SCHEME OF EXAMINATION/INSTRUCTION -B. TECH

Credit requirements:

Category	Credits
Departmental Core (DC)	146
Departmental Elective (DE)	72-90
Basic Sciences/1st Year	78
HM	0-6
OC	0-12

III Semester

Code	Course	L-T-P	Credits
Core			
EEL201	Network theory	3-0-0	6
ECL206	Electronic Devices and Circuits	3-0-0	6
MAL201	Integral transform and PDE	3-0-0	6
EEL204	Measurement and Instrumentation	3-0-0	6
EEP201	Network Lab	0-0-2	2
ECP206	EDC Lab	0-0-2	2
EEP204	Measurement and Instrumentation Lab	0-0-2	2
Elective			
EEL206	Electromagnetics	3-0-0	6

IV Semester

Code	Course	L-T-P	Credits
Core			
EEL202	Signals and Systems	3-0-0	6
EEL203	Electrical Machines-I	3-0-0	6
ECL207	Digital Circuits	3-0-0	6
EEP203	Electrical Machines-I Lab	0-0-2	2
ECP207	Digital Circuits Lab	0-0-2	2
Elective			
EEL208	MATLAB Programming	2-0-2	4
PHL202	Intro to Material Science	3-0-0	6
MAL205	Numerical Methods & Probability Theory	3-0-0	6
EEL215	Electrical Power Utilization	3-0-0	6
EEP207	Adv Prog. Lab	0-0-2	2
EEP208	MATLAB Prog. Lab	0-0-2	2

V Semester

Code	Course	L-T-P	Credits
Core			
EEL301	Electrical Power System-I	3-0-0	6
ECL321	Microprocessor & Interfacing	3-0-0	6
EEL302	Electrical Machine-II	3-0-0	6
EEL305	Control System-I	3-0-0	6
EEP302	Electrical Machine-II Lab	0-0-2	2
EEP305	Control System-I Lab	0-0-2	2
EEP306	Electrical Engg Workshop Lab	0-0-2	2
Elective			
EEL307	Electrical Machine Design	3-0-0	6
EEL405	Power Station Practice	3-0-0	6

VI Semester

Code	Course	L-T-P	Credits
Core			
EEL303	Power Electronics	3-0-0	6
EEL304	Electric Drives and Control	3-0-0	6
ECL320	Linear Electronic Circuits	3-0-0	6
EEL401	Electrical Power System-II	3-0-0	6
EEP303	Power Electronics Lab	0-0-2	2
ECP320	Linear Electronic Circuits Lab	0-0-2	2
ECP321	Microprocessor Lab	0-0-2	2
Elective			
EEL406	Electrical Installation Design	3-0-0	6
EEL418	Control System-II	3-0-0	6
EED301	Mini Project	0-0-2	4
MEL424	Industrial Engg & Management	3-0-0	6

VII Semester			
Code	Course	L-T-P	Credits
Core			
EEL402	High Voltage Engineering	3-0-0	6
EEL403	Switchgear and Protection	3-0-0	6
EEP402	High Voltage Engineering Lab	0-0-2	2
EEP403	Switchgear and Protection Lab	0-0-2	2
EED401	Project Phase-I	0-0-2	4
Elective			
EEL409	HVDC	3-0-0	6
EEL417	Energy Conservation & Audit	3-0-0	6
EEL410	Advanced Control Theory	3-0-0	6
EEL421	Power Quality	3-0-0	6
EEL407	Electrical Power Distribution System	3-0-0	6

VIII Semester			
Code	Course	L-T-P	Credits
Core			
EEL404	Sampled Data & Digital Control	3-0-0	6
EED402	Project Phase-II	0-0-4	8
Elective			
EEL408	Advanced Power Electronics	3-0-0	6
EEL411	App of Power Electronics to Power System	3-0-0	6
EEL412	DSP App to Power System	3-0-0	6
EEL414	Microprocessor Applications in PE & PS	3-0-0	6
EEL413	Adv Elect Drives & Control	3-0-0	6
EEL416	Renewable Energy Sys	3-0-0	6
EEP415	Computer Application in Electrical Engineering Lab	0-0-2	2

FIRST SEMESTER

EEL101: ELECTRICAL ENGINEERING (3-0-0-6)

Objectives

- ***To teach basic ideas and principles of Electrical Engineering.***
- ***Understanding of details, electrical power system, transformer, generator and motor.***

Contents

Electrical Circuit:- Circuit Elements Resistance, Inductance & Capacitance, Kirchhoff's Laws, Voltage Source (Definition, Characteristics of Practical Source, and Equivalent Current Source), and Star-Delta Transformation

Magnetic Circuit, Flux, MMF, Reluctance, Analogy with Electric Circuits. Simple Calculations for Composite Magnetic Circuits

AC Circuits :-Periodic Function, Average & R.M.S., Values, Steady State Behavior With Sinusoidal Excitation, Phasor Representation, Reactance & Impedance, Series & Parallel Circuit, Power Factor, Principle of Generation of Single Phase & Three Phase Voltages, Power in Balanced Three Phase AC System

Electrical Measurements:- Definition, Indicating, Integrating & Recording Instruments, Deflecting Controlling & Damping Mechanisms, Ammeter & Voltmeters, P.M.M.C. Type & Moving Iron Type, Electrodynamometer Type Wattmeters, Induction Type Single Phase Energy Meter

Transformers:- Introduction, Basic Principles, Construction, Phasor Diagram for Transformer under No Load Condition Transformer On Load, Balance of MMF on Sides, Phasor Diagram, Equivalent Circuit, Open Circuit & Short Circuit Test, Voltage Regulation and Efficiency

Power Systems: - Elementary Idea about Power Generation, Transmission and Distribution

Electric Machines:-

DC Shunt and Series Motor – Construction, Principle of Working, Characteristics, Speed Control and Applications

Induction Motors – Construction, Principle of Working of Single Phase and 3-Phase Motors. Torque Slip Characteristics

Text/ Reference Books

1. Hughes, Electrical Technology, Pearson Publishers
2. B.L. Theraja, Electrical Technology, S. Chand Publishers
3. Kothari D.P. and Nagrath I.J.,Theory And Problems Of Basic Electrical Engineering, Prentice Hall India
4. D.C. Kulshresta, Basic Electrical Engineering, TMH India
5. Mittle & Mittal, Basic Electrical Engineering, TMH, 2005

Deliverables

- ***Making students familiar with the principle/working/operation of transformer, generator, and motor along with AC and DC circuits.***

EEP101: ELECTRICAL ENGINEERING (0-0-2-2)
LIST OF EXPERIMENTS:

1) Study and verification of Kirchhoff's Laws applied to direct current circuit.
2) Determination of B/H curve of a magnetic material
3) Study of AC series circuits.
4) Study of AC Parallel circuits.
5) To study Balanced three phase circuit.
6) Determine Voltage regulation and efficiency of a single phase transformer by direct loading.
7) Speed control of a DC motor a) By varying field current with armature voltage kept constant
   b) By varying armature voltage with field current kept constant.
8) Reversal of three phase induction motor.

THIRD SEMSESTER

EEL201: NETWORK THEORY (3-0-0-6)

Objectives

- ***The subject deals with the various methods of analysis of electrical circuits under transient and steady state conditions.***
- ***It provides a solid foundation for later learning as well as for future professional activities.***

Contents

Node and Mesh Analysis: Node and Mesh Equation, Matrix Approach of Complicated Network Containing Voltage and Current Sources and Reactances, Source Transformation and Duality.

Network Theorem: Superposition, Reciprocity, Thevenin's, Nortons, Maximum Power Transfer, Compensation and Tallegen's Theorem as Applied to AC Circuits

Trigonometric and Exponential Fourier Series: Discrete Spectra and Symmetry of Waveform, Steady State Response of a Network to Non-Sinusoidal Periodic Inputs, Power Factor , Effective Values, Fourier Transform and Continuous Spectra, Three Phase Unbalance Circuit and Power Calculation.

Laplace Transforms and Properties: Partial Fraction, Singularity Functions, Waveform Synthesis, Analysis of RC, RL and RLC Networks with and Without Initial Conditions with Laplace Transforms Evaluation of Initial Conditions.

Transient Behavior, Concept of Complex Frequency, Driving Points and Transfer Functions Poles and Zeros of Immittance Function, Their Properties, Sinusoidal Response from Pole-Zero Locations, Convolution Theorem and Integral Solutions.

Text/ Reference Books

1. Van Valkenburg, Network Analysis, Prentice Hall of India, 2000
2. Sudhakar, A.Shyammohan, S. P., Circuits and Network, Tata MC-Graw Hill
3. Kelkar, Pandit, Linear Network Theory, Pratibha Publication
4. G.K. Mittal, Network Analysis, Khanna Publication, 2011

Deliverables

- ***Useful in analyzing Power Systems in general and transmission and distribution systems in particular.***
- ***Useful for electronic circuit analysis and design.***

EEP201: NETWORK THEORY LAB (0-0-2-2)

1. Study of 3 phase, Star connected, Unbalanced circuit.
2. Verification of Maximum Power Transfer Theorem
3. Verification of Superposition Theorem.
4. Verification of Reciprocity Theorem.
5. Determination of Two port parameters of given network.
6. Study of 3 phase, Delta connected, Unbalanced circuit.
7. Verification of Thevenin's and Norton's Theorem.
8. Study of Series and Parallel Resonance.

Note: The experiments are to be conducted for AC networks and excitation.

EEL206: ELEMENTS OF ELECTROMAGNETICS (3-0-0-6)

Objectives

- ***To learn the fundamental concepts applied in Electrostatics, Magnetostatics, Time-varying fields and Electromagnetic Waves.***
- ***To apply the principles of Electromagnetic Field Theory for the design and analysis of Power Transmission lines.***

Contents

Vector Algebra, Cartesian, Cylindrical and Spherical Co-Ordinate System. Transformation of Variables from Cartesian to Cylindrical and Spherical Coordinate System and Vice-Versa

Coulomb's Law, Electric Field Intensity, Field of 'N' Point Charges, Field Of Line And Sheet Of Charge, Electric Flux Density, Gauss's Law and Its Applications, Divergence and Divergence Theorem

Definition of Potential Difference and Potential, Potential of Point Charge and System of Charges Potential Gradient, Energy Density in Electrostatic Field. Poisson's and Laplace's Equations, Current and Current Density, Continuity of Current Capacitance

Biot-Savart, Amperes Circuital Laws and their Applications, Curl, Stoke's Theorem, Magnetic Flux Density, Scalar and Vector Magnetic Potential, Maxwell's Equations in Steady Electric and Magnetic Fields

Force on Moving Charge and Differential Current Element, Force and Torque on a Closed Circuit. Time Varying Fields and Maxwell's Equations

Uniform Plane Waves, Wave Motion in Free Space, Perfect Dielectric, Lossy Dielectric and Good Conductor, Skin Effect, Poynting Vector and Power Considerations. Reflection of Uniform Plane Waves, Standing Ratio

Text/ Reference Books

1. Hayt W.H., Engineering Electromagnetics, Tata Mc-Graw Hill, 7th Edition
2. N. Narayan Rao, Elements of Engineering Electromagnetics, Prentice Hall Of India, 6th Edition
3. Mathew, N.O. Sadiku, Elements of Electromagnetics, Oxford University Press, 4th Edition

Deliverables:

- ***Students have grasped the basic concepts and have applied to various types of problems in Electromagnetics, Magnetostatics, Time-varying fields and Electromagnetic Waves.***

ECL206: ELECTRONIC DEVICES & CIRCUITS (3-0-0-6)

Objectives

- ***To introduce students with the various concepts of electronic devices and circuits.***
- ***To teach the theory of various types of diodes, transistors, amplifiers, oscillators etc.***

Contents

Semiconductor Physics, P & N Type Semiconductors, Diodes and Power Supplies, Theory of P-N Junction Diode, Junction Capacitance, Characteristics & Applications of Following Diodes, Zener, Schottkey, Photodiode, LED, LCD, Varactor Diode & Tunnel Diode

