

SEMESTER IV

EE1406 POWER SYSTEM – I

(3—1—0)

Generation of Electric Power: Brief description of Thermal, Hydro, Nuclear and Gas Power Plants and other non-conventional power plants

Transmission and Distribution Systems:

DC 2-wire and 3-wire systems, AC single phase, three phase and 4-wire systems, and comparison of copper efficiency;

Distribution Systems: Primary and Secondary distribution systems, concentrated and uniformly distributed loads on distributors fed at one and both ends, ring distribution, sub mains and tapered mains, voltage drop and power loss calculations, voltage regulators;

Overhead Transmission Lines:

Types of conductors, Line Parameters: Calculation of inductance and capacitance of single and double circuit transmission lines, three phase lines with stranded and bundle conductors, generalized ABCD constants and equivalent circuits of short, medium and shunt compensation, introduction to FACTS, per unit representation of system quantities, steady state performance of transmission network, elements of load flow analysis, nature of faults in electrical systems, fault calculations in power networks, elements of economic operations

Overhead line insulators:

Type, string efficiency, voltage distribution in string of suspended insulators, grading ring, preventive maintenance,

Mechanical design of transmission lines:

Different type tower, Sag-tension calculation, Sag-template, string chart, vibration and damping, corona - corona losses, radio and audio noise, transmission line – communication line interference;

Cables: Calculation of capacity of cables, charging current, stress, grading, heating of cables, construction and characteristic of HV and EHV cable.

Tariffs and load curves:

Definition and different tariffs for domestic, commercial, industrial application, different Load and Load duration curve, curves and their significance

Introduction to EHV/HVDC transmission: Brief description of both the systems with working and constructional details.

Suggested Books and References

- Grainger John, J. Stevenson, Jr. W. D., “ Power System Analysis”, McGraw Hill, 1994

Review of Binary numbers, Boolean functions, Karnaugh Maps, and minimal realization of combinational circuits;

Half an Full Adder, Comparator, Schmitt Triggers, monostable, bi stable astablemultivibrators, Multiplexer, Demultiplexers, Decoders and encoders, counters, Transistors (**BJT & MOS**) as switching element;

Logic Gates: **TTL, ECL** and **CMOS** gates;

Memories: **RAM, ROM, EPROM, EEPROM, R-S, J-K, T** and **D** flip-flops;

State transition diagram, Asynchronous and synchronous design, counters, registers;

Shift registers, A/D, and D/A Converters;

Arithmetic Circuits, State Machine Design, Memory Cells, Introduction to Digital Circuit Testing, Introduction to Hardware Description Language, Introduction to Field Programmable Devices.

Suggested Books & References:

- Taub and Schilling, “*Digital Integrated Electronics*”, McGraw Hill, 1976.

EE 1403

ELCTROMAGNETIC THEORY (3 – 1 – 0)

General Principles: Concept of gradient, divergence and curl, Ampere's Laws, Magnetic vectors and scalar potentials; Eddy current Loss and Skin Effect, The field concept, Source of Electromagnetic-field, Classifications, Boundary conditions.

Boundary value problems in Electrostatics: Laplace and Poisson's equations, Product solution method of solving Laplace's equation, Rectangular, Spherical and Cylindrical coordinates, method of Images; Field plotting methods.

Magneto-static Fields: Integral theorems; Coulomb's Law, Gauss' Equipotential surface, Divergence theorem, Poisson's evaluation of capacitance, Electrostatic energy, Electrostatic uniqueness theorem, Faraday's Law of Magneto-static energy, Ampere's Laws, Magnetic vector and scalar potentials; Eddy current Loss and Skin Effect, Boundary value problems in Magneto-static; Current sheet and flux sheet.

