Course Structure & Curriculum
For
B. Tech. Programme

In
ELECTRICAL ENGINEERING

Department of Electrical Engineering
Motilal Nehru National Institute of Technology Allahabad

Curriculum for
Bachelor of Technology in
Electrical Engineering

3rd Semester (Electrical Engineering)

Course Code	Course name	L	T	P	Credit
EE-1301	Networks & Systems	3	1	-	4
EE-1302	Electrical Measurement and Measuring Instruments (EMMI)	3	1	-	4
EC-1304	Principles of Electronics	3	1	-	4
CS-1302	Data Structure and Operating Systems	3	-	-	3
MA-1304	Numerical Methods and Statistical Techniques	2	1	-	3
AM-1306	Electrical Engineering Material and Devices	3	-	2/2	3
EE-1351	Networks & Systems (Lab)	-	-	3	2
EE-1352	Electrical Measurement and Measuring Instruments (EMMI) (Lab)	-	-	3	2
EC-1354	Principles of Electronics (Lab)	-	-	3	2
CS-1354	Data Structure and Operating Systems (Lab)	-	-	3	2
	Total	17	4	14	29

4th Semester (Electrical Engineering)

Course Code	Course name	L	T	P	Credit
EE-1401	Basics of Electrical Machine	3	1	-	4
EE-1402	Basic Control System	3	1	-	4
EE-1403	Power System –I	3	1	-	4
EC-1402	Digital Electronics	3	1	-	4
EC-1403	Electro-Magnetic Theory	2	1	-	3
EE-1451	Electrical Machine-I (Lab)	-	-	3	2
EE-1452	Basic Control System (Lab)	-	-	3	2
EE-1453	Power System –I (Lab)	-	-	3	2
EC-1452	Digital Electronics (Lab)	-	-	3	2
	Total	14	5	12	27

5th Semester (Electrical Engineering)

Course Code	Course name	L	T	P	Credit
EE-1501	AC Electric Machine	3	1	-	4
EE-1502	Advance Control System	3	1	-	4
EE-1503	Power System - II	3	1	-	4
EC-1504	Communication System and Networking	3	1	-	4
HS-1501	Principles of Management	3	-	-	3
EE-1551	AC Electric Machine (Lab)	-	-	3	2
EE-1552	Advance Control System (Lab)	-	-	3	2
EE-1553	Power System – II (Lab)	-	-	3	2
EC-1554	Communication System and Networking (Lab)	-	-	3	2
	Total	15	4	12	27

6th Semester (Electrical Engineering)

Course Code	Course name	L	T	P	Credit
EE-1601	Power Electronics	3	1	-	4
EE-1602	Microcontroller & Computer Organization	3	1	-	4
EE-1603	Instrumentation	3	1	-	4
EE-1604	Applied Control	3	1	-	4
EE-1605	Modern Electrical Machines	3	1	-	4
HS-1601	Communication Skill Workshop	0	0	0	0
EE-1607	Power Plant Engineering	3	-	-	3
EE-1651	Power Electronics (Lab)	-	-	3	2
EE-1652	Microcontroller & Computer Organization (Lab)	-	-	3	2
EE-1653	Instrumentation (Lab)	-	-	3	2
	Total	18	5	9	29

7th Semester (Electrical Engineering)

Course Code	Course name	L	T	P	Credit
EE-1701	Electrical Drives	3	1	-	4
EE-1702	Renewable Energy Sources and Distributed Generation	3	1	-	4
EE-1731 to 1740	Professional Elective – I	3	1	0	4
OE-1781 to 1790	Open Elective – I	3	1	0	4
EE-1751	Electrical Drives (Lab)	-	-	3	2
EE-1791	Project	-	-	6	6
	Total	12	4	9	24

8th Semester (Electrical Engineering)

Course Code	Course name	L	T	P	Credit
EE-1801	Advance Power Electronics	3	1	-	4
EE-1831 to 1840	Professional Elective – II	3	1	0	4
EE-1841 to 1850	Professional Elective – III	3	1	0	4
OE-1881 to 1890	Open Elective – II	3	1	0	4
EE-1851	Advance Power Electronics (Lab)	-	-	3	2
EE-1891	Project	-	-	6	6
	Total	12	4	9	24

1st digit; 1: UG, 2nd digit; 2, 3, etc.: Semester

Code	Description
01-30	Theory Courses
31-40	Professional Elective – I
41-50	Professional Elective – II
51-70	Practical Courses
81-90	Open Elective
91-99	Project

NETWORK AND SYSTEMS (EE-1301)

UNIT 1: Network Analysis & Classifications- Steady-state analysis of AC circuits: Sinusoidal and phasor representation of Voltage & current, single phase ac circuit behavior of R, L and C. Combination of R, L and C in series and parallel resonance. Three Phase AC circuits: Line and phase voltage/current relationship for star & delta connections. 5(L)

UNIT 2: Network classification & Introduction to continuous time signals and systems: Unit Step, ramp and impulse signals, Example of each signal, Differential Equation formulation of linear time invariant continuous system, Responses for unit step, ramp, square pulse and impulse function. 6(L)

UNIT 3: Review of Laplace Transform- Initial value and Final Value Theorem, Properties and solution of differential equation using LT, Time domain analysis of LTI network using Laplace transform, Waveform Synthesis, LT of Complex waveforms, Concept of Transform Impedance, Voltage ratio, Transfer function, Relation between impulse response and system function. 5(L)

UNIT 4: Networks Theorems- Thevenin's and Norton's Theorem, Maximum power transfer Theorem, Superposition, Telligen's, Milliman's. 8(L)

UNIT 5: Concepts of Poles and Zeros- Relation between locations of Poles, time response and stability, frequency response and bode plots, interrelation between frequency response and time response, convolution integral. 6(L)

UNIT 6: Two Port networks-Two port network parameters (z, y, T, T , h, g), Symmetrical & Reciprocal networks, Inter-conversion of two port network parameters, Interconnection of two port networks, Ladder networks, T-M transformation, Image & characteristic impedance. Network functions: Driving point and Transfer functions. 5(L)

UNIT 7: Positive Real function- Definition and properties and testing, Synthesis of LC, RL & RC circuits using Cauer and Foster s first and second form. 5(L)

Text/ Reference Books:

- M.E. Van Valkenberg, Network Analysis Prentice Hall
- M.E. Van Valkenberg, Network Synthesis Prentice Hall
- D. Roy Choudhary, Networks & Systems
- W. H. Hayt & J. E. Kemmerly, Engineering circuit Analysis, TMH
- A Chakrabarti & S. Bhadra, Networks & Systems Dhanpat Rai & Co.

ELECTRICAL MEASUREMENT AND MEASURING INSTRUMENTS (EMMI) (EE-1302)

UNIT 1: Principles of Measurement and error analysis-Methods of measurement, Characteristics of instruments & measurement systems, Errors in measurement & its analysis. 5(L)

UNIT 2: Analog Instruments-Classification, Principle of operation of Permanent Magnet Moving Coil (PMMC) and Moving Iron Instruments, Voltmeters & ammeters, Errors in Voltmeter and Ammeters, Range extension, Advantages and disadvantages ,Electrodynamometer Instruments, Power & Energy measurement. 7(L)

UNIT 3: Electronic Instruments-Digital Instruments for measurement of current, voltage, resistance etc., Measurement of frequency & phase, Cathode Ray Oscilloscopes (CRO) –analog and special CRO 6(L)

UNIT 4: Potentiometers & Bridges-D.C. & A.C. Potentiometers, D.C. & A.C. Bridges, Measurement of inductance and capacitance & quality factor, Measurement of low, medium, high resistances and earth Resistances. 6(L)

UNIT 5: Instrument Transformers- Principle of operation and applications, Current transformer and its error analysis, Potential transformer and its error analysis, Misc. Measurement**,** Frequency & power factor, Harmonic analyser, Power analyser 6(L)

UNIT 6: Introduction to DAC & ADC System-Analog to Digital Conversion: Ramp, Voltage to Frequency Converter (Integrating type), Dual slope integration Techniques, Digital to Analog Conversion: Weighted Resistor type, R-2R Ladder type, Specification of D/A Converter -Resolution, Accuracy 7(L)

Text/ Reference Books:

- E.W.Golding & F.C.Widdis, "Electrical measurement & measuring instruments" A.H.Wheeler &Co.Pvt Ltd. India.
- A.D.Helfrick & W.D.Cooper, "Electronic Instruments & Measurement Technique" Prentice Hall of India.
- David A. Bell, "Electronic Instrumentation & Measurement" Prentice Hall of India.
- M.B.Stout, "Basic Electrical measurement" Prentice Hall of India.
- H.S.Kalsi, "Electronic Instrumentation" Tata McGrall Hill.

PRINCIPLES OF ELECTRONICS (EC-1304)

UNIT 1: Diodes-Introduction to *pn* diode and its applications as rectifier, rectifier as DC Power Supply, Clamper, Clipper, Voltage multiplier etc., Zener diode and its applications as regulator, Tunnel diode and Varactor diode 8(L)

UNIT 2: Transistors-Review of Transistor working, characteristics & its parameters, Transistor as an amplifier, Biasing of bipolar junction transistors, *h*-parameters & transistor equivalent circuits, small signal single-stage amplifier, frequency response, concept of feedback. 8(L)

UNIT 3: JFET and MOSFET-Basic construction, working, concept of pinch-off, characteristics of JFET, MOSFET (Enhancement and Depletion), FET as a voltage variable resistor 6(L)

UNIT 4: Operational amplifier-Ideal & non-ideal characteristics, concept of summing junction and virtual ground. Application of operational amplifier as: Adder, Subtractor, Differentiator, Integrator, Multiplier, Unity gain amplifier & Logarithmic amplifier 6(L)

UNIT 5: Introduction to Digital Electronics-Review of number systems, complements, codes, Boolean algebra, Logic gates, Minterm and Maxterms, Canonical and Standard forms, Logic functions & Logic circuits. Minimization of Boolean functions using K-map. 6(L)

UNIT 6: Measuring Instruments-Working of Cathode Ray Oscilloscope, Power supply, Multimeter and Function generator. 6(L)

Text/ Reference Books:

- Electronic devices and circuit theory by Robert Boylested and Louis Nashelsky
- Electronic principles by Albert Malvino
- Integrated Electronics by Jacob Millman, Chistos C. Halkias
- Digital design by Morris Mano
- Modern Digital Electronics by R. P. Jain
- Modern electronics Instrumentation and Measurement Techniques by A. D.
- Helfrick and W. D. Cooper

DATA STRUCTURE AND OPERATING SYSTEMS (CS-1302)

UNIT 1: Basic Computer Architecture, Function and structure of Hardware and Software Components, CPU, ALU, Memory, I/O devices, System Software, Application Software. 6(L)

UNIT 2: Introduction, Motivation, and Overview of an Operating System with an emphasis on its role as a Manager of Hardware Resources, History of Computer Hardware (including a review of H/W structures) and how Operating Systems Evolved in tandem with the Hardware. 7(L)

UNIT 3: Programming software (Writing software),Program and Process, Program specifications and design, Abstract data types, Basics of C, Time and space complexity of Programs. 5(L)

UNIT 4: Need of Data Structures, Linear and nonlinear Data structure, Stack, Queue, Tree, Graph, B-tree 5(L)

UNIT 5: Processor and Memory Management, Process Management, Concurrent Process, Semaphores, Fork and Join, CPU Scheduling including Preemptive, and Non-Preemptive, Application of Stack and Queue, Sequential and linked implementation, in designing program for CPU and Disk scheduling, Page Tables, Page Replacement Algorithms. 7(L)

Text/ Reference Books:

- Fundamentals of data structures by Horowitz and Sahni
- Data Structure Using C by Tanenbaum
- Operating System Concepts, Abraham Silberschatz and Peter Galvin

NUMERICAL METHODS AND STATISTICAL TECHNIQUES (MA-1304)

UNIT 1: Algebraic and Transcendental Equations-Errors in numerical computation and their analysis, Bisection method, Iteration method, Newton-Raphson Method, Method of False Position, rate of convergence, Method for complex root, Muller's Method, Quotient Difference method,. 6(L)

UNIT 2: Interpolation-Introduction, Errors in Polynomial interpolation, Finite differences, Decision of errors, Newton's formula for interpolation, Gauss, Sterling, Bessel's, Everett's Formula, Interpolation by unevenly spaced points, Lagrange interpolation formula, Divided Difference, Newton's General interpolation Formula. 7(L)

UNIT 3: Curve Fitting, Cubic Spline & Approximation-Introduction, Method of Least Square curve fitting procedures, Fitting a straight line, Curve fitting by sum of exponential, Data fitting with cubic splines, Approximation of functions. 6(L)

UNIT 4: Numerical Integration and Differentiation-Introduction, Numerical differentiation, Picard Iteration Method of Solution, Numerical integration, Trapezoidal rule, Simpson 1/3 rule, Simpson 3/8 rule, Booles & Weddles rule, Euler-Maclaurin's formula, Gaussian Formula, Numerical evaluation of singular integrals. 4(L)

UNIT 5: Numerical Linear Algebra-Numerical techniques for finding solution of system of linear equations and eigen values: Gauss Jordan, Gauss Seidel methods, Power method for estimating eigen values: LU and LL* factorization of matrices. 4(L)

UNIT 6: Statistical Computations-Frequency Chart, Regression Analysis, Least Square fit, Polynomial fit, Linear and Nonlinear Regression, Multiple Regression, Statistical Quality Control Methods. 5(L)

Text/ Reference Books:

- C. F. Gerald and P.O.Wheatley, Applied Numerical Analysis, Pearson Education
- M.K.Jain, S.R.K.Iyenger and R.K.Jain, Numerical Methods for Scientific and Engineering
- Computation, Wiley Eastern Ltd.
- S.S Sastry, Introductory Methods of Numerical Analysis, Prentice Hall
- S.Rajasekharan, Numerical Methods for Science and Engineering, S.Chand.
- James I. Buchman and Peter R.Turner, Numerical Methods and Analysis, McGraw-Hills Inc.

ELECTRICAL ENGINEERING MATERIALS AND DEVICES (AM-1306)

UNIT 1: Introduction-Classification of materials on the basis of energy gap, conductors, semiconductors, dielectrics, superconductors, ferroelectrics, pyroelectrics, piezoelectrics, perovskites (titanates, zirconates, hafnates) etc. 2(L)

UNIT 2: Electrical Properties and Conducting Materials-Mechanism of electrical conduction, electron theories of solids, free electron theory, Factors affecting electrical conductivity, Wiedemana-Franz law, Lorentz number, thermoelectric properties, characteristics, properties and examples of high voltage conducting materials, high and low resistance materials. Contact fuse and filament materials. Conductors, cable & wire materials. Solder, sheathing, and sealing materials. Electrical properties of these materials. Related calculations. 4(L)

UNIT 3: Electronic Properties and Semiconducting Materials-Energy band theory, Brillouin zone theory, Fermi energy level, effective mass, concept of doping, energy diagrams, types of semiconductors, semiconductor compounds and alloys and their properties. structures of semiconductors, amorphous semiconductor, Junction properties, materials for different devices. Related calculations. 4(L)

UNIT 4: Superconductivity and Superconducting Materials-Concept of superconductivity, Phenomenon, properties of superconductors, Meissner effect, Critical magnetic field & critical temperature. Types of superconducting materials. Type I & II superconductors, Silsbee rule. Mechanism of superconduction. BCS theory, Debye temperature. London's & Glag theories, High temperature ceramic superconductors, applications: NMR, Maglev, MHO etc., recent advances. Related calculations. 5(L)

UNIT 5: Dielectric Properties and Insulating Materials-Dielectric constant, dielectric strength and dielectric loss. Polarizability, mechanism of polarization, factors affecting polarization, polarization curve and hysteresis loop, types of dielectric materials-solid, liquid and gaseous types; natural and synthetic types. Characteristic, properties, and applications of different types of mica, transformation oil, vacuum etc. Behavior of polarization under impulse and frequency switching. Ferroelectrics, piezoelectric, pyroelectrics, electrostriction effect. Clausius -Mosotti equation. Related calculations. 5(L)

UNIT 6: Magnetic Properties and Magnetic Materials-Origin of magnetism, basic terms and properties. Types of magnetic materials. Introduction to dia, para, ferro, antiferro and ferrimagnetic materials, Curie temperature. Laws of magnetic materials. Domain theory, Domain growth and domain wall rotation, Magnetic anisotropy. Magnetostriction & its mechanism. Ferrites, spinels & garnets. Ferromagnetic domains, magnetic hystersis. Magnetoplumbite, hexaferrite. Magnetic hysteresis loop, hysteresis loss. Hard and soft magnetic materials. Textured magnetic materials, Oxide magnetic materials. Magnetic tape, Magnetic bubble, Magnetic glasses, Colossal magneto- resistance. High energy hard magnetic materials, Commercial magnetic materials such as Supermalloy, Alnico, Cunife, Cunico etc., Conventional and non-conventional applications, characterisation of magnetic materials, Recent developments. Related calculations. 8(L)