Power Supplies, Halfwave & Fullwave , Rectifiers, Filters, Ripple-Factor, Zener & Emitter Follower Type Regulators

Junction Transistors Theory of Operation, Static Characteristics , Break Down Voltages, Current Voltage Power Limitations, Biasing of BJT Different Biasing Arrangements, Stability Factor, Thermal Runaway, Power Transistors

Small Signal Analysis & High Frequency Analysis of BJT CE, CB, CC Amplifiers and Comparison High Frequency Analysis Calculation of Frequency Response, Gain Bandwidth Product

Power Amplifiers Classification A, B, AB, C Classes, Efficiency, Push Pull Configuration, Complimentary Symmetry, Second Harmonic & Cross Over Distortion. Positive and Negative Feedback Amplifiers Classification, Practical Circuits, Applications, Advantages Oscillators, Stability, Barkhausen Criteria RC, LC & Crystal Oscillators

Field Effect Transistor & MOSFET, Principle of Operation & Characteristic, Biasing Arrangement, Small Signal Analysis of CG, CD & CS, High Frequency Analysis

Text/ Reference Books

1. Milman and Halkias, Integrated Electronics, McGraw Hill.
2. Boylestad and Nashelsky, Electronic Devices & Circuit theory, PHI
3. Schilling & Belove, Electronic Circuits - Discrete and Integrated, McGraw Hill
4. Bapat, Theory & Problem in Circuit analysis, McGraw Hill
5. Carr, Electronic Devices, Tata McGraw Hill
6. Nagrath I.J, Electronics - Analog and Digital, PHI

Deliverables

- ***Students are able to analyze various electronic circuits.***
- ***Students have learnt various applications of electronic devices.***

ECP206: ELECTRONIC DEVICES & CIRCUITS LAB (0-0-2-2)

List of Experiments:

1) To plot V-I Characteristics of diode and compare various parameters (both in forward and reverse bias)
2) To study zener diode as a voltage regulator & plot its load regulation characteristics.
3) To study full wave rectifier with & without filters and compare the ripple factor theoretically and practically.
4) To draw input/ output characteristics of common emitter configuration and compute the h-parameters.
5) To study JFET characteristics and compute various parameters.
6) To study and plot the frequency response of single stage BJT amplifier.
7) To study RC phase shift oscillator using BJT.

EEL204: MEASUREMENT AND INSTRUMENTATION (3-0-0-6)

Objectives

- ***Necessity and importance of measurement and instrumentation.***
- ***To know about all kinds of electrical parameter measurements.***
- ***To apply proper sensor for measurement of physical quantities etc.***

Contents

Introduction to Measurement and Instrumentation- Necessity, Errors in Measurement, Classification of Measuring Instruments, Comparison of Analog And Digital Instruments, Advantages of Digital Instruments, Classification of Analog Instruments, Absolute and Secondary Instruments, Indicating Type, Recording Type and Integrating Type Instruments, Extension of Range by Shunts and Multipliers, Loading Effect of Instruments

DC And AC Potentiometers- Principles and Use of DC Potentiometer for Calibration Purposes, Principle and Applications of AC Potentiometer

General Theory of Bridges- Resistance, Inductance and Capacitance Bridges and Their Applications

Measurement of Power and Energy- Measurement of Active And Reactive Power in Poly Phase Circuits Using Dynamometer Type Instruments, Measurement of Energy in Single and Poly-Phase Circuits using Induction Type Instruments, Errors in Power and Energy Measurements, Maximum Demand Indicator, Tri-Vector Meter

Industrial Metering- General Theory of Extension of Range Using CT And PT, Errors in Instrument Transformers, Applications of Instrument Transformers and Connection of CT and PT to TV Meter, Concept of TOD and ABT Meters

Electrical Instrumentation- Classification of Transducers, Electrical Transducer for Motion Measurement, LVDT, RVDT, Piezoelectric Transducers, Variable Inductive and Variable Capacitive Transducers, Measurement of Shaft Torque and Power, Construction and Application of Megger

Electronic Instrumentation- Introduction to Data Acquisition Systems, Methods for Analog to Digital Conversion, Errors in Analog to Digital Conversion, Application of Digital Voltmeters, Frequency Measurement, Integrated Circuits in Instrumentation: Timer (555), Function Generators (2206), Constant Current Source

Text/ Reference Books

1. Rangan, Sarma ,Instrumentation.: Devices and Systems, Tata McGraw Hill Publication
2. Doeblin, Measurement Systems , Tata McGraw Hill Publication
3. Sawhaney A.K., A Course in Electrical and Electronics Measurements and Instrumentation, Dhanpat Rai & Sons, Eleventh Edition
4. Golding E.W., Widdis F. C., Electrical Measurements and Measuring Instruments, Wheeler's Student Edition, Third Edition
5. Cooper W.D., Helfrick A.D., Electronic Measurements and Instrumentation, Prentice-Hall of India, Third Edition
6. Gayakwad Ramakant, OP-AMPS and Linear Integrated Circuits, Prentice-Hall of India Private Ltd, Third Edition

Deliverables

- ***Able to find energy consumption of any LT/HT consumer.***
- ***Able to apply instrument/sensor for measurement of physical quantities.***
- ***Measurement of electrical quantities can be performed.***

EEP204: MEASUREMENT AND INSTRUMENTATION LAB (0-0-2-2)
LIST OF EXPERIMENTS:

1) Measurement of low resistance by Kelvin double bridge.
2) Measurement of medium resistance by ammeter voltmeter method
3) To study polarity marking of current transformers.
4) Measurement of three phase power by two wattmeter method.
5) To study the characteristics of pressure cell with respect to signal conditioned output voltage.
6) To study and plot characteristics of LVDT.
7) To study the characteristics of developing torque and signal conditioned sensor output voltage.
8) Testing of poly phase energy meter by direct loading.

MAL201: INTEGRAL TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS (3-0-0-6)

Objectives

- ***To teach various mathematical transforms.***
- ***Study of partial differential equations.***

Contents

Laplace Transforms: Definition of Laplace Transforms, Linearity Property, Condition For Existence of Laplace Transform, First And Second Shifting Properties, Transforms of Derivatives And Integrals, Evaluation of Integrals By Laplace Transform. Inverse Laplace Transform, Convolution Theorem, Laplace Transform of Periodic Functions, Unit Step Function and Dirac Delta Function. Applications of Laplace Transform To Solve Ordinary Differential Equations

Fourier series and Fourier Transforms: Fourier series, Half Range Sine and Cosine Series Expansions, Exponential Form of Fourier Series. Fourier Integral Theorem, Fourier Transform, Fourier Sine and Cosine Transforms, Linearity, Scaling, Frequency Shifting and Time Shifting Properties, Convolution Theorem

Z-Transform: Z - Transform, Properties of Z-Transforms, Convolution of Two Sequences, Inverse Z-Transform, Solution of Difference Equations

Partial Differential Equations: Formation of First and Second Order Equations, Solution of First Order Linear Equations: Lagrange's Equation, Particular Solution Passing through a Given Curve. Higher Order Equations with Constant Coefficients, Classification of Linear Second Order Poles, Method Of Separation of Variables, Solution of One Dimensional Wave Equation, Heat Equation, Laplace Equation (Cartesian And Polar Forms), D'Alembert Solution of Wave Equation

Text/ Reference Books

1. Kreyszig, E John, Advanced Engineering Mathematics, Wiley & Sons, Eighth Edition
2. Jain R.K. and Iyengar S.R.K, Advanced Engineering Mathematics, Narosa Publishers
3. Thomas G.B. and Finney R.L, Calculus and Analytic Geometry, Addison Wesley Longman Inc

Deliverables

- ***Students are able to understand theory and application of various transforms and partial differential equations.***

EEL210: ELECTRICAL SCIENCES (3-0-0-6)

Objectives

- ***To teach basics of electrical engineering by various methods of network analysis, measuring instruments, electrical machines etc.***
- ***Study of various electronic instruments.***

Contents

Nodal Analysis, Mesh Analysis, Source Transformation, Duality

Theorems: Superposition Theorem, Reciprocity Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem

Two Port Network: Two Port Network Parameters, Their Inter-Relation, Interconnection of Two Port Networks

Measurement of Low, Medium and High Resistances, Elementary Methods of Measurement of Inductance and Capacitance, Generalized Theory of Ac Bridges, Their Uses for Measurement of Inductance and Capacitance

Measuring Instruments: Classification, Absolute and Secondary Instruments

Electronic Instruments: Digital Voltmeters, Digital Multimeters, Cathode Ray Oscilloscope, Synchroscope Etc.

Generalized Principle of Operation of Alternators, Armature Reaction, Principle of Operation of Synchronous Motors, Starting Methods, Stepper Motor

Text/ Reference Books

1. Sawhney A. K. A course in electrical and electronics measurements and instrumentation, Dhanpat Rai and Sons, 11th edition
2. Van Valkenburg, Network Analysis, Prentice Hall of India Pvt. Ltd., 3rd edition
3. Kelkar, Pandit, Network Analysis, Pratibha Publications
4. B.L. Theraja , A.K. Theraja, A textbook of Electrical Technology (vol-II), S. Chand and company

Deliverables

- ***Find out various network parameters using nodal, mesh analysis, source transformation and theorems.***
- ***Understand working of basic electrical and electronic instruments as well as basic electrical machines.***

FOURTH SEMESTER

MAL205: NUMERICAL METHODS & PROBABILITY (3-0-0-6)

Objectives

- ***Study of various numerical methods.***
- ***Study of probability theory.***

Contents

Numerical Analysis:

Solutions of Algebraic and Transcendental Equations by Iteration Method, Method of False Position, Newton-Raphson Method and Their Convergence, Solutions of System of Linear Equations by Gauss Elimination Method, Gauss Seidal Method, LU Decomposition Method Newton-Raphson Method for System of Nonlinear Equations, Eigen Values and Eigen Vectors: Power and Jacobi Methods.

Numerical Solution Of Ordinary Differential Equations:

Taylor's Series Method, Euler's Modified Method, Runge-Kutta Method, Adam's Bashforth And Adam's Moulton, Milne's Predictor Corrector Method. Boundary Value Problems: Shooting Method, Finite Difference Methods.

Probability Theory:

Random Variables, Discrete and Continuous Random Variable, Probability Density Function; Probability Distribution Function for Discrete and Continuous Random Variable Joint Distributions

Definition of Mathematical Expectation, Functions of Random Variables, The Variance and Standard Deviations, Moment Generating Function Other Measures of Central Tendency and Dispersion, Skewness and Kurtosis.

Binomial, Geometric Distribution, Poisson Distribution, Relation between Binomial and Poisson's Distribution, Normal Distribution, Relation Between Binomial And Normal Distribution.

Introduction to Stochastic Processes

Text/ Reference Books

1. S. D. Cante and C. de Boor, Elementary Numerical Analysis-an algorithmic approach, McGraw-Hill
2. Gerald and Wheatley Addison, Applied Numerical Analysis, Wesley.
3. K.S. Trivedi, Probability Statistics with Reliability, Queuing and Computer Science applications Prentice Hall of India
4. Spiegel M.R, Theory and problems of Probability and statistics, McGraw-Hill Book Company

Deliverables

- ***Students are able to solve problems based on all types of numerical methods.***
- ***Study and applications of probability theory is done by the students.***

EEL202: SIGNALS AND SYSTEMS (3-0-0-6)

Objectives

- ***The subject deals with various methods of analysis for continuous time and discrete time systems in time domain and frequency domain.***
- ***Being a basic course, students need to master this subject well and associate its basic concepts in order to become competent engineers.***

Contents

Elements of Signal Space Theory: Different Types of Signals, Linearity, Time Invariance and Causality, Impulse Sequence, Impulse Functions and Other Singularity Functions.
Convolution: Convolution Sum, Convolution Integral and Their Evaluation, Time Domain Representation and Analysis, of LTI Systems Based on Convolution and Differential Equations.

