Reference Books :

1.Mano; Digital design; Pearson Education Asia

2. Thomas Blakeslee; Digital Design with standard MSI and LSI; Wiley Interscience

3. Jain RP; Modern digital electronics; TMH

4. M.Mano; Digital logic & Computer Design; PHI

5. Tocci ; Digital Systems Principle & applications; Pearson Education Asia

6. Gothmann; Digital Electronics; PHI

7. R.H.Gour; Digital Electronics and Micro Computer - (Dhanpat Rai)

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Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	**Electrical Engineering Drawing**	**EX- 4041**	**4L-0T-2P**	**6**

Course Outcomes:

CO1 Electrical Drawing Is An Important Engineering Subject Taught To Electrical / Electronic Engineering Students Both At Degree And Diploma Level Institutions. The Course Content Generally Covers Assembly And Working Drawings Of Electrical Machines And Machine Parts, Drawing Of Electrical Circuits,

CO2 Learning how to draw the shapes, angels and lines and others which is essential for engineer.

CO3 The ability to read and understand information contained on drawings is essential to perform most engineering-related jobs

CO4 Engineering drawings are the industry's means of communicating detailed and accurate information on how to fabricate, assemble, troubleshoot, repair, and operate a piece of equipment or a system

CO5 Importance of Engineering Drawing Technical drawing allows efficient communication among engineers and can be kept as a record of the planning process. Since a picture is worth a thousand word

CO6 Learning the main idea from assembly and detail drawing.

CO7 Technical drawing is essential for communicating ideas in industry and engineering. To make the drawings easier to understand, people use familiar symbols, perspectives, units of measurement, notation systems, visual styles, and page layout. Technical drawings are understood to have one intended meaning.

CO8 Get information about the important tools for engineering drawing. This will give student basic knowledge of technical drawings professions and means of communications to others.

Course Contents:

UNIT-I

Introduction to general purpose graphics software, AutoCAD, plotting techniques, coordinate systems, line Drawings, polygon and circle generation, drawing entity commands of computer drafting. Sectional and Dimensional drawing using computer.\

UNIT-II

Conventional Symbols and brief introduction to electrical equipment's and electronic devices, measuring Instruments, parts of MI and MC instruments.

UNIT-III

Sectional drawing of different types of Cables, overhead conductors, wiring systems, domestic, staircase and Godown wiring, wiring installation in small residences.

UNIT-IV

Mounting and types of enclosures for electric motors, types of transformer and their parts, core construction, Sectional view of 1-phase and 3-phase transformers, H.T and L.T windings. DC machine and its parts, Construction of pole, yoke and field coils, commentator and its details.

UNIT-V

Sketches of transmission line structures, types of towers, insulating equipment's, single line diagram of power
Sub-station.

List of Practical

1. To design transformer.
2 To design ac winding
3. Introduction to laboratory measuring instruments and their application
4. To Understand the Name plate Data of Electrical Machine

Reference Books:

1. Electrical Drawing -K.L.Narang
2. Engineering Drawing - N.D.Bhatt
3. Engineering Drawing with AutoCAD - T.Jayapoorva
4. Electrical Engineering Drawing (Part I & II) - Surjit singh

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SECOND YEAR- **Semester – IV**

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	**POWER SYSTEM-I**	**EX-4051**	**4L-0T-2P**	**6**

Course Outcomes:

CO1 Gain the knowledge on Steady State, Transient and Voltage Stability aspects.Acquire in-depth advance knowledge in the domain of modern and industrial oriental power systems.

CO2 Analyze the given power system network with respect to stability point of view ,Critically analyze various power systems components, models and their operation, optimization of cost criteria

CO3 Fundamentals and concepts to analyze, formulate and solve complex problems of electrical power systems and its components and control of frequency and voltages

CO4 Use advanced techniques, skills and modern scientific and engineering tools for professional practice for power system to enhanced power quality, reliability, security and load ability.

CO5 To prepare graduates who have the ability to identify and address current and future problems in the domain of power systems, power electronics and electrical machines

CO6 Power Systems in Restructured Environment; Distributed and Dispersed Generation; Environment Aspects of Electric Power Generation

CO7 Reactive Power Sensitivity and Voltage Control; Load Compensation with Capacitor Banks; Line Compensation with Reactors; Shunt and Series Compensation; Fixed Series Capacitors; Thyristor Controlled Series Capacitors

CO8 Impart the knowledge of generation of electricity based on conventional and non-conventional energy sources.

Course Contents:

UNIT-I

Electrical Design of Lines:
Layout of different transmission and distribution systems, advantages of high voltage transmission, concept of Short, medium and long lines, parameters of lines, performance of short lines (Regulation, efficiency, vector Diagrams) corona formation and its effects on performance of lines.

UNIT-II

Transmission Systems:
Various systems of transmission & their comparison, HVDC transmission Converter, inverter, filters & substation Layout. Voltage and Reactive Power control. Types of supports, types of conductors, types of insulators, their Properties, selection and testing, voltage distribution of string insulators, equalization of potential. Vibration Dampers various system of transmission & their comparison, HVDC transmission Converter, inverter, filters & Substation layout. Voltage and Reactive Power control.

UNIT-III

Distribution System
Distribution System Distribution Systems: Primary and secondary distribution systems, concentrated & Uniformly distributed loads on distributors fed at one and both ends, ring distribution, sub mains and tapered Mains, voltage drop and power loss calculations, voltage regulators, Feeders Kelvin's law and modified Kelvin's
Law for feeder conductor size and its limitations.
Construction of Distribution Lines: Erection of pole, fixing of insulators on conductors, testing, operation and Maintenance of lines.

UNIT IV

Overhead Transmission Lines: Types of Conductors, Line Parameters: calculation of inductance and Capacitance of single and double circuit transmission lines, three phase lines with stranded and bundle conductors, Generalized ABCD constants and equivalent circuits of short, medium & long lines. Line Performance: circle Diagram, regulation and efficiency of short, medium and long lines, Series and shunt compensation, FACTS.

UNIT V

Underground Cables: Classification, Construction and characteristic of different types. Insulation resistance and Capacitance, grading (capacitance and inter sheath), laying, jointing and splicing of cables. Phenomenon of Dielectric losses, dielectric stress and sheath loss in cables. Carrier Communication: Principle of carrier communication over Power Lines, purposes, equipment, Differences between radio transmission and carrier communication, block diagram.

References:

1. Nagrath IJ and Kothari DP; "Power System Engineering", Tata McGraw Hill
2. John S. Grainger and W. D. Stevenson Jr.," Power System Analysis", McGraw Hill.
3. Deshpande MV; "Electric Power System Design", TMH.
4. Central Electricity Generating Board; "Modem Power System Practice", Vol 1-8, Pergamon Oxfd
5. James J. Burke," Power Distribution Engineering: Fundamentals & Applications"; Marcel Dekker
6. Westinghouse Electric Corp; Electric Transmission & Distribution Reference Book; East Pittsbrg
7. Wadhwa CL" Electric Power Systems"; Wiley Eastern Limited.
8. Ashfaq Hussain;"Electrical Power System
9. Gupta BR; Power System Analysis and Design"
10. Ray "Electrical Power System: Concepts, Theory and practice", PHI

List of Experiment Subject-Power System I

1. To study the Thermal Power Station.
2. To study the Hydro Power Station.
3. To study the Nuclear Power Station.
4. To study & draw Towers used in Transmission lines.
5. To study & draw the different types of insulator.
6. To study & design Electrical Power Transmission line.
7. Determination of Transmission Parameters of a transmission line

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SECOND YEAR- **Semester – IV**

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	**JAVA PROGRAMINING**	**EX-4061**	**0L-0T-2P**	**2**

Course Outcomes:

CO1 Write, compile, and execute Java programs that may include basic data types and control flow constructs using J2SE or other Integrated Development Environments (IDEs) such as Eclipse, Net Beans, and Developer. ()

CO2 Write, compile and execute Java programs using object oriented class structures with parameters, constructors, and utility and calculations methods, including inheritance, test classes and exception handling. ()

CO3 Write, compile, and execute Java programs using arrays and recursion. ()

CO4 Write, compile, and execute Java programs manipulating Strings and text documents. ()

CO5 Write, compile, execute Java programs that include GUIs and event driven programming.

