SYLLABUS

B.TECH. (ELECTRICAL ENGINEERING)

3EE1A ELECTRONIC DEVICES & CIRCUITS (Common to EE, EX, EC and EI)

Unit 1
Semiconductor Physics: Mobility and conductivity, charge densities in a semiconductor, Fermi Dirac distribution, , Fermi-Dirac statistics and Boltzmann approximation to the Fermi-Dirac statistics, carrier concentrations and Fermi levels in semiconductor, Generation and recombination of charges, diffusion and continuity equation, transport equations, Mass action Law, Hall effect.

Unit 2
Junction Diodes: Formation of homogenous and hetrojuntion diodes and their energy band diagrams, calculation of contact potential and depletion width, V-I characteristics, Small signal models of diode, Diode as a circuit element, diode parameters and load line concept, C-V characteristics and dopant profile. Applications of diodes in rectifier, clipping, clamping circuits and voltage multipliers.Transient behavior of PN diode.Breakdown diodes, Schottky diodes, and Zener diode as voltage regulator.Construction, characteristics and operating principle of UJT.

Unit 3
Transistors: Characteristics, Current Components, Current Gains: alpha and beta. Variation of transistor parameter with temperature and current level, Operating point, Hybrid model, DC model of transistor, h-parameter equivalent circuits.CE, CB and CC configuration.DC and AC analysis of single stage CE, CC (Emitter follower) and CB amplifiers AC & DC load line, Ebers-Moll model.Biasing & stabilization techniques.Thermal runaway, Thermal stability.

Unit 4
JFET & MOSFET: Construction and operationofJFET & MOSFET, noise performances of FET, parasitic of MOSFET, small signal models of JFET & MOSFET, biasing of JFET's & MOSFET's. Low frequency single stage CS and CD (source follower) JFET amplifiers.FET as voltage variable resistor and active load.

Unit 5
Small Signal Amplifiers at Low Frequency: Analysis of BJT and FET multistage amplifier, DC and RC coupled amplifiers. Frequency response of single and multistage amplifier, mid-band gain, gains at low and high frequency. Analysis of DC and differential amplifiers, Miller's Theorem, use of Miller and bootstrap configuration.Cascade and cascade configuration of multistage amplifiers (CE-CE, CE-CB, CS-CS and CS-CD), Darlington pair.

Suggested Readings:

1. Integrated Electronics By MillmanHalkias, TMH
2. Electronic devices & circuits theory By R. L. Boylestad, Louis Nashelsky,Pearson education
3. Electronic Devices & Circuits By David Bell, Oxford Publications
4. Grob's Basic Electronics by Schultz, T.M.H.

5. Millman, Electronics Devices and Circuits, ed. 3, TMH
6. Cathey, Electronics Devices and Circuits, ed. 3, TMH
7. J. Millman and A. Grabel, Microelectronics, McGraw Hill, International,
8. B.G. Streetman, Solid State Electronic Devices, Prentice Hall of India, New Delhi.
9. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College, Publishing
10. Salivahnan, Electronics Devices and Circuits, ed. 3, TMH.
11. R.T. Howe and C.G. Sodini, Microelectronics : An integrated Approach, Prentice Hall International,
12. Neamen, Semiconductor Physics and Devices, ed.4, TMH

3EE2A CIRCUIT ANALYSIS-I

Unit 1
Introduction: Introduction to circuit elements and their characteristics. Current and voltage reference. Response of single element, double element and triple element circuits. Resonance, selectivity & Q-factor in ac circuits.
Network Analysis: Network voltages. Mesh & node systems of network equations and their comparison. Graph of network, tree, incidence matrix, fundamental circuit functions, cut sets, f-circuits analysis and f-cut set analysis, node and node pair analysis. Duality. Method of obtaining dual network.

Unit 2
Network Theorems: Thevenis's, Norton's, Superposition, Reciprocity, Compensation, Millman's, Tellegen's, Maximum power transfer and Miller`s theorems in DC & AC Circuits.

Unit 3
Polyphase Circuits: General Circuit Relations: Three Phase Star, Three Phase Delta, Star and Delta Combination, Four Wire Star Connection.
Balanced and unbalanced Three Phase Voltages, currents and Impedances. Power and Reactive Volt-Amperes in a 3-Phase System.
Power Relations in AC Circuits: Instantaneous Power in AC Circuits, Power Factor, Apparent Power, Reactive Power, Power Triangle, Complex Power.

Unit 4
Non-Sinusoidal Waves: Complex Periodic Waves and Their Analysis By Fourier Series. Different Kinds of Symmetry, Determination of Co-Efficients. Average and Effective Values of a Non-Sinusoidal Wave, Power in a Circuit of Non-Sinusoidal Waves of Current and Voltage, Form Factor, Equivalent Sinusoidal Wave and Equivalent Power Factor. Response of Linear Network to Non-Sinusoidal Periodic Waves.

Unit 5
Time Domain and Frequency Domain Analysis: Response of networks to step, ramp, impulse, pulse and sinusoidal inputs. Time domain and frequency domain analysis of circuits. Shifting theorem, initial and final value theorems. Special signal waveforms with Laplace transform & applications to circuit operations.