Electromagnetic fields: Propagation of electromagnetic waves in dielectrics and conductors, space sheet, transmission lines, Polarization, Reflection and Refraction of plane waves, Brewster angle, Surface impedance, Polynting theorem, Power loss in plane conductor, Transmission line equations, Standing waves, Impedance matching, Transmission charts, Smith charts, guide wave, Rectangular wave guides, wave impedance and characteristic impedance; Retarded potentials, Radiation from elementary dipole and half wave dipole, Radiation Pattern.

Radiation and Antenna: Retarded potential, Hertzian dipole, Antenna pattern, directivity and gain, Application of field theory to electrical devices.

Suggested Text books & References:

- Rao, N.N., "Elements of Engineering Electromagnetics", Third Edition, Prentice Hall, India, 1992.
- Mathew, N., Sadiku, O., "Elements of Electromagnetics", Second Edition, Saunders College Publishing, 1994.
- Ramo, S., Whinnery, S. and Van Duzer, T., "Fields and Waves in Communication Electronics", 3rd Edition, John Wiley and Sons, 1994.
- Kraus, J.D., "Electromagnetics", 3rd Edition, McGraw Hill, 1989. Jordan, E.C. and Balmain, K.G., "Electromagnetic Waves and Radiating Systems".

EE 1404 ELECTRICAL MACHINES- I (3-1-0)

Electromagnetic and transformers:

Review of laws of Electromagnetic and Electro-mechanics.

Autotransformer: Equivalent circuits and equations shown step-up and step-down operations; comparison with two winding transformer on the basis of copper losses and volume of copper.

Three-phase transformers, special constructional features – cruciform mitering, alternative winding arrangements, cooling methodology, conservators, breathers, Buchholz relay, Transformer connections, vector phase groups. Phase conversions -3 to 1, 3 to 2, 3 to 6 and 3 to 12.

Parallel operations of single and three-phase transformers and load sharing; testing of 3-phase transformers; Special purpose Transformers; pulse, Isolation, Welding, rectifier, High frequency.

DC Machines:

Review of constructional features. Methods of excitation, Armature windings, Power balance, Voltage and torque equations; Operation as generator – Self excitation principles; Armature reaction, Characteristics of generators and motors, commutation; starting and speed control including solid state controllers; Banking losses, Efficiency; Testing, efficiency and application of DC motors ; parallel operation of generators; Amplifying and Metaldyne.

Poly-Phase Synchronous Machines:

Constructional features, Poly-phase Distributed AC Windings; Types; Coil span and Winding factors; Excitation systems, e.m.f. equation and harmonic elimination; Interaction between excitation flux and armature m.m.f., equivalent circuit model and phasor diagram for circle diagram; power angle equations and characteristics; Voltage regulation and affect of AVR; Synchronizing methods, parallel operation and load sharing, active and reactive power control, operation on infinite bus-bar.

Analysis under sudden short circuit; Transient parameters;

Motoring mode, Transition from motoring to generating mode Phasor diagram steady state operating characteristics, V-curves, starting, synchronous condenser, hunting damper winding effects, speed control including solid state control.

Testing of synchronous machines- Stability considerations; Brushless generators, Single-phase generators;

Induction Machines:

Review of basic theory and construction, phasor diagram and equivalent circuits,

ELECTRICAL ENGINEERING

Torque-speed characteristics, testing and circle diagram; Starting and speed control including solid state controllers.

Suggested Books & References:

- Mcpherson, George, “*Introduction to Electric Machines and Transformer*”, John Wiley and sons, 1980
- NaserSyed,A, “*Electric Machines and Transformer*” , New York, Macmillan, 1984.
- Sen, P.C., “Thyristor DC Drives “, New York, Wiley, 1991
- Sen, P.C., “Principles of Electric Machines and power Electronics”,(Second Edition), John Wiley & Sons 1997.
- Say, M.G.,” *Alternating Current Machines*”,(5th Edition) McGraw-Hill Book co.,1992.

(CS1402) DATA STRUCTURE & PROGRAMMING METHODOLOGY (2-1-0)

Elementary data structures: Arrays and strings; packing; space arrays; algorithm development; recursion.