CO6 Write a final project that may be selected from among the following: applets for inclusion in web pages; applets to access enterprise data bases in robust, enterprise three level applications; secure communications over the internet; or an approved project chosen by the student. ()

LIST OF Experiments

1:Write a Java program to demonstrate String handling methods.

2:Write a Java program for sorting a given list using inheritance concept.

3:Write a Java program for creating one base class for student personal details and inherit those details into the sub class of student Educational details to display complete student information.

4:Write a Java program to implement matrix operations using multidimensional arrays.

THIRD YEAR- **Semester – V**

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	**ELECTRICAL MACHINE-II**	**EX- 5011**	**4L-0T-2P**	6

Course Outcomes:

CO1 Acquire knowledge about the constructional details and principle of operation of alternator

CO2 Acquire knowledge about the working of synchronous machines as generators and motors.

CO3 Acquire knowledge about testing and applications of synchronous machines.

CO4 Acquire knowledge about the constructional details and principle of operation of three phase and single phase induction motors.

CO5 Acquire knowledge about the starting and speed control of induction motors

CO6 Acquire knowledge about testing and applications of induction motors.

CO7 Acquire hands on experience of conducting various tests on dc machines and obtaining their performance indices using standard analytical as
Well as graphical methods.

CO8 Acquire hands on experience of conducting various tests on transformers and obtaining their performance indices using standard analytical as well as graphical methods

Course Contents:

UNIT-I

THREE PHASE INDUCTION MOTOR

Construction and principle of operation of three phase induction motor – Equivalent circuit – Torque & Power equations – Slip – Torque characteristics – No load & blocked rotor tests – Separation of core loss – circle diagram.

UNIT-II

STARTING AND SPEED CONTROL OF INDUCTION MOTOR

Starting methods of three phase induction motor – Cogging & Crawling – Speed control – Voltage control – Rotor resistance control – Pole changing – Frequency control – Slip – energy recovery scheme – Double cage rotor – Induction generator – Synchronous induction motor.

UNIT-III

SYNCHRONOUS MACHINE-I

Construction; types of prime movers; excitation system including brushless excitation; polyphase distributive winding, integral slot and fractional slot windings; emf equation, generation of harmonics and their elimination; armature reaction; synchronous reactance and impedance, equivalent circuit of alternator, relation between generated voltage and terminal voltage, voltage regulation of alternators using synchronous impedance, mmf, zpf and new A.S.A method.

UNIT-IV

SYNCHRONOUS MACHINE-II

Salient pole machines; two reaction theory equivalent circuit model and phasor diagram; determination of Xd and Xq by slip test; SCR and its significance; regulation of salient pole alternator, power angle equation and characteristics; synchronizing of alternator with infinite busbar,; parallel operation and load sharing; synchronizing current, synchronizing power and synchronizing torque coefficient; synchroscopes and phase sequence indicator; effect of varying excitation and mechanical torque,.

UNIT-V

SYNCHRONOUS MACHINE-III

Synchronous motor operation, starting and stopping of synchronous motor, pull in torque, motor under load power and torque, reluctance torque, effect of excitation, effect of armature reaction, power factor adjustment, V curves, inverted V curves, synchronous motors as power factor correcting device, super synchronous and sub synchronous motors, hunting and damper winding efficiency and losses. Analysis of short circuit oscillogram,

determination of various transient, sub transient and steady reactance and time constants, expression of transient and sub transient reactance in terms of self and mutual inductances of various winding, short circuit current, equivalent circuit. Single phase synchronous motors- hysteresis motor, reluctance motor. Repulsion motor, stepper motor, switched reluctance.

Books:

M.G. Say, Performance & design of AC machines, CBS publishers & distributors, Delhi, 3rd edition
A.E. Clayton & N.N. Nancock, The Performance & design of DC machines CBS publications & distributors, Delhi, 3rd edition
P.S. Bhimbra, Electrical Machinery, Khanna Pub.
P.S. Bhimbra, Generalized theory of Electrical Machines, Khanna publishers, Delhi,
Ashfaq Husain, Electric Machines, Dhanpat Rai, New Delhi
I.J. Nagrath & D.P. Kothari, Electric Machines, Tata McGraw Hill , New Delhi,
Syed A. Nasar,Electric Machines & Power Systems, Volume I , Tata McGraw Hill, New Delhi
A. E. Fitzerald, C. Kingsley & S.D. Umans , Electric Machinery Tata McGraw Hill ,New Delhi ,5th edition.

LIST OF EXPERIMENTS (EXPANDABLE)

Experiments can cover any of the above topics, following is a suggestive list:

To plot magnetization characteristic of a separately excited DC generator
To perform load test on DC generators.
To perform load test on DC series and shunt motor
To perform Swinburne's test on a DC machine and find out its efficiency under full load condition.
To conduct Hopkinson's test on a pair of DC shunt machine.
To perform OCC and SCC test on an alternator and determine its regulation.
To determine regulation of alternator using mmf and zpf methods.
To synchronise alternator with infinite bus bar.

To plot V and inverted V curves for a synchronous motor
To find Xd and Xq of salient pole synchronous machine by slip test.
To determine negative sequence and zero sequence reactance of an alternator.
To determine sub transient direct axis and quadrature axis synchronous reactances of salient pole machine.

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	Switchgear And Protection	EX-5021	3L-1T-2P	6

Course Outcomes:

CO1 Acquire the knowledge of various abnormal conditions that could occur in power system.

CO2 Ability to design various protective devices in power system for protecting equipment and personnel.

CO3 **K**nowledge of various types of existing circuit breakers, their design and constructional details.

CO4 **K**nowledge of various conventional relays, their design and latest developments.

CO5 **K**nowledge of standards and specifications related to switchgear and protection.

CO6 Select suitable method and mathematical model for short circuit and load flow studies

CO7 Design and develop different protection schemes

CO8 Understand
- various types of faults
- Protective schemes
- Power system protective equipment
- significance of relay testing and co-ordination

Course Contents:

UNIT I

FAULT ANALYSIS

Fault Analysis per unit, representation and its advantages, faults in power systems (Symmetrical & Unsymmetrical), Single line and equivalent impendence diagram representation of power system components. Symmetrical components and its application to power systems, fault analysis, Sequence networks and their interconnection for different types of faults, Effect of fault impedance, Current limiting reactors, its location and application, Short circuit calculation.

UNIT II

PROTECTIVE RELAYS

Introduction to protective relaying-classification of relays – over current relays - directional over current relays - differential relays-distance relays - frequency relays-negative sequence relays - Introduction to

static relays - comparison of electromagnetic and static relays, Bucholz Relay.

UNIT III

PROTECTION OF GENERATOR, TRANSFORMER AND BUSBAR

Generator protection-differential protection, balanced earth fault protection, restricted earth fault protection, statorinter-turn protection. Transformer protection-percentage differential protection-station bus zone protection differential, Fault bus protection- protection of transmission lines-time graded, differential, distance protection.