Multi Input-Output Discrete and Continuous Systems: State Model Representation, Solution of State, Equations, State Transition Matrix.

Transform Domain Considerations: Laplace Transforms and Z-Transforms, Application of Transforms to Discrete And Continuous Systems Analysis, Transfer Function, Block Diagram Representation, and DFT.

Fourier series And Fourier Transform: Sampling Theorem, Discrete Fourier Transform (DFT), Estimating Fourier Transform Using (DFT).

Text/ Reference Books

1. Ziemer R.F., Tranter W.H. and Fannin, J D.R.., Signals and Systems - Continuous and Discrete Prentice Hall,4th Edition
2. Oppenheim A.V., Willsky A.S. and Young I.T., Signals and Systems, Prentice Hall
3. Roberts M.J., Signals and Systems, Tata McGraw-Hill, 2003.

Deliverables

- ***Useful in analysis and design of continuous time and discrete time systems.***
- ***Useful for harmonics analysis in power system/ power electronic circuits.***

EEL203: ELECTRICAL MACHINES-I (3-0-0-6)

Objectives

- ***To learn the basic operation and control of DC machines.***
- ***To learn transformer operation w.r.t. harmonics and connections.***

Contents

Winding: Types of Windings of DC and AC Machine, MMF of winding and induced EMF.

D.C. Motor: Basic Principle and Operation, Classification, Armature Reaction and Commutation, Interpole and Compensating winding, Torque, Characteristics, Starting, Speed Control, Braking, Permanent Magnet Machines, Losses, Efficiency, Testing, Applications

Three Phase Transformer: Connection and Phasor Groups, Effect of Polarity Marking and Phase Sequence, Parallel Operation, Excitation Phenomenon and harmonics, Tertiary Winding, Unbalanced Operation, Single Phasing, Open Delta Connection, Testing of Transformer Bank for Proper Connection, Scott Connection, Tap Changing Transformer, Cooling of Transformer, Applications

Three Phase Induction Motor: Principle and Operation, Classification, Torque Speed Characteristics
Single Phase Induction Motor: Principle and Operation, Types, Equivalent Circuit, Characteristics, Applications

Text/ Reference Books

1. Bhimbra P.S., "Electrical Machinery", Khanna Publishers.
2. Bhimbra P.S., "Generalized Theory in Electrical Machines", Khanna Publishers.
3. Nagrath, I. J., Kothari, D. P., "Electric Machines", Tata McGraw-Hill Publishing Company Ltd., Third Edition
4. Fitzgerald, A. E., Charles Kingsley, Jr. Stephen D. Umans, "Electric Machinery", Tata McGraw-Hill, Fifth Edition
5. Mukharjee P. K., Chakravarti S., "Electric Machines", Dhanpat Rai & Sons.
6.. D. P. Kothari, B. S. Umre, "Laboratory Manual for Electrical Machines", IK International New Delhi.

Deliverables

- ***Students can properly handle DC motor in industry.***
- ***In power system the knowledge of transformer connections and harmonics is useful for generation/transmission/distribution.***

EEP203: ELECTRICAL MACHINES-I LAB (0-0-2-2)

List of experiments:

1. To study the speed control of DC Shunt Motor by a)varying armature voltage with field current kept constant, b)varying field current with armature voltage kept constant.
2. To perform Load Test on DC Shunt Generator.
3. To perform O. C. and S. C. Test on a Single Phase Transformer
4. To study the **a)** Polarity Markings on Single Phase Transformer Windings and to study **b)** Autotransformer.
5. To study the Load Test on a D C Cumulatively Compounded Motor.
6. To study the Load Test on a 3-Phase Induction Motor.
7. To determine Voltage Regulation and Efficiency of a Single Phase Transformer by Direct Loading.
8. To Study Scott-Connection of Transformers (Three Phase to Two Phase Conversion)

ECL207: DIGITAL CIRCUITS (3-0-0-6)

Objectives

- ***Study of various number systems and logic gates.***
- ***Study of flip-flops, counters, encoders, decoders, multiplexers etc.***

Contents

Analog Vs. Digital Systems, Transistor as a Switch, Boolean Identities, Logic Problems, Binary, Gray, Octal, Hex and ASCII Codes, Gates And Their Truth Tables, De Morgans Law, Sum of Products And Product of Sums.

Combinational Basic Concepts, SSI, MSI, VLSI Circuit Classification, Standard TTL, CMOS Characteristics, Decoders, Encoders, Multiplexers, Code Converters Characteristics of Display Devices, Standard Configuration of Gates As SSI/MSI/LSI Circuits, Arithmetic Circuits-Adders, Subtractors (Half And Full) BCD Adder/Subtractor, Concept of ALU.

Karnaugh Map, Simplification of Sum of Products and Product of Sums, Solution to Problems Using MUX as A Function Generator, Simplification of Logical Functions Using Quine-Mclausky Method.

Introduction To Flip-Flop, Latches, Concept of Clock, Memoir Organization With Flip-Flop as Basic Cell, RAM, ROM, EPROM, EEPROM, An Overview, Master Slave Combination And Conversion of One Type To Another Type Flip-Flops, Multi-Vibrators and Their Design Parameters.

Execution Tables and Introduction to Sequential Circuits, Counters, Synchronous / Asynchronous, Different Module Counters with Reset/Clear Facility, Design of Counters of Arbitrary Module with K-Maps, Lock Free Counters

Introduction to Sequential System, Design of Sequential System Using Moore and Miley System, Fundamental Mode Sequential Circuits

Text/ Reference Books

1. Taub H., Digital Integrated Electronics, McGraw Hill
2. Jain R.P., Digital Logic Design, PHI
3. Malvino, Leach, Digital Principles and Applications, McGraw Hill
4. Anand Kumar A. Fundamentals of Digital Circuits, PHI

Deliverables

- ***Students are able to understand and do various number conversions.***
- ***Students are able to design and implement basic digital circuits.***

ECP207: DIGITAL CIRCUITS LAB (0-0-2-2)

List of Experiments:

1) Study of logic gates.
2) Implementation of basic gates using universal gates.
3) Implementation of formula $F=\sum(0,1,4,5,6,8,9,12,13,14)$ using NAND gate only.
4) To study the half adder and full adder.
5) To study the MUX and DEMUX.
6) To study the encoder and decoder.
7) To study of JK, D, T flip flops.
8) Study of counters.
9) Study of shift registers.

EEL208: MATLAB PROGRAMMING (2-0-2-4)

Objectives

- ***To learn MATLAB as a language for technical computing which integrates computation, visualization and programming.***
- ***To introduce some of the toolboxes like Symbolic Math and Signal Processing.***
- ***To introduce Simulink.***

Contents

1. Introduction To MATLAB : Command Line Versus Programming
2. MATLAB Variables , Arithmetic Operations , Logical And Relational Operations, Mathematical Functions, Graphical Functions, Input-Output Operations , Elementary Matrix Manipulations
3. String Handling In MATLAB
4. Structures And Cell Arrays
5. MATLAB Language Constructs
    - If, Else, Else-If, For , While , Switch , Eval , Feval Etc.
6. MATLAB Scripts And User Created MATLAB Functions
7. In-Line Functions And Anonymous Functions
8. File Handling In MATLAB
9. 2-D And 3-D Plotting In MATLAB 14
10. Introduction To Concept Of Tool-Boxes And Block-Sets In MATLAB
11. Advanced Features
    - Object Oriented Concepts In MATLAB
    - Introduction To Simulink
    - Communicating With Simulink Through MATLAB Script
    - Graphical User Interface

Text/ Reference Books

1. Rudra Pratap, Getting Started with MATLAB 7, Oxford University Press (Indian Edition) 2006
2. O. Beucher and M. Weeks, Introduction to MATLAB and Simulink: A Project Approach, Third Edition
3. S.J.Chapman, MATLAB Programming for Engineers, Thomson Learning, Third Edition
4. R.K.Bansal, A.K.Goel, M.K.Sharma, MATLAB and its Applications in Engineering, Pearson Education, 2009

Deliverables

- ***Development of skills for problem solving using computers.***
- ***Able to write efficient and well structured programs in MATLAB.***
- ***Able to analyze simple electrical/ electronic circuits.***

EEP208: MATLAB PROGRAMMING LAB (0-0-2-2)

1) Write a program to plot frequency response of LP/HP filters.
2) Write a program for study of maximum power transfer theorem.
3) Write iterative and recursive functions to generate Fibonacci sequence/to find factorial of a number etc.
4) Write a program to plot the transient response of the given RC and RL circuits using analytical solution.
5) Write a program to plot the transient response of the given RC and RL circuits using function in symbolic math tool box.
6) Write a program to compute standard deviation and RMS values of the signal using file I/O.
7) Write a program to extract the fundamental component of a signal using full cycle window DFT.
8) Write program to implement sorting methods: exchange sort, insertion sort, selection sort.
9) Write program to implement searching methods: sequential search, binary search.
10) Write a program to create student database using array of structures and perform functions such as searching and sorting.
11) Write a program to create a bank customer database using cell and perform functions such as searching and sorting.
12) Design the GUI for impedance calculator for series/ parallel RLC circuit.
13) Create a model in simulink to simulate faults on simple transmission system.

PHL202: INTRODUCTION TO MATERIAL SCIENCE (3-0-0-6)

Objectives

- ***To learn in depth about electrical and magnetic properties of materials.***
- ***To study properties of dielectric and semiconductor materials.***

Contents

Electrical Conduction : Electronic and Ionic Conduction , Conductivity in Metals , Ohm's Law , Relaxation Time , Collision Time , Mean Free Path of an Electron , Electron Scattering , Resistivity of Metals , Effect of Temperature and Impurity on Conductivity , Joule's Law , High Conductivity And Resistivity Materials , Superconductivity and Applications

Polarization of Dielectrics : Polar and Non-Polar Dielectrics , Basic Concept of Polarization , Types of Polarization, Dielectric Constant ,Internal Field in Dielectrics , Ferroelectric ,Spontaneous Polarization, Curie-Weiss Law, Piezoelectric And Pyroelectric , Dielectric Loss , Breakdown in Dielectrics, Dielectric in Alternating Field : Dielectric Properties of Insulators in Alternating Fields, Complex Dielectric Constant , Electronic Polarization , Ionic Polarization , Frequency Dependence of Electronic Polarization, Dielectric Constant of Non-Polar Solids , Dipolar Relaxation , Loss Tangent

Magnetic Properties of Materials: Atomic Interpretation of Diamagnetic, Paramagnetic, Anti-Ferromagnetic and Ferromagnetic Materials. Ferromagnetic Domain , Alloy for Core Materials for Rotating Machines , Transformers , Permanent Magnets and Non Magnetic Steels , Nonmetallic Magnetic Materials , Thin Film Magnets , Magnetic Materials for Ferromagnetic Tape And Memory Devices

Semiconductor Material Technology: Method for Material Preparation, Purification and Doping, Introduction to Processes of Manufacturing Semiconductor Devices, Transistors, Integrated Circuits .Monolithic Diodes, Integrated Resistors and Integrated Capacitor

Text/ Reference Books

1. Dekkar, A.J., Electrical Engineering Materials, Prentice Hall Publications Co.
2. Kasap S.O., Principle of Electronic Materials and Devices, Tata McGraw- Hill, 2nd Edition
3. Choudhary, D.Roy, Jain, Shail, Linear Integrated Circuits, New Age International
4. Pillai, S.O., Solid State Physics, New Age International Publishers, 3rd edition

Deliverables

- ***Students get detailed idea about various concepts and technologies used in material science.***
- ***Thorough study of various semiconductors, magnetic and dielectric materials is done.***

EEL215: ELECTRICAL POWER UTILIZATION (3-0-0-6)

Objectives

- ***To enable the students to understand the concepts of electrical heating, welding, illumination, traction and their uses in industry***

Contents

Electrical Traction : Features of an Ideal Traction System, Systems of Electrical Traction, Mechanism of Train Movement, Speed- Time Curve, Traction Supply System, Transmission Line to Substation, Feeding and Distribution System on an AC Traction, System of Current Collection, Traction Motors, Tractive Effort and Horse Power, Speed Control Schemes, Electric Braking