Sequential search, Divide and Conquer binary search; selection and insertion sort, merge sort; quick sort; complexity of sorting. Linear lists – stacks; stack use-postfix notation recursion removal. Queues-circular queues. Linked list-definition on Pascal and C; creation and deletion of nodes; circular and doubly linked lists; applications of list; Graphs; UNION and FIND operations; graph algorithms ; optimization and greedy method; minimum spanning tree, shortest path. Trees, binary trees; threaded trees; heap sort; tries and B-trees; external search.Backtracking.String algorithms-pattern search and text editing. Structured approach to programming step wise refinement approach. Reasoning about programs, program specification, pre and post condition, weakest [pre-conditions, program assertions, loop invariants. Programming style-documentation, basic concepts program testing.

Suggested Text Books & Reference

- Wirth Niclus, “Algorithms +Data Structure=Programs”, Prentice hall International 1978
- Horwitz, E, andSahni, S.”Fundamentals of Data Structures”, Computer Science Press, 1978.
- Kuth,D.”Theart of computer programming”, vols.1-2, Addison-Wesley,1970-80.
- Aho A.v.,Hopcroft, and Ullman; J.E.”DataStructure and Algorithms”, Admission Wesley,19782.
- Trembley and Sorenson, “Data structures using Pascal”, McGraw Hill, 1985.
- Stubbas,D.”Dtastructurewith abstract data types and Modula 2”,Books & Cole publications Comp.1987
- Srivastava, “Data structure through C in depth”, 2nd edition, BPB publication.

EE 1402

CIRCUIT THEORY

(2-1-0)

Review of circuit concepts:

L, C, Mutual Inductance, Controlled sources, Transformers, Dot convention for coupled circuits, Nodal & Loop analysis, Relation between field & circuit parameters.

Network Theorems (with proof):

Thevenin's, Norton's, Tellegen's, Reciprocity theorem, Maximum power transfer theorem, Compensation theorem, Reciprocity theorem.

Time and frequency domain analysis of circuits for step, ramp, exponential and damped exponential inputs, Wave form synthesis, Laplace transform method and complex frequency approach.

Network functions:

Driving point and Transfer function, Calculations of network function. Poles and zeros and their significance, concept of stability of active networks, Frequency response (frequency & phase plots);

Coupled circuits and Two-port Networks:

Analysis of mutually coupled circuits; two port parameters, relation among different parameters, scattering parameters

Elements of Filter Design:

Low-Pass, High-Pass and Band-Pass filters; Butter worth and Chebyhev approximations: Design of first order and second order low-pass filters; Elementary synthesis techniques.

Suggested Text Book & References:

- Kuo, F.F., "Network Analysis", John Wiley and Sons inc., 1966.
- Valkenburg, Van "Network Analysis", PHI

PRACTICAL

EE 1407-P CIRCUIT THEORY LAB

(0-0-3)

List of Experiments:

- i. Verification of Tellegen's Theorem and Reciprocity theorem.
- ii. Time and Frequency domain analysis of circuits for Step, Ramp and Exponential inputs.
- iii. Design of first order and second order Filters.
- iv. Analysis of mutually coupled circuit.
- v. Response of RLC series circuit for Step input.
- vi. Wave form Synthesis using CRO.
- vii. Design and simulation circuit by using software.