UNIT IV

CIRCUIT BREAKERS

Theory of arcing and arc quenching-RRRV-current chopping-capacitive current breaking-DC circuit breaking switchgear- fault clearing and interruption of current-Breakers-classification of circuit breakers-construction and operation of circuit breakers-minimum oil circuit breaker-air-blast circuit breaker-vacuum circuit breaker-SF6 circuit breaker-circuit breaker rating-circuit breaker testing.

UNIT V

FUSES & MICROPROESSOR BASED RELAYS

Definitions-characteristics of fuses-types of fuses-low voltage fuses-HRC fuses-high voltage fuses
Introduction to Microprocessor based over current relays, impedance relays, Directional and reactance relay.

List of Experiments:

- Determination of drop out factor of an instantaneous over current relay.
- Determination of operating characteristic of IDMT relay.
- Determination of operating characteristic of differential relay.
- Study and operation of gas actuated protective relay.
- Study and operation of static over current relay.
- Determination of transmission line parameters using MATLAB.
- Analysis of power system faults (Symmetrical & Asymmetrical) using MATLAB.
- Study of SF6 circuit breaker
- Protectional simulation study of generator, Transformer, Feeder & Motor protection.

References:

B. Ravindran and M Chander, Power System protection and Switchgear, New Age International reprint 2006.Badrirka, Power System protection and switchgear, TMH.

CL Wadhwa, Electrical Power systems, new age International.

Haddi Saadet, Power System Analysis, TMH

A.R. Bergen, Vijay Vittal, "Power System Analysis, Pearson Education, Asia. Switchgear & protection Sunil S. Rao. Khanna Publication

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THIRD YEAR- **Semester – V**

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	Energy Conservation Management	EX- 5031	4L-0T-0P	4

Course Outcomes:

CO1 Gain knowledge on non-renewable sources like solar, biomass, wind energies .Realize solar energy applications using photo voltaic cell.

CO2 Acquire the knowledge of basic principles of energy auditing, types and objectives, Instruments used .

CO3 To learn energy efficient control methods and schemes for improvement of starting efficiency in electrical motors.

CO4 Understand efficient control strategies, Optimal selection, sizing, operation of variable speed drives like pumps and fans.

CO5 Acquire the knowledge of analysis of Transformer loading and Feeder loss evaluation, Methods, scheme for reactive power management, energy efficient illumination system.

CO6 Acquire the knowledge of different types and schemes of cogeneration. Analyses biogas performance and testing

CO7 To learn the Energy conservation measures and optimal operation methods for electic load like air conditioning, refrigeration, gysers-solar.

CO8 Acquire the knowledge of fundamentals of economic operation of an electrical system.Water heaters, compressors, electrolytic process

Course Contents:

UNIT-I

General energy problem: Energy use patterns and scope for conservation. Energy audit: Energy monitoring, Energy accounting and analysis, Auditing and targeting. Energy conservation policy, Energy management & audit, Energy audit, Types of energy audit, energy management (audit), qualities and function of energy managers, language of an energy manager, Questionnaire, Check list for top management, Loss of energy in material flow, energy performance, Maximizing system efficiency, Optimizing, input energy requirements, Energy auditing instruments, Material load energy balance diagram.

UNIT-II

Thermodynamics of Energy Conservation. Basic principle. Irreversibility and second law efficiency analysis of systems. Primary energy sources, optimum use of prime movers, energy efficient housekeeping, energy recovery in thermal systems, waste heat recovery techniques, thermal insulation. Thermal energy audit in heating, ventilation and air conditioning, Maintenance and Energy audit – friction, lubrication and tribo-logical innovations. Predictive and preventive maintenance.

UNIT-III

Load curve analysis & load management DSM, Energy storage for power systems (Mechanical, Thermal,

Electrical & Magnetic) Restructuring of electric tariff from energy conservation consideration, Economic analysis depreciation method, time value of money, Evaluation method of projects, replacement analysis, special problems inflation risk analysis. Payback period, Energy economics, Cost Benefit Risk analysis, Payback period.

UNIT-IV

Energy efficient electric drives, Energy efficient motors V.S.D. power factor improvement in power system. Energy Conservation in transportation system especially in electric vehicle. Energy flow networks, Simulation & modeling, formulation & Objective & constraints, alternative option, Matrix chart.

UNIT-V

Energy conservation task before industry, Energy conservation equipments, Co- Generation, Energy conservation process, Industry Sugar, Textiles, Cement Industry etc Electrical Energy Conservation in building, heating and lighting. Domestic gadgets

References:

Energy Management – W.R. Murphy & G. Mckey Butler worths.
Energy Management Head Book- W.C. Turner, John Wiley
Energy Management Principles- Craig B. Smith, Pergamon Press
Energy Conservation- Paul O Callagan- Pergamon Press
Design & Management of energy conservation. Callaghan,
Elect, Energy Utilization & Conservation. Dr. Tripathi S.C.,

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	CONTROL SYSTEM	EX- 5041	4L-0T-0P	4

Course Outcomes:

CO1 Learn the characteristics of nonlinear systems and common types of nonlinearities
CO2 Analyze the behavior of nonlinear systems using both phase plane and describing function methods
CO3 Test the stability of nonlinear systems
CO4 Design full order and reduced order observers
CO5 Design state feedback controllers
CO6 Learn microprocessor/ microcontroller/ DSP based control programmable logic controllers
CO7 To design a Lead, lag and Lag-Lead compensator sand to obtain the characteristics by experiment and simulation using MATLAB
CO8 Set up a system for closed loop voltage regulation for a dc separately excited generator using amplidyne and obtain its characteristics

Course Contents:

UNIT-I

TRANSFER FUNCTION

Introduction and classification of control systems – linear, nonlinear, time varying, time in-variant, continuous, discrete, SISO and MIMO systems – definitions. Mathematical modeling of mechanical (translation and rotational) and electrical systems – mechanical – electrical analogies – Transfer function block diagram reduction technique and signal flow graphs using Mason's gain formula. Transfer function of armature controlled and field controlled dc motor. Servomotors – Taco-generators – gear train – A Brief introduction on P, PI, PD and PID controllers.

UNIT II

TRANSIENT AND STEADY STATE ANALYSIS

Transient and steady state response – definitions – mathematical expression for standard test signals – type and order of systems–step response of first order and second order under damped systems. - Time domain specifications of second order under damped systems – Step response of second order critically damped and over damped systems. – Responses of first order systems with P, PI, PID controllers – Steady state error analysis.

UNIT-III

FREQUENCY DOMAIN ANALYSIS

Modeling and mathematical description of dynamic systems in the time and frequency domain. DC motor Modeling using time and frequency domain Frequency response analysis – frequency domain specifications of second order systems – minimum phase, no minimum phase and all pass transfer functions – polar plots, bode plots, constant M and N circles, Nichols plot, Nichols chart.