Electric Heating: Classification, Heating Element, Losses in Oven and Efficiency, Resistance Furnace, Radiant Heating, Induction Heating, High Frequency Eddy Current Heating, Dielectric Heating, Arc Furnace, Heating of Furnace, Electric Welding, Methods and Equipments, Electrolysis and Electroplating Applications

Illumination: Radiant Energy, Terms and Definitions, Laws of Illumination, Polar Curves, Photometry, MSCP, Integrating Sphere, Luminous Efficacy, Electrical Lamps, Design of Interior and Exterior Lighting Systems, Illumination Levels for Various Purposes, Light Fittings, Factory Lighting, Flood Lighting, Street Lighting, Energy Conservation in Lighting

Air Conditioning and Refrigeration: Control of Temperature, Protection of Motors, Simple Heat-Load and Motor Calculations, Air Conditioning, Functioning of Complete Air Conditioning System, Type of Compressor Motor, Cool Storage, Estimation of Tonnage Capacity and Motor Power, Technology of Electric and Hybrid Electric Vehicles

Basics of Domestic Electrical Wiring, Types of Cables, Flexible Wires Sizes and Current Capacity, Use of Fuse, MCB and MCCB (Working and Construction), Idea about Megger, Basics of Air Flow for No Fans in a Room

Text/ Reference Books

1. Taylor E. Openshaw, Utilization of Electrical Energy, Orient Longman, 1968
2. Gupta J. B., Utilization of Electric Power and Electric Traction, S. K. Kataria and Sons, 2002
3. Wadhwa C.L., Generation, Distribution and Utilization of Electrical Energy, Wiley Eastern Limited, 1993
4. Soni, Gupta, Bhatnagar, A Course in Electrical Power, Dhanpat Rai and Sons, 2001
5. Uppal S. L., Electrical Power, Khanna Publishers, 1988
6. Garg and Girdhar, Utilisation of Electric Energy
7. Pratab H., Art and Science of Utilization of Electrical Energy, Dhanpat Rai and Sons, New Delhi, Second Edition
8. Tripathy S.C., Electric Energy Utilization and Conservation, Tata McGraw Hill 1993
9. bee-india.org
10. eia.doe.gov
11. www.irfca.org
12. IEEE bronze book- IEEE Press

Deliverables:

- ***Students get detailed idea about effective power utilization.***
- ***Thorough study of various concepts such as electrical heating,welding, illumination,traction and their uses in industry .***

EEP207: ADVANCED PROGRAMMING LAB (0-0-2-2)

LIST OF EXPERIMENTS:

1) First step in graphics.

2) Drawing Resistor Symbol.

3) Lissajous Patterns.

4) Synthesis if Square Wave Using Fourier Series.

5) Manually creating a Linked list.

6) Creating a Linked List programmatically.

7) Relative Grading program

8) Deleting User Selected Node from Linked list.

9) Reversing a linked list (Not in Place).

10) Towers of Hanoi: Generating Moves for solving.

11) Study of Recursion.

12) Implementation of Stack Using Array.

13) Queue Implementation of Stack Using Array.

14) Passing a function using function pointer: Table of reciprocals

15) Passing a function using function pointer: Numerical integration.

16) To do list using linked list of CHAR pointers.

17) Online Quiz.

18) Discrete Fourier transform.

19) Interfacing Hardware through pointer port

FIFTH SEMESTER

EEL307: ELECTRICAL MACHINE DESIGN (3-0-0-6)

Objectives

- ***To teach the design principles of magnetic circuit and winding, three phase transformers and 3 phase induction motor.***
- ***Study of heating and cooling of machines.***

Contents

Review Of Material Used In Construction of Electrical Machines Classification of Insulating Materials Depending Upon Permissible Temperature Rise, Properties of Transformer Oil, Standard Specifications, C.M.R. and Short Time Rating of Machines. Heating and Cooling Characteristics

Transformer Design: Specific Loading, Equation for Voltage per Turn for Power and Distribution Transformer Output Equation

Principle of Electric and Magnetic Circuit, Design, Method of Cooling and Cooling Circuit Design Estimation of Performance Characteristics from the Design Data

Induction Motor: Main Dimensions, Output Equation, Loading Constants, Estimation of Axial Lengths, Air Gap Diameter, Winding Design. Air Gap Length, Slot Dimension for Stator and Rotor, Cage Rotor and Wound Rotor Design, Calculation of No Load Current and Other Performance On Characteristics for Design Data

Synchronous Machines: Air Gap Length, Methods of Obtaining Sinusoidal Output Voltage, Field Coil Design for Salient Pole Machine and For Turbo Generator Rotor. Ventilation of Synchronous Generator, Cooling Air Circuits, Closed Ventilation/Quantity of Cooling Medium Hydrogen and Water as Cooling Media

Text/ Reference Books

1. Say M.G., Performance and design of A.C. Machines
2. Sawhney A.K., Electrical Machine Design, Dhanpatrai and sons
3. Balbir Singh, Electrical Machine Design, Bright Student Publication
4. Vasutinksy S.B., Power Transformer, P.S.G. College of Technology
5. Deshpande H.V., Electrical Machine Design

Deliverables
Students are able to design

- ***Distribution and power transformer.***
- ***Three phase induction motor.***

ECL321: MICROPROCESSORS & INTERFACING (3-0-0-6)

Objectives

- ***To learn architecture, assembly language of microprocessor.***
- ***Interfacing microprocessor with various devices.***

Contents

VSLI Circuit Concept, Approach to Integrated System Design Using Microprocessors. Bus Concepts Address Data and Control Organization of a Computer with MPU
Bits/Bytes/Words/Long Words – Their Ranges – Accuracy and Precision Memory Organization Linear/Absolute Decoding

Introduction to Intel's 8085A Architecture, Description, Software Instructions, Addressing Modes, Advantages, Timing Diagram Assess Assemblers and Dissemblers (By Hand Coding)

Flag Structure, Concept of PSW Stacks and Subroutines, Simple and Nested PUSH, POP Instructions and CALL/RETURN Instruction Stack Manipulation Simple Programs, Counters and Timing Delays.
Interrupts – Concept And Structure In 8085 Interrupt Service Routines. Advanced Instructions &Programming of 8085 and Programming

Methods of Data Transfer- Serial, Parallel, Synchronous Asynchronous. IN/OUT Instructions Timing Diagrams Simple Hardware Interface to 8085 of Standard Latches/Buffers/Keys/Display Devices as I/O Ports Handshaking Concepts Architecture and Interface of 8255 And 8253 To 8085

Hardware Considerations – Bus Contention Slow Memory Interfacing Complete Signal
Description of 8085 Multiplexed Key Board/Display Interface and Assembler Directives,
General Awareness about Micro-Computer System Related Products..

Text/ Reference Books

1. Gaonkar R.S., Microprocessor architecture- Programming & Applications 8085, Penram International, 4th Edition.
2. Uffenbeck J., Microcomputers and Microprocessors, Prentice Hall of India, 3rd Edition.

Deliverables

- ***Students are able to write codes for microprocessor programming.***
- ***Various interfacing techniques are learnt by students.***

EEL301: ELECTRICAL POWER SYSTEM-I (3-0-0-6)

Objectives
Study of

- ***Basic power system and infrastructure.***
- ***Connection of generation, transmission, distribution and utilization in power system.***
- ***Grid system and power flow, per unit calculation.***

Contents

General Structure of Electrical Power System- Introduction to Power System, Generation, Transmission, Distribution and Utilization- Overview Single Line Diagram (SLD) Representation

Transmission Substations- Different Types of Transmission Substations, Idea About Substation and Equipments in Substation, Radial and Grid Systems, Concept of Instantaneous, Real, Reactive and Complex Power, Three Phase Power and Power Loss.

Transmission Lines- Types of Transmission Lines, Basic Concept of Inductance and Capacitance of Transmission Lines, Modes of Short, Medium, Long Transmission Lines, A, B, C, D Parameters, Transmission Line Voltage Control Methods

Per Unit System- Necessity, Advantages, Applications in Power Systems and Calculations

Load Flow Analysis- Y Bus Formation, Gauss Iterative and Gauss Seidal Method, Method for Solution of Load Flow Problem (Not More Than 3 Buses) MATLAB Program

Control Model- Load Frequency Control, Model of Turbine Speed Governing System, Load Sharing By Generators, Concept Of Control Area, Two Area Load Frequency Control, Model of Automatic Voltage Regulator (AVR), Voltage Behind Reactance Model of Generator and Power Angle Characteristics.

Text/ Reference Books

1. Stevenson W.D. Jr., Elements of power system analysis, Mc- GrawHill publications, 3rd Edition
2. Nagrath I. J., Kothari D. P., Power System Engineering, Tata – Mc GrawHill publications
3. Elgerd O. I., Electric Energy Systems Theory, Mc- GrawHill publications
4. Grainger John J., Stevenson W.D. Jr., Power System Analysis, Mc- GrawHill international editions
5. Sadat Hadi, Power System Analysis, Mc- GrawHill international

Deliverables

- ***Able to draw single line diagram.***
- ***Solve load flow problem by computer application.***
- ***Able to perform p.u. calculation to power system.***

EEL302: ELECTRICAL MACHINES-II (3-0-0-6)

Objectives

- ***This subject gives construction, operation and applications of synchronous and induction motors.***

Contents

Three Phase Induction Motor: Torque Slip Characteristics, Determination of Equivalent Circuit Parameters, Losses and Efficiency, Circle Diagram, Starting, Speed Control and Breaking, High Torque Motors (Double Cage Motor), Crawling and Cogging, Applications, Induction Generator.

Three Phase Synchronous Generator: Introductions, Constructional Features of Cylindrical and Salient Pole Rotor Machines, Steady State Operation of Three Phase Synchronous Generators: Phasor Diagram, Regulation. Steady State Performance of Three Phase Synchronous Generator

Synchronizing of Generator with another Generator: Parallel Operation, Reactances (Parameters) and their Measurement (Experimental Determination), Short Circuit Ratio, Losses and Efficiency
Synchronous Machines on Infinite Bus: Phasor Diagram, Expression for Torque, Load/Torque Angle, Synchronous Motor Operation, Effects of Variable Excitation and Power Input on Generator Operation and Effect of Variable Excitation and Load on Motor Operation.

Transient Behavior: Sudden 3-Phase Short Circuit, Time Constants and Equivalent Circuit Diagrams, Damper Windings.

Introduction To Special Machines: Repulsion Motors, AC Series Motors, Universal Motors, Reluctance Motor, Hysteresis Motor, Schrage Motor, Power Selsyns, Position Selsyns, (Only Elementary Aspects Of The Above Types Are Expected),

Text/ Reference Books

1. Bhimbra P.S., "Electrical Machinery", Khanna Publishers.
2. Bhimbra P.S., "Generalized Theory in Electrical Machines", Khanna Publishers.
3. Nagrath, I. J., Kothari, D. P., "Electric Machines", Tata McGraw-Hill Publishing Company Ltd., Third Edition
4. Fitzgerald, A. E., Charles Kingsley, Jr. Stephen D. Umans, "Electric Machinery", Tata McGraw-Hill, Fifth Edition
5. Mukharjee P. K., Chakravarti S., "Electric Machines", Dhanpat Rai & Sons.
6. D. P. Kothari, B. S. Umre, "Laboratory Manual for Electrical Machines", IK International New Delhi.