EE 1408-P ELECTRICAL MACHINES LAB

(0-0-3)

List of Experiments:

Characteristics of DC Machines motors and generators with different excitation;

Hopkinsin's test and Fields test-loss calculations and prediction of performance characteristics;

- Griffiths D.J., "Introduction to Electrodynamics", PHI, 1981.
- Nasar Syed, A., "Electric Machines & Power Systems, Volume-I", McGraw-Hill, Inc U.S.A., 1995.
- NasarSyed,A. &Unnewehr, L.E., "Electromechanics& Electric Machines, Volume-II", John Wiley & Sons, Canada, 1971.
- OpenshawTaylor,E., "The performance & Design of A.C.Commutator Motors", A.H Wheeler & Co(P)Ltd., Allahabad, 1971.
- Ivanov-Smolonsky, A., "Electrical machines vol-2", Mir Publishers Moscow, 1982.
- Ivanov-Smolonsky, A., "Electrical machines vol-3", Mir Publishers Moscow, 1982.
- Filzgerald, A.E. & Kingsley Charles, Jr., "Electrical Machinery"(2nd Ed.), McGraw-Hill & Kogakusha company Ltd. Japan, 1961.

Speed control of DC motors-conventional and electronics.

Determination efficiency of single-phase transformer by using back-to-back test;

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Determination efficiency of single-phase transformers by R-L & R-C loads.

Determination of equivalent circuit parameters of a three-phase slip-ring induction motors;

Determination of equivalent circuit parameters of a three-phase squirrel cage induction motor by block rotor test and to draw circle diagram;

Phase conversion using Scott connection and perform load test.

No-load short-circuit and zero power factor (ZPF) tests on a synchronous machine;

Determination of voltage regulation at specified load by (i)EMF (ii)MMF (iii) Potier method,

(iv) ASA methods and comparison of results; Load angle characteristic and comparison with theoretically predicted results.

V-curves and inverted V-curves of synchronous machines; Comparison with predicted characteristics; Synchronization of three phase alternator with infinite bus bar; Study of variation of excitation and mechanical power input on performance.

Slip test, short circuit and lagging current test on a salient pole machine and determination of armature parameters; Estimation of voltage regulation at specified loads using Blondé's method; Comparison with results from load test.

Sudden short circuit test and determination of X_c, X^d, X^d and machine time constants. Determination of X_1, X_2, X_0 by fault simulation methods;

Study of Automatic Voltage Regulators(AVR) and from grid to stand alone mode.

- McPherson, G. and Laramore R.D., "An Introduction to Electrical Machines and Transformer", (2nd Edition), John Wiley & Sons, 1990.
- Say M.G., and Taylor, E.O., "Direct Current Machines", 3rd Ed. Pitman 1961.
- Del Toro, V., "Electrical Machines & Power Systems", 1985, Prentice Hall, Inc Englewood Cliffs, 1985.
- Del Toro, V., "Electromechanical devices for Energy Conversion & Control Systems", 1985, PHI Pvt. Ltd., 1985.
- Garik, M.L. & Weil, R.T., "DC & AC Machines", Affiliated East-West PVT Ltd. East-West student Edition, 1968.
- Konsow, I.L., "Electric Machinery & Transformers", PHI, 2nd Ed. 1992.

EE 1409-P DIGITAL ELECTRONICS LAB

(0-0-3)

List of Experiments:

- To study the switching characteristics of a diode.
- To study the switching characteristics of a Bipolar Junction Transistor.
- Implementation of logic functions using gates, Multiplexers and De-multiplexers.
- To set up an RS, a clocked RS, J-K, Edge triggered J-K, Master Slave K-J flip-flops using NAND Gates.
- Design & implementation of sequential memory using shift register to design and test counters and sequence detectors using J-K flip-flops.

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POWER SYSTEM – I

(0-0-3)

List of experiments:

- 1) Determination of the generalized constants A, B, C, D of a long transmission line;
- 2) Simulation of DC distribution by network analyzer.
- 3) Measurement of earth resistance by earth tester.
- 4) Dielectric strength test of insulating oil.
- 5) Determination of break down strength of solid insulating material.
- 6) Different parameter calculation by power circle diagram.
- 7) Study of different types of insulators.
- 8) Active & reactive power control of an alternator.
- 9) Study and analysis of an electrical transmission line circuit with the help of PSPICE.
- 10) Dielectric constant, tan delta, resistivity test of transformer oil.