

Electrical Machines

EECL 201B

3 - 0 - 0 = 3

Transformer: Basic principle, Construction & types, emf equation, ideal and practical transformer, Equivalent circuit, Voltage regulation, losses and efficiency, auto transformers, introduction to three phase and high frequency transformers.

DC Machines:

DC Generators: Basic concept of rotating electrical machines, construction of DC machines, working principle of DC generator, types of DC generators, armature reaction, characteristics of DC generators, numerical.

DC Motors: Working principle of DC motor, types of DC motors, Back emf, Voltage equation, armature torque of a motor, rotational losses of DC machines, characteristics of various motors, speed control, necessity of a starter, numerical, applications.

Polyphase Induction Motor: Rotating field concept, principle of working, construction, types, equivalent circuit, torque equation, torque slip characteristics, methods of starting, speed control, numerical, application of polyphase induction motors.

Single phase motors: Principle of working-double revolving theory, starting characteristics, application of single phase motor, universal motor, repulsion motor, AC series motor.

Synchronous Machines:

Synchronous generator: Introduction to alternator, constructional features and types of alternator, alternator on load, equivalent circuit, voltage regulation, parallel operation of alternators.

Synchronous motor: Principle of operation, torque of synchronous motor, power developed by salient pole synchronous motor, applications.

Suggested readings:

- 1) A course in electrical machinery: P.S.Bhimbra
- 2) Electric machines: I.J.Nagrath & D.P.Kothari.
- 3) Electrical machines: Smarajit Ghosh
- 4) Electric machines: J.B.Gupta
- 5) Electrical machinery: B.R.Gupta.

Electronic Circuits & Simulation

EECL 202B

3 - 0 - 0 = 3

Bias stability: - Operating point, Q point variation due to changes in β & temperature, Stability factor, stability factor analysis (variation of I_{co} , V_{be})

Small signal Analysis:-BJT small signal analysis, h parameters, FET small signal analysis, small signal high frequency model (n model), Millers theorem.

Large Signal Amplifiers: Classification of power amplifiers (Class A,B& C), push pull amplifier,

Multistage Amplifier:-General cascade system, configuration of RC coupled, transformer coupled, direct couple multistage amplifier, General frequency consideration, Effect of cascading on the bandwidth of an amplifier.

Frequency response of Amplifier:-Frequency response characteristics, the high frequency response of CE stage, the gain bandwidth product, common source stage at high frequency, Emitter and source followers at high frequency, the time constant method of obtaining the response. Bode Plots.

Feedback Amplifiers:-Feedback concepts, the transfer gain with feedback, general characteristics of feedback amplifier. Input resistance, output resistance, voltage series feedback pair, current series feedback, current shunt feedback, voltage shunt feedback.

Regulated power supplies:- ordinary DC power supply, voltage regulators,, zener as voltage regulator, series voltage regulators, principle of switching voltage regulator, IC voltage regulator, its specification and performance characteristics

Suggested Readings:

- Integrated Electronics, Millman & Halkias, Tata Mc Graw Hill
- Microelectronics, Millman & Grabel, Tata Mc Graw Hill
- Electronics Circuits, Schilling & Belove, McGraw Hill

Antenna & Wave Propagation

EECL 203B

3 - 0 - 0 = 3

Radiation: Vector potential in the electro magnetic field oscillation, electric dipole and power-radiated application to short antenna. Radiation from a half dipole and its radiation resistance.

Antenna fundamentals: Radiation pattern, Antenna gain, Effective joint of an antenna, Antenna aperture, relation between antenna gain and antenna aperture, elementary idea of self and mutual impedances in antenna, Antenna terminal impedance, reciprocity theorem of an antenna.

Antenna arrays: Arrays of two point source, linear arrays of n-point sources, broad side and End fire arrays, Pattern multiplication Binomial arrays.

Special purpose antennas: Loop antenna traveling wave antenna, Rhombic antenna, Yagi antenna, Horn and reflector type antennas.

Ground wave propagation: Introduction to different region of the atmosphere. Various propagation paths, Basic ideas of ground wave propagation, space wave and surface wave, True Tropospheric refraction, radius of curvature of a ray in the troposphere. Concept of modified earth, Duct propagation.

Sky wave propagation: Structure of the ionosphere, effective permittivity & conductivity of an ionized region. Effect of earth magnetic field. Critical frequency. MUF and OPWF. Virtual height, skip distance fading.