Suggested Readings:

1. Van Valkenburg – Network Analysis, PHI
2. Hayt&Kemmerly, "Engineeirng Circuit Analysis", 6/e (TMH)
3. J. Edminster& M. Nahvi, "Electric Circuits (SIE)", 5/e, Scaum's Out Line.
4. Nagsarkar&Sukhija, "Circuits & Networks", Oxford
5. John Bird, "Electric Circuit Theory & Technology", ELSEVIER
6. D Roy Chodhary, "Network & Systems", New Age
7. Ghosh&Chakrabarti, "Network Analysis and Synthesis", (TMH)
8. A. Chakarvorty, "Circuit Theory", Publisher DhanpatRai& Co. (Pvt.) Ltd.

3EE3A DIGITAL ELECTRONICS (Common to EE, EX, EC, EIC, CS and IT)

Unit 1
Number Systems, Basic Logic Gates & Boolean Algebra: Binary Arithmetic & Radix representation of different numbers. Sign & magnitude representation, Fixed point representation, complement notation, various codes & arithmetic in different codes & their inter conversion. Features of logic algebra, postulates of Boolean algebra.Theorems of Boolean algebra.Boolean function. Derived logic gates: Exclusive-OR, NAND, NOR gates, their block diagrams and truth tables. Logic diagrams from Boolean expressions and vica-versa. Converting logic diagrams to universal logic. Positive, negative and mixed logic.Logic gate conversion.

Unit 2
Digital Logic Gate Characteristics: TTL logic gate characteristics: Theory & operation of TTL NAND gate circuitry. Open collector TTL. Three state output logic. TTL subfamilies.MOS & CMOS logic families. Realization of logic gates in RTL, DTL, ECL, C-MOS & MOSFET. Interfacing logic families to one another.

Unit 3
Minimization Techniques: Minterm, Maxterm, Karnaugh Map, K map upto 4 variables. Simplification of logic functions with K-map, conversion of truth tables in POS and SOP form. Incomplete specified functions. Variable mapping.Quinn-McKlusky minimization techniques.

Unit 4
Combinational Systems: Combinational logic circuit design, half and full adder, subtractor. Binary serial and parallel adders.BCD adder.Binary multiplier. Decoder: Binary to Graydecoder, BCD to decimal, BCD to 7-segment decoder. Multiplexer, demultiplexer, encoder.Octal to binary, BCD to excess-3 encoder.Diode switching matrix.Design of logic circuits by multiplexers, encoders, decoders and demultiplexers.

Unit 5
Sequential Systems: Latches, flip-flops, R-S, D, J-K, Master Slave flip flops. Conversions of flip-flops. Counters: Synchronous & asynchronous ripple and decade counters, Modulus counter, skipping state counter, counter design, state diagrams and state reduction techniques. Ring counter. Counter applications. Registers: buffer register, shift register.

Suggested Readings:

1. Digital Integrated Electronics, By Herbert Taub, Donald L. Schilling, TMH
2. Digital Logic and Computer Design By M. Morris Mano, Pearson
3. Pulse Switching and Network By MillmanTaub, TMH
4. Fundamentals of Digital circuits By A. Anandkumar, PHI
5. Digital Funadamentals by Floyd, Pearson
6. Digital circuit design By S. Salivahanan, Sarivazhagan, Vikas publications
7. Leach, Digital Principles and Applications, ed. 7, TMH Mandal, Digital Electronics: Principles and Applications, TMH

3EE4A OBJECT ORIENTED PROGRAMMING (Common to EE, EX, CS and IT)

Unit 1

Introduction: Review of structures in C, accessing members of structures using structure variables, pointer to structures, passing structures to functions, structures as user defined data types.

Unit 2

Introduction to Programming Paradigms: (Process oriented and Object oriented). Concept of object, class, objects as variables of class data type, difference in structures and class in terms of access to members, private and public Basics of C++: Structure of C++ programs, introduction to defining member functions within and outside a class, keyword *using*, declaring class, creating objects, constructors & destructor functions, Initializing member values with and without use of constructors, simple programs to access & manipulate data members, *cin* and *cout* functions. Dangers of returning reference to a private data member, constant objects and members function, composition of classes, friend functions and classes, using *this* pointer, creating and destroying objects dynamically using *new* and *delete* operators.

Static class members, container classes and iterators, proxy classes.members of a class, data & function members. Characteristics of OOP- Data hiding, Encapsulation, data security.

Unit 3

Operator Overloading: Fundamentals, Restrictions, operator functions as class members v/s as friend functions. Overloading stream function, binary operators and unary operators.Converting between types.

Unit 4

Inheritance: Base classes and derived classes, protected members, relationship between base class and derived classes, constructors and destructors in derived classes, public, private and protected inheritance, relationship among objects in an inheritance hierarchy, abstract classes, virtual functions and dynamic binding, virtual destructors.

Unit 5

Multiple inheritance, virtual base classes, pointers to classes and class members, multiple class members. Templates, exception handling.