UNIT 7: Optical and Optoelectronic Materials-Optical properties, Solar cell, Principles of photoconductivity. simple models, effect of impurities. Principles of luminescence, types; semiconductor lasers; LED materials, binary, ternary photoelectronic materials, effect of composition on band gap, crystal structure and properties. LCD materials, photo detectors, application of photoelectronic materials, introduction to optical fibers, light propagation, electro-optic effect, Kerr effect, Pockel's effect. 5(L)

UNIT 8: Recent Advances. Developments and Researches-Spintronics: materials and devices, Diamond semiconductors, Ferromagnetic semiconductors, Giant magneto- resistance (GMR), Left handed materials, Left and right handed (LH & RH) composite materials, Diluted magnetic semiconductor etc. 3(L)

UNIT 9: Fabrication of Electronic and Opto-electronic Devices-Methods of crystal growth, zone refining 2(L)

UNIT 10: Term Paper-On application/recent advances based on literature survey and/or lab/industry visit(s) 2(L)

Text/ Reference Books:

- L. Solymar, D. Walsh, 'Electrical Properties of Materials', Oxford University Press, USA, 2004. ,
- David C. Jiles, 'Introduction to the Electronic Properties of Materials', Taylor and Francis, 200 I.
- D.C. Jiles, 'Introduction to Magnetism and Magnetic Materials', Springer, 1990.
- M.Tech. (Material Science and Engineering) 2010-11 21/21
- Manijeh Razeghi, 'Optoelectronic Materials and Device Concepts', SPIE-International Society for Optical Engine, 1991.
- Rose R.M., Shepard L.A., Wulff J., 'Structure and Properties of Materials', Volume IV, 'Electronic Properties', 4th Edition, 1984.
- K.M. Gupta, 'Electrical Engineering Materials', 3rd Edition, Umesh Publication, Delhi, 2005.
- B.D. Cullity, 'Introduction to Magnetic Materials', Addison-Wesley publishing company, California, London, 1972.
- Goldman, 'Modem Ferrite Technology', Van Nostrand, New York, 1990.
- J.P. Jakubovics, 'Magnetism and Magnetic Materials', Institute of Materials, London, 1994.
- Tareev B., 'Physics of Dielectric Materials', MIR, 1975.
- Rolf E. Hummel, 'Electronic Properties of Materials', Springer, 2004.
- Safa O. Kasap, 'Principles of Electronic Materials and Devices', McGraw-Hili, 2005.
- Irene, 'Electronic Materials Science', Wiley-Interscience, 2006.
- Jasprit Singh, 'Smart electronic materials: Fundamentals and Applications', Cambridge University Press, 2005.
- M.E. Lines, A.M. Glass, 'Principles and Applications of Ferroelectrics and Related Materials', Oxford University Press, USA, 200 I.
- Dekker A.J., 'Solid State Physics', Macmillan India, 1995.
- Robert C., O' Handley, 'Modem Magnetic Materials: Principles and Applications', Wiley-Interscience,1999

NETWORKS & SYSTEMS (LAB) (EE-1351)

Experiment 1: To verify Thevenin's Theorem.
Experiment 2: To verify Norton's theorem.
Experiment 3: To verify maximum power transfer theorem.
Experiment 4: (a) To verify superposition theorem using D. C. Sources.
(b) To verify superposition theorem using A. C. Sources.
Experiment 5: Transient response of the RC circuit. To study the transient response of the RC circuit with step input with different values of R. To verify the calculated values of different parameters with that of measured values.
Experiment 6: Frequency response of RLC series circuits. To study the variation of current and capacitor voltage with change in frequency for RLC series circuit.
Experiment 7: To study the variation of current and capacitor voltage with change in frequency for RLC parallel circuit.
Experiment 8: To find out the frequency response of Twin – T Notch Filter.
Experiment 9: To determine z and h parameter of two port networks and compute the other parameter.
Experiment 10: Verification of parameter properties in interconnected two port networks (series, parallel & cascaded).

ELECTRICAL MEASUREMENT AND MEASURING INSTRUMENTS (EMMI) (LAB) (EE-1352)

Experiment 1: Range Extension of Ammeter & Voltmeter.
Experiment 2: Calibration of
(a) Ammeter for application as Voltmeter and
(b) Voltmeter for application as Ammeter.
Experiment 3: Calibration of a given Sine-Responding Voltmeter for other types of Waveforms (such as Squire & Rectangular).
Experiment 4: Measurement of Power in a 1-Phase load using 3-Voltmeter method and its Calibration using Wattmeter.
Experiment 5: Calibration of Wattmeter by Direct-load test.
Experiment 6: Calibration of 3-Phase Energymeter.
Experiment 7: Measurement of Signal Amplitude, Frequency and Phase using C.R.O.
Experiment 8: Measurement of capacitance and inductance using A.C. bridges
Experiment 9: Measurement of Earth-Resistance.
Experiment 10: Measurement of High Resistance using Insulation Tester and its Study.

PRINCIPAL OF ELECTRONICS (LAB) (EC-1354)

Experiment 1: Familiarization to basic test and measuring instruments like Cathode Ray Oscilloscope (CRO), Function Generator, Power supply, Bread board etc.

Experiment 2: To measure the frequency and amplitude of various waveforms using CRO.

Experiment 3: To verify the truth tables of different logic gates by using ICs and implement different logic gates using IC 7400.

Experiment 4: To study the *pn* junction diode characteristics under forward and reverse bias conditions.

Experiment 5: To study the application of a zener diode as voltage regulator.

Experiment 6: To determine the ripple factor of Half-Wave and Full-wave (Bridge) rectifiers.

Experiment 7: To observe the clipping wave forms in different clipping configurations.

Experiment 8: To observe the clamping wave forms in different clamping configurations.

Experiment 9: To determine the CE (Common Emitter) characteristics of a given BJT.

Experiment 10: To plot the drain and transfer characteristics of a given FET and to find drain resistance.

Experiment 11: To verify the addition and subtraction operation using op-amp 741.

DATA STRUCTURE AND OPERATING SYSTEMS (LAB) (CS-1354)

Experiment 1: a) Write a program to implement linear search in a single dimensional array.
b) Write a program to implement linear search in a 2- dimensional array, when array is stored in a row major order.
c) Write a program to implement linear search in a 2- dimensional array, when array is stored in a column major order.

Experiment 2: a) Write a program to implement binary search using iteration.
b) Write a program to implement binary search using resursion.

Experiment 3: a) Write a program to implement bubble sort and insersion sort.
b) Write a program to implement Merge Sort.

Experiment 4: Write a program to implement Quick Sort.
Experiment 5: a) Write a program to implement a singly link list.
b) Write a program to implement a doubly link list.
c) Write a program to reverse a doubly link list.
Experiment 6: Write a program to implement a binary search tree.
Experiment 7: Write a program to simulate preorder, inorder and postorder traversal over a binary search tree.

Operating Systems

Experiment 8: Write a program to implement
a) Creation of file
b) Read contents of a file
c) Write to a file
d) Link and unlink a file
e) Copy file
f) Read contents of a file in a reverse order

Experiment 9: Write a program to simulate the following CPU Scheduling Algorithms:
a) FCFS
b) SJF
c) Priority
d) Round Robin

Experiment 10: Write a program to simulate Bankers algorithm for Deadlock Avoidance.
Experiment 11: Write a program to simulate the following Page Replacement Algorithms:
a) FIFO
b) LRU

BASICS OF ELECTRICAL MACHINE (EE-1401)

UNIT 1: Transformer-Transformer principles, Construction details, Equivalent circuits (Exact and approximate), OC & SC test, Voltage regulation, Efficiency, Losses in Transformer, Separation of hysteresis and eddy current losses, All-day efficiency, Three-phase transformers: Connections, Parallel operation (conditions, equal and unequal voltage turn ratio), Division of load between parallel transformers, Polarity test, Sumpner's test. 14(L)

UNIT 2: Electromechanical Energy Conversion-Principles of electromechanical energy conversion, Singly- and multiply-excited systems- Energy, co-energy, Determination of Torque/Forces from energy/co-energy 5(L)

UNIT 3: Basics of rotating machines-Introduction to AC machine- Stator & rotor (cylindrical and salient), DC machines- Field & Armature, Flux lines due to field and stator excitation, Windings layout, connections, Armature windings- Simplex-Lap and wave types. 4(L)

UNIT 4: DC machines-Construction details, Speed and voltage expression, Torque production in D.C. machines, Types according to excitation (with circuit representation and equations), Magnetization curve- effect of field resistance and speed, Series, shunt and compound machines: DC generator & DC motor- Characteristics, Speed control and starting methods, Efficiency, Armature reaction: reduction and compensation, Commutation action, Testing of DC machines: Hopkinson's test, Swinburne's test, Braking methods. 16(L)

Text/ Reference Books:

- E. Fitzgerald, Charles Kingsle, Jr. Stephen D. Umans, Electric Machinery, Tata McGraw Hill.
- Stephen J Chapman, Electrical Machinery and Power System Fundamentals, McGraw-Hill Higher Education.
- P.S. Bhimbhra, Generalized Theory of Electrical Machines, Khanna Publications, New Delhi
- J. Nagrath, D. P. Kothari, Electric Machines, TMH Publications, New Delhi
- G. K. Dubey, Fundamental of Electrical Drives, Narosa Publishing House, New Delhi.

BASIC CONTROL SYSTEM (EE-1402)

UNIT 1: Introduction to Control System-Introduction, Closed-loop control versus open-loop control 2(L)

UNIT 2: Mathematical Modelling of Control Systems-Control hardware and their models, various physical system modeling, Block diagram reduction, Signal flow graph, Basic characteristics of Feedback, Modes of feedback control: proportional, integral and derivative, PID, The performance of Feedback systems 10(L)

UNIT 3: Transient Response Analysis-Time response analysis, Concepts of Stability and Routh's Stability Criteria, Steady-state error analysis 6(L)

UNIT 4: Root-Locus Analysis& the Frequency-Response Method-Root-locus plots, Rules of constructing Root Loci, Root-locus analysis of control systems 4(L)

UNIT 5: Frequency Response Analysis- Bode plots, Polar plots, The Nyquist Stability Criterion and Stability Margins, Closed loop frequency response (M & N circles) 7(L)

UNIT 6: Design and Compensation Techniques-Design considerations, Lag Compensation, Lead Compensation, Lag-lead Compensation, Compensator Design Using Root-locus and Frequency Response methods 10(L)

Text/ Reference Books:

- Kuo B.C., "Automatic Control System", Prentice Hall.
- Ogata K., "Modern Control Engineering", Prentice Hall.
- Nagrath & Gopal, "Modern Control Engineering", New Ages International.
- Stephani R.T., "Design of Feedback Control Systems", Oxford University Press.

POWER SYSTEM –I (EE-1403)

UNIT 1: Introduction to Power system: Single line diagram of power system, Brief Description of Power system elements such as Synchronous Machine, Transformer; Busbar, Circuit Breaker etc., Per unit system and their application to power system network, Different kinds of supply system and their comparison; Choice of transmission voltage, conductor size, Kelvin's law 2(L)

UNIT 2: Transmission lines: Conductor materials, types of conductors, Parameters-Resistance, Inductance and capacitance of lines, Current distortion effects-Skin, Proximity etc., Mathematical Analysis of transmission lines., Interference with communication lines, Reduction methods; 8(L)

Mechanical Design: Main components of overhead line, line supports, sag, stringing chart,vibrations, 2(L)

Insulators: types, material, potential distribution, string efficiency, methods of improvement of string efficiency, causes of failure, testing of insulators, 3(L)

Corona: formation, critical disruptive voltage, visual disruptive voltage, power losses, factors affecting corona, reduction methods 4(L)

UNIT 3:Cables: types and applications, construction, Potential distribution; Equalizing the potential, Insulation Resistance, Capacitance of single phase and three phase cables, Dielectric Loss 4(L)

UNIT 4: Load flow Analysis: Complex power,Y bus and Z bus formulation, Load flow analysis-Newton Raphson and fast decoupled methods, Methods of voltage control 5(L)

UNIT 5: Power System Stability: Dynamic stability, transient stability, equal-area criterion, Numerical Solution and improvement of system stability for single machine and multi machine. 4(L)

UNIT 6: Neutral grounding: Necessity and methods of neutral grounding, Grounding Practice. 2(L)

Text/ Reference Books:

- Power System analysis, John.J.Grainger & W. D. Stevenson, Mc Graw Hill
- Modern Power System Analysis, D.P.Kothari, & I.J. Nagarth, Tata MCGraw-Hill Publishing Company Limited, New Delhi,2003
- Electric Power System, C.L.Wadhwa, New Age International Ltd., 2000
- Power system stability and control, Prabha Kundur, Power system Engineering Series
- Power System Stability, Paul.M.Anderson, Electrical Engineering Power system Series.
- Power System analysis, Hadi Sadat, Second edition, 2002, Mc Graw- Hill
- Stephen J. Chapman, Electric Machinery and Power System Fundamentals, McGraw Hill, New York, 2002

DIGITAL ELECTRONICS (EC-1402)

UNIT 1:COMBINATIONAL LOGIC-Introduction, Design Procedure, Adders, Subtractors, Code Converters, Magnitude Comparator, BCD to Seven Segment decoder, Parity generator and Checker, Decoders, Encoders, Multiplexers, Demultiplexers, ROMs, Design of the circuits using Decoders, Multiplexers, ROMs. 7(L)

UNIT 2: PROGRAMMABLE LOGIC DEVICES-Programmable Logic Array (PLA), Programmable Array Logic (PAL), Design of the circuits using PLA and PAL, Field Programmable Gate Array (FPGA). 5(L)

UNIT 3: SEQUENTIAL LOGIC-Introduction, Flip-Flops, Flip-Flop Excitation Tables, Triggering of Flip-Flops, Analysis of Clocked Sequential Circuits, State Reduction and Assignment, Race Around Condition, Master-Slave flip-flops, Conversion design of flip-flops. 4(L)

UNIT 4: Design of synchronous & ripple counters, Mod-k or Divide-by-k counters, Decade counter, BCD Counter, UP/DOWN Counters, Lock Out problem, Design with State Equations. 6(L)

UNIT 5: Shift register, Serial to Parallel Converter, Parallel to Serial Converter, Ring counters, Twisted-ring counter, Sequence Generator. 3(L)

UNTI 6: TIMING CIRCUITS: Multivibrators (Monostable, Astable,) 2(L)

UNIT 7: LOGIC FAMILIES-Characteristics of Digital ICs, DTL, TTL, ECL, MOS Logic & CMOS Logic, Calculation of noise margins and fan-out. 8(L)

UNIT 8: INTRODUCTION to VHDL- Basics, Simulation of Multiplexers, Demultiplexers etc 3(L)

Text/ Reference Books:

- M. Morris Mano: Digital Design, Third Edition, Prentice Hall
- R. P. Jain: Modern Digital Electronics, Third Edition, TMH
- Taub and Schilling: Digital Integrated Electronics, McGRAW HILL
- Sandige: Digital concept Using standard ICs
- R. J. Tocci: Digital Systems: Principles and Applications, Fourth Edition, Prentice Hall

ELECTRO-MAGNETIC THEORY (EC-1403)

UNIT 1:INTRODUCTION- Review of scalar and vector field, Vector representation of surface, Physical interpretation of gradient**,** divergence and curl, Divergence theorem, Stokes theorem, Different coordinate systems. 4(L)

UNIT 2: ELECTROSTATIC FIELDS- Electric field due to point, surface and volume charges, Electrostatic potential for different charge distributions, Gauss's law, Solution of Laplace's and Poisson's equation in one dimension, Method of images applied to plane boundaries, Electric flux density, Boundary conditions, Capacitance, Electrostatic energy. 8(L)

UNIT 3:MAGNETOSTATIC FIELDS- Biot- Savart's law , Ampere's law, magnetic flux density, Boundary conditions,Faraday's law, Energy stored in magnetic field, Scalar and Vector Magnetic Potential. 8(L)

UNIT 4: TIME VARYING ELECTROMAGNETIC FIELDS-Continuity equation, Displacement current, Maxwell's equations in point form and integral form, Retarded potential, Plain wave equation and it's solution in conducting and non conducting media, Phase velocity, Group velocity, Plane waves in lossy dielectrics, Propagation in good conductors: skin effect, impedance of conducting medium, Polarization, Reflection and Refraction of plain waves at plain boundaries, Poynting Vector, Poynting theorem and power considerations. 8(L)

UNIT 5: TRANSMISSION LINES-Transmission line equations, parameters- primary and secondary constants, Analogy of transmission lines with8e.m. waves, determination of α, β, γ and v_p ,characteristics impedance, Input impedance of a lossless line, open and short circuited lines, distortionless lines, reflection coefficient and standing wave ratio, matched transmission line, Impedance matching, Smith chart and its applications. 8(L)

UNIT 6: COMPUTATIONAL ELECTROMAGNETICS-Finite element method (FEM) and Finite difference time domain method (FDTD) 4(L)

Text/ Reference Books:

- Hayt William., "Engineering Electromagnetics", Tata Mc Graw Hill
- Matthew N.O. *Sadiku* 'Elements of Electromagnetics'
- Kraus J.D, "Electromagnetics" Mc Graw Hill
- Complex Electromagnetic Problems and Numerical Simulation Approaches, Levent Sevgi, IEEE Press and John Wiley, New York, 2003.
- Jordan E.C. and Balmain K.G., "Electromagnetic waves and Radiating Systems"PHI
- Plonsey R. and Collin R.E., "Principles and Applications of Electromagnetic fields", Tata Mc Graw Hill.