UNIT-IV

STABILITY ANALYSIS

Stability analysis-characteristic equation-location of roots in s-plane for stability – Routh's stability criterion – relative stability analysis – root locus technique – construction of root loci, stability analysis using bode plot, Nyquist stability criterion

UNIT-V

DESIGN OF COMPENSATORS

Design of lead, lag, lead-lag compensating networks using bode plot technique, feedback compensation, Design of PI, PD and PID using bode plot technique**.**

References:

I.J. Nagrath and M. Gopal, "Control system Engineering", New Age International.
Modern Control Systems by Roy Chaudhary.PHI
K. Ogata, Modern Control Engineering, PHI.
B.C. Kuo, Automatic Control systems, PHI
Gopal M., Control System Principles & Design, TMH.
Stefani, Shahian, Savant, Hostetter, "Design of feed back control System's", Oxford.
Krishna. K. Singh & Gayatri Agnihotri, System Design through MATLAB control tool & Simulink, Stringer Verlag, U.K.
Rudra Pratap, Getting Started with MATLAB, Oxford.
Dhanesh N.Manik, Control Systems, CENGAGE Lea

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	CONTROL SYSTEM LAB	EX- 5061	0L0-0T-2P	2

List of Experiments:

- Time response of second order system.
- Characteristics of Synchros.
- Effect of feedback on servomotors.
- Determination of transfer function of A-C servomotor
- Determination of transfer functions of D-C motor.
- Formulation of PI & PD controller and study of closed loop responses of 1st and 2nd order dynamic systems.
- State space model for classical transfer function using MATLAB.
- Simulation of transfer function using operational amplifier.

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THIRD YEAR- **Semester – V**

Course Content

Branch	Subject Title	Subject Code	Contact Hours	Total Credits

			per Week	
EEE	**ELECTRICAL SIMULATION LAB-I**	**EX- 5051**	**0L-0T-2P**	**2**

OUTCOMES

1. At the end of the course, the student should have the
2. Ability to understand the concept of MATLAB programming in solving power systems problems.
3. Ability to understand power system planning and operational studies.
4. Ability to acquire knowledge on Formation of Bus Admittance and Impedance Matrices and Solution of Networks.
5. Ability to analyze the power flow using GS and NR method.
6. Ability to find Symmetric and Unsymmetrical fault.
7. Ability to understand the economic dispatch.
8. Ability to analyze the electromagnetic transients.
9. Ability to acquire knowledge on power system analysis methods.
10. Ability to effectively employ different techniques to analyze different power system network conditions.

Course Contents

Unit- I

MATLAB Basics Simulation Mechanism and Simulation Tools, Starting and Ending MATLAB, MATLAB Desktop, Help Browser, Types of Files, Command Input Assistance, Operators and Special Characters, Variables and Arrays, Handling Arrays, Useful Built-in Functions, Control Structures, Input/output Commands, File Handling

Unit- II

Introduction to Plotting The plot command, Formatting and Labeling a Plot, Multiple Plots, Adding Legend, Sub Plots, Plotting Complex Data, 2-D and 3-D Plots, Plotting a Function, Plot Editor, Interactive Plotting using Plotting Tool

Unit- III

Programming in MATLAB MATLAB Editor, MATLAB Programming, Debugging MATLAB Programs, MATLAB Debugger, Functions and Function Files, Differential Equation Solver, Symbolic Mathematics, Programming Examples

Unit- IV

Basic Electrical and Networks Applications Analysis of Electrical Networks – Experiments based on Solution of Series-Parallel Circuits, Solution of system with linear equations - Experiments based on mesh and nodal analysis, Experiments forValidation of Network Theorems, Solution of Network Problems, Solution of First Order DifferentialEquation – Experiments for the study of Transients, Experiments for AC Signal Waveform Analysis, Study of Resonance in AC Circuit, Study of Frequency Response Waveform Analysis, Study of Resonance in AC Circuit, Study of Frequency Response

Unit- V

System Modeling using SIMULINK Simulation Steps, Getting Simulink, Creating and Simulating a Simulink Model, Simulink Solution of Differential Equation, Assigning Variables, Observing Variables During Simulation, Storing/Saving Data, Linking M-file with Model file, Creating and Masking Sub-systems, Solution using LaplaceTransform Approach, Solution using Laplace Transform Approach, Study of dynamic response,Simulation of Non-Linear System, Examples such as Simulink model to generate sine, cosinewaveform and ramp signal

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	Microprocessors and Microcontrollers	EX-6011	4L-0T-2P	6

Course Outcomes:

CO1 **Design** the VLSI circuit and **study** the Introduction of Intel 8085 architecture.

CO2 **Understand** the Assembly language program.

CO3 **Analyze** the Interrupts and methods of data transfer

CO4 **Understand** the External peripheral devices.

Course Contents

UNIT I

Microprocessor 8086

Introduction to 16-bit 8086 microprocessors, architecture of 8086, Pin Configuration, interrupts, minimum mode and maximum mode, timing diagram, Memory interfacing, Comparative study ofSalient features of 8086, 80286 and 80386.

UNIT II

Microprocessor 8086 programming

Instruction set of 8086, Addressing mode, Assembler directives & operations, assembly and machine language programming, subroutine call and returns, Concept of stack, Stack structure of 8086,timings and delays,

UNIT III

Input-Output interfacing:

Memory Mapped I/O and Peripherals I/O. PPI 8255 Architecture and modes of operation, Interfacing to 16-bit microprocessor and programming, DMA controller (8257) Architecture, Programmable interval timer 254, USART 8251, 8 bit ADC/DAC interfacing and programming.

UNIT IV

Microcontroller 8051

Intel family of 8 bit microcontrollers, Architecture of 8051, Pin description, I/O configuration, interrupts; Interrupt structure and interrupt priorities, Port structure and operation, Accessing internal& external memories and different mode of operations, Memory organization, Addressing mode,instruction set of 8051 and programming.

UNIT V

8051 Interfacing, Applications and serial communication

8051 interfacing to ADC and DAC, Stepper motor interfacing, Timer/ counter functions, 8051 based thyristor firing circuit, 8051 connections to RS-232, 8051 Serial communication, Serial communication modes, Serial communication programming, Serial port programming in C.

List of Experiment

1. Introduction to 8086 & 8051 kit, hardware features & modes of operation.

2. Technique of programming & basic commands of kit.
3. Instruction set of 8086 & 8051.
B. Assembly language programming of 8086 & 8051.
1. Write a program to add two 8-bit numbers.
2. Write a program to add two 16-bit numbers.
3. Write a program for 8-bit decimal subtraction.
4. Write a program to find 1's complement and then 2's complement of a 16-bit numbers.
5 . Write a program to find larger of two numbers.
6. Write a program to shift an 8-bit number left by 2-bits.
7. Write a program to multiply two 16-bit numbers .
8. Write a program for factorial of given number by recursion.
9. Write a program to square of an 8-bit number.
10. Write a program to generate a square wave of 2 KHz Frequency on input pin.

BOOKS:

1. Hall Douglas V.,Microprocessor and interfacing, Revised second edition 2006, Macmillan, McGraw Hill .
2. A.K. Ray & K.M.Bhurchandi, Advanced Microprocessors and peripherals- Architecture, Programming and Interfacing, Tata McGraw – Hill, 2009 TMH reprint..
3. Kenneth J. Ayala**,** The 8086 microprocessor: programming and interfacing the PC,
Indian -edition , CENGAGE Learning.
4. Muhammad Ali Mazidi and Janice Gillespie Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson education, 2005.
5. Kenneth J. Ayala**,** The 8051 Microcontroller Architecture, III edition, CENGAGE Learning.
6. V.Udayashankara and M.S.Mallikarjunaswamy, 8051 Microcontroller: Hardware, Software & Applications, Tata McGraw – Hill, 2009.
7. McKinlay, The 8051 Microcontroller and Embedded Systems – using assembly and C, PHI, 2006 / Pearson, 2006.
8. Microprocessor and Interfacing, I edition 2012, oxford press setnil kumar, Saravam Jeevanathan shah.

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	Power System-II	EX-6021	3L-1T-2P	6

Course Outcomes:

CO1 To comprehend the different issues related to overhead lines and underground cables.