Suggested Readings:

1. How to Program C++, Dietel, Pearson
2. Mastering C++ By K.R.Venugopal, TMH
3. Object Oriented Programming in C++ By Robert Lafore, Pearson
4. Object Oriented Design & Modelling, Rambaugh, Pearson

3EE5A ELECTRICAL MACHINES-I (Common to EE and EX)

Unit 1
(i)Magnetic circuits: Magnetic circuits, magneto motive force magnetic field strength, permeability, reluctance, analogy between electric and magnetic-circuits, B-H curve, hysteresis, series and parallel magnetic circuits, practical magnetic circuits, permanent magnet and their applications.
(ii)Electromechanical energy conversion: Basic principles, conservation of energy, physical phenomenon involved in conversion, energy balance, energy stored in magnetic field.

Unit 2
DC Generators: Introduction, construction, types, emf equation, lap and wave windings, armature reaction, commutation, methods of improving commutation, equalizer rings, demagnetizing and cross magnetizing ampere turns, various characteristics of shunt, series and compound generators, voltage build up, losses and efficiency, condition for maximum efficiency.

Unit 3
DC Motors: Introduction, principals, back-emf, torque of motor, types, characteristics of shunt, series and compound motors, speed control (field and armature control methods), basic idea of solid state devices in controlling of DC motors, starting of DC motors, three point and four point starters, losses and efficiency, testing (brake test and swimburnes test), electric braking of DC motors, Applications.

Unit 4
Transformer: Construction, Principal, Types, emf equation, no load and short circuit test, equivalent circuits, back-to-back (Sumpner's test), phasor diagram, Voltage regulation, Efficiency, Condition for maximum efficiency, all day efficiency, parallel operation , auto-transformer, basic idea of welding transformer, current and potential transformer,separation of losses.

Unit 5
Polyphase Transformer: Construction,Various connections and groups, choice of connections, open delta connection, Scott connection, three phase to two phase conversion and vice-versa, Applications, Parallel operation and its conditions, Three to six phase conversion.Excitation phenomenon in transformers, magnetizing harmonic currents and their effects,switching currents in transformers, inrush of magnetizing current.Three winding transformer.

Suggested Readings:

1. A. E. Fitggerald, C.KingsleyJr and Umans,"Electric Machinery" 6th Edition McGraw Hill, International Student Edition.
2. Kothari &Nagrath, Electric Machines 3/e,TMH
3. M. G. Say, "The Performance and Design of AC machines", Pit man & Sons.
4. Guru, ELECTRIC MACHINERY 3E, Oxford
5. R. K. Srivastava, Electrical Machines, Cengage Learning.
6. P. S. Bimbhra, "Electrical Machinery", Khanna Pub.
7. Stephen J Chapman, "Electric Machinery Fundamentals", McGraw-Hill
8. Husain Ashfaq , "Electrical Machines", DhanpatRai& Sons
9. Bhag S. Guru and Huseyin R. Hizirogulu, "Electric Machinery and Transformers" Oxford Uiversity Press, 2001

3EE6A ADVANCED ENGINEERING MATHEMATICS-I(Common to EE and EX)

Unit 1
Laplace Transform: Laplace transform with its simple properties, applications to the solution of ordinary and partial differential equations having constant coefficients with special reference to wave and diffusion equations, digital transforms.

Unit 2
Fourier Transform: Discrete Fourier transform, Fast Fourier transform, Complex form of Fourier transform and its inverse applications, Fourier transform for the solution of partial differential equations having constant coefficients with special reference to heat equation and wave equation.

Unit 3
Fourier Series: Expansion of simple functions in Fourier series, half range series, change of interval, harmonic analysis.
Calculus of Variation: Functional, strong and weak variations, simple variation problems, Euler's equation

Unit 4
Complex Variables: Analytic functions, Cauchy–Riemann equations, Elementary conformal mapping with simple applications, Line integral in complex domain, Cauchy's theorem, Cauchy's integral formula.

Unit 5
Complex Variables: Taylor's series, Laurent's series, poles, Residues. Evaluations of simple definite real integrals using the theorem of residues.Simple contour integration.

Suggested Readings:

1. M. Ray, J. C. Chaturvedi& H.C. Sharma – Differential Equations. Pub: Students friends & company
2. Chandrika Prasad – Mathematics for Engineers, Prasad Mudralaya.
3. Bird-Higher Engineering Mathematics, ELSEVIER.
4. Jeffrey-Advanced Engineering Mathematics, ELSEVIER.
5. Chandrika Prasad – Advanced Mathematics for Engineers, Prasad Mudralaya.
6. Ervin Kreyzig - Advanced Engineering Maths, Wiley.

3EE7A ELECTRONIC DEVICES LAB(Common to EE, EX, EC and EI)

1. Study the following devices: (a) Analog & digital multimeters (b) Function/ Signal generators (c) Regulated d. c. power supplies (constant voltage and constant current operations) (d) Study of analog CRO, measurement of time period, amplitude, frequency & phase angle using Lissajous figures.

