



Other university B.E./B.Tech - G EE Level 2 syllabus

Electromagnetic Fields

PCC-EE07 Electromagnetic Fields

4 credits

Module 1: Review of Vector Calculus

Vector algebra-addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus-differentiation, partial differentiation, integration, vector operator del, gradient, divergence and curl; integral theorems of vectors. Conversion of a vector from one coordinate system to another.

Module 2: Static Electric Field

Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density.

Module 3: Conductors, Dielectrics and Capacitance

Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations.

Module 4: Static Magnetic Fields

Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors.

Module 5: Magnetic Forces, Materials and Inductance

Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances.

Module 6: Time Varying Fields and Maxwell's Equations

Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces. Boundary Conditions.

Module 7: Electromagnetic Waves

Derivation of Wave Equation, Uniform Plane Waves, Maxwell's equation in Phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect. Poynting theorem.

Text / References:

1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.
2. A. Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, NewDelhi, 2009.
3. A. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India, 2012.
4. G.W. Carter, "The electromagnetic field in its engineering aspects", Longmans, 1954.
5. W.J. Duffin, "Electricity and Magnetism", McGraw Hill Publication, 1980.
6. W.J. Duffin, "Advanced Electricity and Magnetism", McGraw Hill, 1968.
7. E.G. Cullwick, "The Fundamentals of Electromagnetism", Cambridge University Press, 1966.
8. B. D. Popovic, "Introductory Engineering Electromagnetics", Addison-Wesley Educational Publishers, International Edition, 1971.
9. W. Hayt, "Engineering Electromagnetics", McGraw Hill Education, 2012.

Electrical Measurement & Instrumentation

203144: Electrical Measurements and Instrumentation

Credits

Unit 01:

A. Classification of Measuring Instruments: Characteristics of measuring instruments: static and dynamic, accuracy, linearity, speed of response, dead zone, repeatability, resolution, span, reproducibility, drifts. Necessity of calibration, standards and their classification, absolute and secondary instruments, types of secondary instruments: indicating, integrating, and recording, analog / digital. Ammeter and Voltmeter Theory: Essentials of indicating instruments deflecting, controlling and damping systems. Construction, working principle, torque equation, advantages and disadvantages of Moving Iron (MI) instruments (attraction and repulsion). block diagram and operation of digital ammeter & voltmeter.

B. Range Extension: Instrument Transformers : Construction, connection of CT & PT in the circuit, advantages of CT / PT for range extension of MI Instruments, transformation ratio, turns ratio, nominal ratio, burden, ratio and phase angle error.(descriptive treatment only)

Unit 02:

A. Measurement of Resistance: Measurement of low, medium and high resistance. Wheatstone bridge, Kelvin's double bridge, ammeter-voltmeter method, megger. Earth tester for earth resistance measurement.

B. Measurement of Inductance: Introduction, sources and detectors for A.C. bridge, general equation for bridge at balance. Maxwell's inductance, Maxwell's inductance - Capacitance Bridge, Anderson's bridge.

Unit 03:

Measurement of Power: Construction, working principle, torque equation, errors and their compensation, advantages and disadvantages of dynamometer type wattmeter, low power factor

wattmeter, poly-phase wattmeter. Active & reactive power measurement in three phase system for balanced and unbalanced load using three wattmeter method, two wattmeter method & one wattmeter method.

Unit 04:

Measurement of Energy: Construction, working principle, torque equation of single phase conventional (induction type) energy meter. Block diagram and operation of single phase and three phase static energy meter. Calibration of static energy meter. TOD meter.

Unit 05:

A. Oscilloscope: Introduction, various parts, front panel controls, use of CRO for measurement of voltage, current, period, frequency. Phase angle & frequency by Lissajous pattern. Introduction to DSO.

B. Transducers: Introduction, classification, types: resistive, inductive, capacitive, basic requirements for transducers.

C. Pressure Measurement: Introduction, classification of pressure as low, medium & high, absolute, gauge, vacuum, static, dynamic & head pressure. High pressure measurement using electric methods, low pressure measurement by McLeod gauge and pirani gauge, capacitive pressure transducer.

Unit 06:

A. Level Measurement: Introduction and importance of level measurement, level measurement methods: mechanical, hydraulic, pneumatic, electrical, nucleonic and ultrasonic.

B. Displacement Measurement: LVDT & RVDT – construction, working, applications, specifications, advantages & disadvantages, effect of frequency on performance.

C. Strain Gauge: Introduction, definition of strain, types of strain gauge: wire strain gauge, foil strain gauge, semiconductor strain gauge; their construction, working, advantages and

disadvantages.

Text Books

[T1] A. K. Sawhney, "A Course in Electrical and Electronic Measurements & Instrumentation",
Dhanpat Rai & Co.

[T2] J. B. Gupta, "A Course in Electronics and Electrical Measurements and Instrumentation", S.
K. Kataria & Sons,

[T3] R. K. Jain, "Mechanical and Industrial Measurements", Khanna Publishers.

[T4] B. C. Nakra & K. K. Chaudhari, "Instrumentation Measurement and Analysis", Tata McGraw Hill.

Reference Books

[R1] E. W. Golding & F. C. Widdies, "Electrical Measurements & Measuring Instruments",
Reem Publications.

[R2] Dr. Rajendra Prasad, "Electronic Measurements & Instrumentation", Khanna Publishers.

[R3] Arun K. Ghosh, "Introduction to Measurements and Instrumentation", PHI Publication.