CO2 To train the students with a solid foundation in power system concepts required to solve engineering problems.

CO3 To provide the knowledge about the system transients, sag and various issues related to cables and transmission lines.

CO4 The student is capable of using differnt methods of power system analysis and design in sufficient depth for short circuit calculations and stability.

Course Contents

UNIT-I

General - Problems associated with modern interconnected power Systems, deregulation, power systems restructuring, distributed generation, congestion, available transfer capacities, pricing of energy and transmission services.

UNIT-II

Power flow studies - Formulation of static power flow equations and solutions using Gauss- Seidel, Newton Raphson and FDLF methods, comparison of these methods, Economic operation of power system – economic dispatch, Emission dispatch, line loss, ITL, economic dispatch using lagrangian multiplier method.

UNIT-III

MW Frequency control- Coherency, control area, modeling of speed control mechanism, load damping, block diagrammatic representation of single and two area interconnected system, static and dynamic response, optimum parameter adjustment.

UNIT-IV

MVAR Voltage control Problem- Difference in control strategy over MW – f control, characteristics of an excitation system, DC AC and static excitation system, General block diagram representation of voltage regulators.

UNIT-V

Power System Stability - Steady state, dynamic and transients stability, Swing equation , equal area criterion, solution of swing equation using step by step method modified Eulers method and Rnge-Kutta method, methods of improving transient stability.

Reference Books :

1. Modern Power System Analysis-by I.J. Nagrath & D.P. Kothari Tata Mc Graw – Hill Publication Company Ltd 2nd edition.
2. Electrical Power Systems-by C.L. Wadhwa New Age International (P) Limited Publishers, 2nd edition 1998.
3. Reactive power Control in Electric Systems-by T.J.E. Miller, John Wiley & Sons.
4. T.K. Nagsarkar, M.S. Sukhiza, -"Power System Analysis", Oxford University Press.

Elgerd O.I., “Electric Energy Systems Theory”, TMH, New Delhi, Second Edition 1983.
6. Prabha Kundur, “Power system stability and control”, Mc-Graw Hill Inc, New York, 1993.
7. Taylor C.W., “Power System Voltage Stability”, Mc-Graw Hill Inc, New York, 1993.
8. Nagrath IJ, Kothari D.P., “Power System Engineering”, Tata Mc-Graw Hills, New Delhi 1994.
9. Weedy B.M. “Electric Power System” John Wiley and Sons, 3rd edition.
10. P.S.R. Murthy, “Power System Operation and Control”, B S Publ-ication
11. Power Generation, Operation and Control by A.J. wood and B.F. Wollenberg John Wiley & Sons Inc.

1. **List Of Experiments:**
2. To develop a program in Mat lab for information of Y-bus matrix for N bus system.
3. Load flow solution for 3-bus system using Gauss- Seidel, Newton Raphson and FDLF methods up to 3
4. iteration.
5. Load flow solution for IEEE 6-bus and 30-bus system in Mat lab using Newton Rap son method.
6. Assessment of transient stability of a single machine system.
7. Effect of compensation on voltage profile of IEEE 6-bus system.
8. Study of any software tools (PSAT, EDSA, MY POWER, ETAP etc).

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	Utilization Of Electrical Energy	EX - 6031	4L-0T-0P	4

Course Outcomes:

CO1 Illumination engineering is a field that spans many topics, including the development of sources, design of luminaires and light pipes, measurement of lighting conditions, and machine vision

CO2 To Learn the process of HEATING & WELDING and understand the process of ELECTROLYSIS.

CO3 To Understand the action of drawing a body, vehicle, train, or the like, along a surface, as a road, track, railroad, or waterway.

CO4 Understand starting, speed control and braking of electric system

CO5 Learn and analysis the working of drives & Hybrid system used in traction.

Course Contents

UNIT-I

ILLUMINATION ENGINEERING

Nature of light, units, sensitivity of the eye, luminous efficiency, glare. Production of Light; Incandescent lamps, arc lamps gas discharge lamps- fluorescent lamps polar curves, effect of voltage variation on efficiency and life of lamps, Distribution and control of light, lighting calculations, solid angle, inverse square and cosine laws, methods of calculations, factory lighting, flood lighting and street lighting, Direct diffused and mixed reflection & transmission factor, refractors, light fittings.

UNIT-II

HEATING, WELDING AND ELECTROLYSIS

Electrical heating-advantages, methods and applications, resistance heating, design of heating elements, efficiency and losses control. Induction heating: core type furnaces, core less furnaces and high frequency eddy current heating, dielectric heating: principle and special applications, arc furnaces: direct arc furnaces, Indirect arc furnaces, electrodes, design of heating elements, power supply and control. Different methods of electrical welding, resistance welding, arc welding, energy storage welding, laser welding, electro beam welding, and electrical equipment for them. Arc furnaces transformer and welding transformers. Review of electrolytic principles, laws of electrolysis, electroplating, anodizing-electro-cleaning, extraction of refinery metals, power supply for electrolytic process, current and energy efficiency.

UNIT-III

TRACTION

Special features of Traction motors, selection of Traction Motor, Different system of electric traction and their Advantages and disadvantages, Mechanics of train movement: simplified speed time curves for different services, average and schedule speed, tractive effort, specific energy consumption, factors affecting specific energy consumption, acceleration and braking retardation, adhesive weight and coefficient of adhesion,

UNIT-IV

ELECTRIC DRIVES

Individual and collective drives- electrical braking, plugging, rheostatic and regenerative braking load equalization use of fly wheel criteria for selection of motors for various industrial drives, calculation of electrical loads for refrigeration and air-conditioning, intermittent loading and temperature rise curve.

UNIT-V

INTRODUCTION TO ELECTRIC AND HYBRID VEHICLES

Configuration and performance of electrical vehicles, traction motor haracteristics, tractive effort, transmission requirement, vehicle performance and energy consumption.

References:

1. Open Shaw ,Taylor, .Utilization of electrical energy., Orient Longmans, 1962.
2. H. Pratap, Art and Science of Utilization of Electrical Energy.
3. Gupta, J.B., Utilization of Elect. Energy ,Katariya and sons, New Delhi.
4. Garg, G.C., Utilization of Elect. Power and Elect. Traction.
5. N V Suryanarayan, Utilization of Elect. Power including Electric Drives and Elect.

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	Electronic Instrumentation	EX - 6041	4L-0T-0P	4

Course Outcomes:

CO1 Explain basic concepts and definitions in measurement, bridge configurations and their applications

CO2 Elaborate discussion about the importance of signal generators and analyzers in measurement

CO3 Explain the basic features of oscilloscope and different types of oscilloscopes

CO4 Apply the complete knowledge of various electronics instruments/transducers to measure the physical quantities in the field of science, engineering and technology.

Course Contents

Unit-I

Introduction to CRO, Different parts of CRO, Its Block diagram, Electrostatic focusing, Electrostatic deflection, post deflection acceleration, Screen for CRTs, Gratitude, Vertical & Horizontal deflection system, Time base circuit, Oscilloscope probes and transducers, Attenuators, Application of CROs, Lissajous patterns, Special purpose CROs- Multi input, Dual trace, Dual beam, Sampling, Storage (Analog & Digital) Oscilloscopes.

Unit-II

A.C. Bridge Measurement:-

Sources and detectors, Use of Bridges for measurement of inductance, Capacitance & Q factor Maxwells bridge, Maxwells inductance capacitance bridge, Hays bridge, Andersons bridge, Owen's Bridge, De-sauty's Bridge, Schering Bridge, High Voltage Schering bridge, Measurement of relative permittivity, Heaviside cambell's bridge, Weins bridge, Universal bridge, Sources of errors in Bridge circuit, Wagner's Earthing device, Q meter and its applications and measurement methods.