2. Plot V-I characteristic of P-N junction diode & calculate cut-in voltage, reverse saturation current and static & dynamic resistances.

3. Plot V-I characteristic of zener diode and study of zener diode as voltage regulator. Observe the effect of load changes and determine load limits of the voltage regulator.

4. Plot frequency response curve for single stage amplifier and to determine gain bandwidth product.

5. Plot drain current - drain voltage and drain current – gate bias characteristics of field effect transistor and measure of Idss&Vp.

6. Application of Diode as clipper & clamper.

7. Plot gain- frequency characteristic of two stage RC coupled amplifier & calculate its bandwidth and compare it with theoretical value.

8. Plot gain- frequency characteristic of emitter follower & find out its input and output resistances.

9. Plot input and output characteristics of BJT in CB, CC and CE configurations. Find their h-parameters.

10. Study half wave rectifier and effect of filters on wave. Also calculate theoretical & practical ripple factor.

11. Study bridge rectifier and measure the effect of filter network on DC voltage output and ripple factor.

3EE8A ELECTRICAL CIRCUIT LAB

1. Draw the circuit symbols.
2. Verify theorems for A. C. & D. C. circuits.
3. PSPICE Programs for Circuit Analysis:
   a. DC: Analysis resistor networks to determine node voltages, components voltages, and component currents.
   b. DC: Analysis of resistor networks that have several voltage and current sources and variable load resistors.
   c. Transient: Analysis of RC & RL circuits to produce tables of component voltage & current levels for a given set of time instants & to produce graphs of voltages & currents versus time.
   d. AC: Analysis of impedance networks to determine the magnitude & phase of node voltages, components voltages and component currents.
4. Determine the magnitude & phase and component voltages and currents in resonant circuits & produce voltage and current verses frequency graphs.
5. Programs for Circuit Analysis:

a. Calculate the resistance of a conductor, given its dimensions & resistivity or determine the change in conductor resistance when the temp changes.
b. D.C.: Analysis of resistor networks to determine all junction voltages, component voltages, and component currents.
c. Transient: Analysis RC & RL circuits to produce tables of component voltage & current levels for a given set of time instants.

6. Convert Y-connected resistor networks to delta-connected circuits.

3EE9A DIGITAL ELECTRONICS LAB (Common to EE, EX, EC, EI, CS and IT)

1. To verify the truth tables of basic logic gates: AND, OR, NOR, NAND, NOR. Also to verify the truth table of Ex-OR, Ex-NOR (For 2, 3, & 4 inputs using gates with 2, 3, & 4 inputs).

2. To verify the truth table of OR, AND, NOR, Ex-OR, Ex-NOR realized using NAND & NOR gates.

3. To realize an SOP and POS expression

4. To realize Half adder/ Subtractor& Full Adder/ Subtractor using NAND & NOR gates and to verify their truth tables.

5. To realize a 4-bit ripple adder/ Subtractor using basic Half adder/ Subtractor& basic Full Adder/ Subtractor.

6. To verify the truth table of 4-to-1 multiplexer and 1-to-4 demultiplexer. Realize the multiplexer using basic gates only. Also to construct and 8-to-1 multiplexer and 1-to-8 demultiplexer using blocks of 4-to-1 multiplexer and 1-to-4 demultiplexer.

7. Design & Realize a combinational circuit that will accept a 2421 BCD code and drive a TIL - 312 seven-segment display.

8. Using basic logic gates, realize the R-S, J-K and D-flip flops with and without clock signal and verify their truth table

9. Construct a divide by 2,4& 8 asynchronous counter. Construct a 4-bit binary counter and ring counter for a particular output pattern using D flip flop.

10. Perform input/output operations on parallel in/Parallel out and Serial in/Serial out registers using clock. Also exercise loading only one of multiple values into the register using multiplexer.

Note: As far as possible, the experiments shall be performed on bread board. However,

Experiment Nos. 1-4 are to be performed on bread board only.

3EE10A C++ PROGRAMMING LAB (Common to EE, EX, CS and IT)

1. To write a simple program for understanding of C++ program structure without any CLASS declaration. Program may be based on simple input output, understanding of keyword using.

2. Write a C++ program to demonstrate concept of declaration of class with public & private member, constructors, object creation using constructors, access restrictions, defining member functions within and outside a class. Scope resolution operators, accessing an object's data members and functions through different type of object handle name of object, reference to object, pointer to object, assigning class objects to each other.

3. Program involving multiple classes (without inheritance) to accomplish a task. Demonstrate composition of class.

4. Demonstration Friend function friend classes and this pointer.

5. Demonstration dynamic memory management using new & delete & static class members.

6. Demonstration of restrictions an operator overloading, operator functions as member function and/ or friend function, overloading stream insertion and stream extraction, operators, overloading operators etc.

7. Demonstrator use of protected members, public & private protected classes, multi-level inheritance etc.

8. Demonstrating multiple inheritance, virtual functions, virtual base classes, abstract classes

3EE11A HUMANITIES & SOCIAL SCIENCE (Common to EE and EX)

Unit 1
India: Brief history of Indian Constitution, farming features, fundamental rights, duties, directive principles of state. History of Indian National Movement, socio economic growth after independence.