ELECTRICAL MACHINE-I (LAB) (EE-1451)

Experiment 1: To obtain magnetization characteristic of a DC. Shunt generator.

Experiment 2: To obtain load characteristic of a D.C. shunt generator.

Experiment 3: To obtain speed torque characteristic of a D.C. series motor.

Experiment 4: To obtain speed torque characteristic of a D.C shunt motor.

Experiment 5: Speed control of a DC shunt motor by armature and field control

Experiment 6: To perform load test on a single phase transformer

Experiment 7: To perform polarity & ratio test on a single-phase transformer and Parallel operation of two single-phase transformers.

Experiment 8: To determine efficiency & regulation of a one-phase transformer by O.C. & S.C. Tests.

Experiment 9: To study 3-phase to 2-phase conversion by Scott connection.

Experiment 10: To obtain efficiency & regulation of two single-phase transformers by Sumpner's (back to back) test.

BASIC CONTROL SYSTEM (LAB) (EE-1452)

A-EXPERIMENT BASED LABORATORY PRACTICAL

Experiment 1: Determine the transfer function of a separately excited DC generator.

Experiment 2: Obtain the frequency response characteristics of the first and second order active LPF.

Experiment 3: Obtain the graph between output errors and angular position difference of a given potentiometer error detector.

(a) When the excitation is DC.

(b) When the excitation is AC.

Experiment 4: Determine the time response of different order of system using linear system simulator.

(a) Determine the time constant of first order system for open loop system

(b) Determine the time constant of type-1 system for closed loop system.

Experiment 5: Determine the frequency response of given open loop linear system and time response of closed loop system.

Experiment 6: Obtain the frequency response of LAG and LEAD Compensator.

Experiment 7: To draw the frequency response of a given L,R,C network theoretically and to capture the time response for a given square wave input at 50Hz (power supply).

Experiment 8: Use Lag and Lead compensator with the given closed loop system and show that the lead compensator improves transient performance and lag compensator improves the steady state characteristics.

B. SIMULATION BASED LABORATORY PRACTICAL (Using MATLAB)

Experiment 9: To study the performance of PID controller under closed loop with open loop transfer function

$$G(s) = \frac{1}{LCs^2 + RCs + 1}$$

Where L=1mH, C=5μF, R=5Ω.

Experiment 10: Use MATLAB to draw the bode plot and determine GM and PM for the given open loop transfer function and comment on stability.

$I.\ G(s) = \frac{10}{s(s+2)}$

$II.\ G(s) = \frac{20(0.5s+1)}{s^2(0.2s+1)}$

$III.\ G(s) = \frac{50}{s^2+2s+5}$

Experiment 11: Use MATLAB to draw the root locus for the unity feedback system with the following open loop transfer function.

$$G(s) = \frac{k(s+6)}{s(s+4)(s^2+4s+8)}$$

Determine k for ξ=0.5using root locus. At this value of k, obtain the closed loop transfer function using function 'feedback()'. Obtain the step response of closed loop system and verify the value of ξ using measurement of peak overshoot. Also obtain the impulse and ramp response of the closed loop system.

Commands: rlocus, feedback, step, impulse, lsim.

Experiment 12: Represent the following system in the state space form using MATLAB 'ss' function.

$$\begin{bmatrix} \dot{x_1} \\ \dot{x_2} \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -3 & -4 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \end{bmatrix} u$$

$$y = [10 \quad 0] \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + [0]u$$

a) Find out the time response for unit step input for initial condition of x1(0)=-1, x2(0)=2.

b) Test for controllability and observability.

c) Test the stability from eigenvalue of A-matrix.

Commands: ss, step, ctrb, obsrb, eig.

POWER SYSTEM –I (LAB) (EE-1453)

Experiment 1: Determination of positive, negative and zero sequence impedances of a three phase transformer.
Experiment 2: Determination of ABCD parameters of a transmission line model.
Experiment 3: To calculate the voltage regulation of a transmission line.
Experiment 4: Calculate the string efficiency of a suspension type insulator with and without guard ring.
Experiment 5: To determine the dielectric strength of transformer oil.
Experiment 6: To study the flow of active and reactive power using an inter-connector.
Experiment 7: To study the effect of load power factor on power system stability.
Experiment 8: Determination of R, L and C parameters of a transmission line model and observing the Ferranti effect.

DIGITAL ELECTRONICS (LAB) (EC-1452)

Experiment 1: Verification of operation of Full Adder and Full Subtractor.
Experiment 2: Design & verification of 4-bit binary adder/subtractor using binary adder IC.
Experiment 3: Realization of operation of full adder and full subtractor using IC 74151/74153 MUX.
Experiment 4: Design & verification of full adder and full subtractor using an inverted output 3 to 8 line decoder.
Experiment 5: Design and verification of operation of a BCD Adder using IC 7483.
Experiment 6: Realization of 4 X 1 MUX using basic gates.
Experiment 7: Verification of operation of BCD to Seven segment code conversion using IC 7447.
Experiment 8: Verification of Truth Tables of SR & D Flip flops.
Experiment 9: Verification of Truth Tables of Master Slave JK Flip-Flop.
Experiment 10: Design of MOD-8 UP/Down synchronous counter.
Experiment 11: Design of BCD ripple counter.
Experiment 12: Design of Universal Shift Register.
Experiment 13: Design of a sequential circuit from given state diagram.
Experiment 14: Design and verification of Astable Multivibrator using IC 555.
Experiment 15: Design and verification of Monostable Multivibrator using IC 555.
Experiment 16: Implementation of Basic Combinational and sequential circuits using VSM (Virtual System Modelling)
Experiment 17: Implementation of Basic Combinational and sequential circuits using VHDL

AC ELECTRIC MACHINE (EE-1501)

UNIT 1: Synchronous machine-Construction features, EMF eqn. Winding coefficients/factors, Harmonics in emf induced, Rotating magnetic field including rotating phasors of MMF, OC & SC characteristics, Short circuit ratio, Armature reaction in synchronous machine, Equivalent circuit model and analysis (Regulation), Armature reaction, Voltage regulation, Flux and MG wave of salient rotor (d-and q-axis reactance), Power-angle expression (Cylindrical and salient rotor), Operating characteristics as generator & motor, V-curves, Inverted V-curves, Starting methods of synchronous motors, Excitation systems-basic types (DC and AC) and their block diagram, Synchronization, Parallel operation- Active and reactive power control, Synchronous motor as condenser. 17(L)

UNIT 2: Polyphase induction machine-Introduction, Construction features, Generating principle, Emf expression, Equivalent circuit and its analysis (torque-slip expression), Losses and efficiency, T-s characteristics, Effect of rotor resistance on the same characteristic, No-load and block rotor test, Starting methods, Speed control, Deep bar, double cage IM motor and their T-s characteristic, Induction generator driven by Wind turbine. 16(L)

UNIT 3 Single phase induction motors: Construction details, Double revolving field theory, Equivalent circuit, starting methods along with performance characteristics. 7(L)

Text/ Reference Books:

- E. Fitzgerald, Charles Kingsle, Jr. Stephen D. Umans, Electric Machinery, Tata McGraw Hill.
- Stephen J Chapman, Electrical Machinery and Power System Fundamentals, McGraw-Hill Higher Education.
- P.S. Bhimbhra, Generalized Theory of Electrical Machines, Khanna Publications, New Delhi
- J. Nagrath, D. P. Kothari, Electric Machines, TMH Publications, New Delhi.
- G. K. Dubey, Fundamental of Electrical Drives, Narosa Publishing House, New Delhi.

ADVANCE CONTROL SYSTEM (EE-1502)

UNIT 1 Introduction-Signal Processing in Digital Control: Introduction to digital control systems, Principles of signal conversion, Sampling and reconstruction, Principles of discretization, Impulse and step invariance, Finite difference approximation, Bilinear transformation 6(L)

UNIT 2 Models of Digital Control Devices and Systems : Mathematical models discrete time signals and systems, Transfer function and system response, Stability on the z-domain, Closed loop digital control systems, System with dead time, Commonly used digital devices, Examples of industrial control systems 8(L)

UNIT 3 Design of Digital Control Algorithms: Transform design of digital controllers, Root locus methods and frequency domain method 5(L)

UNIT 4 Control System Analysis Using State Variable Methods : State variable representation of continuous and discrete time systems, Conversions state variable models to transfer function models, Conversion of transfer function to canonical models, Eigen values and eigenvectors, Solution of state equations, Sampled continuous-time systems, Controllability and Observability properties 12(L)

UNIT 5 Design of Control Systems by State Variable Methods: Pole-placement design, Observer design, Lyapunov Stability analysis 8(L)

Text/ Reference Books:

- M.Gopal, "State space and Digital Control System", Wiley Eastern Ltd.
- Ogata K., "Discrete-Time Control Systems", Prentice-Hall, 1987.
- Kuo, B.C., "Digital Control System", Oxford University Press, second edition, 1992

POWER SYSTEM – II (EE-1503)

UNIT 1: Faults in Power System: Fundamental principle of fuses, Symmetrical components, Symmetrical and Unsymmetrical fault, Fault calculation in Power System network, Switch gear and substation apparatus, Relays and circuit breakers, plug setting. 9(L)

UNIT 2: Short circuit studies: Calculation using bus impedance method, Algorithms for calculating system conditions after occurrence of fault, Comparison between symmetrical component and phase co-ordinate methods. 6(L)

UNIT 3: Protection systems: Classification of protection schemes, Transformer protection, Generator protection, Role of voltage and current transformer in power system protection, Relay co-ordination, Over current protection schemes for feeders. 8(L)

UNIT 4: Numerical Relaying: Introduction to numerical relaying, Numerical relaying algorithms for over current distance and differential protection with application to transmission system, transformer and bus bar protection. 5(L)

UNIT 5: Optimal Power Flow: Reactive power control for loss minimization, gradient method for optimal power flow, Lagrange function for optimal load flow, computational procedures, conditions for optimal load flow, implementation of optimal conditions. 6(L)

UNIT 6: High Voltage Transmission: Introduction to extra and ultra H.V.A.C., Transmission and High Voltage D.C. Transmission – Kind of D.C. Link, Merits and Demerits of HVDC transmission, Introduction to FACTS. 4(L)

UNIT 7: Advanced topics: SCADA and Computer control voltage, Expert system applications to power systems. 2(L)

Text/ Reference Books:

- Analysis of Faulted Power Systems, P.M. Anderson, Wiley.
- Power System Protection Static Relays, T.S.M. Rao, Tata McGraw Hill.
- Power System Protection and SWITChgear, B. Ravindranath, M. Chander, New age international.
- Digital Power System Protection, R.P. Singh, PHI.
- Power System Restructuring and Deregulation, L.L. Lai, Wiley

COMMUNICATION SYSTEM AND NETWORKING (EC-1504)

UNIT 1: INTRODUCTION TO COMMUNICATION SYSTEMS-Elements of a General Communication System, Modulation, Need for Modulation, Fundamental Limitations of a Communication System, Analog and Digital Signals and Systems, Baseband and Bandpass Communication, Introduction to Radio Communication, Analog Modulation Techniques: Amplitude Modulation, Frequency Modulation and Phase Modulation, Model of a Digital Communication System, Elements of a Digital Communication System, Logarithmic Measure of Information, Entropy and Information Rate, Source Coding, Fixed and Variable Length Code Words, Mutual Information and Channel Capacity of a Discrete Memoryless Channel, Hartley-Shannon Law. 10(L)

UNIT 2: Pulsemodulation and waveform coding techniques-

Sampling and Reconstruction of Analog Signals, Types of Pulse Modulation System: PAM, PWM and PPM, Quantization, Encoding, Pulse Code Modulation (PCM), Bandwidth of PCM, Differential PCM, Delta Modulation (DM), Threshold of Coding and Slope Overload, Adaptive Delta Modulation (ADM), ADPCM, Comparison of PCM and DM Line Coding and its Properties, NRZ and RZ Types, Signaling Format for Unipolar, Polar, Bipolar (AMI), and Manchester Coding, Digital Multiplexing. 10(L)

UNIT 3: DIGITAL MODULATION TECHNIQUES-Types of Digital Modulation, Waveforms for Amplitude, Frequency and Phase Shift Keying, Method of Generation and Detection of Coherent and non-coherent Binary ASK, FSK and PSK, Differential Phase Shift Keying (DPSK), Quadrature Modulation Techniques: Quadrature Amplitude Modulation (QAM) and Quadrature Phase Shift Keying (QPSK), Minimum Shift Keying (MSK) – Generation and detection. 10(L)

UNIT 4: COMPUTER NETWORKS-Local Area Networks: LAN architecture, Bus/Tree LANs, Ring LANs, star LANs, wireless LANs. LAN Systems: Ethernet and Fast Ethernet, CSMA/CD, Token Ring and FDDI, 100VG-Any LAN, ATM LAN, Fiber Channel, Wireless LAN Bridges: Bridge Operation, Routing with Bridges, ATM LAN Emulation. Internetworking: Principles of Internetworking, connectionless Internetworking, The Internet Protocol, Routing Protocol, IPv6,ICMPv6. 10(L)

Text/ Reference Books:

- Transport Services, Protocol Mechanism, TCP, UDP.
- B. Sklar, "Digital Communications: Fundamentals and Applications," Pearson Education.
- Behrouz A. Forouzan, "Data Commn& Networking," TMH
- B.P. Lathi "Modern Digital and Analog Communication Systems," Oxford University Press.
- S. Haykin, "Digital Communication," John Willey.
- T. Schilling, "Principles of Communication Systems," TMH.
- J.J. Proakis, "Digital Communications," McGraw Hill.
- A.B. Carlson, "Communication Systems," TMH.
- G. Kennedy, "Electronic Communication Systems," TMH.

PRINCIPLES OF MANAGEMENT (HS-1501)

UNIT 1: Introduction to Management-Definition of Management – Science or Art – Management and Administration, Functions of Management – Types of Business Organization. Levels of management and Managerial skills 5(L)

UNIT 2: School of Management Thoughts: Evolution of Management thoughts, classical approach, neo- classical approach, contribution of Taylor, Weber and Fayol, modern approach. 6(L)

UNIT 3: Planning Nature & Purpose – Steps involved in Planning ,Objectives, Setting Objectives, Process of Managing by Objectives ,Strategies, Policies & Planning Premises Forecasting Decision-making. 8(L)

UNIT 4: Organizing Nature and Purpose – Formal and informal organization – Organization Chart – Structure and Process – Departmentation by difference strategies – Line and Staff authority – Benefits and Limitations – De-Centralization and Delegation of Authority – Staffing – Selection Process-Techniques-HRD-Managerial-Effectiveness. **Directing:** Scope – Human Factors – Creativity and Innovation – Harmonizing Objectives – Leadership – Types of Leadership Motivation – Hierarchy of needs – Motivation theories – Motivational Techniques – Job Enrichment – Communication – Process of Communication – Barriers and Breakdown – Effective Communication – Electronic media in Communication. 11(L)

UNIT 5: Controlling-System and process of Controlling – Requirements for effective control – The Budget as Control Technique – Information Technology in Controlling – Use of computers in handling the information – Productivity – Problems and Management – Control of Overall Performance. Coordination. 5(L)

UNIT 6: Organisational Behaviour- Organisational change, Conflict Management and Stress Management, **Functional management:** Human Resource Management, Financial management, Marketing Management. 5(L)

Text/Reference Books:

- Tripathy PC and Reddy PN, "Principles of Management", Tata McGraw-Hill, 1999.
- Decenzo David, Robbin Stephen A, "Personnel and Human Reasons Management", Prentice Hall of India, 1996
- JAF Stomer, Freeman R. E and Daniel R Gilbert, "Management", Pearson Education, Sixth Edition, 2004.
- Fraidoon Mazda, "Engineering Management", Addison Wesley, 2000.
- Harold Kooritz & Heinz Weihrich "Essentials of Management", Tata McGraw-Hill, 1998
- Joseph L Massie "Essentials of Management", Prentice Hall of India, (Pearson) Fourth Edition, 2003

AC ELECTRIC MACHINE (LAB) (EE-1551)

Experiment 1: Determination of equivalent circuit of a three phase induction motor from light running and blocked rotor test.

Experiment 2: Determination of equivalent circuit of a single phase induction motor from light running and blocked rotor test.

Experiment 3: Speed control of induction motor by voltage and frequency control

Experiment 4: Determination of voltage regulation of an alternator by synchronous impedance method and Potier triangle method

Experiment 5: Determination of losses and efficiency of an alternator.