Unit-III

Transducers

Transducers definition and classification, mechanical devices as primary detectors, Characteristic & choice of Transducers, Resistive inductive and capacitive transducers, strain gauge and gauge factor, Thermistor, Thermo couples, LVDT, RVDT, Synchros, Piezo-Electric transducers, Magnet elastic and magnetostrictive Hall effect transducers, Opto-electronic transducers such as photo voltaic, Photo conductive, photo diode and photo conductive cells, Photo transistors, Photo optic transducers. Introduction to analog & Digital data acquisition systems-Instrumentation systems used, Interfacing transducers to electronic control & measuring systems Multiplexing –

Unit-IV

Signal Generators:-

Fixed & variable frequency AF oscillators, Sine wave generators, Standard signal generator, AF Sine and Square wave generator Function generator, Square and pulse generator, Random noise generator, Sweep generator, TV Sweep generator, Marker generator, Sweep- Marker generator, Wobbly scope, Video pattern generator Vectroscope, Beat frequency oscillator **Wave analyser** Basic wave analyzer, Frequency selective

wave analyzer, Heterodyne wave analyzer, Harmonic distortion, analyzer, spectrum analyzer digital Fourier analyzer.

Unit-V

Digital Instruments:-

Advantages of Digital instruments over analog instruments, resolution and sensitivity of Digital meters., Digital Voltmeter - Ramp type, Dual slope integration type, Integrating type, Successive approximation type, Continuous balance DVM or Servo balancing potentiometer type VM. , compression of Electronic & Digital Volt meter, Digital Millimeter, Digital frequency meter, Time period measurement, High frequency measurement, Electronic counter, Digital tachometer, Digital PH meter, Digital phase meter, Digital capacitance meter. Digital display system and indicators like CRT, LED, LCD, Nixies, Electro luminescent, Incandescent, lectrophoretic image display, Liquid vapour display dot-matrix display, Analog recorders, X-Y recorders. Instruments used in computer-controlled instrumentation RS 232C and IEEE 488, GPIB electric interface.

.

References:

1. Albert. D. Helfrick, W.D. Cooper, Modern Electronic Instrumentation and measurement techniques, PHI.
2. Kalsi H.S., Electronic Instrumentation, TMH.
3. A.K. Sawhney, Electrical and Electronic measurements and Instrumentation, Dhanpat Rai and Co.
4. E.W. Golding, Electrical Measurement and Measuring Instruments Sir Isaac Pitman and Sons,

THIRD YEAR- **Semester – VI**

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	**SIMULATION LAB-II**	**EX - 6051**	**0L-0T-2P**	**2**

OUTCOMES

1. *At the end of the course, the student should have the*
2. *Ability to understand the concept of MATLAB programming in solving power systems problems.*
3. *Ability to understand power system planning and operational studies.*
4. *Ability to acquire knowledge on Formation of Bus Admittance and Impedance Matrices and Solution of Networks.*
5. *Ability to analyze the power flow using GS and NR method.*
6. *Ability to find Symmetric and Unsymmetrical fault.*
7. *Ability to understand the economic dispatch.*
8. *Ability to analyze the electromagnetic transients.*
9. *Ability to acquire knowledge on power system analysis methods.*
10. *Ability to effectively employ different techniques to analyze different power system network conditions.*

THIRD YEAR- **Semester – VI**

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	**ELECTRONICS INSTRUMENTATION LAB**	**EX - 6061**	**0L-0T-2P**	**2**

List of Experiments:-

1. Measurement of inductance of a coil using Anderson Bridge.
2. Measurement of capacitance of a capacitor using schering bridge.
3. LVDT and capacitance transducers characteristics and calibration.
4. Resistance strain gauge- Strain Measurement and calibration.
5. Measurement of R,L,C & Q using LCR-Q meter.
6. Study & measurement of frequency using Lissajous patterns.
7. Measurement of pressure using pressure sensor.
8. Study of Piezo-electric Transducer and Measurement of impact using Piezo-electric Transducer
9. Measurement of Displacement using LVDT.
10. Measurement of speed of a Motor using photoelectric transducer.
11. Study & Measurement using ph meter.
12. Temperature measurement & Control using thermo couple & using thermistor

FOURTH YEAR- **Semester – VII**

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	**Power Electronics**	**EX - 7011**	**2L-1T-1P**	**4**

Course Outcomes:

CO1 Learn basic operation of various power semiconductor devices & understand basic principle of switching circuits.

CO2 Analyze and design an AC/DC rectifier circuit & DC/DC converter circuits

CO3 Analyze DC/AC inverter circuit

CO4 Understand the role power electronics in the improvement of energy usage efficiency and demonstrate the development of renewable energy technologies.

Course Contents

UNIT-I

POWER SEMICONDUCTOR DEVICES

Basic structure & switching characteristics of power diodes, Power transistor & SCR, Triggering methods of SCR, R, RC, and UJT firing circuits for SCR, series and parallel operation of SCR, need for snubber circuits, di/dt & dv/dt protection. Introduction to Triac, GTO, MOSFET, IGBT, FCT and MCT.

UNIT II

CONTROLLED RECTIFIERS

Operation of 1-phase half wave rectifiers with R load, 1-phase FWR with R, RL & RLE load (fully controlled & half controlled), operation and analysis of FWR using R & RL loads (RMS, average & PF), operation of 3-phase HWR & FWR with R & RL loads for continuous current mode, effect of source inductance in 1-phase FWR, Introduction to 1-phase dual converter operation.

UNIT III

CHOPPERS

DC Choppers: Classification & operation of choppers (A,B,C,D,E), control strategies, operation of voltage, current and load commutated choppers.AC Choppers: Operation of 1-phase voltage regulator with R, RL loads, 1- phase step up & step down cycloconverters.

UNIT IV

INVERTERS

Types of inverters, operation of 1-phase VSI and 3-phase VSI (120o , 180o) modes, Y with R load, operation 1- phase of CSI with ideal switches, 1-phases ASCSI operation, basic series inverter, Modified series Inverter, 1- phase parallel inverter operation (without feedback diode), 1-phase basic McMurray inverter, Introduction to harmonics and PWM inverters.

UNIT V

APPLICTIONS OF POWER ELECTRONICS CONVERTERS

Single phase (mid point & bridge configuration) and three phase cyclo convertor configuration and operating principles. Speed control of DC motor using rectifiers and choppers, SMPS, UPS (on line and off line), Introduction to FACTS – shunt and series compensators.

TEXT BOOKS

1. Bhimbra. Dr.P.S., Power Electronics Khanna Publishers, 2001.
2. Singh. M.D. & Khanchandani. K.B Power Electronics Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2000.
3. M.H. Rashid, Power Electronics Circuits, Devices and Applications, Pearson Education, Singapore, 1993.
4. Dubey, G.K. et al, Thyristorised Power Controllers, New Age International (P) Publishers Ltd., 2002.
5. Vedam Subramaniam, Power Electronics, New Age International (P) Publishers Ltd., 2000.