Unit 2
Society: Social groups- concept and types, socialization- concept and theory, social control: concept, social problem in contemporary India, status and role.

Unit 3
The Fundamentals of Economics: meaning, definition and importance of economics, Logic of choice, central economic problems, positive and normative approaches, economic systems-socialism and capitalism.

Unit 4
Microeconomics: Law of demand supply, utility approach, indifference curves, elasticity of demand and supply and applications, consumer surplus, Law of returns to factors and returns to scale.

Unit 5
Macroeconomics: concepts relating to National product–National income and its measurement, Simple Keynesian theory, simple multiplier, money and banking. Meaning, concept of international trade, determination of exchange rate, Balance of payments.

4EE1A ANALOG ELECTRONICS(Common to EE, EX, EC and EI)

Unit 1
Feedback Amplifiers: Classification, Feedback concept, Feedback Topologies, Transfer gain with feedback, General characteristics of negative feedback amplifiers. Analysis of voltage-series, voltage-shunt, current-series and current-shunt feedback amplifier.Stability criterion.Compensation techniques, miller compensation.

Unit 2
Oscillators &Multivibrators: Classification. Criterion for oscillation.Tuned collector, Hartley, Colpitts, RC Phase shift, Wien Bridge and crystal oscillators, Astable, monostable and bistablemultivibrators. Schmitt trigger. Blocking oscillators

Unit 3
High Frequency Amplifiers: Hybrid Pi model, conductances and capacitances of hybrid Pi model, high frequency analysis of CE amplifier, gain bandwidth product, unity gain frequency f_T.Emitter follower at high frequencies.

Unit 4
Tuned Amplifier:Band Pass Amplifier, Parallel resonant Circuits, Band Width of Parallel resonant circuit. Analysis of Single Tuned Amplifier, Primary & Secondary Tuned Amplifier with BJT & FET. Double Tuned Transformer Coupled Amplifier. Stagger Tuned Amplifier. Pulse Response of such Amplifier. Class C tuned amplifiers, Shunt Peaked Circuits for Increased Bandwidth.

Unit 5
Power Amplifiers: Classification, Power transistors & power MOSFET (DMOS, VMOS). Output power, power dissipation and efficiency analysis of Class A, class B, class AB, class C, class D and class E amplifiers as output stages. Pushpull amplifiers with and without transformers. Complementary symmetry & quasi complimentary symmetry amplifiers

Suggested Readings:

1. Millman, Integrated Electronics, ed. 2, TMH.
2. A. S. Sedra, Kenneth C. Smith, Microelectronic Circuits, Oxford university press.
3. M. H. Rashid, Microelectronic Circuits Analysis and design, Cengage Learning.
4. David A. BELL, Electronic Devices and Circuits, Oxford university press.
5. Salivahnan, Electronics Devices and Circuits, ed. 3, TMH.

4EE2A CIRCUIT ANALYSIS-II

Unit 1
Impedance and Admittance Functions: The concept of complex frequency, transform impedance and admittance, series and parallel combinations.

Unit 2
Network Functions: Terminals and terminal pairs, driving point impedance transfer functions, poles and zeros. Restrictions on pole and zero location in s-plane. Time domain behavior from pole and zero plot. Procedure for finding network functions for general two terminal pair networks

Unit 3
Network Synthesis: Hurwitz polynomial, positive real functions, reactive networks. Separation property for reactive networks. The four-reactance function forms, specification for reactance function. Foster form of reactance networks. Cauer form of reactance networks. Synthesis of R-L and R-C networks in Foster and Cauer forms.

Unit 4
Two Port General Networks: Two port parameters (impedance, admittance, hybrid, ABCD parameters) and their inter relations. Equivalence of two ports. Transformer equivalent, inter connection of two port networks. The ladder network, image impedance, image transfer function, application to L-C network, attenuation and phase shift in symmetrical T and pi networks.

Unit 5
Two Port Reactive Network (Filters): Constant K filters. The m-derived filter. Image impedance of m-derived half (or L) sections, composite filters. Bands pass and band elimination filters. The problem of termination, lattice filters, Barlett's bisection theorem. Introduction to active filters.

Suggested Readings:

1. M. E. Van Valkenburg, "An Introduction to Modern Network Synthesis", Wiley Eastern
2. Nagsarkar&Sukhija, "Circuits & Networks', Oxford
3. ChoudharyD.Roy, "Network & Systems", Wiley Eastern Ltd.
4. Ghosh&Chakrabarti, "Network Analysis and Synthesis", TMH
5. SamarajitGhosh, "Network Theory: Analysis and Synthesis", Prentice Hall of India, 2008
6. A.Chakrabarti, "Circuit Theory", DhanpatRai& Co.
7. UmeshSinha, "Transmission Lines and Networks", Satyaprakashan.
8. Murthy and Kamath, "Basic Circuit Analysis", Jaico Publishing House.