Experiment 6: Determination of V-curves of a Synchronous motor

Experiments 7: Determination of direct axis and quadrature axis reactance of a salient pole alternator

ADVANCE CONTROL SYSTEM (LAB) (EE-1552)

MATLAB BASED LABORATORY EXCERCISE

Experiment 1: Obtain the state space model of a given RLC series circuit and plot unit step response of the system with following data. Vin=5 V, L = 5 mH, R = 3 Kohm, C = 1 microF

Experiment 2: For a given state space model

$$\begin{bmatrix}\dot{x}\\ \ddot{x}\\ \dot{\Phi}\\ \ddot{\Phi}\end{bmatrix}=\begin{bmatrix}0 & 1 & 0 & 0\\ 0 & -0.1818 & 2.6727 & 0\\ 0 & 0 & 0 & 1\\ 0 & -0.4545 & 31.1818 & 0\end{bmatrix}\begin{bmatrix}x\\ \dot{x}\\ \Phi\\ \dot{\Phi}\end{bmatrix}+\begin{bmatrix}0\\ 1.8182\\ 0\\ 4.5455\end{bmatrix}u$$

$$y=\begin{bmatrix}1 & 0 & 0 & 0\\ 0 & 0 & 1 & 0\end{bmatrix}\begin{bmatrix}x\\ \dot{x}\\ \Phi\\ \dot{\Phi}\end{bmatrix}+\begin{bmatrix}0\\ 0\end{bmatrix}u$$

a) Find the Transfer function of the system

b) Check the controllability, Observablity and stability of the system.

Experiment 3: Consider the following MIMO transfer function matrix:

$$G(s)=\begin{bmatrix}1/(s+1) & 0 & (s-1)/[(s+1)(s+2)]\\ -1/(s-1) & 1/(s+2) & 1/(s+2)\end{bmatrix}.$$

Using MATLAB convert this to state space and find

a) Unit step, impulse, ramp response for the above system.

b) Check the controllability and observability.

c) Comment on the stability of the system

Experiment 4: Consider the continuous-time linearised model of twin rotor MIMO system given:

$$A=\begin{bmatrix}0 & 1 & 0 & 0 & 0 & 0\\ -4.7059 & -0.0882 & 0 & 0 & 1.3588 & 0\\ 0 & 0 & 0 & 1 & 0 & 0\\ 0 & 0 & 0 & -5 & 1.617 & 4.5\\ 0 & 0 & 0 & 0 & -0.9091 & 0\\ 0 & 0 & 0 & 0 & 0 & -1\end{bmatrix},\quad B=\begin{bmatrix}0 & 0\\ 0 & 0\\ 0 & 0\\ 0 & 0\\ 1 & 0\\ 0 & 0.8\end{bmatrix}\quad\text{and}\quad C=\begin{bmatrix}1 & 0 & 0 & 0 & 0 & 0\\ 0 & 0 & 1 & 0 & 0 & 0\end{bmatrix}$$

a) Discretize the system for T=0.5 sec. and represent the system in discrete-time state space form.

b) Design a state feedback controller which will place the close loop poles at -1/2±j/4, 1/2±j/4, 1/2 and -1/2.

Experiment 5: Consider the coupled mass system shown below under the influence of applied force u(t). The system has equation of motion

My”+B(y’-d’)+K(y-d)=u

Md”+B(d’-y’)+K(d-y)=0

If we assume the measurable outputs are the displacements d & y the state and output equations are:

$$A=\begin{bmatrix}0 & 1 & 0 & 0\\ -K/m & -b/m & K/m & b/m\\ 0 & 0 & 0 & 1\\ K/M & b/M & -K/M & -b/M\end{bmatrix};B=\begin{bmatrix}0\\ 0\\ 0\\ 1/M\end{bmatrix};C=\begin{bmatrix}1 & 0 & 0 & 0\\ 0 & 0 & 1 & 0\end{bmatrix}$$

Where, $x=\begin{bmatrix}d\\ d'\\ y\\ y'\end{bmatrix}$; M=1 ; m=0.1 ; K=0.091 ; b=0.0036.

a) Discretize the system for T_s = 0.4 sec.

b) Design a deadbeat controller.

Experiment 6: Consider the inverted pendulum system given:

$$\dot{x}=Ax+Bu$$

$$y=Cx$$

with, $A=\begin{bmatrix}0 & 1 & 0 & 0\\ 4.4537 & 0 & 0 & 0\\ 0 & 0 & 0 & 1\\ -0.5809 & 0 & 0 & 0\end{bmatrix};B=\begin{bmatrix}0\\ -0.3947\\ 0\\ 0.9211\end{bmatrix};C=[0\quad 0\quad 1\quad 0]$

Determine:

a) Controllability and 0bservability properties of the given system.

b) Unit step, impulse & ramp response of the system.

c) Plot the response for the initial conditions given by - X_0=[1 1 1 1]’.

d) Find the characteristic equation of the system and its roots.

e) Convert this system to the unity feedback system and find its response to unit step input also comment on its stability.

f) For the above system find all the forms of the state space representation.

Experiment 7: Consider the linearised model of twin rotor MIMO system given:

$$A=\begin{bmatrix}0 & 1 & 0 & 0 & 0 & 0\\ -4.7059 & -0.0882 & 0 & 0 & 1.3588 & 0\\ 0 & 0 & 0 & 1 & 0 & 0\\ 0 & 0 & 0 & -5 & 1.617 & 4.5\\ 0 & 0 & 0 & 0 & -0.9091 & 0\\ 0 & 0 & 0 & 0 & 0 & -1\end{bmatrix},$$

$$B=\begin{bmatrix}0 & 0\\ 0 & 0\\ 0 & 0\\ 0 & 0\\ 1 & 0\\ 0 & 0.8\end{bmatrix}\quad\text{and}\quad C=\begin{bmatrix}1 & 0 & 0 & 0 & 0 & 0\\ 0 & 0 & 1 & 0 & 0 & 0\end{bmatrix}$$

Determine:

a) Controllability and 0bservability properties of the given system.
b) Unit step, impulse & ramp response of the system.
c) Plot the response for the initial conditions given by - X_0=[1 1 1 1]'.
d) Find the characteristic equation of the system and its roots.
e) Convert this system to the unity feedback system and find its response to unit step input also comment on its stability.
f) For the above system find all the forms of the state space representation.

Experiment 8: Consider dynamics the following state-space representation of the linearized longitudinal aircraft

$$\begin{bmatrix} v^{(1)}(t) \\ \alpha^{(1)}(t) \\ \theta^{(1)}(t) \\ q^{(1)}(t) \end{bmatrix} = \begin{bmatrix} -0.045 & 0.036 & -32 & -2 \\ -0.4 & -3 & -0.3 & 250 \\ 0 & 0 & 0 & 1 \\ 0.002 & -0.04 & 0.001 & -3.2 \end{bmatrix} \begin{bmatrix} v(t) \\ \alpha(t) \\ \theta(t) \\ q(t) \end{bmatrix} + \begin{bmatrix} 0 & 0.1 \\ -30 & 0 \\ 0 & 0 \\ -10 & 0 \end{bmatrix} \begin{bmatrix} \delta(t) \\ \mu(t) \end{bmatrix}$$

$$\begin{bmatrix} y_1(t) \\ y_2(t) \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} v(t) \\ \alpha(t) \\ \theta(t) \\ q(t) \end{bmatrix} + \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} \delta(t) \\ \mu(t) \end{bmatrix}$$

Find the following for the above problem?

- Convert this to a transfer function model ?
- Find unit step, ramp, and impulse response for the system?
- Find the response of the system for u(t)= 9*exp(5*t)?
- Comment on the stability of the system?
- Comment on the controllability and observability of the system?
- Find the response for the initial conditions x0=[1 1 1 1]'.

POWER SYSTEM – II (LAB) (EE-1553)

Experiment 1: Obtaining line parameters of a 345 kV transmission line and its modeling in MATLAB.
Experiment 2: Study of load flow analysis of a power system using (a) Gauss–Seidel and (b) Newton-Raphson methods.
Experiment 3: Study the effect of transformer in a power system while load flow analysis using MATLAB.
Experiment 4: To Study the effects of sudden short-circuit on a synchronous generator output using MATLAB.
Experiment 5: To obtain the current harmonics drawn by power electronics interface.
(a) To study the effect of real and reactive powers on bus voltages.
(b) Modeling of thyristor Controlled Reactors (TCR).
(c) Modeling of thyristor Controlled Series Capacitors (TCSC).
Experiment 6: To calculate transient stability limit of a 3-bus power system.
Experiment 7: To study the effect of symmetrical and unsymmetrical short-circuit faults of transmission lines.
Experiment 8: To study over voltages resulting from switching of transmission lines and limiting them by sing ZnO arresters.

COMMUNICATION SYSTEM AND NETWORKING (LAB) (EE-1554)

Experiment 1: To design and implement a Band Pass Filter for the range (400Hz-1KHz).
Experiment 2: To implement Amplitude Modulation (AM), demodulation and calculate the modulation index.
Experiment 3: To implement Frequency Modulation (FM) using IC 2206 and demodulation using IC 565.
Experiment 4: To implement Pulse Amplitude Modulation (PAM) and Demodulation.
Experiment 5: To implement Pulse Position Modulation (PPM).
Experiment 6: To implement Pu.lse Width Modulation (PWM).
Experiment 7: To implement Phase Locked Loop (PLL)and find out the lock range and capture range.
Experiment 8: To determine the performance of PCM.
Experiment 9: Study of LAN transmission media's , topologies , interconnection devices & LAN standards.
Experiment 10: Study of TCP/IP & Internet.
Experiment 11: To generate a random wireless scenario.
Experiment 12: To generate wireless MANETs scenario.
Experiment 13: To compare AODV and DSR routing protocols for wirelwss MANETs.
Experiment 14: To use Voice over IP application in wireless scenario.
Experiment 15: To compare reactive and Hybrid routing protocols for MANETs.

POWER ELECTRONICS (EE-1601)

UNIT 1: Introduction-Introduction to Power Electronics, Power Electronics Systems, Role of Power Electronics in the field of electric power control. 2(L)

UNIT 2: Power Electronic Devices-A Brief Survey of Power Semiconductor Devices:Power Diodes, Thyristor, Diac, Triac, UJT, GTO etc. Construction characteristics and their applications, methods of triggering a SCR. Different firing (R, RC and UJT) circuits, commutation of SCR, converter grade and inverter grade SCRs, series parallel operation of SCRs, Protection of SCR and GTO thyristor and triggering of GTO thyristor 10(L)

UNIT 3: Other Power Electronics Devices-Characteristics, operation, constructional details and application of Power Transistor (BJT), MOSFET, IGBT and MCT. 4(L)

UNIT 4: Controlled Rectifiers-Phase controlled Rectifiers operation on resistive and inductive loads, use of free-wheeling diode, Single -Phase and Three phase controlled and Fully controlled bridge rectifiers, Semi-converters, Dual converters, Effect of source impedance on converter, Line commuted inverters 9(L)

UNIT 5: Choppers-Principle of operation and control technique of chopper, classification of Choppers, current and voltage waveforms for resistive, inductive and motor loads, Power Transistor and MOSFET based chopper circuits, step up chopper and its application. 5(L)

UNIT 6: Inverters-Single-phase and Three-phase (six-step) inverters, voltage and current waveforms, Bridge Inverter, voltage control & PWM strategies of VSI., Series and parallel inverters, Methods of voltage control, and various techniques of phase width modulation. Comparisons of voltage source, current source inverters and their applications. 6(L)

UNIT 7: Cycloconverters-Single-phase and three-phase Step-up and Step down cycloconverter, full bridge and half bridge configurations. 2(L)

UNIT 8: Applications-Static circuit breakers, UPS, Static frequency converter, Power factor control. 2(L)

Text/ Reference Books:

- Power Electronics – M. H. Rashid
- Thyristorised Power Controllers - G. K. Dubey, S. R. Doradla, A. Joshi & V. P. Sinha
- Power Electronics - P. C. Sen
- Power Electronics – P. S. Bimbhra
- Power Electronics- Cyril W. Lander
- Power Electronics (Converter, Applications & Design) – Ned Mohan, T. M. Undeland & W. P. Robbin
- Power Electronics - R .S. Ramstrand.
- Power Electronics- Vineeta Agrawal & Krishna Kant

MICROCONTROLLER & COMPUTER ORGANIZATION (EE-1602)

UNIT 1: Introduction-Introduction to COA, Basic Computer Model, Working Principle, and Main Memory Organization, Microprocessor 3(L)
UNIT 2: ALU-Operation and Hardware Implementation, Implementation issues of some of the instructions 2(L)
UNIT 3: Memory-Concept of Memory, Cache Memory, Memory management, Virtual memory 4(L)
UNIT 4: Instruction set and addressing 3(L)
UNIT 5: Processor Organization, Control Unit, Micro programmed Control 4(L)
UNIT 6: I/O operation 4(L)
UNIT 7: Organization of Intel 8085 Micro-Processor 2(L)
UNIT 8: Instruction set of Intel 8085 Micro-Processor & Assembly programming 4(L)
UNIT 9: Introduction to Peripherals 2(L)
UNIT 10: Micro-controller Architecture 4(L)
UNIT 11: Addressing Mode, Digital and Analog I/O, timing and delay, Interrupts 6(L)
UNIT 12: Application of micro controller. 2(L)

Text/ Reference Books:

- Computer Organization and Architecture: Designing for Performance, : William Stallings, Publisher: Prentice-Hall India
- Computer Organization : Carl Hamacher, Zvonko Vranesic and Safwat Zaky Publisher: McGraw Hill
- 8051 Microcontroller An Applications Based Introduction D. M. Calcutt, Frederick J. Cowan, G. Hassan Parchizadeh, Publisher: Elsevier Publication
- Microcontrollers : Rajkamal Publisher: Pearson Education
- The 8051 Microcontroller and Embedded Systems: Muhammad Ali Mazidi,Janice Gillispie Mazidi
- The 8051 Microcontroller: Scott Mackenzie

INSTRUMENTATION (EE-1603)

UNIT 1: Instrumentation Systems: Role of instrumentation; Elements of instrumentation system; Use of monitored information; Classification of data acquisition systems; Standards of instrumentation; Calibration; Recent developments.4(L)

UNIT 2: Transducer Instrumentation: Sensors and transducers; Primary sensing elements; Electrical Transducers-characteristics, classification, desirable properties. 3(L)

UNIT 3: Passive transducers: Resistive, inductive, capacitive, frequency generating or modulating type; opto-electronic transducers; ultrasonic transducers; Hall-effect transducers- types, principle, modeling, analysis, industrial applications. 6(L)

UNIT 4: Active and digital transducers: Thermo-electric type, piezoelectric type, electromagnetic type; photo-electric type; digital transducers- types, principle, modeling, analysis, industrial applications. Applications with transducers for common industrial variables- temperature, pressure, flow, level, weight/ load/force, position, speed, acceleration, vibration. 7(L)

UNIT 5: Electronic Instrumentation: Analog Signal Conditioning and signal conversion- Transducer bridges- for resistive, reactive transducers; Amplifiers- instrumentation amplifiers, special purpose amplifiers; V/I and I/V signal converters; Precision rectifiers and applications; Active filters- low-pass first, second order types, features and design; Linearization of transducer characteristics for common transducers. 10(L)

UNIT 6: Data converters and digital signal conditioning- Sampling and Hold operations; Digital to analog convertors (DACs)-R/2R , Binary weighted, BCD to analog types; Analog to digital convertors (ADCs)- classifications; Capacitor charging type- VFC, PWM type, dual slope integrator types; Discrete voltage comparison type- counter ramp, successive approx, flash types, Properties and specifications. 6(L)

UNIT 7: Telemetry and Networked Systems: Types of data telemetry systems- land line, wireless, analog and digital, current, voltage, position, frequency telemetry; Network requirements; Communication interface- types of buses, IEEE 1451 standards; Data acquisition systems- configurations, comparative; Sensor networks and smart transducers. 4(L)

Text/ Reference Books:

- Patranabis,D. – Principles of industrial instrumentation (TMH)
- Seippel,R.G. – Transducers, sensors and detectors (Reston pub)
- Rangan, Sarma, Mani – Instrumentation systems and devices (TMH)
- Hoeschele - Analog-to-Digital and digital –to-analog converters (MGH)
- Shiengold- Transducer interfacing handbook (Analog devices)
- Roychaudhary,D. and S.Jain – Linear integrated circuits (Wiley eastern)

APPLIED CONTROL (EE-1604)

UNIT 1: Optimal Control: Performance Indices, Euler-Lagrange Equation, Linear Quadratic Regulator, Dynamic programming, Pontryagin's minimum principle 6(L)

UNIT 2: Nonlinear systems: Phase-plane, Describing function methods, advanced stability theory, nonlinear control system design. 6(L)

UNIT 3: Sliding mode control: Variable structure, definition of sliding mode, a simple sliding mode controller, sliding in multi input systems, sliding mode and system zeroes, non-ideal sliding mode, sliding surface design, state estimation of uncertain systems. 8(L)

UNIT 4: Adaptive Control: Model reference adaptive control and self-tuning regulators, MIT rule, Design of MRAS using Lyapunov theory, stochastic adaptive control. 5(L)

UNIT 5: Fuzzy Logic: Fuzzy arithmetic and Fuzzy relations, Fuzzy logic control, stabilization using Fuzzy models, adaptive Fuzzy control. 6(L)

UNIT 6: Micro-controller and DSP control, Distributed digital control system, PLCs, Embedded and FPGA controllers, Hardware-in-loop control. 6(L)

Text/ Reference Books:

- Stanislaw H. Zak, Systems and Control.
- Wolovich William A., "Automatic Control Systems", Oxford University Press, 1st Indian ed., 2010.
- Chidambaram, M., "Computer Control of Processes", Narosa Publishing House, 3rd reprint, New Delhi, India
- Kuo, B.C., "Digital Control System", Oxford University Press , second edition, 1992.
- Nagrath & Gopal , "Modern Control Engineering", New Ages International.
- V. I. Utkin, "Sliding Modes in control and optimization", Springer-Verlog, 1992.
- W. Pedrycz, "Fuzzy control and Fuzzy systems", Research Studies Press, Taunton, Somerset, England, 1993.
- H. K. Khalil, "Nonlinear control Systems", Prentice Hall, NJ, 1996.
- D. E. Kirk, "Optimal Control Theory: an introduction", Prentice Hall, NJ, 1970.