Antenna design: Design consideration for antennas at various frequency domains, common type of antennas in different frequency domains eg. Wide band antenna (Log periodic antenna)

Suggested Readings:

- Fields & Wave Electromagnetics , DK Cheng

- Fields & Wave in Communication Electronics, Ramo Whinnery & Duzer
- Electromagnetic Waves and Radiating Systems, Jordan & BaLMMAIN
- Antenna Theory: Analysis & Design, A. Balanis
- Elements of Electromagnetics, Sadiku
- Antenna & Wave Propagation, K.D. Prasad

Digital Electronic Circuits

EECL 206B

3 – 1 – 0 = 4

Basic concepts of Boolean Algebra: Review of number systems - Binary, Hexadecimal, conversion from one to another, complement arithmetic, Signed and unsigned numbers and their arithmetic operations. BCD, Excess-3, Gray and Alphanumeric codes. Review of Boolean algebra, De-Morgan's Theorems, Standard Forms of Boolean Expressions, Minimization-Techniques: K-MAPS, VEM Technique, Q-M (Tabulation) method.

Logic Gates & families: Logic Families: TTL, MOS, CMOS, Bi-CMOS; Performance parameters of IC families: input and output loading, fan-in, fan-out, tri-state, current drive, voltage levels, noise margins, power-speed tradeoff; Unused inputs; Interfacing between logic families.

Combinational Logic Circuits: Problem formulation and design of Basic Combinational Logic Circuits, Combinational Logic Using Universal Gates. Basic Adders, ALU, Parity-Checkers and Generators, Comparators, Decoders, Encoders, Code Converters, Multiplexer (Data Selector), De-multiplexers

Sequential Circuits: Latches, Flip-flops (SR, JK, T, D, Master/Slave FF,) Edge-Triggered Flip-Flops, Flip-Flop Operating Characteristics, Basic Flip-Flop Applications, Asynchronous Counter Operation, Synchronous Counter Operation, Up/Down Synchronous Counters.

Shift registers & Memories

Shift Register Functions, Serial In - Serial Out Shift Registers, Serial In - Parallel Out Shift Registers, Parallel In - Serial Out Shift Registers, Parallel In - Parallel Out Shift Registers, Bidirectional Shift Registers, Basics of Semiconductor Memories, Random-Access Memories (ROM), Read Only Memories (ROMs), Programmable ROM's (PROMs and EPROM's), PAL, PLA.

Synchronous and Asynchronous Sequential circuits

Sequential Circuits: Synchronous sequential circuits and finite state machines (FSM); Mealy machine; Moore machine; State table; State diagram; Synchronous Sequential circuit analysis; System design; State minimization; State assignment; ROM implementation; Asynchronous sequential circuits, Threshold functions, Hazards, Pulse Mode Circuits.

Circuit and electrical interfacing considerations

Transmission line effect, reflection, crosstalk, Noise sources, shielding and decoupling

Textbooks & References:

- "Digital Fundamentals" by Thomas L. Floyd, Prentice Hall, Inc, 4th Edition 1997.
- "Digital Systems - Principles and Applications" by Tocci, R. J. and Widner, Prentice Hall, 2001
- Switching and finite automata theory: Z V Kohavi. 2M Edn. –TMH
- Digital Logic Circuit Analysis & Design, by Victor P. Nelson, H. Troy Nagle, Bill D. Carroll and J. David Irwin, Prentice Hall, 1995.

- Digital logic and computer design: M Morris Mano –PHI
- Modern digital electronics: R.P. Jain. 2nd Edn TMH
- *Digital Design: Principles and Practices*, by Wakerly J F, Prentice-Hall, 3rd Ed, 2000
- "Digital Experiments Emphasizing Systems and Design," by David Buchla, Prentice Hall, Inc, 4th Edition 1997.

Power Electronics & Applications

EECL 210B

3 – 0 – 0 = 3

Review of semiconductor devices: SCR'S, Diacs, triacs, and other thyristors, Protection, series parallel operation, firing circuits. Two transistor analogy, series and parallel operation of thyristors, UJT relaxation oscillator, programmable UJT, Complementary UJT, Silicon controlled switch.

Phase controlled rectifier and chopper: Principles of phase control, Full-wave (single phase) controlled converters, Three phase diode and thyristor converter circuits, Principles of chopper operation, step up chopper.

DC regulated power supplies: Basic series regulator, switching regulator: Step up, Step down, Inverter.

Relays and Timers: The relay (basic construction), AC relay, Reed relay, Solid state relay, 555 timer.

Industrial circuits: Temperature control circuit, proximity detector, AC voltage regulators, fan regulators/ lamp dimmers, uninterrupted power supplies (UPS).

Automation & Robotics: Programmable controllers, A typical system, Programming terminals: Input/ output track, Robots, Machine visions.