4EE3A ELECTRICAL MEASUREMENTS (Common to EE and EX)

Unit 1
Measuring Instruments: Moving coil, moving iron, electrodynamic and induction instruments-construction, operation, torque equation and errors. Applications of instruments for measurement of current, voltage, single-phase power and single-phase energy. Errors in wattmeter and energy meter and their compensation and adjustment. Testing and calibration of single-phase energy meter by phantom loading.

Unit 2
Polyphase Metering: Blondel's Theorem for n-phase, p-wire system. Measurement of power and reactive kVA in 3-phase balanced and unbalanced systems: One-wattmeter, two-wattmeter and three-wattmeter methods. 3-phase induction type energy meter. Instrument Transformers: Construction and operation of current and potential transformers. Ratio and phase angle errors and their minimization. Effect of variation of power factor, secondary burden and frequency on errors. Testing of CTs and PTs. Applications of CTs and PTs for the measurement of current, voltage, power and energy.

Unit 3
Potentiometers: Construction, operation and standardization of DC potentiometers– slide wire and Crompton potentiometers. Use of potentiometer for measurement of resistance and voltmeter and ammeter calibrations. Volt ratio boxes. Construction, operation and standardization of AC potentiometer – in-phase and quadrature potentiometers. Applications of AC potentiometers.

Unit 4
Measurement of Resistances: Classification of resistance. Measurement of medium resistances – ammeter and voltmeter method, substitution method, Wheatstone bridge method. Measurement of low resistances – Potentiometer method and Kelvin's double bridge method. Measurement of high resistance: Price's Guard-wire method. Measurement of earth resistance.

Unit 5
AC Bridges: Generalized treatment of four-arm AC bridges. Sources and detectors. Maxwell's bridge, Hay's bridge and Anderson bridge for self-inductance measurement. Heaviside's bridge for mutual inductance measurement. De Sauty Bridge for capacitance measurement. Wien's bridge for capacitance and frequency measurements. Sources of error in bridge measurements and precautions. Screening of bridge components. Wagner earth device.

Suggested Readings:

1. H.S. Kalsi, "Electronic Inst. & Measurement", Tata Mc-Graw Hill.
2. Morris, "Electrical Measurements & Instrumentation", ELSEVIER.
3. Bell, "Electronic Instrumentation and Measurement", Oxford.
4. W.D. Cooper, "Electronic Inst. & Measurement Techniques", Prentice Hall, India.
5. A.K. Sawhney, "Electrical & Electronic Measurement &Inst", DhanpatRai& Sons.
6. E.W. Golding & F.C. Widdis, "Electrical Measurement & Measuring Instrument", A.W. Wheeler.
7. Forest K. Harries, "Electrical Measurement",Willey Eastern Pvt. Ltd. India.

4EE4A GENERATION OF ELECTRICAL POWER

Unit 1
Conventional Energy Generation Methods :(i) Thermal Power plants: Basic schemes and working principle. (ii) Gas Power Plants: open cycle and closed cycle gas turbine plants, combined gas & steam plants – basic schemes. (iii) Hydro Power Plants: Classification of hydroelectric plants. Basic schemes of hydroelectric and pumped storage plants. (iv) Nuclear Power Plants: Nuclear fission and nuclear fusion. Fissile and fertile materials. Basic plant schemes with boiling water reactor, heavy water reactor and fast breeder reactor. Efficiencies of various power plants.

Unit 2
New Energy Sources: Impact of thermal, gas, hydro and nuclear power stations on environment. Green House Effect (Global Warming).Renewable and non-renewable energy sources. Conservation of natural resources and sustainable energy systems. Indian energy scene. Introduction to electric energy generation by wind, solar and tidal.

Unit 3
Loads and Load Curves: Types of load, chronological load curve, load duration curve, energy load curve and mass curve. Maximum demand, demand factor, load factor, diversity factor, capacity factor and utilization.
Power Factor Improvement: Causes and effects of low power factor and advantages of power factor improvement. Power factor improvement using shunt capacitors and synchronous condensers.

Unit 4
Power Plant Economics: (i) Capital cost of plants, annual fixed and operating costs of plants, generation cost and depreciation. Effect of load factor on unit energy cost. Role of load diversity in power system economics.(ii) Calculation of most economic power factor when (a) kW demand is constant and (b) kVA demand is constant. (iii) Energy cost reduction: off peak energy utilization, co-generation, and energy conservation.

Unit 5
(i) Tariffs: Objectives of tariffs. General tariff form. Flat demand rate, straight meter rate, block meter rate. Two part tariff, power factor dependent tariffs, three-part tariff. Spot (time differentiated) pricing.**(ii) Selection of Power Plants:** Comparative study of thermal, hydro, nuclear and gas power plants. Base load and peak load plants. Size and types of generating units, types of reserve and size of plant. Selection and location of power plants.

Suggested Readings:

1. B.R. Gupta. Generation of Electrical Energy (4/e), S.Chand Publication.
2. S.L. Uppal. Electrical Power (13/e), Khanna Publishers
3. V.K. Mehta. Principles of Power system (3/e), S.Chand Publication.
4. Soni, Gupta and Bhatnagar. Generation of Electrical Power, Dhanpat Rai & Sons.
5. L. ElgerdOlle. Electric Energy Systems Theory, PHI.
6. C.A. Gross. Power System Analysis, TMH.