Deliverables

- ***Students can properly handle three phase synchronous generator, induction motor and special machines in industry.***
- ***This knowledge is also useful for higher studies.***

EEP302: ELECTRICAL MACHINES-II LAB (0-0-2-2)

LIST OF EXPERIMENTS:

1. To Study the Variation of Speed and Load Test on Schrage Motor.
2. To Plot *V* and Inverted *V (Λ)* Curves of a Synchronous Motor.
3. To determine the ratio X_q/X_d for Three Phase Alternator by using "Slip Test"
4. To Study the Synchronization of an Alternator with an Infinite Bus by "Dark Lamp Method"
5. To determine Potier Reactance of Three Phase Alternator by"Zero Power Factor Saturation Curve".
6. To determine Negative Sequence and Zero sequence Reactances of Synchronous Generator.
7. To Study the Characteristics of Three Phase Induction Generator.
8. To Determine Direct Axis Subtransient (X_d"), Quadrature Axis Subtransient (X_q") Synchronous Reactances of Synchronous Machine.

EEL405: POWER STATION PRACTICE (3-0-0-6)

Objectives

- ***To learn the operations of various power plants.***

Contents

Conventional Sources of Electrical Energy - Steam, Hydro, Nuclear, Diesel and Gas; Their Scope and Potentialities for Energy Conversion

Generation – Different Factors Connected With a Generating Station; Load Curve, Load Duration Curve, Energy Load Curve; Base Load and Peak Load Plants.

Thermal Stations – Selection of Site, Size and Number of Units, General Layout, Major Parts, Auxiliaries, Generation Costs Of Steam Stations.

Hydro Stations – Selection of Site, Mass Curve, Flow Duration Curve, Hydrograph, Classification of Hydro Plants, Types of Hydro Turbines, Pumped Storage Plants.

Nuclear Stations – Main Parts, Location, Principle of Nuclear Energy, Types of Nuclear Reactors, Reactor Control, Nuclear Waste Disposal.

Power Station Control and Interconnection – Excitation Systems, Excitation Control, Automatic Voltage Regulator Action; Advantage of Interconnection

Alternate Energy Sources Overview

Text/ Reference Books

1. M.V. Deshpande, Elements of Electrical Power Station Design, Wheeler Publishing Co.
2. B.R. Gupta, Generation of Electrical Energy, Eurasia Publishing house,2003
3. MME1-Wakil, Power Plant Technology, McGraw- Hill, 1985
4. Arora and Dombundwar, A Course in Power Planr Engineering, Dhanpat Rai and Sons

Deliverables

- ***With the help of this course students are able to realize the different sources to generate electrical energy***
- ***As well as how to erect and where to erect the plants can be done.***

EEL305: CONTROL SYSTEM -I (3-0-0-6)

Objectives

- ***Control system is a tool subject. The lessons in basics will help to use this tool in various main subjects like power system and power electronics.***
- ***The use of feedback to improve the system performance can be understood if this subject is studied.***

Contents

Introduction to Need for Automation and Automatic Control Use of Feedback, Broad Spectrum of System Application
Mathematical Modeling, Diff. Equations, Transfer Functions, Block Diagram, Signal Flow Graphs, Application to Elementary System Implications, Effect of Feedback on Parameter Variation, Disturbance Signal Servomechanisms and Regulators.
Control System Components, Electrical, Electromechanical, And Other Components. Their Functional Analysis and Input Output Representation.
Time Response of Systems, First Order and Second Order System, (Standard Inputs) Concept of Gain and Time Constants Steady State Error, Type of Control System, Approximate Methods for Higher Order System
Root Location and Its Effect on Time Response, Elementary Idea of Root Locus, Effect of Adding Pole and Zero and Proximity of Imaginary Axis**.**
Stability of Control Systems, Conditions of Stability Characteristic Equation, Routh Hurwitz Criterion, Special Cases for Determining Relative Stability.
Frequency Response Method of Analyzing Linear System, Nyquist and Bode Plots, Stability and Accuracy Analysis From Frequency Responses, Open Loop And Close Loop Frequency Response. Nyquist Criterion, Effect Of Variation Of Gain And Addition of Pole and Zero on Response Plot, Stability Margins in Frequency Response.
State Variable Method of Analysis, Characteristic of System State Choice of State Representation of Vector Matrix Different Equation Standard Form, Relation between Transfer Function and State Variable

Text/ Reference Books

1. Nagrath & Gopal, Control System Analysis
2. D'Azzo Houpis, Logakusha, Huelsoman,Linear System Analysis, McGraw Hill
3. Kuo B.C., Automatic Control Systems, Prentice Hall
4. Norman Nise, Control System Engineering, John Wiley & Sons Inc
5. Gopal M, Control Systems- Principle of Design

Deliverables

- ***This course helps in higher studies to model various systems.***
- ***It also helps to check for system stability.***

EEP305: CONTROL SYSTEM –I LAB (0-0-2-2)
LIST OF EXPERIMENTS

1. A) To Study the characteristics of Potentiometer as an error detector.
   B) To Study the characteristics of a i) Synchro transmitter
   ii) Synchro as an error detector
2) To Study transient response of second order R-L-C Circuit using discrete components.
3) To study the Torque-Speed characteristics of Two Phase A.C Servo motor .
4) To Study the effect of addition of pole to the second order closed loop control system by using MATLAB.
5) To Study the frequency response of a second order R-L-C series circuit using discrete components.
6) To Study the phase lead and phase lag networks Using discrete components.
7) A) To study the effect of addition of pole on frequency response of second order closed loop system by using MATLAB
   B) To study the effect of Zero and pole to open loop transfer function of a second order system with unity feed back by using MATLAB.
8) To study the effect of PID controller using a Kit.

EEP306: ELECTRICAL ENGINEERING WORKSHOP LAB (0-0-2-2)

LIST OF EXPERIMENTS:

1) To Study different Electrical symbols.

2) To Study Characteristics of fuse wire.

3) To design single phase 50hz 230/12 v , 50VA transformer

4) To Study power quality interference caused CFL

5) Study of switching transients in power system.

6) Study of phase shift of star delta transformer.

7) Study of impact of balanced non linear load on neutral current.

8) Industrial visit report.

9) Study different electrical switchgear in substation

10) Introduction to mini hardware & software project.

11) To study household wiring.

12) Hardware and software mini project.

SIXTH SEMESTER

EEL303: POWER ELECTRONICS (3-0-0-6)

Objectives

- ***To learn different power semiconductor devices.***
- ***To learn different converter topologies, their operation and applications.***

Contents

SCR and Its Characteristics, Gate Characteristics SCR Ratings, Series and Parallel Connections of SCRs, Uni-Junction Transistor Triggering Circuits and Optocouplers, Commutating Circuits, Protection of SCR. Gate Circuit Protection. Over Voltage and Over Current Protection Snubber Circuit Design Converter Circuit Faults and Their Protection

Line Commutated Converters: Working of Single Pulse Converter. Two Pulse Converters Three Phase Six Pulse Bridge Converters Effect of Source Inductance in Converters Effect of Free Wheeling Diode, Speed Control of DC Motor Using Converter. AC Voltage Controllers, Cyclo-Converters (Single Phase)

Static Controllable Switches: Characteristics and Working of MOSFET. Gate Turn Off Thyristor And Insulated Gate Bipolar Transistor.

D.C Choppers: Classification, Principles of Step Down Chopper Step Up Chopper, Impulse Commutated And Resonant Chopper. Multiphase Choppers Application of Choppers

Single Phase and Three Phase Bridge Inverters: Output Voltage Control, Harmonics in Output Voltage Waveform, Harmonics Attenuation by Filters, Harmonic Reduction by Pulse Width Modulation Techniques Analysis for Single Pulse Width Modulation Working Of Current Source Inverters Few Applications of Inverters, Principle of Resonant Inverter

Text/ Reference Books

1. Rashid M, Power Electronics, PHI
2. Singh M.D., Khanchandani K.B., Power Electronics, Tata McGraw Hill
3. Ned Mohan, Power Electronics, John Willey, 2000
4. Lander C.Y., Power Electronics, McGraw Hill International, 1993
5. Bose B.K., Modern Power electronics, Pearson Education India, 2003
6. Joseph Vithyathil, Principles of Power Electronics

Deliverables

Students are able to understand

- ***Operation and applications of various power electronics converters.***
- ***AC voltage controllers and cyclo-converters.***

EEP303: POWER ELECTRONICS LAB (0-0-2-2)

1) To study the Vt , It characteristics of SCR.
2) To study DC circuit breaker using SCR.
3) To study phase control AC-DC converter using SCR.
4) To study the relaxation oscillator using UJT.
5) Simulation of i) Single phase half wave rectifier.
   ii) Single phase full wave fully controlled rectifier [R, R-L, R & high L].
6) To study four modes of operation of TRIAC
7) To study AC Voltage regulator using SCR.
8) To study single phase inverter using self controlled devices as IGBT/MOSFET(single PWM, Multiple PWM, Sinusoidal PWM)
9) To study the Three phase inverter.
10) To study DC-DC converter i) Buck converter ii) Boost converter.
11) simulation of following experiments using PSIM
    i) AC Voltage regulator using SCR
    ii) Single phase inverter using self controlled devices as IGBT/MOSFET (Single PWM, Multiple PWM, sinusoidal PWM).
    iii) Three phase inverter.
    iv) DC-DC converter **: -** a) Buck converter. b) Boost converter.

EEL304: ELECTRIC DRIVES & THEIR CONTROL (3-0-0-6)

Objectives

- ***Understanding the operation of various drives.***
- ***Learning about PLC and control of motors.***

Contents

Definitions, Classification and Speed Torque Characteristics Of Common Drive Motors and their Characteristics Under Starting, Running, Braking And Speed Control

Rating & Service Capacity: Selection of Motor, Power Capacity For Continuous And Intermittent Periodic Duties, Load Equalization: Flywheel Effect, Speed-Time Relations

Programmable Logic Controllers: Basic Construction, Operation Block Diagram Arrangement, Its Elementary Programming and Applications in Electric Drives

AC And DC Contactors And Relays: Magnetic Structure, Operation, Arc Interruption Contactor Rating, H.V. Contactors, Control Circuits For Automatic Starting And Braking Of DC Motor And Three Phase Induction Motor, Control Panel Design

Traction Motors: Motor Used In AC/DC Traction, Their Performance and Desirable Characteristics, Requirements and Suitability of Motor for Traction Duty. Control of D.C. Traction Motor, Series Parallel Control Starting and Braking Of Traction Motor

Brief Idea About Drives Commonly Used In Industries, Digital Control Of Electric Motors, Block Diagram Arrangement, Comparison With Other Methods Of Control

Text/ Reference Books

1. Heumann G.W., Magnetic Control of Industrial Motors, John Wiley & Sons, Second Edition
2. Soni M.L., Gupta P.V, Bhatnagar U.S., A course in Electrical Power, Dhanpat Rai & Sons 1999
3. Partab H., Art & Science of Utilization of Electrical Energy, Dhanpat Rai & Sons, 1999
4. Partab H., Modern Electrical Traction, Pritam Surat & Brothers, 1973
5. Vedam Subrahamanyam, Electric Drives – Concepts & Applications, Tata McGraw-Hill 1997

Deliverables

Students are able to

- ***Design drives for industrial applications.***
- ***Analyze drive performance under various dynamic operating conditions.***

ECL320: LINEAR ELECTRONIC CIRCUITS (3-0-0-6)

Objectives

- ***Study of operational amplifiers.***
- ***Understanding working of linear circuits and linear ICs.***

Contents

Basic Operational Amplifier Circuits: Differential Amplifier Stages, Current Source, Biasing, Level Shifting Techniques, Common Mode and Difference Mode Gains and Impedance of a Differential Stage. Overload Protection Circuits, Frequency Response and Compensation, Characteristics of Ideal and Non-Ideal Operational Amplifier, Error Measurement of Various Parameters

Simple Linear Circuits: Inverting, Non-Inverting Buffer Amplifiers, Summer, Integrator, Differentiator, Log, Antilog, Multipliers, Divider Circuits, Differential Amplifier Configuration, Bridge Amplifiers, Instrumentation Amplifier, Grounding And Shielding Problem In Instrumentation Amplifier

Precision Rectifier, RMS To DC Conversion, Constant Current And Voltage Sources, Sinusoidal Oscillators With Frequency And Amplitude Stabilization, Elementary Idea Of Active Filter With Butterworth 2^{nd} Order Filter Design Procedure

Applications of Operational Amplifier for Clipping Clamping, Comparator Circuits With Nonlinear
Components, Multiplexers, Demultiplexers, Astable Monostable, Bistable Multivibrator Circuits Using OA Sample/ Hold Circuits D/A and A/D Conversion Circuits Phase Locked Loops

Study of Linear ICS like: LM741, LM555, LM565 and LM723

Text/ Reference Books

1. Gayakwad R, Op-Amps and Linear Integrated Circuits, PHI Pub, 4th edition
2. Coughlin R., Driscoll F., Operational Amplifiers and Linear Integrated Circuits, PHI Pub.
3. Tobey, Grames and Huelsman, Operational Amplifiers: Design and Applications, McGraw Hill

Deliverables

- S***tudents are able to design linear electronic circuits.***
- ***They are able to understand various circuit requirements as per a particular application.***

ECP320: LINEAR ELECTRONIC CIRCUITS LAB (0-0-2-2)

1) OP-amp as inverting amplifier
2) OP-amp as non-inverting amplifier
3) OP-amp as integrator
4) OP-amp as differentiator.
5) OP-amp as low pass filter.
6) OP-amp as High pass filter.
7) OP-amp as Schmitt trigger.
8) OP-amp as Comparator.
9) OP-amp as Half wave rectifier.
10) OP-amp as Full wave rectifier.
11) 555 As an Astable multivibrator.
12) 555 As an Monostable multivibrator.