MODERN ELECTRICAL MACHINE (EE-1605)

UNIT 1: Precision Motors: Servo & Stepper Motor: stepper motors: construction, operation and characteristics of stepper motors; electronic as well as microprocessor based controllers for stepper motors; stepper motor applications in control, instrumentation, computer peripheral devices, CNC systems, robotics, etc.; and stepper motor analysis and design 7(L)

UNIT 2: Reluctance Motor: Synchronous and Switched reluctance Motors, Variable reluctance stepping motor: principle of operation of the switch reluctance motor (SRM): Introduction, Background, Elementary Operation of the Switch Reluctance Motor, Principle of Operation of the Switched Reluctance, Motor, Derivation of the Relationship Between Inductance and Rotor Position, Equivalent Circuit, SRM Configurations, Linear Switched Reluctance Machines 7(L)

UNIT 3: Wound rotor Induction Generator: Steady State, Transient and Control, Self Excited Induction Generators 6(L)

UNIT 4: Permanent Magnet Synchronous Motor / Generators (PMSM/ PMSG): Steady State and dynamic modeling 6(L)

UNIT 5: Brushless DC Machines: Steady State and dynamic modeling 4(L)

UNIT 6: Linear motors & its application MEGLEV 4(L)

UNIT 7: Electrostatic motor and its application in MEMS, Nanotube nanomotor, piezoelectric motors. 4(L)

Text/ Reference Books:

- Stepper Motors: Fundamentals, Applications and Design by V.V. Athani, New Age International Publisher
- Handbook of Small Electric Motors by William H. Yeadon and Alan W, Yeadon, eds. McGraw-Hill, 2001
- Stepping motors: a guide to modern theory and practice by Acarnley, Peregrinus on behalf of the IEE, 1984
- Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design, and Applications by R. Krishnan, CRC Press
- Switched Reluctance Motor Drives: Fundamentals of Magnetic Design and Control by Babak Fahimi, CRC Press
- Special Electric Machines edited by K. Venkataratnam, CRC Press
- Permanent Magnet Synchronous and Brushless DC motor Drive by R. Krishnan, CRC Press
- Electric Motors and Drives Fundamentals, Types and Applications by Austin Hughes, Elsevier
- Variable Speed Generators by I. Boldea CRC Press 2005

COMMUNICATION SKILL WORKSHOP (HS-1601)

Experiment 1: Art of communication: What is communication, good communication and effective communication, barriers and filters, activity on barriers and filters.
Experiment 2: Body language: verbal and non –verbal behavior interpretation, activity on non-verbal communication.
Experiment 3: Active listening. Active listening quiz.
Experiment 4: Feedback: How to give and receive feedback, Activity on feedback.
Experiment 5: Hidden date of communication: Feelings. Activity on how to handale feelings.
Experiment 6: Practical skills: assertiveness, activity on assertiveness, self-confidence, activity.
Experiment 7: In the world of teams: the team concept, element of teamwork. Team formation, effective team, exercise on team, Team players, activity.
Experiment 8: Discussions, decisions and presentations: Structured and un-structured group discussions. Activity on each.
Experiment 9: Adapting to Corporate life: exercise on grooming and dressing, getting ready for interview.
Experiment 10: Business Etiquette/Dining etiquette.

POWER PLANT ENGINEERING (EE-1607)

UNIT 1: Introduction to Power plants-Conventional power plant- Thermal, Hydro, Nuclear, Combined cycle, etc, Non-conventional power plant-Small hydro, wind (on shore/off-shore), fuel cell, PV etc, their layout, Load duration curves, Switchyard. 6(L)

UNIT 2: Thermal power plant (steam based)-Study on different sections- fuel and ash handling, Furnace and mechanical strokers, Pulverizers, Steam boiler types and cycles (including fluidized bed), Turbo-generators, Excitation system, Draught, Electrostatic precipitator, Cooling towers 8(L)

UNIT 3: Nuclear power plant-Nuclear energy-Fission and fusion reaction, Types of reactors, pressurized water reactor, waste disposal. 4(L)

UNIT 4: Hydro power plant: Different layout- Dam and run-of-river, Main sections- Intake, Tunnel, Surge tank, Penstock, Tail race, Turbine types, Hydro generators, Governors. 8(L)

UNIT 5: Diesel and Gas turbine power plant-Types of diesel power plant, components, Selection of engine type, Gas turbines, Open and closed cycles, reheating, Regeneration, Inter-cooling. 6(L)

UNIT 6: Economics of power plants-Cost of electrical energy- Fixed and operating cost, Tariff rates, Economics of load sharing, Comparison of cost from different power plants, Power plant instrumentation and major Electrical Equipment, Pollution and its control. 6(L)

Text/ Reference Books:

- Power plant engine- P.K. Nag
- Tata McGraw- Hill Publishing company Ltd., New Delhi
- Power plant Technology- M.M.EI-Wakil, McGraw Hill.
- Power plant engg.-Mahesh verma.
- Power plant engg. F.T. Morse & D.Van Nostianopl.
- British Electricity international London [CEGB], Modern power station practice, Third Ed. Voil1-8, Pergamon press.
- Modren power plant engineering- J.Weisman and Eckert, prentice- Hall of India New Delhi.
- A Text Book of power plant engineering R.K. Raajpoot, Luxmi publication (P) Ltd, New Delhi.

POWER ELECTRONICS (LAB) (EE-1651)

Experiment 1: Obtain the V-I Characteristics of the following devices
a) SCR
b) Triac
Experiment 2: To test the characteristics of single phase diode-bridge module under varying load condition.
Experiment 3: Implement the UJT as an Oscillator.
Experiment 4: Implement R and RC firing circuits for SCR.
Experiment 5: To program the given microprocessor (8085) for varying the firing angle of SCR triggering.
Experiment 6: Operation of Semi converter and half wave converter.
Experiment 7: To design and implement controlled bridge rectifier using single-phase and three-phase SCR bridge modules.
Experiment 8: Study the isolated gate drivers for transistor–transistor logic (TTL) pulses.
Experiment 9: Operation of SCR based Series Inverter and MOSFET based Half-bridge Inverter.
Experiment 10: To design and implement assembled open PCB for MOSFET Bridge used as a chopper and as an inverter**.**
Experiment 11: To determine the speed-torque characteristics of single-phase AC motor using thyristorised AC voltage controller with open loop and closed loop control.

MICROCONTROLLER & COMPUTER ORGANIZATION (LAB) (EE-1652)

Programs on 8085 Kit

Experiment 1: Write a program to Add two 8 bit Data result may be (i) 8 bits (ii) 16 bits.
Experiment 2: WAP to Subtraction of two 8 bit Data.
Experiment 3: WAP to Add series of 8 bit numbers. Result by be 8 bit or 16 bit.
Experiment 4: WAP to find the 2's complement of 16 bit Number.
Experiment 5: WAP for (ii) Multiplication and (ii) Division, data is of 8 bits and result bay be 8 or 16 bits.
Experiment 6: WAP for multi byte (ii) Addition and (ii) Subtraction.
Experiment 7: WAP for multi byte Addition of number of series.
Experiment 8: WAP to find the (i) largest and (ii) smallest number from a Data array.
Experiment 9: WAP to arrange a Data array in (i) Ascending (ii) Descending order.
Experiment 10: WAP to Display your name and moving display.

Study cards:

Experiment 11: 8155, 8255, 8253, 8251, 8259 8279, 8257

Interfacing modules:

Experiment 12: Traffic light control

DC motor control
Thumbwheel control
Stepper motor control
Elevator Simulator
D/A converter
A/D converter
Keyboard Simulator
Experiment 13: Basic programs of 8086 microprocessor

INSTRUMENTATION (LAB) (EE-1653)
Experiment 1: Study and experimentation on displacement measurement using LVDT.
Experiment 2: Study and experimentation on speed Measurement.
Experiment 3: Study and experimentation on pressure measurement.
Experiment 4: Study and experimentation on Piezoelectric transducers for force/ Load measurement.
Experiment 5: Study and experimentation on temperature sensing transducers such as thermocouple, thermistor, and RTD.
Experiment 6: Study and experimentation on Strain Gauge measurement.
Experiment 7: Sample - Hold and ADC-DAC operations.
Experiment 8: Design and testing of low pass filters.
Experiment 9: Design and testing of high pass filter.
Experiment 10: Design with timer-555
Experiment 11: Design and testing of Instrumentation Amplifiers.
Experiment 12: Interfacing of transducer with Microprocessor.
Experiment 13: Study of process control trainer

ELECTRICAL DRIVES (EE-1701)

UNIT 1: Introduction of Drives-Concept of Electrical Drive, Classification of Drives, Block Diagram of an Electrical Drive, power modulators, Sources, Control Unit , Choice of Electrical Drive, Status of DC and AC Drive, Load Characteristics, Load With Rotational Motion and Transnational Motion, Classification of Load Torques, Load Torques function of Speed, Time, Path or Position Taken by the Load during Motion and Quadrant Operation 7(L)

UNIT 2: Dynamics of Electrical Drive-Electric motor speed torque characteristics, Joint Speed-Torque Characteristic of an Electric Motor and Driven Unit, Stability of Drive System, Determination of Moment Of Inertia, Load Equalization, Concept of Transient Stability, Selection of motor under Continuous Duty, for Continuous variable Duty, for Short Duty Load, and intermittent Duty Load, Effect of Load Inertia, Environmental Factors 7(L)

UNIT 3: Starting and Braking of DC Drives-Effect of staring on power supply, motor and load, Types of starters, Different methods of starting of a motor, Starting Circuit as a Function of Motor Speed, Function of Current and Function of Time, Thyristors and the resistance starter, Thyristor starting without resistance, Braking of DC Drives, Type of Braking, Friction Braking and Electrical) 6(L)

UNIT 4: Speed Control of DC Drives-Performance parameters for Power Controller Fed DC Drives, Classify various power electronics controller fed DC drives, Types of controlled rectifier fed DC drives, Performance of Controlled Rectifier Fed DC Shunt Motor and Series Motor, Performance of Chopper fed DC drives 7(L)

UNIT 5: Starting and Braking of AC Drives-Need of using starters for AC Drives, Two (Star-Delta and Auto-transformer) types of starters used for Squirrel cage Induction motor, Starter using additional resistance in rotor circuit, for Wound rotor (Slip-ring), Starting of Synchronous Motor, Principle of electric braking for AC drives, Types of braking of AC drives 6(L)

UNIT 6: Speed Control of AC Drives-Different methods of speed control of induction motor, Advantage of low frequency starting of induction motor, Sources of Variable frequency generation, Variation of supply voltage, Injection of voltage in rotor circuit, static Scherbius Drive, Static Kramer Drives, Rotor resistance control Speed Control of Synchronous Motor Drives, Traction Motor drive 7(L)

Text/ Reference Books:

- Vineeta Agarwal, Electrical Drive, Agrawal Publisher, New Delhi,
- G.K.Dubey- Fundamental of electric drives. Narosa Publishing House
- S. K. Pillai, A First Course on Electrical Drives, New Age International Publishers
- P.C.Sen- Thyristor DC drives. Wiley inter science publication.
- B.K.Bose- Thyristor AC drives. Wiley inter science publication
- V. Subramanayam- Thyristor control of electric drives. Tata McGraw Hill Publication.
- S. B. Dewan- Thyristorized Power Controller Drives, Wiley Inter
- J. M. D. Murphy- Power electronics control of AC motors, Perganmon press, Newyork.

RENEWABLE ENERGY SOURCES AND DISTRIBUTED GENERATION (EE-1702)

UNIT 1 Distributed Generation Resources: Renewable energy types solar, wind, small-hydro, diesel generator, marine, fuel cells etc., distributed generation technologies, standalone, hybrid and grid connected 6(L)

UNIT 2 Wind Energy System: Wind Turbines, Fixed speed and variable speed wind turbines, Synchronous generator, PMSG, Induction generator, doubly fed synchronous generator, Land vs. offshore wind turbines, wind turbine characteristics. 7(L)

UNIT 3 Solar PV: Solar photovoltaic (PV) cell, PV characteristics, Modules and Arrays, Utility, Commercial and Residential PVs, Hybrid 7(L)

UNIT 4 Other DG Technologies: Energy Storage, Batteries, Capacitors, Ultra-capacitors, flywheel, Thermal Storage, Fuel Cells and its characteristics. 6(L)

UNIT 5 Grid Integration: Standards for grid connection, Power Quality, Eigen analysis, optimal location of DG, Islanding issues, Solar and Wind power park, Smart grid. 6(L)

UNIT 6 Power Electronics in DG: AC/DC, DC/DC and DC/AC converters in DG, Fully rated and partially rated converters, Battery charging, maximum power point tracking (MPPT) methods, Solar water pumping, Inverter topologies for solar and wind. 8(L)

Text/ Reference Books:

- Ghosh and G. Ledwich, *Power Quality Enhancement using Custom Power Devices*, Kluwer Academic Publisher, Boston, MA, 2002.
- Mukund R. Patel, "Wind and Solar Power Systems", CRC Press LLC, 1999.
- G. M. Masters, Renewable and Efficient Electric Power Systems
- M. H. Rashid (ed), *Power Electronics Handbook*, Academic Press, Florida, 2001.

PROFESSIONAL ELECTIVE – I

NEURAL NETWORK AND FUZZY SYSTEM (EE-1731)

UNIT 1: Introduction of Artificial Intelligence techniques-Role of artificial intelligence techniques in engineering; Characteristics of ANN and Fuzzy Systems 3(L)

UNIT 2: Neural Networks Systems-Biological neurons, NN terminology, Activation functions, Fundamental models of NN; McCulloch Pitt's, Hebb, Single layer perceptron, Adaline network, solving logic gate function using these models, Types of NN based on learning methods, Supervised learning (Hebb learning rule, Bolzmann learning, Delta learning rule, Gradient descent techniques, Adaptation, Generalized delta rule), Unsupervised learning, Reinforcement learning, Self-organizing mapping, Adaptive resonance theory 12(L)

UNIT 3: Multilayer NNs-Types according to architecture- Feedforward NN, Recurrent NN, Dynamic learning of NN, Applications of NNs- Identification (Nonlinear model structures-NNFIR, NNARX, NNFIR, NNARMAX, NNOE), Control (Direct inverse, internal model, feedforward) 5(L)

UNIT 4: Fuzzy systems-Introduction, Definition and terminology, Fuzzy set operations, Their properties, Fuzzy relations, Its operations and properties, Fuzzy composition, Fuzzy linguistic variables, Rule structure- consequent and antecedent part, rule framing, Fuzzification, De-fuzzification (Max membership principle, Centroid, Weighted average, Mean max membership, Center of sums, Center of largest area), Inference system 12(L)

UNIT 5: Fuzzy system applications- Fuzzy controllers, approximate reasoning and approximation. 3(L)

UNIT 6: NN-Fuzzy systems-ANFIS- Block diagram and operation at different layers 2(L)

Text/ Reference Books:

- S. N. Sivanandam, S. Sumathi, S. N. Deepa, Intriduction to Neural Networks using MATLAB 6.0, Tata McGraw Hill.
- S. Haykin, Neural Networks: A comprehensive Foundation, Pearson Education.
- Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley student edition, Wiley-India.
- J. S. R. Jang, C. T. Sun, and E. Mizutani, Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence, Prentice Hall-India Ltd.

HIGH VOLTAGE ENGINEERING (EE-1732)

UNIT 1: Break Down Phenomenon-Basic Process of breakdown, breakdown phenomenon in gaseous, liquid & composite dielectrics, breakdown in vacuum insulation

UNIT 2: Generation of High Test Voltages-Generation of high d.c. voltage by voltage multiplier circuit and electrostatic generators, generation of high a.c. voltage by cascade transformers and resonant transformers, generation of impulse voltages, triggering & synchronization of impulse generators, generation of high impulse current.