LIST OF EXPERIMENTS

1. R, RC & UJT Triggering circuits
2. Single phase& Full converter
3. Single phase AC voltage controller using Traic
4. Single phase series inverter (Basic & Proto type)
5. Single phase Parallel inverter
6. Single phase Mc Murray inverter
7. Commutation circuits
8. Speed control of DC shunt motor (using Rectifier & Chopper)
9. Speed control of Universal motor.
10. Speed control of TPIM using PWM inverter

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THIRD YEAR- **Semester – VII**
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	Electrical Drive	EX-7021	3L-1T-0P	4

Course Outcomes:

CO1 Understand starting, speed control and braking and their numerical

CO2 Define and distinguish heating and cooling of motors, flywheel and solve their numerical

CO3 Demonstrate PLC's, contactors and relays in the Industry

CO4 Learn and analysis the working of drives used in traction and the drives used in the Industry

Course Contents

UNIT-I

Control of D.C. motors by converters:- Introduction to Thyristor Controlled Drives, single phase semi and fully controlled converters and three semi and fully controlled converters connected to d.c. separately excited and d.c. series motors-continuous current operation, Output voltage and current waveforms, Speed and Torque expression, Speed-Torque Characteristics, Problems on converter fed d.c. motors.

UNIT-II

Four quadrant operation of D.C. Drives.: Introduction to Thruster Controlled Drives, single phase semi and fully controlled converters and three semi and fully controlled converters connected to d.c. separately excited and d.c. series motors-continuous current operation, Output voltage and current waveforms, Speed and Torque expression, Speed-Torque Characteristics, Problems on converter fed d.c. motors. Losses in electrical drive system, Energy conservationin electric drives

UNIT-III

Control of Induction Motors on stator side:-Control of Induction Motor by AC Voltage controllers-Waveforms, Speed torque characteristics, Variable frequency control of induction motor by Voltage Source, Current Source inverters and cycloconverters, PWM control Comparison of VSI & CSI operations, Speedtorque Characteristics, Numerical problems on induction motor drives, Closed loop operation of induction motor drives. (Block diagram only)

UNIT-IV

Control of Induction Motors from rotor side:-Static rotor resistance control, Slip power recovery static Scherbius Drive, Static Kramer Drive, Their performance and speed torque characteristics advantagesapplicationproblems.

UNIT-V

Control of Synchronous Motors:- Separate control & Self control of synchronous motors, Operation of self controlled synchronous motors by VSI, CSI and Cycloconverters. Load commutated CSI fed Synchronous motor, Operation, Waveform, Speed torque Characteristics, Application, Advantage, Numerical problems, Closed loop operation os synchronous motors drives. (Block diagram only)

References:

1. G.K. Dubey “Fundamentals of Electrical Drives”-. Narosa Publications
2. Gopal K. Dubey “Power semiconductor Controlled Drives”- PHI
3. S.B. Dewan, G.R. Slemon, A. Straughen “Power semiconductor Controlled Drives”
4. B.K. Bose “Power Electronic control of AC Drives”.
5. V. Subramanyam “Thyristor control of Electric Drive” Tata Mc Graw Hill Pub
6. N.K. De , P.K. Sen “Electric Drives” PHI
7. S.K. Pillai, “A first course of Electrical Drive” New age International.
8. S.K. Pillai. “Analysis of Thyristor Power conditioned Motors” University Press (India)Ltd. Longman
9. P.V. Rao, “Power semiconductor Drives”, BS Publications.

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THIRD YEAR- **Semester – VII**
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	Power System Protection	EX - 7031	4L-0T-0P	4

Course Outcomes:

CO1 Acquire the knowledge of various abnormal conditions that could occur in power system
CO2 Ability to design various protective devices in power system for protecting equipment and personnel.

CO3 Knowledge of various types of existing circuit breakers, their design and constructional details. Knowledge of various conventional relays,
their design and latest developments.

CO4 To Learn standards and specifications related to switchgear and protection

Course Contents

Unit-I

Fault Analysis:-
Faults in power systems, single line diagram, equivalent impedance diagram, per unit reactances. Analysis (using matrices) of power systems by symmetrical components under:
(a) Three phase short circuit.
(b) Line to line fault.
(c) Line to ground fault.
(d) Double line to ground fault.
Sequence networks and their inter connections for different types of faults, effects of fault impedance. Current Limiting Reactors: Applications, types, construction and location of current limiting reactors, short circuit calculation using reactors.

Unit-II

Relays :-
General considerations, sensing of faults, construction of electro-magnetic attraction and induction types relays, Buchholz and negative sequence relay, concept of reset, pick up, inverse time and definite time characteristics, over current , over voltage, directional, differential and distance relays on R-X diagram. Static Relays: Introduction, advantage and limitation of static relays, static over current, directional, distance and differential relays.

Unit-III

Protection:-
Types & detection of faults and their effects, alternator protection scheme (stator, rotor, reverse power protection etc.). Power transformer protection (external and internal faults protection), generator-transformer

unit protection scheme, bus bar protection. Transmission line protection (current/time grading, distance), Pilot relaying schemes, power line carrier protection.

Unit-IV

Switchgear:-

Theory of current interruption- energy balance and recovery rate theory, arc quenching, recovery and restricting voltages. Types of circuit breakers. bulk oil and minimum oil, air break and air blast, sculpture hexa fluride (SF6) and vacuum circuit breakers. Rating selection and testing of circuit breakers/operating mechanisms. LT switchgear, HRC fuses, types construction and applications.

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Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	**Electrical Drive-LAB**	**EX-7041**	**0L-0T-2P**	**2**

- ***LIST OF EXPERIMENT***

- Study of thyristors controlled DC Drive.
- Study of Chopper fed DC Drive.
- Study of AC Single phase motor-speed control using TRIAC.
- PWM Inverter fed 3 phase Induction Motor control using PSPICE / MATLAB / PSIM Software.
- VSI / CSI fed Induction motor Drive analysis using MATLAB / SPICE / PSIM Software.
- Study of V/f control operation of 3phase induction motor drive.
- Study of permanent magnet synchronous motor drive fed by PWM Inverter using Software
- Regenerative / Dynamic braking operation for DC Motor - Study uses software.
- Regenerative / Dynamic braking operation of AC motor - study uses software.
- 10.PC/PLC based AC/DC motor control operation.

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Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	**Power System Protection -LAB**	**EX - 7051**	**0L-0T-2P**	**2**

1.To perform symmetrical and asymmetrical fault analysis in a power system
2.Study and Testing of Over Current Relay Training System
3.Study and Testing Differential Relay Training System
4.Operational characteristic of SF6 circuit breakers
5.Operating mechanisms of MCB and HRC fuse
6.To perform alternator protection for faulty condition

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Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	COMPUTER AIDED ELECTRICAL MACHINE DESIGN	EX-8011	2L-1T-1P	4

Course Outcomes:

CO1 Select proper materials based on their properties and selection criterion, IS standards Used in electrical machine design.

CO2 Design commercial Electrical Machine.

CO3 Apply computer aided optimization techniques for design of electrical machines

CO4 Understand general concepts of CAD

CO5 Understand and implement CAD of Three phase Induction Motor

CO6 Understand and implement CAD of Single phase Induction Motor

Course Contents

Unit-I

Introduction: Design problem-Mathematical programming methods, computer aided design- Mathematical formulation of the problem. Programming techniques (LP & NLP only), Methods of solution, Unconstrained optimization problems, constrained optimization problems.

Unit-II

Optimal design of DC machine:-Design of armature, Windings and field systems, Selection of variables for optimal design, Formulation of design equations, Objective function, Constraint functions, Algorithms for optimal design.

Unit-III

Optimal design of power transformer:-Design of magnetic circuit, Design of windings, Selection of variables for optimal design, Formulation of design equations, Objective function, Constraint functions, Algorithms for optimal design.