4EE5A ELECTRICAL MACHINES –II (Common to EE and EX)

Unit 1
AC Machines Fundamentals: Introduction, emf equation, mmf of three phase AC winding, production of rotating magnetic field, types of AC windings, concentric, distributed and chorded windings, pitch factor, distribution factor, effect of these factors on induced emf, effect of harmonics.

Unit 2
Polyphase Induction Motor: Introduction. Construction, cage and wound rotors, principal, starting and running torque, condition for maximum torque, equivalent circuits, no load and block rotor test, torque-slip characteristics, losses and efficiency, circle diagram, starting of cage and wound motors, speed control, cogging and crawling, double cage rotor, induction generator, application.

Unit 3
(i) **Single Phase Induction Motor:** Introduction, construction, principal, double revolving field theory, equivalent circuit, performance calculations, starting methods, and their types, torque slip characteristics of various types.

(ii) **Special Machines:** Single phase synchronous motor, series motor, universal motor, Stepper motors variable reluctance, permanent magnet and hybrid stepper motors.

Unit 4
Synchronous Generators (Alternators): Introduction, Construction, advantages of rotating field, types of rotors, emf equation, excitation systems, equivalent circuit and their phasor diagrams, voltage regulation, synchronous impedance method, mmf method, Zero power factor method, two reaction theory of salient pole rotor, phasor diagram, power developed and power angle characteristics of salient pole machine, determination of X_d and X_q, synchronization, synchronizing power and torque, parallel operation application**.**

Unit 5
Synchronous Motors: Introduction, construction, principal of operation, starting of synchronous motor, equivalent circuit and phasor diagrams, power and torque, performance calculation, speed torque characteristics, power factor control-effect of change of excitation, V curve and inverted V curve, synchronous condenser and reactors, synchronous phase modifiers, hunting-causes and remedies, applications, synchronous induction motor application.

Suggested Readings:

1. A. E. Fitggerald, C.KingsleyJr and Umans, Electric Machinery, 6th Edition McGraw Hill, International Student Edition.
2. Kothari &Nagrath: Electric Machines 3/e,TMH
3. M. G. Say, "The Performance and Design of AC machines", Pit man & Sons.
4. Guru: ELECTRIC MACHINERY 3E, Oxford.
5. R. K. Srivastava, Electrical Machines, Cengage Learning.
6. P. S. Bimbhra-Electrical Machinery, Khanna Pub.
7. Stephen J Chapman: Electric Machinery Fundamentals, McGraw-Hill
8. Husain Ashfaq ,Electrical Machines, DhanpatRai& Sons
9. Irving L.Kosow, "Electric Machine and Tranformers", Prentice Hall of India.

4EE6A ADVANCED ENGINEERING MATHEMATICS-II
(Common to EE and EX)

Unit 1
Numerical Analysis: Finite differences - Forward backward and central difference. Newton's forward and backward differences interpolation formulae. Sterling's formulae, Lagrange's interpolation formula. Solution of non-linear equations in one variable by Newton Raphson and Simultaneous algebraic equation by Gauss and Regula Falsi method. Solution of simultaneous equations by Gauss elimination and Gauss Seidel methods. Fitting of curves (straight line and parabola of second degree) by method of least squares.

Unit 2
Numerical Analysis: Numerical differentiation, numerical integration trapezoidal rule, Simpson's one-third and one eighth rule. Numerical Integration of ordinary differential equations of first order, Picard's method, Euler's & modified Euler's methods. Miline's method and Runga Kutta fourth order method. Simple linear difference equations with constant coefficients.

Unit 3
Special Functions: Bessel's function of first and second kind, simple recurrence relations, orthogonal property of Bessel functions, Transformation, Generating functions, Legendre's function of first kind, simple recurrence relations, orthogonal property, Generating functions.

Unit 4
Statistics & Probability: Elementary theory of probability, Baye's theorem with simple applications, Expected value.Theoretical probability distributions – Binomial, Poisson and Normal distributions.

Unit5
Statistics & Probability: Lines of regression, co-relation and rank correlation. **Transforms**: Z-transforms, its inverse, simple properties and application to difference equations.

Suggested Readings:

1. Jeffrey-Advanced Engineering Mathematics , ELSEVIER
2. Ervin Kreyzig - Advanced Engineering Maths, John Wiley
3. Bird-Higher Engineering Mathematics , ELSEVIER
4. Chandrika Prasad – Advanced Mathematics for Engineers, Prasad Mudralaya
5. Kaplan, W. "Advanced Mathematics for Engineers", Addison-Wesley Publishing Co.
6. Brigham, E.O. "The Fast Fourier Transform and its Applications", Prentice-Hall
7. J.N. Kapur, Mathematical Statistics, S. Chand & company Ltd.,2000
8. R.K. Jain & S.R.K. Iyenger, Advance Engineering Mathematics, Narosa Pub., 2002.
9. E. Kreysig, Advanced Engineering Mathematics, John Wiley & Sons, 2005.