Suggested Readings:

- Industrial solid state Electronics: Devices and Systems, Timothy J. Power Electronics, P. C. Sen
- Thyristors, Sughandhi & Sughandhi

Circuits & Simulation Lab

EECP 201B

0 – 0 – 2 = 1

1. Design a transistor bias circuit.
2. Study of h-parameters of Transistor
3. Design a two stage RC coupled amplifier-using BJT.
4. Design a bias circuit of FET
5. Design a single stage amplifier using FET.
6. Design a power supply with C filter.
7. Design a voltage regulator.
8. Design a push pull class B amplifier without input and output transformer.
9. Study of Feedback Amplifier
10. Input impedance output impedance of common emitter Amplifier and measurement of gain.

Note: Minimum five practicals need to be completed from each set

Electrical Machines Practical

1. To find no load, full load losses and efficiency of single phase transformer.
2. To study working of D.C. machines.
3. Operating characteristics of D.C. Generator.(Compound).
4. Study of D.C. motor starters.
5. To study speed control of D.C. shunt motor.
6. To study working of induction motors (Squirrel cage and Phase wound Induction motor).
7. To find speed torque characteristics of induction motors.
8. To find the starting and operating characteristics of a universal motor, repulsion motor and single phase induction motor.
9. To find the voltage regulation and efficiency of an alternator.
10. To study working of synchronous motor.

Power Electronics Practical

1. SCR triggering Circuits.
2. Forced Commutation Circuits.
3. SCR Pulse Control Circuits.
4. Triac Phase Control Circuits.
5. Fully Controlled Single Phase Thyristor Bridge.
6. SCR DC Circuit Breaker.
7. Zero Voltage Switching.
8. Voltage Commutated DC Chopper.
9. Current Commutated DC Copper.
10. Microprocessor based three Phase Thyristor Bridge.
11. Series Connected Single Phase Converters.
12. Series Inverter.
13. Inverter Fed Drive.

Digital Electronics Lab

1. Study of PIN diagram of various ICs & to test the logic gates and verify their truth table.
2. Implementation of Half adder, Full adder & Half subtracter using NAND gates only.
3. Implementation of Boolean functions of three and four variables using 74153 (4:1) Mux.
4. Implementation of De-multiplexer, decoder and encoder.
5. To add two 4 bit binary numbers using 7483.
6. To compare two 4 bit binary number using 7485 (magnitude comparator).
7. To verify the operation of different modes of shift Register using 7495.
8. To design an asynchronous counter of any modulus using JK FF's (7473).
9. To design a synchronous counter of any arbitrary count using 7473.
10. Design of BCD to seven-segment display using logical gates ICs.
11. To study and verification by truth tables of SR, JK, MSJK, D & T flip flops.
12. To design and test non-sequential counter and study of shift registers.

Fourier Analysis: Periodic functions, trigonometric series, Fourier series for functions with period 2π , complex form of the series, functions with arbitrary period, even and odd functions, half range series, approximation by trigonometric polynomials, square error, Bessel's inequality, Parseval's identity, Fourier integral.

Evaluation of inverse Laplace transform, partial fraction method, Heaviside development, convolution theorem. Application to solve initial and boundary value problems involving the ordinary differential equation with one dependent variable

Laplace Transforms: Function of bounded variation, Laplace transform of I , t^n , e^{at} , $\sin(at)$, $\cos(st)$, $\sinh(at)$, $\cosh(at)$, $\text{erf}(t)$, shifting properties, expressions with proofs for:

1. $L\{t^n f(t)\}$ 2. $L\{f(t)/t\}$ 3. $L\{\int f(u) du\}$

Unit step functions, Heaviside, Dirac delta functions and their Laplace transformation, Laplace transform of periodic function.

Complex Analysis: Curves and regions in complex plane, complex functions, analytic functions, Cauchy-Riemann equations, Laplace equations. Rational, exponential, trigonometric, hyperbolic functions, derivatives of analytic functions, Power series, Taylor series, Laurent series, zero and singularity behavior of $f(z)$ at infinity.

Suggested Readings:

1. Advanced Engineering Mathematics, Kreyszig, Wiley
2. Advanced Mathematical Analysis, Malik & Arora, S. Chand & Co.
3. Advanced Differential Equations, M.D. Rai Singhaniya S. Chand & Co.
4. Complex Analysis., M.R. Spiegel, Schaum's outline Series
5. Higher Engineering Mathematics, B.S. Grewal, Khanna Publisher
6. Advanced Engineering Mathematics E. Kreyszig, New Age International