EEL418: CONTROL SYSTEMS - II (3-0-0-6)

Objectives

- ***Study of nonlinear system, optimal control system.***
- ***State feedback design and tuning of PID controller.***

Contents

Nonlinear Systems: Common Physical Nonlinearities, Phased-Plane Method, Construction Of Phase Trajectories, The Describing Function Method, Derivation Of Describing Functions, Stability Analysis By Phase Plane And Describing Function Method, Liberalized Model Of Nonlinear Systems

Liapunov's Stability Analysis: Liapunov's Stability Criterion, Direct Method of Liapunov, Methods of Constructing Liapunov Functions for Nonlinear System

Sate Variable Design: Concepts of Controllability and Operability, Pole Placement by State Feedback, Observer Systems

Optimal Control Systems: Parameter Optimization, Optional Control Problems: Transfer Function Approach And State Variable Approach, Linear Quadratic Regulator

Realization of PI, PD, PID Controllers, Tuning Rules for PID Controllers

Text/ Reference Books

1. Nagrath & Gopal, Control System Analysis
2. D'Azzo Houpis, Logakusha, Huelsoman, Linear System Analysis, McGraw Hill, 1975
3. Kuo B.C., Automatic Control Systems., Prentice Hall, 1991
4. , Norman Nise, Control System Engineering, John Wiley & Sons Inc, 2000
5. Gopal M., Control Systems- Principle of Design

Deliverables

- ***Students are able to do stability analysis of systems.***
- ***They are able to design different controllers for improvement in the system response.***

EEL406: ELECTRICAL INSTALLATION DESIGN (3-0-0-6)

Objectives

- ***Study of essentials of electrical installation.***
- ***Study of consumer services, stability of power system and optimization techniques.***

Contents

Planning and Forecasting- Types of Loads, Distribution of Power Loads, Loads and Energy Forecasting. Planning Design and Operation Methodology, System Calculations, Load Flow, Fault Studies Voltage Control, Harmonics Due To Nonlinear Loads, System Losses, Ferro Resonance.

Consumer Services- Supply Industry, Rational Monopoly, Regulations & Other Legal Provisions, Supply Rules, Standards, Consumer Load Requirements Maximum Diversity and Load Factor Determination of Capacity of Distribution/ Power Transformer of Distribution Network, Electric Bill, House Hold Wiring and Protection, ELCB

Grounding- Grounding Systems, Earth and Safety, Types of Potentials, Earth Electrode Sizes, Design of Earthling Electrodes, Earthling Schemes, Earth Tester

Rural Power Supply- Over-Voltage and Protection, Power Capacitors Rural System, Improvement in Existing Distribution System, Concept of Single Phasing, Feeder Separation

System Performance- System Protection Schemes for Distribution Network, System Maintenance, HT- LT Network, Switching Stations

Text/ Reference Books

1. Pabla A.S., Electronic power distribution system, Tata McGraw Hills, 1995
2. Lekerai E. & Holmes E.J., Electricity distributions network design, IEE Publications, London 1998
3. Faulkenberry, Luces M. & Walter Cofter, Electrical Power Distribution & Transmission, Princtice Hall Inc., 1998

Deliverables

- ***Students will be able to implement various planning methodologies for electrical installation.***
- ***They will be able to apply the knowledge of grounding and safety in practice.***

EEL401: ELECTRICAL POWER SYSTEM-II (3-0-0-6)

Objectives

- ***Appreciation of power system concepts.***
- ***Study of fault, stability and economic operation of power system.***

Contents

Symmetrical Component Transformation Three Phase Power in Unbalanced Circuit In Terms Of Symmetrical Component Sequence Impedance of Generator Transformer Transmission Line & Passive Loads Phase Shift In Y/Delta Three Phase Transformer (Yd1, Yd11 Connection)Symmetrical Fault Analysis Without & With Pre-Fault Load Currents. Selection of Circuit Breakers Ratings, Current Limiting Reactors

Unsymmetrical Fault Analysis: L-G, L-L-G-, L-L-L, L-L-L-G, Open Conductors Fault Using Symmetrical Components

Stability of Power System – Steady State Dynamic and Transient Stability Definition and Comparison Dynamics of Synchronous Machine Swing Equation Swing Equation for Single Machine Connected To Infinite Bus, Power Angle Equation. Steady State Stability Studies

Transient Stability Studies: Swing Curve, Equal Area Criterion for Transient Stability Application of Equal Area Criterion for Different Disturbances. Solution of Swing Equation by Point by Point Method of Improving Transient Stability

Economic Operation of Power System: Introduction, Distribution of Load between Units within the Plant. Optimum Generation Scheduling, Considering, Transmission Losses Representation of Transmission Loss Using Loss Formula Co-Efficient Derivation of Loss Formula Co-Efficient Simulation of Co-Ordination Equation on Digital Computer

Grounding Of Neutral in Power System Shunt & Series Compensation Generalized Equation, Shunt Reactor Compensation of Very Long Line with Intermediate Switching Station. Series Capacitor Compensation at Line Centre Shunt Reactor at both Ends and Series Capacitor in Middle of Line Elementary Idea of Sub-Synchronous Resonance Problem and Counter Measures

Text/ Reference Books

1. W.D. Stevenson Jr., Elements of power system analysis, Mc- Graw Hill publications, 3rd Edition
2. I. J. Nagrath, D. P. Kothari, Power System Engineering, Tata Mc- Graw Hill publications 1989
3. O. I. Elgerd, Electric Energy Systems Theory, Mc- GrawHill publications 1971

Deliverables

Students are able to

- ***Apply symmetrical components.***
- ***Analyze various faults.***
- ***Analyze transient stability.***
- ***Understand economic operation.***

ECP321: MICROPROCESSORS & INTERFACING LAB (0-0-2-2)

LIST OF EXPERIMENTS:

1) Addition of two 16 bit numbers and store 17 bit result in B-C-D registers.

2) Subtraction of two 32 bit numbers stored in BC & HL register pairs. Store result in memory.

3) Subtraction of two 32 bit numbers stored in memory. Store result in consecutive locations (using register indirect Addressing Mode).

4) Subtraction of two 32 bit numbers stored in memory. Store result in memory. (Use direct Addressing Mode).

5) A block of 10 numbers is stored in memory. Arrange these numbers in reverse sequence in a) different memory locations, b) same memory locations.

6) A block of 10 bytes stored in memory. Scan for a byte FFH. If true then stored them in a) different memory locations, otherwise in b) same memory locations.

7) A block of 10 bytes stored in memory. Store all even bytes and odd bytes in different memory locations.

8) Arrange numbers in ascending or descending order in the same memory locations.

9) Solve logical function Y=D2 (D4bar).D5+D2(D3bar)+(D0bar)D7 (D0……..D7 are bits of number in memory).

10) Write subroutine fro generation of delay of 1ms.

11) Generation of square wave and rectangular wave using 8255 and power flow control.

12) Generation of square wave (Varying width) Using 8253.

SEVENTH SEMESTER

EEL410: ADVANCED CONTROL THEORY (3-0-0-6)

Objectives

- ***To teach determination of linear and non-linear systems' relative stability.***
- ***Study of analog and digital control techniques.***

Contents

Review of State Variable Analysis, Controllability and Observability

Digital Control Systems, Models of Digital Control Devices, State Description of Digital Processors and Sampled Continuous Time Plants, Discretisation Of Digital Continuous Time State Equations, Solution Of State Difference Equation.

Controllability and Observability Tests For Digital Control Systems, Stability of Discrete Time Systems, Pulse Transfer Function and Its Realization, Stability Improvement By State Feedback, Pole-Placement Design And State Observers

Lyapunov Stability Analysis: Basic Concepts, Stability Definitions, Stability Theorems, Lyapunov Functions for Linear and Non Linear Systems

Optimal Control: Parameter Optimization Techniques, Lagrange Parameters Techniques, Calculus Of Variation, Unconstrained And Constrained Minimization Of Functional, Two Point Boundary Value Problems, Poynting's Minimum Principle, Optimal Regulator And Tracking Problems, Optimal Digital Control System

Text/ Reference Books

1. M.Gopal, Digital Control and State Variable Methods, Tata McGraw Hill, New Delhi, 1997
2. D.E. Kirk, Optimal Control Theory, Prentice Hall, 1970
3. M.Gopal, Digital Control Engineering, Wiley Eastern, 1988

EEL402: HIGH VOLTAGE ENGINEERING (3-0-0-6)

Objectives

- ***Understanding the breakdown phenomenon of insulating materials used in electrical system.***
- ***Various high voltage generation and measuring techniques.***
- ***Quality evaluation through testing methodologies in high voltage engineering.***

Contents

CHAPTER1: Breakdown Mechanism in Dielectrics: Ionization Process, Townsend's Criterion for B.D.: Breakdown in Electro-Negative Gases. In Non-Uniform Fields Corona Discharges And Introduction Of Corona, Post B.D. Phenomenon And Applications, Practical Considerations In Using Gases For Insulation Purpose, Vacuum Insulation: Liquid As Insulators. Of Solid Di-Electrics in Practice: B.D. In Composite Dielectrics

CHAPTER2: Lighting And Switching Over Voltages: Mechanism of Lighting, Types Of Strokes, Parameter Characteristics Lighting Strokes, Characteristics Switching Surges: Power Frequency Over Voltages Control Of O.V. Due To Switching. Protection of Lines by Ground Wires, Protection by Lighting Arrester, Gap Type and Gapless L.A. Selection of L.A. Ratings, Surge Absorbers

CHAPTER3:Traveling Waves and Insulation Co-Ordination: Traveling Waves on Transmission Lines. Classification of Lines Attenuation and Distortion of Traveling Waves Reflection and Transmission of Waves Behaviors of Rectangular Waves at Transition Points Introduction to Insulation Co-Ordination Associated Terms. Impulse Wave-Form Introduction to BIL Reduced BIL and SIL

CHAPTER4: Generation of High Voltages and Currents: Generation of High D.C. Voltages by Rectifiers. Voltage Doublers and Multiplier Circuits (Derivations of Not Required), Electrostatic Machines. Generation AC Voltages by Transformers Resonant Transformer Generation of High Frequency AC High Voltages, Generation of Impulse Voltages Standard Impulse Wave Shapes Analysis of Model and Commercial Impulse Generation Circuits Wave Shape Control Marx Circuit Tripping and Control of Impulse Generation. Generation of Switching Surges Generation of Impulse Current. Measurement of High AC and DC Voltages by Micro Ammeter

CHAPTER5: Generating Voltmeters Resistance and Potential Divider Series Impedance Voltmeters CVT Magnetic Type Potential Transformers. Electrostatic Voltmeter Peak Reading AC Voltmeters Sphere Measurement of Impulse Voltage by Potential Dividers and Peak Reading Voltmeters Measurement of High AC DC Currents Measurement of High Frequency and Impulse Current by Resistive Shunted (Bifillar Strip Shunt Only).