UNIT 3: Measurement of High Voltage & Current-Resistance, capacitance and RC potential dividers, sphere gap, electrostatic voltmeter, generating voltmeter, impulse voltage measurement, measurement of high d.c., a.c. & impulse currents

UNIT 4: High Voltage phenomenon and Insulation coordination-Requirement of high voltage test circuits, L.S specifications; impulse and power frequency test of transformers, lighting arresters, bushing, power cables, circuit break and isolators; measurement of resistivity dielectric constant and loss factor, partial discharge measurement

UNIT 5: Over Voltage Phenomenon and Insulation Coordination-Lightning and switching phenomenon as caused by over voltage, protection of transmission line and substation against over voltage, insulation coordination

UNIT 6: Testing of Materials and Electrical Apparatus-Testing of Transformers, motors, generators. Non destructive testing

UNIT 7: Design, Planning and Layout of High Voltage Laboratories-Laboratory layouts, Switchyard layouts

Text/ Reference Books:

- E. Kuffel & W.S Zaegnol, "High Voltage Engineering", Pergamon Press
- M.S Naidu & V. Kamaraju, "High Voltage Engineering", Tata Mc-Graw Hill
- M.P Chaurasia, "High Voltage Engineering", Khanna Publishers.
- R.S Jha, "High Voltage Engineering",
- C.L Wadhwa, "High Voltage Engineering", Wiley Eastern Ltd.
- T. J. Gallagher and A. J. Pearmain, High Voltage Measurement, Testing and Design, NY: Wiley, 1983.
- L. L. Alston, High Voltage Technology, Oxford University Press, 1968.
- Arrilaga,.J., "High voltage direct current transmission", Peter Peregninver Ltd., London, U.K.,1983

UTILIZATION OF ELECTRICAL ENERGY & ELECTRIC TRACTION (EE-1733)

UNIT 1: Electric Heating and Welding-Salient features of electric heating, resistance heating, induction heating, electric arc heating, dielectric heating, methods of generating high frequency power illumination: Laws of illumination, polar curves, design of indoor and outdoor systems, street lighting. Electrolytic Process: Principle of electro deposition, laws of electrolysis, applications of electrolysis.

UNIT 2: Electric Traction-Electric traction-Salient features, comparision with other types of traction systems, types of electric traction; systems of track electrification, traction system in India, speed time curves, tractive effort and specific energy consumption, coefficient of adhesion, suitability of electric motors for traction service, conventional and solid state control of traction motors, electric braking, current collection systems, dc and ac substations, signalling system, diesel electric traction.

Text/ Reference Books:

- H.Pratab,Utilization of Electrical Energy, Dhanpat Rai &Sons.
- G.K.Dubey,Fundamentals of Electrical Drives, Narosa Publishing House.
- Dover, Electric Trection, Pitiman & Sons.
- H.Cotton,Illumination Engineering, Pitman &Sons.
- E.O.Taylor, Utilization of Electrical Energy, Pitman &Sons.

UTILIZATION OF ELECTRICAL ENERGY & ELECTRIC TRACTION (EE-1734)

UNIT 1: Electric Heating, Advantages of electrical heating, heating methods: Resistance heating, Induction heating, Electric arc heating, Dielectric heating, Infra-red heating, Microwave heating, Simple design problems of resistance heating element 7(L)

UNIT 2: Advantages of electric welding, Welding method, Principles and Types of resistance welding, Principle of arc production, electric arc welding, Comparison between AC and DC arc welding, Welding control circuits, Welding of aluminum and copper, Introduction to TIG, MIG Welding (Gas Tungsten Arc Welding (GTAW) (frequently referred to as TIG welding) Gas Metal Arc Welding (GMAW) (frequently referred to as MIG Welding) 8(L)

UNIT 3: Electrical Circuits used in Refrigeration and Air Conditioning and Water Coolers: Principle of air conditioning, vapour pressure, refrigeration cycle, eco-friendly refrigerants, 6.2 Description of Electrical circuit used in a) refrigerator, b) air-conditioner, and c) water cooler 5(L)

UNIT 4: Illumination, Nature of light, visibility spectrum curve of relative sensitivity of human eye and wave length of light, Laws of illumination, Different type of lamps, Illumination schemes, Illumination levels, Main requirements of proper lighting methods of generating high frequency power illumination: Laws of illumination, polar curves, design of indoor and outdoor systems, street lighting. Electrolytic Process: Principle of electro deposition, laws of electrolysis, applications of electrolysis. 8(L)

UNIT 5 Electric Traction: Advantages of electric traction, Different systems of electric traction, Types of services – urban, sub-urban, and main lines and their speed-time curves, Different accessories for track electrification, Factors affecting scheduled speed 6(L)

UNIT 6: Electrical block diagram of an electric locomotive, Types of motors used for electric traction, Starting and braking of traction motors, Introduction to EMU and metro railways 6(L)

Text/ Reference Books:

- Utilization of Electrical Energy by J.B. Gupta, Kataria Publications, Ludhiana
- Utilization of Electrical Energy by OS Taylor, Pitman Publications
- Generation, Distribution and Utilization if Electrical Power by C.L. Wadhwa, Wiley Eastern Ltd., New

ADVANCED SEMI-CONDUCTOR DEVICES (EE-1735)

UNIT 1: Status of development of power semiconductor Devices, Diodes Types - P-N junction, schottky, contact, Gunn diodes, IMPATT (Impact ionization Avalanche Transit-Time) diodes; Step recovery diodes; Electrical rating - Switching and steady state characteristics - switching aid circuits - Series and parallel operation , Resonant tunnelling structures, RTD oscillators 9(L)

UNIT 2: Special Types of Thyristors-Field controlled thyristors and MCTs: Electrical rating - Switching and steady state characteristics - protection - Gate circuit requirements-Turn ON and Turn OFF methods 5(L)

UNIT 3: Transistors Types – BJT, Hetro junction BJTs; (HBT), ratings - static and switching characteristics - driver circuit - switching aid circuit -Power Darlington. Static Induction Transistor SIT 6(L)

UNIT 4: Field Effect Transistors Types (JEFT, MESFET, Metal Semiconductor Field Effect Transistor, MOSFET, HEMT, High Electron Mobility Transistor). Transport in low dimensional structures: HEMTs: Design of high frequency amplifiers and oscillators 6(L)

UNIT 5: IGBTs, Principle of working – switching characteristics - Gate drive requirements, Emerging Devices: - Power Integrated circuit - Characteristics –- New semiconductor materials for devices, (SiC, GaAs, PwrSoc), 6(L)

UNIT 6: Intelligent power modules, Wide band gap devices, nano-electronics and ballistic devices, Terahertz and Millimeter Wave Devices 6(L)

Text/ Reference Books:

- Ned Mohan, Power Electronics, PHI
- M. H. Rashid, Power Electronics PHI
- Williams, B. W., "Power Electronic Devices, Applications and Passive Components", ELBS Oxford University Press, 1992
- Mohan, M.et.al."Power Electronics converters, Applications and Design", Second edition, John Wiley and sons, New York, 1995.
- Rashid, M. H.,"Power Electronic Circuits, Devices and Applications," Second Edition, Prentice Hall of India, New Delhi, 1994.

NETWORK SYNTHESIS (EE-1736)

UNIT 1: Elements of Network Synthesis-synthesis of L- C Driving –point Immitances, , synthesis of R-C Impedances or R-L Admittances , Synthesis of certain R-L -C Functions. 5(L)

UNIT 2 Elements of Transfer function Synthesis: Properties of Transfer function, Synthesis of Y21 Z 21 with 1-Ω termination, Synthesis of Constant Resistance Networks. 7(L)

UNIT 3: Filter Design-Filter design problem, Low Pass Filter Approximations, Synthesis of Low Pass Filter, Magnitude and Frequency Normalization, Frequency Transformations. 6(L)

UNIT 4: Biquad Circuits-Biquad Circuits, Four Op-Amp Biquad Circuit, Frequency and Phase Response of Biquad Circuit .Butterworth Low Pass filter,Chebychev,Bessel Thomson Filter, 7(L)

UNIT 5: Leapfrog Simulation of Ladders- Ladder Simulattion,Bandpass Leapfrog Filters,Active Resonators,Bandpass Leapfrog Design,Girling-Good Form of Leapfrog. 6(L)

UNIT 6: Switched Capacitor Filters-Switched Capacitor,Analog Operations ,Range of Circuit elements Sizes,Bandpass Switched –Capacitor Filters. OP Amp Oscillators: Loop gain, Conditons for Third –Order Circuit Oscillations Amplitude Stabilization 6(L)

Text/ Reference Books:

- Franklin F. Kuo, "Network Analysis and Synthesis" ,John Wile
- M E Valkenberg, "Analog Filter Design" ,Oxford University Press.
- A S Sedra and P O Brackett, "Filter Theory and design: Active and Passive", Matrix Publishers.
- F.W.Stephenson, "RC Active Filter Design Handbook", John Wiley & Sons
- Wai-Kai Chen, "Passive and Active Filters Theory and Implementations", John Wiley & Sons.

VIRTUAL INSTRUMENTATION (EE-1737)

UNIT 1: Introduction, Virtual Instrumentation (VI) advantages 2(L)
UNIT 2: Graphical programming techniques, data flow programming, VI's and sub VI's 10(L)
UNIT 3: Structures, Arrays and Clusters 12(L)
UNIT 4: Data acquisition methods, File I/O, DAQ hardware, PC hardware; operating systems, Instrumentation buses, ISA, PCI, USB, PXI 8(L)
UNIT 5: Instrument control, Data communication standards, RS-232C, GPIB 4(L)
UNIT 6: Real time operating systems, Reconfigurable I/O, FPGA 4(L)

LAB

Exprtiment 1: Familiarization with LabVIEW Programming: Creating simple VI, navigation and editing, developing VI, converting VI into Sub-VI, boolean switch action.

Exprtiment 2: LabVIEW Functions & Debugging: Use of WHILE-loop, FOR-loop, IF-THEN, CASE structure, shift registers, local variables and debugging.

Exprtiment 3: Advance LabVIEW Functions: Mathematical functions, arrays, clusters, waveforms and charts, formula node, global variables.

Exprtiment 4: Data Acquisition: Analog I/O, digital I/O, application of measurement & automation explorer (MAX).
Exprtiment 5: VI Applications: Temprature measurement, signal analysis (RMS, FFT, DFT, etc.), PLL, PWM output etc.

Text/ Reference Books:

- Virtual Instrumentation Using LabVIEW, Jovita Jerome, PHI India New Delhi
- Virtual Instrumentation Using LabVIEW, S. Gupta & J. John., Tata McGraw-Hill, New Delhi INDIA, ISBN – 0-07-059099-0
- Labview 7 Express Student Edition, Robert Bishop, PHI, ISBN - 0-13-123926-0
- LabVIEW User Manual, National Instruments, Texas Instruments, USA, available at www.ni.com
- LabVIEW RT User Manual, National Instruments, Texas Instruments, USA April 2000, available at www.ni.com
- LabVIEW FPGA Module User Manual, National Instruments, Texas Instruments, USA, March 2004, available at www.ni.com
- Application LabView, Leonard Sokoloff, PHI, OSBN – 0-13-833949-X
- LabVIEW For Electrical Circuits, Machine Drives and Labs, Nesimi Ertugrul, PHI, ISBN – 0-13-0618860-1
- Advanced LabVIEW Labs, John Essick, PHI, ISBN – 0-13-833949-X
- LabVIEW Graphical Programming. Garry Johnsons, Mc Graw Hill.

ELECTRICAL DRIVES (LAB) (EE-1751)

- Determination of Moment of Inertia of a motor
- Two-Quadrant operation of a 1-phase Full Converter using D.C. drive.
- Performance & speed control of D.C motor by single phase Semi-converter
- Performance of Chopper fed D.C. Drive
- Operation of a four quadrant Chopper on D.C. Drive
- Operation of a 1-phase A.C. Voltage controller on motor load.
- Operation of a 3-phase A.C Voltage controller on a 3- phase Squirrel Cage Induction Motor.
- Performance & speed control of S.C. Induction motor by Static Rotor Resistance Controller.
- Performance & speed control of 3-phase Induction motor using 3-phase PWM Inverter.
- Performance & speed control of S.C. Induction motor using cyclo-converter

PROJECT (EE-1791)

ADVANCE POWER ELECTRONICS (EE-1801)

UNIT 1: DC-DC converters & power supplies-Review of assumed knowledge and switching devices; Review of steady-state characteristics of DC-DC converter circuits. SEPIC and Cuk converters; PSIM models. 4(L)

Analysis of non-ideal switches and circuit elements in DC-DC converters, efficiency calculation, voltage transfer characteristics with continuous and discontinuous inductor current. PSIM models 4(L)

Representation of dynamics of buck, boost and forward converters; state-space averaging, PWM controller; control loop design, voltage control, current mode control; Limiting of inrush current; Inductor and capacitor components. 4(L)

Isolated DC-DC Converters: Full-Bridge and Half-Bridge Isolated Buck Converters, Forward Converter, Push-Pull Isolated Buck Converter, Flyback Converter, Boost-Derived Isolated Converters, Isolated Versions of the SEPIC and the Cuk Converter 4(L)

UNIT 2: DC-AC Inverters-Review of assumed knowledge on DC-AC inverter circuits; advanced modulation techniques, SVM; Compensation for dead time and device voltage drops. PSIM Models; Current source inverters, multi-level and Z-source inverters. Rectifier/inverter with bi-directional power flow. 6(L)

UNIT 3: Resonant converters-Hard switched and Soft Switched Converter: Zero-current switched (ZCS) DC-DC converter, Zero-voltage switched (ZVS) DC-DC converter, Load Resonant Converters, Series,Parallel and Hybrid Loaded Converters, Series-resonant converter/inverter, Parallel-resonant converter/inverter, Series-parallel resonant converter, Resonant DC-link inverter/converter. Resonant Switch Converter, DC-DC resonant link inverters, hybrid resonant link inverters, Quasi resonant link converters, switched mode rectifiers, synchronous link converters 6(L)

UNIT 4: Modern Rectifiers-Power and Harmonics in Nonsinusoidal Systems, Pulse-Width Modulated Rectfiers, Modeling, analysis, and control of low-harmonic rectifiers, Boost, flyback, and other topologies for controlling the input current waveform of an ac-dc rectifier, Average-current, peak-current-mode, critical conduction mode, and nonlinear carrier control techniques, Determination of rms currents, and comparison of performances of popular topologies, System considerations. Modelling losses. Simulation. 6(L)

UNIT 5: Converter dynamics and control-Advanced control techniques, Small signal modeling, Advanced converter transfer functions 2(L)

UNIT 6: Research studies, literature review and discussions in emerging power electronics topics such as-Solar Power Conversion Systems, Wind Power Conversion, Battery Charging, Power Factor Correction, Multilevel converters and Matrix converter. 4(L)

Text/ Reference Books:

- N. Mohan, T. M. Undeland & W. P. Robins, "Power Electronics; Converters, Applications and Design", John Wiley, Second Edition, 1995, New York.
- J. G. Kassakian, M.F. Schlecht & G.C. Verghese, "Principles of Power Electronics", Addison Wesley, 1991.
- R. W. Erickson, "Fundamentals of Power Electronics", Kluwer Academic Publications, 1997.
- D. W. Hart, "Introduction to Power Electronics", Prentice Hall International, 1997.
- Erickson and Maksimovic, *Fundamentals of Power Electronics*, 2nd edition, Springer Science+Business (2000), ISBN 0-7923-7270-0

PROFESSIONAL ELECTIVE – II

EHV AC & DC TRANSMISSION (EE-1831)

UNIT 1: General aspects and converter circuits- HVAC and HVDC links - comparison, reliability, choice of best circuit for HVDC converters- transformer connection. 7(L)

UNIT 2: Bridge converters- analysis and control – power reversal- desired features of control - actual control characteristics 9(L)

UNIT 3: Mis-operation of converters and protection-Converter disturbance - bypass action in bridges - commutation failure - basics of protection - DC reactors - voltage and current oscillations - circuit breakers – over voltage protection. 8(L)

UNIT 4 Harmonics, filters and converter charts: Characteristics and uncharacteristic harmonics - troubles due to harmonics - harmonic filters - converter charts of direct current and voltage - active and reactive power. 7(L)

UNIT 5: Design of EHV lines-based on steady state limits and transient over voltages - design of extra HV cable transmission 7(L)

UNIT 6: XLPE cables-gas insulated cables – corona. 2(L)

Text/ Reference Books:

- Rakesh Das Begamudre,"Extra High Voltage AC Transmission Engineering", Wiley Eastern Limited.
- K. R. Padiyar, "HVDC Power Transmission System", Wiley Eastern Limited.
- E. W. Kimbark, "EHV-AC and HVDC Transmission Engineering & Practice", Khanna Publishers.
- Arrilaga,.J., "High voltage direct current transmission", Peter Peregninver Ltd., London, U.K.,1983

ELECTRIC VEHICLE TECHNOLOGY (EE-1832)