Unit-IV

Optimal design for 3-phase alternator:-Design of stator, windings, Design of Field systems for salient pole and non-salient pole machines, Selection of variables for optimal design, Formulation of design equations, Objective function, Constraint functions, Algorithms for optimal design.

Unit-V

Optimal design of 3-phase induction motor:-Design of stator, Windings Design of squirrel cage rotor, Design of slip ring rotor, Selection of variables for optimal design, Formulation of design equations, Objective functions Constraint functions, Algorithms for optimal design.

References:

1. Computer- Aided Design of Electrical Equipment- by Dr. M. Ramamoorthy-Affiliated East-West press Pvt. Ltd. New Delhi.

2. Electrical Machine Design- by A.K. Sawhney, Dhanpat Rai & Sons.

3. Principles of Electrical Machine Design with Computer Programmes by- S.K. Sen, Oxford & IBH Publishing Co.

4. Performance and Design of A.C. Machines-M.G. Say, Affiliated East West Press Pvt. Ltd., New Delhi.

5. Performance and Design of D.C. Machines- Clayton & Hancock.

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Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	COMPUTER APPLICATION TO POWER SYSTEM	EX-8021	3L-1T-0P	4

Course Outcomes:

CO1 ***Recent techniques and computer application for modeling of practical and large interconnected power system networks using programming languages.***

CO2 ***Recent methodologies for simulation and analysis of power system networks like real and reactive power flows and optimal scheduling.***

CO3 ***Effect of outage of any important component of power system on the operation and reliability of power systems.***

CO4 ***Algorithm required to find out parameters for monitoring and control of power system in real time from actual measurement data.***

CO5 ***Computer Algorithms used to solve algebro-differential pertaining to power system to assess the stability performance of power systems.***

Course Contents

UNIT-I

Models of power system components, network model using graph theory, formation of Z bus, transmission line models, regulating transformer, line loadability, capability curves of alternator.

UNIT-II

Control of load bus voltage using reactive power control variable, SVC & SVS, Regulated shunt compensation, series and shunt compensation, Uniform series and shunt compensation and effect on load ability of transmission lines.

UNIT-III

Sensitivity analysis- General sensitivity relations, generation shift distribution factors, line outage distribution factors, compensated shift factors, sensitivity associated with voltage-VAR, sensitivities relating load bus voltage changes in terms of PV bus voltage changes, sensitivity relating changes in reactive power generation for changes in PV Bus Voltage.

UNIT-IV

Power system security – Security functions, Security level, contingency analysis, security control, economic dispatch using LP formulation, pre-contingency and post- contingency, corrective rescheduling.

UNIT-V

Voltage stability - Difference between voltage and angle stability, PV Curve for voltage stability assessment, proximity and mechanism, modal analysis using reduced Jacobian, participation factor, effect of series and shunt compensation on voltage stability , effect of load models

References:

1. Power Generation, Operation and Control by A.J. wood and B.F. Wollenberg John Wiley & Sons Inc. 1984.
2. Computer methods in power systems analysis – by stage G.W. and E.L. Abiad A.H. Mc Graw Hill.
3. Computer Techniques in Power Systems Analysis- Pai M.A. Tata Mc Graw Hill.
4. Computer Modeling of Electrical Power Systems, Arrillaga J. Arnord C.P Harker B.J. John Wiley & Son
5. Computer Aided Power Systems Analysis Kusic G.L. 2nd Edition, CRC Press
6. Modern Power Systems Analysis Nagrath I.J. and Kothari D.P. Tata Mc Graw Hill.
7. Power System Analysis Grainger J.J. & Stevnson W.D. Mc Graw Hill.
8. Power System Stability and control –P Kundur ,IEEE Press 1994.
9. Advance Power Systems Analysis and Dynamics Singh L.P. John Wiley.

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THIRD YEAR- **Semester – VIII**
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	High Voltage Engineering	EX-8031	3L-0T-0P	3

Course Outcomes:

CO1 Demonstrate knowledge and understanding of extra and ultra high voltage

CO2 Describe the high voltage generation, measurement and testing procedures

CO3 Demonstrate knowledge of the different types of insulators and their applications (Gas, Liquid, and Solids).

CO4 Identify the proper earthing & grounding schemes

CO5 Analysis and measure the electric field and construction of high voltage cables.

CO6 Compare and propose the suitable earthing schemes for specific application.

CO7 Evaluate the breakdown voltage for different insulating material.

Course Contents

UNIT-I

INTRODUCTION:-

Introduction to HV technology, advantages of transmitting electrical power at high voltages, need for generating high voltages in laboratory.Important applications of high voltage.

UNIT-II

BREAKDOWN PHENOMENA:-

Breakdownin Gases: Elementary ideason ionizationby electron collision, Townsend mechanism, Townsend firstand second ionization coefficients, Paschen law, breakdownin non-uniform field sand corona discharges, vacuum breakdown mechanisms,

Breakdownin liquid:, fundamentalsof insulating oils, conductionand breakdownin pure and commercial liquids.

Breakdownin Solids: Fundamentalsof solid insulating materials intrinsic, electromechanicaland thermal breakdown, breakdownin simpleand composite dielectrics, typesof insulating materials, temperature

classification, factor affecting dielectric strength, insulation designof rotating machines, transformers, transmission lines, Switch gear, etc.

UNIT-III

GENERATION OF HV AC DC AND IMPULSE VOLTAGE AND CURRENT:- HV AC-HV transformer; Need for cascade connection and working of transformers units connected in cascade, Series resonant circuit- principle of operation and advantages. Tesla coil. HV DC- voltage doubler circuit, cock croft- Walton type high voltage DC set, Introduction to standard lightning and switching impulse voltages. Analysis of single stage impulse generator-expression for Output impulse voltage, Multistage impulse generator Components of multistage impulse generator. Triggering of impulse generator by three electrode gap arrangement. Triggering gap and oscillograph time sweep circuits. Generation of switching impulse voltage. Generation of high impulse current.

UNIT-IV

MEASUREMENT OF HIGH VOLTAGES:-
Electrostatic voltmeter-principle constructionand limitation. Generating voltmeter- Principle, construction. Series resistance micro ammeter for HV DC measurements. Standard sphere gap measurements of HV AC, HV DC, and impulse voltages; Factors affecting the measurements. Potential dividers-resistance dividers capacitance dividers mixed RC potential dividers. Surge current measurement.

UNIT-V

HIGH VOLTAGE TESTS ON ELECTRICAL APPARATUS:-
Definitions of technologies, tests on isolators, circuit breakers, cables insulators and transformers.

Reference books:

1. E.Kuffel and W.S.Zaengl, “High voltage engineering fundamentals”, 2nd edition, Elsevier, press, 2005.
2. M.S.Naidu and Kamaraju, “High Voltage Engineering”, 3rd edition, THM, 2007.
3. L. L.Alston, High Voltage technology”, BSB Publication, 2007. 3. Rakosh Das Begamudre, Extra High voltage AC transmission engineering, Wiley Easternlimited, 1987.
4. Transmission and distribution reference book-Westing House.C.L.Wadhwa, High voltage engineering, New Age International Private limited, 1995.

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THIRD YEAR- **Semester – VIII**
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EEE	COMPUTER APPLICATION TO POWER SYSTEM-LAB	EX-8041	0L-0T-2P	2

List of Experiments
(Extendable): Matlab based:

- Formation of bus admittance matrix using mat lab.
- Z bus building algorithm using mat lab.
- NEWTON RAPSON load flow analysis.
- Fast de coupled load flow analysis.
- Study of PV Curve for voltage stability.