CHAPTER6: Non Destructive and High Voltage Testing Of Electrical Apparatus: Non-Destructive Testing: Measurement Of DC Resistively, Measurement of Di-Electric Constant and Loss-Factor (Low and Power Frequency Only), Schering Bridge for High Charging Circuits. For High Dissipation Factor, For Three Terminal Measurement. Transformer Ratio Arm Bridges, Partial Discharge Measurements by Straight Detectors by Balance Detectors, Calibration of Detectors, Discharge Detection in Power Cables High Voltage Testing, Testing Of Insulators and S/S Equipments

Text/ Reference Books

1. Naidu M.S., Kamaraju V, High Voltage Engineering, Tata McGraw Hill Publishing India, 1999
2. Wadhawa, C.L., High Voltage Engineering, Wiley Eastern Ltd, New Age Ltd, India, 1995
3. Kuffel E., High Voltage Engineering Fundamentals, Butterworth-Heineman, 2000

Deliverables

- ***Capability to design insulation scheme of electrical machines.***
- ***Test and measuring electrical equipments to the Indian standards.***
- ***Application in EHV substation insulation co-ordination design.***

EEP402: HIGH VOLTAGE ENGINEERING LAB (0-0-2-2)

LIST OF EXPERIMENTS:

1. To determine the breakdown voltage of different solid insulating materials.
2. Testing of transformer oil for breakdown voltage.
3. Calibration of voltmeter by sphere gap arrangement.
4. To study different types of line insulators.
5. To study and find the string efficiency of a given string of insulators.
6. To determine the flashover voltage of pin type insulators under dry and wet conditions.
7. To study the corona phenomenon in overhead lines.
8. To study Impulse Generator.
10. Study of Schering Bridge for capacitance and tan δ measurement of insulating material.

EEL403: SWITCHGEAR AND PROTECTION (3-0-0-6)

Objectives

- ***Comprehensive exposure to philosophy and technology of protection.***
- ***Introduction to switchgear.***

Contents:

General Philosophy of Protective Relaying: Protective Zones. Primary Protection Back Up Protection, Remote and Local Back Up, Selectivity. Medium Voltage Line Protection: Over current Relaying Directional over Current Relays

High Voltage Line Protection: Distance Relays, Carrier Distance Schemes. Unit Carrier Schemes

Equipment Protection: Principles of Differential Relaying, Protection of Generator, Transformers and Bus bars by Differential Relaying and Other Relays. Protection of Induction Motor's Against Overload, Short-Circuits, Thermal Release, Miniature Circuit Breaker.

Introduction To Static Relays: Comparison Of Static And Electro-Mechanical Relays, Two Input Amplitude And Phase Comparators And Their Duality, Generation of Various Distance Relay Characteristics Using Above Comparators

Switchgear: Circuit Breakers, Arc Interruption Theory, Recovery and Restriking Voltages, RRRV, Breaking Of Inductive and Capacitive Current. C.B. Ratio, Different Media of Arc Interruption, Overview of Oil Circuit Breakers, Construction and Operation of Air Blast, SF6 and Vacuum Breakers

Text/ Reference Books

1. C.R. Mason., Art and Science of Protective Relaying, John Wiley & Sons, New York, 1977
2. A.R. Van Warrington, Protective Relaying Vol. I & Vol.II, Chrapman & Hall, London 1969
3. Y. G. Paithankar, S.R. Bhide, Fundamentals of Power System Protection, PHI, 2nd edition, 2010

Deliverables

- ***The students can apply the knowledge in fields for setting, designing and testing of protection equipments.***

EEP403: SWITCHGEAR AND PROTECTION LAB (0-0-2-2)

1) Plotting characteristics of IDMT relay
2) Finding through fault stability of a simple differential scheme
3) Plotting characteristics of directional over-current relay
4) Plotting characteristics of Mho relay on R-X plane
5) Study of response of percentage biased differential protection scheme for a 3-phase delta/star transformer for various faults like L-G, L-L, L-L-G, L-L-L and inter-turn faults
6) Plotting characteristics of a simple impedance relay on R-X plane
7) Plotting characteristics of reactance relay on R-X plane
8) Simulation of sine and cosine type comparators in MATLAB/ Simulink

Text Book

1) C.R. Mason, 'Art and Science of Protective Relaying', Wiley Eastern , 1977

Reference Books

1) A.R. Van C. Warrington , Power System Protection Vol.I and Vol II, Chapman and Hall , 1968
2) English Electric Relay Application Guide
3)S.H. Horowitz and A.G. Phadke, ' Power System Relaying',John Wiley & Sons/RSP , 2008
3) Y.G. Paithankar, 'Transmission Network Protection: Theory and Practice', Marcel Dekker , 1998
4) Y.G. Paithankar and S.R. Bhide, 'Fundamentals of Power System Protection', PHI Learning , 2010

EEL409: HVDC (3-0-0-6)

Objectives

- ***To expose the students to the state of the art HVDC technology.***
- ***Methods to carry out modeling and analysis of HVDC system for inter-area power flow regulation.***

Contents

Development of HVDC Technology, DC versus AC Transmission, Selection of Converter Configuration

Rectifier and Inverter Operation, Digital Simulation of Converters, Control of HVDC Converters and Systems, Individual Phase Control, Equidistant Firing Controls, Higher Level Controls

Characteristics and Non-Characteristics Harmonics Filter Design

Fault Development and Protection, Interaction between AC-DC Power Systems.

Over Voltages on AC/DC Side, Multi-Terminal HVDC Systems, Control Of MTDC Systems

Modeling Of HVDC Systems, Per Unit System, Representation for Power Flow Solution, and Representation for Stability Studies

Text/ Reference Books

1. J. Arrillaga, High Voltage Direct Transmission, Peter Peregrinus Ltd. London, 1983
2. E. W. Kimbark, Direct Current Transmission, Vol.I, Wiley Interscience, 1971
3. K. R. Padiyar, HVDC Power Transmission Systems, Wiley Eastern Ltd., 1990
4. Erich Uhlmann, Power Transmission by Direct Current, B.S. Publications, 2004

Deliverables

- ***Students are able to understand, analyze and model the hvdc long distance bulk power transmission systems along with multi terminal HVDC Light using GTOs and IGBT technology.***

EEL417: ENERGY CONSERVATION AND AUDIT (3-0-0-6)

Objectives
Students are going to learn

- ***Industrial utilization of primary and secondary energy sources.***
- ***Different energy conversion processes.***
- ***Energy auditing procedure.***

Contents

Energy Conservation- Energy Scenario Overview, Basics of Energy and Its Various Forms, Global Environmental Concerns

Energy Efficiency in Thermal Utilities- Fuels and Combustion, Boiler, FBC Boilers, Cogeneration

Energy Efficiency In Electrical Utilities- Electric System, Electric Motors, Fans And Blowers, Pump And Pumping System, Cooling Tower, Lighting System, Energy Efficient Technologies In Electrical System

Energy Assessment- Energy Performance Assessment for Thermal Utilities and Electrical Utilities

Energy Audit- Energy Management and Audit, Material and Energy Balance, Energy Action Planning, Financial Management, Project Management

Text/ Reference Books

1. Giovanni and Petrecca, Industrial Energy Management: Principles and Applications, The Kluwer International Series-207, 1999
2. H.E. Jordan, Energy Efficient Electric Motors and their Applications, Plenum Pub. Corp, 2nd edition, 1994
3. Albert, Plant Engineers and Managers Guide to Energy Conservation, Fairmont Press 10th edition, 2011
4. Albert Thumann, Handbook of Energy Audits, Fairmont press, 5th edition, 1998
5. W.C. Turner, Energy Management Handbook, John Wiley and Sons, 1982
6. Guide books available at www.beeindia.in

Deliverables

Students are capable to

- ***Design the energy conversion processes.***
- ***Energy conservation opportunity.***
- ***Different energy auditing methodologies.***

EEL421: POWER QUALITY (3-0-0-6)

Objectives

- ***To study the aspects of power quality problems.***
- ***Effect of power quality in distribution system is studied.***

Contents

Introduction to Power Quality, PQ Standards, Terms, Definitions

Voltage Sag and Interruptions, Its Sources, Types, Characteristics, Behavior of Different Electric Equipments, Concept of Area of Vulnerability

Voltage Swell And Transient Over voltages, Sources Of Over voltages Like Capacitor Switching, Load Switching, Lightening Etc. Problems Due To Over Voltages, Computer Tools For Transient Analysis

Harmonics Distortions, Voltage And Current Harmonics, THD , Sources Of Other Harmonics, Its Ill Effects, Inter-harmonics, Harmonic Filters, Other PQ Problems Like EMI, Noise, Notching , Flicker , DC Offset.

Typical Wiring and Grounding Problem Causing Poor Power Quality, Solutions to Wiring and Grounding Problem

Need of Measuring and Monitoring Of PQ Problems, Location of Monitoring Equipments and Frequency

Text/ Reference Books

1. Roger C. Dugan, Electrical power system quality, Mc Graw-Hill
2. Alexander Kusko, Power quality in electrical systems, Mc Graw-Hill
3. Ewald Fusch, Power quality in power system and electrical machines, Academic press
4. Math H.J., Understanding power quality problems: voltage sags and interruptions by IEEE press

Deliverables

- ***Students will be able to understand the different power quality indices.***
- ***They will also know the ill effects of all power quality problems in distribution system.***

EEL407: ELECTRIC POWER DISTRIBUTION SYSTEM (3-0-0-6)

Objectives

- ***Learning about power distribution system.***
- ***Study of automation- SCADA.***

Contents

Load and Energy Forecasting: Distribution of Power, Management, Power Loads, Load Forecasting, Power System Loading, Technological Forecasting. Need Based Energy Management (NBEM) – Objectives, Advantages, Distribution Management System (D.M.S.)

Distribution Automation: Definition, Restoration / Reconfiguration of Distribution Network, Different Methods and Constraints. Interconnection of Distribution, Control & Communication Systems

SCADA: Introduction, Block Diagram, SCADA Applied To Distribution Automation. Common Functions of SCADA, Advantages of Distribution Automation through SCADA

Calculation of Optimum Number of Switches, Capacitors, Optimum Switching Device Placement in Radial, Distribution Systems, Sectionalizing Switches – Types, Benefits, Bellman's Optimality Principle, Remote Terminal Units.