4EE7A ANALOG ELECTRONICS LAB (Common to EE, EX, EC and EI)

1. Plot gain-frequency characteristics of BJT amplifier with and without negative feedback in the emitter circuit and determine bandwidths, gain bandwidth products and gains at 1kHz with and without negative feedback.

2. Study of series and shunt voltage regulators and measurement of line and load regulation and ripple factor.

3. Plot and study the characteristics of small signal amplifier using FET.

4. Study of push pull amplifier. Measure variation of output power & distortion with load.

5. Study Wein bridge oscillator and observe the effect of variation in R & C on oscillator frequency.

6. Study transistor phase shift oscillator and observe the effect of variation in R & C on oscillator frequency and compare with theoretical value.

7. Study the following oscillators and observe the effect of variation of C on oscillator frequency: (a) Hartley (b) Colpitts.

8. Design Fabrication and Testing of k-derived filters (LP/HP).

9. Study of a Digital Storage CRO and store a transient on it.

10. To plot the characteristics of UJT and UJT as relaxation.

11. To plot the characteristics of MOSFET and CMOS.

4EE8A ELECTRICAL MEASUREMENT LAB(Common to EE and EX)

1. Study working and applications of (i) C.R.O. (ii) Digital Storage C.R.O. & (ii) C.R.O. Probes.

2. Study working and applications of Meggar, Tong-tester, P.F. Meter and Phase Shifter.

3. Measure power and power factor in 3-phase load by (i) Two-wattmeter method and (ii) One-wattmeter method.

4. Calibrate an ammeter using DC slide wire potentiometer.

5. Calibrate a voltmeter using Crompton potentiometer.

6. Measure low resistance by Crompton potentiometer.

7. Measure Low resistance by Kelvin's double bridge.

8. Measure earth resistance using fall of potential method.

9. Calibrate a single-phase energy meter by phantom loading at different power factors.

10. Measure self-inductance using Anderson's bridge.

11. Measure capacitance using De Sauty Bridge

4EE9A POWER SYSTEM DESIGN LAB

1. Generating station design: Design considerations and basic schemes of hydro, thermal, nuclear and gas power plants. Electrical equipment for power stations.

2. Auxiliary power supply scheme for thermal power plant.

3. Distribution system Design: Design of feeders & distributors. Calculation of voltage drops in distributors. Calculation of conductor size using Kelvin's law.

4. Methods of short term, medium term and long term load forecasting.

5. Sending end and receiving end power circle diagrams.

6. Instrument Transformers: Design considerations of CTs & PTs for measurement and protection.

7. Substations: Types of substations, various bus–bar arrangements. Electricalequipment for substations.

4EE10A ELECTRICAL MACHINE LAB (Common to EE and EX)

1. Speed control of D.C. shunt motor by (a) Field current control method & plot the curve for speed verses field current. (b) Armature voltage control method & plot the curve for speed verses armature voltage.

2. To perform O.C. and S.C. test on a 1-phase transformer and to determine the parameters of its equivalent circuit its voltage regulation and efficiency.

3. To perform back-to-back test on two identical 1-phase transformers and find their efficiency & parameters of the equivalent circuit.

4. To determine the efficiency and voltage regulation of a single-phase transformer by direct loading.

5. To plot the O.C.C. & S.C.C. of an alternator and to determine its Z_s, X_d andregulation by synchronous impedance method.

6. To plot the V-curve for a synchronous motor for different values of loads.

7. To perform the heat run test on a delta/delta connected 3-phase transformer and determine the parameters for its equivalent circuit.

8. To perform no load and blocked rotor test on a 3 phase induction motor and to determine the parameters of its equivalent circuits. Draw the circle diagram and compute the following (i) Max. Torque (ii) Current (iii) slips (iv) p.f. (v) Efficiency.

9. To Plot V-Curve and inverted V-Curve of synchronous motor.

10. To synchronize an alternator across the infinite bus (RSEB) and control load sharing.

4EE11A ELECTRICAL MACHINE DESIGN (Common to EE and EX)

1. **Design of transformers:** output of transformer, output equation- volt per turn, core area and weight of iron & copper, optimum design–(i) minimum cost and (ii) minimum losses. Design of core and windings. Design a 3-phase transformer.

2. **Design of rotating machines:** General concepts. specific loading, output equations –dc machines and ac machines, factor affecting size of rotating machines, choice of specific magnetic and electric loadings.

3. **Design of 3-phase induction motors:** output equation, choice of air gap flux density and ampere conductors permeter, main dimensions. Design of a 3-phase squirrel cage induction motor.

4. **Design of single phase induction motors:** output equation, main dimensions, relative size of single phase and 3-phase induction motors. Design of a single phase capacitor start induction motor.

5. **Design of synchronous machines:** output equation, choice of specific magnetic and electric loadings, main dimensions, short circuit ratio. Design a 3-phase, 2-pole turbo alternator.