UNIT 1: Introduction to Alternative Vehicles-Electric Vehicles, Hybrid Electric Vehicles, Electric and Hybrid Vehicle Components, Vehicle Mass and Performance, Electric Motor and Engine Ratings, Electric and Hybrid Vehicle History Well-to-Wheel Analysis, EV/ICEV Comparison, Electric Vehicle Market, Vehicle Mechanics, Roadway Fundamentals Laws of Motion, Vehicle Kinetics, Dynamics of Vehicle Motion, Propulsion Power, Velocity and Acceleration, Tire–Road Force Mechanics, Propulsion System Design

UNIT 2: Alternative Vehicle Architectures-Electric Vehicles, Hybrid Electric Vehicles, Plug-In Hybrid Electric Vehicle Powertrain Component Sizing, Mass Analysis and Packaging, Vehicle Simulation, Battery Energy Storage, Batteries in Electric and Hybrid Vehicles, Battery Basics, Battery Parameters, Electrochemical Cell Fundamentals, Battery Modeling Traction Batteries, Battery Pack Management

UNIT 3: Alternative Energy Storage-Fuel Cells, Ultracapacitors, Compressed Air Storage, Flywheels, Electric Machines Simple Electric Machines, DC Machines, Three-Phase AC Machines, Induction Machines, Permanent Magnet Machines Switched Reluctance Machines

UNIT 4: Power Electronic Converters-Power Electronic Switches, DC/DC Converters, Cell Balancing Converters

UNIT 5: Electric Motor Drives-Electric Drive Components, DC Drives, Operating Point Analysis, AC Drives, SRM Drives

UNIT 6: Control of AC Machines-Vector Control of AC Motors, dq Modeling, Induction Machine Vector Control, PM Machine Vector Control

UNIT 7: Internal Combustion Engines-Internal Combustion Engines, BMEP and BSFC, Vehicle Fuel Economy, Emission Control System

UNIT 8: Powertrain Components and Brakes-Powertrain Components, Gears, Clutches, Differential, Transmission, Vehicle Brakes

UNIT 9: Cooling Systems-Climate Control System, Powertrain Component Cooling System, Hybrid Vehicle Control Strategy
Vehicle Supervisory Controller, Mode Selection Strategy, Modal Control Strategies, Vehicle Communications, OSI Seven-Layer Model, In-Vehicle Communications, Controller Area Network

Text/ Reference Books:

- Electric Vehicle Battery Systems by Sandeep Dhameja, Elsevier
- Lightweight Electric/Hybrid Vehicle Design by John Fenton & Ron Hodkinson, Elsevier
- Build Your Own Electric Vehicle by Seth Leitman, Bob Brant, McGraw Hill
- Electric and Hybrid Vehicles: Design Fundamentals, Second Edition by Iqbal Husain CRC Press 2010
- Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, Second Edition Mehrdad Ehsani; Yimin Gao; Ali Emadi, CRC Press 2009

BIOMEDICAL-INSTRUMENTATION (EE-1833)

UNIT 1: Theory, Analysis and design of biomedical transducers-Electrical, mechanical, electromechanical, thermoelectric, photo-electric, electrochemical, and optical transducers, Applications to biomedical systems. Transducers for non-electrical quantities. Flow and pressure measuring instruments in biomedical engineering 8(L)

UNIT 2: Electrodes-Theory of electrodes, Lead configurations of ECG electrodes, various types of electrodes, Electrodes used for ECG, EEG and EMG measurement 6(L)

UNIT 3: Cardiovascular system, Sensor characteristics and design for measurement of medical parameters like ECG, arterial blood pressure, heart sounds, Nervous system, measurement of EEG. 7(L)

UNIT 4: Medical laboratory Instrumentation, Development of non-invasive diagnostic instruments for tissue abnormalities, Medical Ultrasonography, Latest biomedical Instruments, Electro surgical unit, Pulse Oximeter, Foetal ECG. 8(L)

UNIT 5: Patient monitoring equipments; pace makers, Defibrillators etc., organization in hospital, Patient safety-physiological effects of electrical currents. Grounding systems in hospital, safety codes for electro-medical equipments. 8(L)

UNIT 6: Biotelemetry- Radio Telemetry principles, FM, AM, PCM. Transmission of biological data through radio telemetry. 3(L)

Text/ Reference Books:

- Khandpur R.S., "Hand book of Biomedical instrumentation", TMH, 2003.
- Cormwell L. et al., "Bio medical Instrumentation & Measurements", PHI
- Carr & Brown, "Introduction to Biomedical Equipment", PHI, 2005.
- Webester J.G. "Medical Instrumentation", 3rd Edition, John Wiley, 1997.
- Richard L. Drake et. Al., "Anatomy for students" Elsevier, 2005.
- Rangaraj M. Rangayyan, "Biomedical Signal Analysis" John Wiley & Sons, 2002.
- Shu Chien et. Al., "An Introductory Text to Bio-Engineering" World Scientific, 2008.

OPERATION RESEARCH (EE-1834)

UNIT 1: Introduction: Introduction to O.R., Necessity of OR in Business and Industry, Scope of OR in modern management, O.R. and Decision Making. Linear programming: Various definitions, statements of basic theorems and properties, Advantages, Limitations and Application areas of Linear Programming, Linear Programming – The Graphical method – Graphical Solution methods of Linear Programming problem, Maximization Linear Programming problem, Maximization Problem. Formulation, Identification of decision variables, Constructing Objective Functions and Constraints, Assumptions. 8(L)

UNIT 2: Methods of Solution: Graphical Method, Simplex method.- Phase I and Phase II of the Simplex Method, The Revised Simplex method, Primal and Dual Simplex Method, Simplex Algorithm for maximization case, Simplex Algorithm for minimization case – Two phase method and the Big –M method. 5(L)

UNIT 3: Duality theory and Sensitivity Analysis: Duality theory: Existence of Dual of a LP problem, Primal Dual relationships in formulation and their solutions. Sensitivity analyses or Post Optimality Analysis: Dual Simplex Method, Changes affecting feasibility, Changes affecting optimality. 5(L)

UNIT 4: Transportation and Assignment problems: The transportation algorithm: Formulation as a LP problem, Determination of Initial solutions, Stepwise Improvement to obtain optimal solution, Special cases Such as Multiple, Unbalanced, Degeneracy etc., The assignment model: Formulation as TP, The Hungarian method of solution. 6(L)

UNIT 5: Network models: Critical Path Analysis (CAP): Network representation of simple projects, Critical path computation: Construction of time schedule, crashing of project duration. 5(L)

UNIT 6: PERT & CPM: Basic differences between PERT and CPM. Arrow Networks, time estimates, earliest expected time, latest – allowable occurrences time, Forward Pass Computation, Backward Pass Computation, Representation in Tabular Form Critical Path, Probability of meeting scheduled date of completion, Calculation on CPM network.

Various floats for activities, Critical path updating projects. Operation time cost tradeoff Curve project, Time cost – tradeoff Curve- Selection of schedule based on Cost Analysis, Crashing the network. 8(L)

Text/ Reference Books:

- Introduction to Operations Research (Frederick S.Hiller, Gerald J.Lieberman), McGraw-Hill Companies
- Operations Research An introduction by Hamdy A. Taha, Prentice-Hall
- Quantitative Technoques, by L.C. Jhamb, Everest Publishing house
- Operations Research by Kanti swarup, Gupta P.K. and ManMohan.
- Optimization Methods in Operations Research and System Analysis by Mital K.V.
- The Critical Path Method by Saffer L.R., Fitter J.B. and Meyer W.L.
- Operation Research by J.K. Sharma
- Introduction to Operation Research: A Computer Oriented Algorithm Approach by Filet B. E.

CONVENTIONAL AND COMPUTER AIDED DESIGN OF ELECTRICAL MACHINES (EE-1835)

UNIT 1: Basic Considerations-Basic concept of design, limitation in design, standardization, modern trends in design and manufacturing techniques, Classification of insulating materials. Modes of heat dissipation & temperature rise time curves. Methods of cooling ventilation (induced & forced, radial & axial), direct cooling & quantity of cooling medium. Calculation of total MMF and magnetizing current. Specific permeance and leakage reactance 6(L)

UNIT 2: Transformer Design-Output equation design of core, yoke and windings, overall dimensions, Computation of no load current to voltage regulation, efficiency and cooling system designs. 10(L)

UNIT 3: Design of rotating machines - I: Output equations of rotating machines, specific electric and magnetic loadings, factors affecting size of rotating machines, separation of main dimensions, selection of frame size. Core and armature design of dc and 3-phase ac machines 7(L)

UNIT 4: Design of rotating machines – II: Rotor design of three phase induction motors. Design of field system of DC machine and synchronous machines. Estimation of performance from design data 7(L)

UNIT 5: Computer Aided Design-Philosophy of computer aided design, advantages and limitations. Computer aided design approaches analysis, synthesis and hybrid methods. Concept of optimization and its general procedure. Flow charts and 'c' based computer programs for the design of transformer, dc machine; three phase induction and synchronous machines. 10(L)

UNIR 6: Various commercial Software packages for electrical machine design

Text/ Reference Books:

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

MICROCONTROLLER & ITS APPLICATIONS (EE-1836)

UNIT 1: Microcontroller Basics-8-Bit and 16-bit Microcontroller Internal Block Diagram, CPU, ALU, address bus, data bus, control signals, Working Registers, SFRs, Clock and Reset circuits, Stack and use of Stack Pointer, Program Counter. I/O Ports, Memory structure, Data Memory, Program Memory, and Execution of Program. Power saving modes and its operation, Timing diagram for execution cycle. Different Addressing Modes, Interrupts priority, interrupt handling, house keeping during power on and power off situations, self-check and recoveries. 6(L)

UNIT 2: Microprocessor Basics-8085 basic concepts & 8086 basic concepts 8(L)

UNIT 3: On Chip Peripheral Interfaces-Interfacing concept and design rule , Interfacing of digital input and output pin PWM, ADC, I/O Pins, Timers, counters, Interrupts, UART, I2C, SPI, ICSP, DATA E2RAM, FLASH RAM 6(L)

UNIT 4: External Interfaces-A to D, D to A, LCD, LED & keyboard interfacing, I/O expansion techniques, Memory expansion techniques, RS232, RS485 transceivers. Stepper motor interfacing, DC Motor interfacing, sensor interfacing, CAN Protocol and its interfacing, USB protocol and its interfacing, Blue-tooth, Zig-bee protocol and its interfacing 8(L)

UNIT 5: Integrated Development Environment (IDE) for Microcontrollers-(Specific examples of ATMEL 89C51 with Kiel IDE or PIC micro controllers with MPLAB IDE) Study of datasheets, programming using assembly language and "C" Cross compiler, programming tools such as simulator, assembler,"C" cross compiler, emulator and debugger. Illustrative applications and programming techniques, Tutorial programs should include programming using: Arithmetic instructions, Jump, Loop and Call instructions, I/O programming, Logic instructions, Single bit instructions, Timer/Counter Programming, UART programming, Interrupt Programming. 8(L)

UNIT 6: Analysis of any reference design-Application examples: Any reference circuit schematic with specification application and firmware analysis can be taken 4(L)

Text/ Reference Books:

- The 8051 microcontroller – Kenneth J. Ayala, Penram International, 3rd edition
- 8051 Microcontroller and embedded systems – M. Mazidi, Pearson Higher Education
- Programming and customizing the 8051 microcontroller – Myke Predko, TATA McGraw Hill Edition.
- Embedded System - Raj Kamal, TATA McGraw Hill Edition
- Microprocessor Architecture, Programming and Application with the 8085 – Ramesh S. Gaonkar
- Microprocessor & Interfacing – D. V. Hall

POWER SYSTEM OPERATION AND CONTROL (EE-1837)

UNIT 1: Characteristics of Modern Power Systems-Physical Structure, Operation and Control Functions and Hierarchies, Design and Operating Criteria 4(L)

UNIT 2: Equipment and Stability Constraints-Capabilities and Constraints of Generators/ Exciters/ Turbines/ Network Elements (Lines, Transformers etc.), Constraints of Energy Supply Systems, Load Characteristics, Introduction to Angle/Voltage Instability phenomena, Stability Constraints 10(L)

UNIT 3: Frequency and Voltage Control-Primary Control of Frequency: Governors, Secondary Control of Frequency: AGC, Voltage control: Automatic Voltage Regulators (generators), Shunt Compensation, SVC 15(L)

UNIT 4: Introduction to Power Flow Control-HVDC, FACTS, Load Curves, Unit Commitment, Introduction to the use of Optimization Methods 10(L)

UNIT 5: Load Dispatch Centre Functions-Preventive, Emergency and Restorative Control, Power system Security: Basic concept, Factors affecting security, contingency analysis: security analysis, linear sensitivity factors, AC power flow methods, contingency selections, concentric relaxation, bounding 4(L)

UNIT 6: Additional Topics-Related to new developments 4(L)

Text/ Reference Books:

- P.M. Anderson and A.A. Fouad, Power System Control and Stability, John Wiley & Sons, Inc. 2003.
- P. S. Kundur, Power System Stability and Control, McGraw-Hill Professional, 1994.
- E. W. Kimbark, Power System Stability, Wiley-IEEE, 1995.
- J. W. Bialek, J. Machowski, Power System Dynamics and Stability, John Wiley, 1997.
- P. W. Sauer, M. A. Pai, Power System Dynamics and Stability, Prentice Hall, 1998.
- K. R. Padiyar, Power System Dynamics: Stability and Control, John Wiley, 1996.
- L. L. Grigsby, Power System Stability and Control, Taylor & Francis, 2007.
- P S R Murty, "Operation And Control In Power Systems", BSP Books Pvt Ltd, 2008

DIGITAL PROTECTION OF POWER SYSTEMS (EE-1838)

UNIT 1: Evolution of relays from electromechanical relays-Performance and operational characteristics of digital protection. Mathematical background to protection algorithms: Finite difference techniques, Interpolation formulas: forward, backward and central difference interpolation. Numerical differentiation, Curve fitting and smoothing, Least squares method, Fourier analysis, Fourier series and Fourier transform, Walsh function analysis.

UNIT 2: Basic elements of digital protection-Signal conditioning : transducers , surge protection , analogue filtering , analogue multiplexers , Conversion subsystem : the sampling theorem , signal aliasing error, sample and hold circuits, multiplexers , analogue to digital conversion , digital filtering concepts , the digital relay as a unit consisting of hardware and software.

UNIT 3: Protection algorithms-Sinusoidal wave based algorithms: Sample and first derivative (Mann and Morrison algorithm) Fourier and Walsh based algorithms: Fourier algorithm: Full cycle window algorithm, fractional cycle window algorithm. Walsh function based algorithm.

UNIT 4: Other algorithms-Least squares based algorithms. Differential equation based algorithms. Travelling wave based techniques.

UNIT 5: Digital differential protection of Electrical Power system-Digital transformer protection. Digital line differential and distance protection. Digital protection of motors

UNIT 6: Recent advances in digital protection of power systems.

Text/ Reference Books:

- Digital Protection for Power Systems: A.T. Johns and S.K. Salman Peter Peregrinus Ltd. on behalf of the IEE London U.K.
- Power System Protection and Switchgear : Badri Ram and D.N. Vishvakarma TMH , New Delhi
- Transmission Network Protection : Theory and Practice : Y.G. Paithankar Marcel Dekker , USA
- Computer Relaying for Power Systems: Arun G. Phadke and J.S. Thorp John Wiley and Sons Ltd. England and Research Studies Press Ltd.
- Fundamentals of Power System Protection: Y.G. Paithankar and S.R. Bhide , 2nd Edition PHI Learning Pvt. Ltd , New Delhi India , July 2010
- J.L. Blackburn, Protective Relaying: Principles and Applications, Marcel Dekker, New York, 1987.
- Network Protection Application Guide: Areva
- Art and Science of Protective Relaying: C.R. Mason

PROFESSIONAL ELECTIVE – III

POWER QUALITY (EE-1841)

UNIT 1: Introduction-Electrical power distribution system, Reliability and Power Quality, Stiff and non-stiff feeders, linear and nonlinear loads, Utility and customers, Power Quality issues 4(L)

UNIT 2 Power Quality Characterization and Analysis: Load power factor, Harmonic distortion, transients, unbalancing, Voltage sag/swell, Power acceptability curves, Limits of harmonic distortions: IEEE 519, IEC standards, Power outages, Harmonic distortion indices, symmetrical components, Analysis of voltage sag/swell and flicker, Effects of harmonic distortion 8(L)

UNIT 3: Conventional Methods of Compensation-Load balancing, Capacitor banks, higher pulse converter, Transformer connections, Harmonic filter design, Tuned and damped filter design, Resonance effect, Transfer function based analysis of filter. 8(L)

UNIT 4: Power Converters and Control-Voltage source inverters (VSIs), Open loop and closed loop modulations, Current controllers, fundamental frequency and sinusoidal pulse width modulation (SPWM), hysteresis and ramp-comparison current control, Sliding mode control. 6(L)

UNIT 5: Reference Current Generation-Reference generation for single-phase compensators, Three-phase compensation, Instantaneous PQ theory, Instantaneous symmetrical component method 6(L)

UNIT 6: Custom Power Devices-Shunt, series and shunt-series active power filters, Uninterrupted power supply (UPS), Distribution static compensator (DSTATCOM), Dynamic voltage restorer (DVR), Unified power quality conditioner (UPQC), etc. 8(L)

Text/ Reference Books:

- Ghosh and G. Ledwich, Power Quality Enhancement using Custom Power Devices, Kluwer Academic Publisher, Boston, MA, 2002.
- G. J. Walkileh, "Power Systems Harmonics", Springer Verlag, New York, 2001.
- IEEE Standard 519-1992, IEEE recommended practices and requirements for harmonic control in electrical power systems, 1992.
- R. C Dugan, S. Santoso, M. F. McGranaghan and H. W. Beaty, Electric Power System Quality, McGraw- Hill, New York, 2003.
- M. H. Rashid (ed), Power Electronics Handbook, Academic Press, Florida, 2001.
- J. K Phipps, "A Transfer function approach to harmonic filter design". IEEE Industry Application Magazine, pp. 68-82, March/April, 1997.
- F. Z. Peng, "Application issues of active power filters", IEEE Ind. Applicat. Mag., vol.4, no.5, pp.21-30, Sept./Oct. 1998.
- M. Carpita and M. Marchesoni, "Experimental study of a power conditioning system using sliding mode control", IEEE Trans. Power Electronics, vol.11, no.5, pp.731-742, Sept. 1996.