Maintenance of Automated Distribution Systems, Difficulties in Implementing Distribution

Automation in Actual Practice, Urban/Rural Distribution, Energy Management

Text/ Reference Books

1. Pabla A.S., Electric Power Distribution, Tata McGraw Hill Publishing Co. Ltd., Fourth Edition
2. Khedkar M.K., Dhole G.M., Learning Material for Electrical Power Distribution, 2004

Deliverables

- ***Command over SCADA.***
- ***Details of energy management system are learnt.***

EIGHTH SEMESTER

EEL404: SAMPLED DATA AND DIGITAL CONTROL (3-0-0-6)

Objectives

- ***The basics of sampling and data processing are covered.***
- ***Data in sampled form is used for controlling purpose.***

Contents

Sampling And Data Reconstruction Processes: Sampled – Data Control Systems, Ideal Sampler, Sampling Theorem, Sample And Hold Operations, Frequency Domain Considerations

Z-Transforms: Properties Inverse, Applications to Solution of Difference Equations, Convolution Sums

Stability Of Discrete Systems: Location of Poles, Jury's Stability Criterion, Stability Analysis through Bilinear Transforms

Design of Digital Control Systems: PID Controllers and Frequency Domain Compensation Design

State Variable Methods and the Discrete Linear Regulator Problem

Text/ Reference Books

1. M.Gopal, Digital Control Engineering and State Variable Methods, Tata McGraw-Hill, 1997

2. K.J. Astrom and B. Wittenmark, Computer Controlled Systems, Prentice-Hall India 1994

3. R.Isermann, Digital Control Vol.1, Narosa Publications, 1993

Deliverables

- ***This course prepares students to understand systems when they work on sampled signals.***
- ***Modeling, checking the stability and designing controllers in the state space is the knowledge imparted.***

EEL408: ADVANCED POWER ELECTRONICS (3-0-0-6)

Objectives

- ***To impart knowledge of recent and advanced developments in PE area.***

Contents

Overview of Power Semiconductor Devices, DC-DC Converters- Principle of Operation of Buck, Boost, Buck-Boost, flyback, forward, push-pull, half bridge and isolated converters

Input and output filter design, multi output operation of isolated converters

Design of transformers and inductors, modeling of the converters using state averaging techniques

Resonant inverters: DC link inverters, modified circuit topologies for DC link voltage clamping, voltage control-PWM techniques, quasi resonant inverters

DC-DC converters- series resonant and parallel resonant, application of zero voltage and zero current switching for DC-DC converters (buck and boost), inverters for induction heating and UPS

Text/ Reference Books

1. Mohan N, Undeland T.M., Robbins W. P., Power Electronics, Converters, Applications and Design, John Wiley & Sons, 1995
2. Rashid M. H., Power Electronics, Circuit, Devices and Applications, Prentice-Hall of India, 3rd Edition 2000
3. Lander C. W., Power Electronics, McGraw Hill, 1993
4. Bausier R., Seguier G., Power Electronic Converters, Springer-Verlag, 1987
5. D.M. Mitchell, DC-DC Switching Regulator analysis, TMH, 1987

Deliverables

- ***Students will be able to design converters with improved performance using recent techniques/topologies/methods.***

EEL411: APPLICATION OF POWER ELECTRONICS TO POWER SYSTEMS (3-0-0-6)

Objectives

- ***To impart the knowledge, to tackle the problem of regulatory constraints on the expansion of power transmission network by introduction of high power electronic controllers for regulation of power flow and voltages in the AC transmission network.***

Contents

Introduction of Semiconductor Devices, Steady State and Dynamic Problems in AC Systems, Power Flow

Flexible AC Transmission Systems (FACTS): Basic Realities & Roles, Types of Facts Controller, Principles of Series and Shunt Compensation

Description of Static VAR Compensators (SVC), Thyristor Controlled Series Compensators (TCSC), Static Phase Shifters (SPS), Static Condenser (STATCON), Static Synchronous Series, Compensator (SSSC) and Unified Power Flow Controller (UPFC)

Modeling and Analysis of FACTS Controllers, Control Strategies to Improve System Stability, Power Quality Problems in Distribution Systems

Harmonics, Harmonics Creating Loads, Modeling, Series and Parallel Resonances, Harmonic Power Flow, Mitigation of Harmonics, Filters, Passive Filters, Active Filters, Shunt, Series, Hybrid Filters

Text/Reference Book

1. N.G. Hingorani, Understanding of FACTs, IEE press
2. G.T. Heydt, Power Quality, Stars in a Circle Publications, Indiana, 1991
3. T.J.E. Miller, Static Reactive Power Compensation, John Wiley & Sons, New York, 1982
4. Yong Hua Song, Flexible AC transmission system (FACTS)
5. Recent publications on IEEE Journals

Deliverables

- ***Students are able to understand and analyze the operation of various FACTs devices***
- ***Model them for overcoming transmission bottle necks and for improvement of power quality***

EEL416: RENEWABLE ENERGY SYSTEMS (3-0-0-6)

Objectives

- ***To learn the principles of generating Heat Energy and Electrical energy from Non-conventional / Renewable Energy Sources.***
- ***To gain understanding of the working of Off-grid and Grid-connected Renewable Energy Generation Schemes.***

Contents

Non-Conventional Sources of Electrical Energy – Solar, Wind, Geo-Thermal, Ocean, Tidal, Wave, MHD and Biomass; Their Scope and Potentialities for Energy Conversion

Solar Energy – Introduction, Physical Principles of Conversion of Solar Radiation into Heat, Solar Energy Collectors, Solar Energy Storage, Solar-Electrical Power Generation and Other Miscellaneous Applications of Solar Energy

Wind Energy – Introduction, Basic Principle Of Wind Energy Conversion, Wind Data And Energy Estimation, Site Selection, Basic Component Of Wind Energy Conversion System, Wind Turbines And Their Analysis, Wind-Electrical Generation. Stand-Alone and Grid Connected Wind-Electrical Power System, Various Applications of Wind Energy.

Tidal Energy- Introduction, Basic Principles of Tidal Power, Site Selection, Storage, Single and Double Effect Tidal Schemes, Analysis of Tidal Energy Plant

Ocean Energy- Introduction to Wave Energy Based Power Plants, Advantages and Disadvantages, Analysis of Wave Energy Plant

Distributed Generation

Text/Reference Books

1. Rao and Parulekar, Energy Technology, Khanna Publishers, New Delhi, Second reprint 2002
2. G.D Rai, Non-conventional Energy Sources, Khanna Publishers, New Delhi, tenth reprint 2002
3. S.P. Sukhatme, J.K. Nayar, Solar Energy, Tata Mc Graw hill Publishing Co. Ltd., New Delhi 2007
4. B. H. Khan, Non-conventional Energy Resources, TMH, 2006

Deliverables

- ***Students have understood the characteristics of different Renewable Energy Sources, working of off-grid and Grid-connected Renewable Energy Generation Schemes.***

EEL413: ADVANCED ELECTRICAL DRIVES AND CONTROL (3-0-0-6)

Objectives

- ***Understand the modeling of AC/DC machines.***
- ***Design procedure of controllers in closed loop operation.***
- ***Various new control methods to improve the performance of the motors in industrial applications.***

Contents

Dynamics of Electric Drives: Basic Elements of an Electric Drives, Classification of Electric Drives, Stability Consideration of Electric Drives.
Analysis of Electric Machinery: Voltage And Torque Equations In Machines Variables, Theory Of Direct Current Machines, Theory Of Symmetrical Induction Machines, Theory Of Synchronous Machines, Reference Frame Theory, Literalized Machine Equations

Solid State Converters For Drives: Solid State Converters For DC Drive System, Speed Control Techniques, Variable Frequency Control Of A. C. Motors Using Inverters, Slip Energy Recovery And Rotor Resistance Control Of Induction Motor..

Control of DC/AC Machines: State Variable Approach, Scalar / Vector Control of Induction Motors,
Digital Control of Drives: Application of Microprocessors / Computers in Electrical Drives Control, Switch Reluctance Motors and Permanent Magnet Brushless Dc Motors

Text/ Reference Books

1. Dubey G.K., Fundamentals of Electrical Drives, CRC Press, 2002
2. Krause P.C., Analysis of Electrical Machinery, McGraw Hill 1987
3. Bose B.K., Power Electronics and AC Drives, Printice Hall, NJ, 1985
4. Leonhard W., Control of Electrical Drives, Narosa Publishing House, India 1984
5. Bridges I. & Nasar S.A., Electric Machine Dynamics, Macmillan Publishing Company, NY, 1986
6. Krishnan, R., Electric Motor Drives, Modelling, Analysis and Control, Prentice Hall India, 2003

Deliverables

- ***Design of drives for industrial applications.***
- ***Energy conservation in drives systems using different controls.***
- ***Analysis of drives performance under various dynamical operating conditions.***

EEL412: DSP APPLICATIONS TO POWER SYSTEM (3-0-0-6)

Objectives

- ***To make students aware of need and advantages of DSP techniques.***
- ***Appreciation of state of the art approach to digital solutions.***

Contents

Overview of the Application of Information Processors in Power System Need For Numerical (Digital / Computer Based) Controllers. Basic Structure of DSP Based Systems:. Power System & DSP System Interface: Signal Transducers, Signal Conditioning: .Data Conversion System Analysis And Design: (Sampling: Shannon's Sampling Theorem, Phenomenon Of Aliasing, Anti-Aliasing Filter Design, Sampling Process, Necessity Of Sample & Hold , Choice Of Sampling Frequency, A/D & D/A Conversion And Quantization Noise, Techniques Of Reducing Quantization Noise, Over-Sampling ADC , Sigma Delta Modulator)Introduction To General Purpose Digital Signal Processors:

Computer Architecture for Signal Processing, Special Purpose DSP Hardware, DSP Arithmetic, ADC Quantization Noise and Signal Quality, Finite World Length Effects, Correlation & Discrete Transform (DFT , Wavelet, Etc) Techniques for Extraction of Fundamental and Harmonic Components Form the Voltage and Current Waveform Samples. DSP Based Relays; Discrete Time FIR and IIR Filters For Implementations of Numerical Relay Algorithms. Power Electronics System Controllers, Some Simple Schemes

Text/ Reference Books

1. A.T. Johns, S.K. Salman, Peter Peregrinus, Digital protection for Power Systems, IEE–U.K. 1995
2. Emmanuel C., Ifeachor, Barrie W Jervis, Digital signal processing (A Practical Approach), Pearson Education Asia, second Edition
3. Alan V Oppenheim, Ronald W Schafer, Discrete time signal Processing, Prentice Hall of India (private) Limited, New Delhi, 1994
4. Vinay K Ingle , John G Proakis, Digital Signal Processing Using MATLAB Broks/Cole Publishing Company
5.Prabhakar S Naidu, Modern Digital Signal Processing, Narosa Publishing house New Delhi, second edition 2006

Deliverables:

- ***Ability to apply various numerical relaying algorithms.***
- ***Ability to use DFT and FFT techniques.***
- ***Design of FIR and IIR filters.***

EEL414: MICROPROCESSOR APPLICATIONS IN POWER ELECTRONICS AND POWER SYSTEMS (3-0-0-6)

Objectives

- ***To learn architecture and instruction set of a processor.***
- ***To learn embedded c programming.***
- ***To study interfacing concepts and applications in area of power system and power electronics.***

Contents

Review of Microprocessors, Architecture and Programming of 8085 Microprocessor, Its Interfacing with Data Converters Various Programmable Interface Devices Such As Multipurpose Programmable Device 8155, Programmable Peripheral Interface 8255, Programmable Counter 8254, DMA Controller 8257, Programmable Interrupt Controller 8259, and Programmable Keyboard / Display Interface 8279, Serial I/O and Data Communication

Microprocessor Vs Microcontroller, Architecture and Programming of 8051 Microcontroller: Special Function Registers, Internal RAM and ROM, Interfacing With External Memory, Programmable Built In Ports, On Chip Counters / Timers, Serial Data

Input/Output, Interrupts, Assembly Language Programming and Applications

Op-Amp Based Analog Signal Conditioning Circuits, Analysis and Design of Inverting, Non- Inverting and Instrumentation Amplifiers, Filters and Comparators, Clippers, Clampers and Precision Rectifier Circuits

Microprocessor Based Applications: Measurement of Various Electrical and Non-Electrical Parameters, Speed Monitoring Control of Various Motors, Control of Firing Circuits of Power Electronics Systems, Numerical Protective Relays Etc

Text/ Reference Books

1. Gaonkar, Ramesh S., Microprocessor Architecture, Programming and Applications with the 8085, Penram International,1997
2. Ayala, Kenneth J., the 8051 Microprocessor Architecture, Programming and Applications, Penram International, 1996
3. Gayakwad, Ramakant A.,Op-amps and Linear Integrated Circuits, Prentice Hall of India, 1998

Deliverables:

- ***Able to program processor with assembly language as well as C language.***
- ***Able to design processor based applications.***
- ***Able to use simulator/ hardware kit for verifying circuit design.***

EEP415 COMPUTER APPLICATION IN ELECTRICAL ENGINEERING LAB (0-0-2-2)

LIST OF EXPERIMENT:

Simulation based on following softwares:

MATLAB (SIMULINK)

PSPICE

Alternative Transients Program (ATP)

PSCAD,

Power word Simulator.