MODELLING AND SIMULATION OF ELECTRICAL MACHINES (EE-1842)

UNIT 1: Review of electrical machines characteristics. Basic-drive schemes and drive applications. Fundamentals of energy conversion. Space vector, two-axis machine and reference frame theories. Torque production in cylindrical machines. Torque production in reluctance machines and elementary rotating machines. 7(L)

UNIT 2: Induction machine modelling. Space vector based modelling and matrix based approach. Transient and steady state performance of three phase induction motors. Induction motor control, (steady state approach). Induction machine drives, (slip ring induction motor drive, v/f drive and vector controlled drives) design and analysis. Starting and braking. Converter systems for drives. 7(L)

UNIT 3: Cylindrical and salient pole synchronous machine modeling and design. Transient and steady state performance of a synchronous machine connected to grid. Analysis of conventional and permanent magnet synchronous machine drives, including v/f and vector controlled drives. 7(L)

UNIT 4: DC machine modelling. Steady state and transient behaviour of various DC machines. Starting and braking methods of DC machines fed by a constant voltage supply. Thyristor controlled and transistor controlled DC machine drives analysis. 4(L)

UNIT 5: Simulation of Electrical Machines and Systems – I, Rotating Field Simulation in AC Machines. Dynamic Simulation of Three-Phase Induction (Asynchronous) Motor. 4(L)

UNIT 6: Simulation of Electrical Machines and Systems – II, Dynamic Simulation of Brushless Permanent Magnet AC Motor Drives. Dynamic Simulation of Direct Current Motors. Simulation of Stepper Motors 4(L)

Text/ Reference Books:

- Fitzgerald and Kingsley, Electric Machinery
- Simmons and Kelly, Introduction to Generalized Machine Theory
- Hancock, Matrix Analysis of Electric Machinery
- LabVIEW® for Electric Circuits, Machines, Drives, and Laboratories, By: Nesimi Ertugrul, Publisher: Prentice Hall

ADVANCED INSTRUMENTATION (EE-1843)

UNIT 1: Introduction-Introduction to embedded systems and architecture, system design using specification and modeling tools. 10(L)

UNIT 2: Computing Platforms-Overview of embedded computing platforms; microprocessors, microcontrollers, DSPs and SoCs, hardware – software design and partitioning. 10(L)

UNIT 3: Designs and trade-offs-Design issues, consideration and trade-offs: performance memory, power, timing, cost, and development time. Memory hierarchy, system interfaces and communication with peripheral units, timers-counters, introduction to real-time system and real-time scheduling. 10(L)

UNIT 4: RTOS-Real-time software development: high level languages and programming issues, systems performance: networked embedded systems. 10(L)

Text/ Reference Books:

- Liu- Real-time systems (Pearson)

ELECTRICAL SYSTEM DESIGN (EE-1844)

UNIT 1: Overview of industry and their requirement of electrical systems, Scope of Electrical Engineers in Modern Industry, Basic Electrical Terms- Definitions, Glossary, Units, Knowing Client requirements & collection of specific data for projects, Understanding various phases of projects, Project management- Project Estimation, Testing & Commissioning, Planning, Procurement Process, Tendering, etc. 8(L)

UNIT 2: Use of International Standards, Electrical Codes & Standards - BS, NEC, IEE, IEEE, NFPA, IEC Design Basis, std. practices/procedure and specifications, Understanding, Basic Electrical Formulae, Basic Design requirement based on the type of various plants, Intra-discipline co-ordination with civil, process, mechanical, piping, telecom HVAC etc. 6(L)

UNIT 3: Wiring Accessories & Cable Management Systems, Cable Selection and Sizing and cable laying methods, Selection and sizing of electrical equipments used in various projects, Preparation of equipments specifications, High Voltage system requirements including substation design. 6(L)

UNIT 4: Lighting systems, Lighting Fixtures (Types & Applications), Lighting Design- Illumination Lux Levels, Emergency & Exit Lighting System, Specialized Engineering like Heat Tracing systems and cathodic protection design, Design of Earthlings system, Lightning system and lightning protection system, Low current systems- Fire alarm & detection system, CCTV system etc. 8(L)

UNIT 5: Generation, Transmission & Distribution of Electricity, Design of power distribution, Earthing and lighting protection systems system, Equipment vendor drawing review and approval. 4(L)

UNIT 6: Electrical System Drafting (CAD)- Preparation of lighting layouts, Preparation of Power Layouts, Preparation of Single Line Diagrams (SLD) or Riser Diagrams, Preparation of Electrical General Installation Details & Sections, Preparation of LV or Electrical Room Details, Procurement Requirements and installation standards., Inspection of Equipments/system. 8(L)

Text/ Reference Books:

- Electrical System Design and Specification Handbook for Industrial Facilities, Steven J. Marrano, Faimount Press.
- Electrical System Design, Theodore R. Bosela.
- Efficient Electrical Systems Design Handbook, Albert Thumannt; Harry Franz; 2009, Fairmount Press.
- Electrical Design Estimating and Costing, K.B. Raina.

FACTS (EE-1845)

UNIT 1 FACTS controllers: Introduction to Flexible AC Transmission Systems (FACTS), challenges and needs, Power Flow in AC transmission line, Power flow control, Description and definition of FACTS controllers 6(L)

UNIT 2 Power Electronic Controllers: Power Electronics Devices, ratings and control characteristics, Diodes, Thyristors, GTOs and IGBTs in FACTS, Static power converter structures, Thyristor circuits, Voltage-sourced and current-sourced converters, Converter output and harmonic control, six-pulse and multi-pulse converters, Sinusoidal pulse width modulation, Multi-level converters 7(L)

UNIT 3 Shunt Compensation: Static VAR compensator (SVC), Thyristor controlled reactor (TCR), Thyristor switched capacitor (TSC), TSC-TCR, FC-TCR, Static synchronous shunt compensator (STATCOM), Operation and control, Configurations and applications, Mid-point compensation 7(L)

UNIT 4 Series Compensation: Ideal series compensation, Sub-synchronous resonance (SSR), GTO capacitor series compensation (GCSC), Thyristor switched series capacitor (TSSC), voltage and impedance control mode, Thyristor controlled series compensator (TCSC), Static synchronous series compensator (SSSC), Operation and control, Configurations and applications 8(L)

UNIT 5 Combination of Shunt series Compensation: Unified power flow controller (UPFC), Power flow studies, operational constraints, Interline power flow controller (IPFC), Configurations and applications 7(L)

UNIT 6 Other FACTS Controllers: Thyristor controlled phase angle regulator (TCPAR), Thyristor Controlled Braking Resistors (TCBR) etc. 5(L)

Text/ Reference Books:

- Narain G. Hingorani and Laszlo Gyugyi, Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems, IEEE Press 2000.
- K.R. Padiyar, FACT's Controllers in Transmission & Distribution, New Age Publishers, Delhi, 2007.
- V. K. Sood, HVDC and FACTS Controllers: Applications of Static Converters in Power Systems, Springer 2004
- Enrique Acha, FACTS: Modelling and Simulation in Power Networks, John Wiley and Sons, 2004.

ANALYTICAL INSTRUMENTATION (EE-1846)

UNIT 1: Introduction-Basics of analytical instrumentation, use of computers in analytical instrumentation, statistical techniques. 4(L)

UNIT 2: Emission and absorption spectroscopy-Introduction, em radiation, laws of absorption radiation, uv and visible radiation spectroscopy, calorimeters, double beam spectro-photometer; Infrared spectroscopy - Basic components, types, sample handling techniques. Atomic absorption spectro-photometers – principle, sources of interference, meter scale. 10(L)

UNIT 3: Flame photometers-Principle and construction, clinical types, expression for concentration, interferences, procedures for determination.

UNIT 4: Mass spectrometers-Types and principle of operation, inductively coupled mass-plasma spectrometer, trapped ion analyzers, ion cyclotron mass spectrometer (ICR), Quadruple ion trap mass spectrometer, uses of mass spectrometry; Separation techniques – Gas, ion and liquid chromatography and head space analysis. 10(L)

UNIT 5: Microscopy-Concept of scanning electron microscopy, transmission electron microscopy, tunneling microscopy, and atomic force microscopy; Applications in material characterization.

UNIT 6: Nuclear magnetic resonance-NMR spectroscopy, principle of NMR, types of NMR spectrometers, constructional details, variation T-60A NMR spectrometer, sensitivity enhancement for analytical NMR spectroscopy, Fourier transform NMR spectroscopy. 10(L)

UNIT 7: Application case studies 6(L)

Text/ Reference Books:

- Khandpur, R.S. – Handbook of analytical instruments (TMH)
- Willard,Meritt, Dean, Settle – Instrumental methods of analysis (CBS Pub)

MECHATRONICS (EE-1847)

UNIT 1: Introduction & Principles of Robotics 2(L)

UNIT 2: Motor Load modeling, Mechanical elements, Mechanisms, Machines, Types of motion, Kinematic Chains, The four-bar chain, The slider-crank mechanism, Cams: Classification of cam mechanisms, Modes of input/output motion, Follower configuration, Follower arrangement, Cam shape, Motion events, Constant velocity motion, Constant acceleration motion, Harmonic motion, etc 6(L)

UNIT 3: Power transmission and sizing, Gearboxes: Planetary gearbox, Harmonic gearbox, Cycloid gearbox, Lead and ball screws, Belt drives, Bearings: Conventional bearings, Air bearings, Magnetic bearings, Couplings, Shafts: Static behavior of shafts, Transient behavior of shafts 4(L)

UNIT 4: Velocity and position transducers, Rotating velocity transducers, Brushed d.c. tachogenerators, Brushless d.c. tachogenerators , Incremental systems , Electromechanical pulse encoders , Position transducers , Brushed potentiometers , Linear variable differential transformers - LVDT , Resolvers , Rotary and linear Inductosyn , Optical position sensors , Application of position and velocity transducers 4(L)

UNIT 5: Induction motor characteristics, Scalar control, Vector control : Vector Control using sensors and Sensorless Vector Control 6(L)

UNIT 6: Motors and actuators such as Voice Coils , Limited-angle torque motors , Piezoelectric motors , Switched Reluctance motors , Shape-memory alloy 2(L)

UNIT 7: Controllers for automation , Servo control , Digital controllers , Advanced control systems , Digital signal processors , Motion controllers , Programmable logic controllers 6(L)

UNIT 8: Networks, Network architecture , Industrial networking 2(L)

UNIT 9: Hardware-in-the-loop simulation and rapid prototyping of real-time closed-loop computer control of electromechanical systems 6(L)

Text/ Reference Books:

- Electric Drives and Electromechanical Systems Applications and Control by Richard Crowder, Elsevier
- Robert H. Bishop. Editor-in-chief. "The Mechatronics Handbook", CRC Press, with ISA– The Instrumentation, Systems, Automation Society (50 Chapters), 2002. ISBN: 0-8493-0066-5. PDF files
- Mechatronics Principles and Applications by Godfrey Onwubolu Elsevier

PROCESS CONTROL (EE-1848)

UNIT 1 Introduction: Motivation and applications; Objectives; Process control systems, configurations, examples; Role of control engineer; Chemical industry equipments and unit operations*; Process documentation. 4(L)

UNIT 2 Mathematical modeling of processes: Type of models; modeling procedure steps; empirical model identification; system identification; Input/Output transfer function and transfer matrix, state -space, time series – AR,MA, ARMA, ARIMA, ARMAX …, Astrom's difference equn model, nonlinear models …….

Control problems, dynamics, modeling, selection, degree of freedom approach with examples. Modeling of temperature sensors, concentration response of isothermal CSTR- with no chemical reaction, first order reaction, higher order reactions. Pressure and liquid systems with linearization approach for real systems; Effect of change in valve positions; Modeling of interacting and non-interacting systems. 8(L)

UNIT 3 Feedback control actions: Review of basic characteristics; performance measures; Degree of freedom controllers and key feature of control actions; Transient response of systems for set point control and regulatory actions for first, second and higher order systems with P, PI, PD, and PID control actions. Effect of measurement lag and process dead-time on response. PID Controller architectures and various process system models. 8(L)

UNIT 4 Complex control concepts in process systems: PID controller tuning methods*; Control valves- types*, dynamics and characteristics; Cascade control, feed-forward control, selector and redundant control concepts, example, design. 5(L)

UNIT 5 Concept of computer control: Real-time control, batch and continuous production; sequential, supervisory and DDC modes of operation; Digital implementation of PID controllers; Computer control architectures- hierarchial, DCS. 5(L)

UNIT 6 Advanced control strategies: Model predictive control; Dead-time compensation; Internal model control; Adaptive control*; Introduction to intelligent control*. 10(L)

*Students' seminars shall be integral components, once per week.

Text/ Reference Books:

- Harriot,P – Process control (TMH)
- Singh, S.K. - Computer Aided process control (PHI)
- Seborg,Edgar, Mellichamp –Process dynamics and control(Wiley)
- Marlin,T.E. – Process control – Designing processes & control systems.(MGH)
- Bennet, S. - Real time computer control (Pearson)

DISTRIBUTION AUTOMATION (EE-1849)

UNIT 1: Distribution system planning-Tools for distribution system planning and design 6(L)

UNIT 2: Substation Automation-Data acquisition from field devices and supervisory control of field devices, Fault location, Fault isolation, service restoration, substation reactive power control 7(L)

UNIT 3: Feeder level Automation-Data acquisition from Field devices at feeder level, supervisory control of field devices, Fault location, Fault isolation, service restoration, Feeder reconfiguration, feeder reactive power control. 7(L)

UNIT 4: Customer level Automation-automatic meter reading, Remote programming of time-of-use (TOU) meters, Remote service connect / disconnect, Automated customer claims analysis 6(L)

UNIT 5: Control hierarchy and control centre architecture-RTU's , IEDs, PLCs, Use of GPS and GIS systems for Asset/Facilities management. 6(L)

UNIT 6: Cost benefit analysis of Distribution Automation schemes-Review of distribution automation roadmaps of prominent utilities in Europe and US, Review of distribution automation in Indian utilities. 8(L)

Text/ Reference Books:

- Mary S. Nardone, Direct Digital Control Systems: Application Commissioning, Kluwer.
- Klaus-Peter Brand and others Substation Automation Handbook

ADVANCE POWER ELECTRONICS (LAB) (EE-1851)

A. EXPERIMENT BASED LABORATORY PRACTICAL

Exprtiment 1: To perform the Sensor less vector control drive for 3-ph, 1-hp induction motor.
Exprtiment 2: To implement Push-Pull Inverter based on IGBT.
Exprtiment 3: To perform the closed loop controlled MOSFET based matrix converter fed induction motor.
Exprtiment 4: To control the speed of BLDC motor using pulse width modulation (PWM) method.
Exprtiment 5: To control the speed of three-phase induction motor using three-phase AC voltage controller by varying the firing angle of thyristor.
Exprtiment 6: To study the Zero Current Source (ZCS) Resonant converter.
Exprtiment 7: To test the Microprocessor based 3-phase SCR Half/Full Converter.
Exprtiment 8: To perform the 3 ph closed loop resonant converter fed induction motor drive.
Exprtiment 9: To perform 3-ph VSI fed PWM inverter AC drive.

B. SIMULATION BASED LABORATORY PRACTICAL (Using PSPICE)

Exprtiment 10: To design a flyback converter and study its characteristics.
Exprtiment 11: To design a push pull converter and study its characteristics.
Exprtiment 12: To design forward converter & study its characteristics.
Exprtiment 13: To design a SEPIC converter & study its characteristics.
Exprtiment 14: To design a suitable single-phase three level inverter as follows
(a) Full bridge (H-bridge)
(b) Neutral point clamped (Diode clamped)
Exprtiment 15: To design a three-phase neutral point clamped three leg line frequency inverter.

PROJECT (EE-1891)