[R4] M. M. S. Anand, "Electronics Instruments and Instrumentation Technology", PHI Publication.

Power Generation Technologies

203141: Power Generation Technologies

Credits

Th: 03

Unit 01: Thermal Power Plant

Basic thermodynamic cycles: Carnot cycle, Rankine cycle; Actual Rankine cycle; Reheat cycle
(theoretical only); heat rate (Numerical on Heat rate).

Thermal Power Plants: Site selection, Main parts and its working. Types of boilers (FBC, Fire tube, and Water tube). Assessment of heat recovery systems Steam turbines Fuel Handling, Ash disposal and dust collection, Draught systems, electrostatic precipitator.

Unit 02: Nuclear, Diesel, Gas Power Plant

A. Nuclear Power Plant: Introduction, atomic physics, nuclear reaction, materials, site selection, nuclear reactors and working of each part, classification of nuclear reactor, nuclear waste disposal.

B. Diesel Power Plants: Main components and its working, Diesel plant efficiency and heat balance (Numerical), Site selection of diesel power plant.

C. Gas Power Plant: Introduction to gas cycles. Simple gas turbine power plant, methods to improve thermal efficiency, open loop and closed loop cycle power plants, gas fuels, gas turbine materials, plant layout. Combined cycle power plants, concept of heat to power ratio.

Unit 03: Hydro Power Plant

Site selection, Hydrology, storage and pondage, general arrangements and operation of hydro power plant, Hydraulic turbines, turbine size, pelton wheel turbine, Francis and Kaplan turbines, selection of turbines, Dams, Spillways, gates, intake and out take works, canals and layout of penstocks, water hammer and surge tank, simple numerical on hydro graphs and number of turbine required. Small, mini and micro hydro power plant (Introduction only).

Unit 04: Wind Energy Systems

Historical Development of Wind Power, Types of wind turbine, Impact of Tower Height, Power in the Wind. Maximum Rotor efficiency, Speed control for Maximum Power, Average Power in the wind (Numerical). Wind Turbine Generators (WTG) - Synchronous and Asynchronous (block diagrams only), Wind Turbine Economics, Simple Estimates of Wind Turbine Energy, Environmental Impacts of Wind Turbines. Change in wind pattern and its effect on power generation. Control of wind turbine generator.

Unit 05: Solar Energy

Principles of solar radiations, solar constant, cloudy index and concentration ratio, measurement

of solar radiation. Solar energy collectors (solar thermal applications), principle of energy conversion, collection systems and their features, types of collectors with comparison. Solar thermal power plants. Over view of recent development of PV technologies. A Generic Photovoltaic Cell, The Simplest Equivalent Circuit for a Photovoltaic Cell From Cells to Modules to Arrays, Numerical on number of solar panel selection. The PV I-V Curve under Standard Test Conditions (STC), Impacts of Temperature and Insolation on I-V Curves, Shading Impacts on I- V curves, System: Introduction to the Major Photovoltaic System Types.

Unit 06: Other Sources and Grid Connection

Biomass energy, conversion to electricity, municipal solid waste to energy conversion, geothermal energy and ocean energy and Fuel cell Energy storage requirements and selection criteria, stand alone, hybrid stand alone and grid connected renewable systems and their requirements.

Text Books:

- [T1] P. K. Nag, "Power Plant Engineering", Tata McGraw Hill Publications.
- [T2] Dr. P. C. Sharma, "Power Plant Engineering", S.K. Kataria Publications.
- [T3] R. K. Rajput, "A text book on Power System Engineering", Laxmi Publications (P) Ltd.
- [T4] Chakrabarti, Soni, Gupta, Bhatnagar, "A text book on Power System Engineering", DhanpatRai publication.
- [T5] R.K. Rajput, "Non-Conventional Energy Sources and Utilization", S. Chand Publications.
- [T6] M.M. Wakil, "Power Plant Engineering", McGraw Hill, Indian Edition.
- [T7] G. D. Rai, "Renewable Energy Sources", Khanna Publications.
- [T8] Chetan singh solanki " Solar Photovotaics: Fundamentals, Technology and Application" PHI Publications.

Reference Books:

- [R1] Arora and Domkundwar, "A Course in Power Plant Engineering", DhapatRai Publication.
- [R2] Dr. S. P. Sukhatme, "Solar Energy", Tata McGraw Hill

Publication.

[R3] Mukund Patel, "Wind and Solar Power Plants", CRC Press.

[R4] Gilbert Masters John, "Renewable Energy", Wiley and sons' publications.

[R5] Robert Foster, Majid Ghassemi, Alma Cota "Solar Energy" CRC Press

Engineering Mathematics III

207006: Engineering Mathematics-III

Credits

Th: 03

Unit I: Linear Differential Equations (LDE) and Applications

LDE of nth order with constant coefficients, Complementary Function, Particular Integral, General method, Short methods, Method of variation of parameters, Cauchy's and Legendre's DE, Simultaneous and Symmetric simultaneous DE. Modeling of Electrical circuits.

Unit II: Laplace Transform (LT)

Definition of LT, Inverse LT, Properties & theorems, LT of standard functions, LT of some special functions viz. Periodic, Unit Step, Unit Impulse. Applications of LT for solving Linear differential equations.

Unit III: Fourier and Z - transforms

Fourier Transform (FT): Complex exponential form of Fourier series, Fourier integral theorem, Fourier Sine & Cosine integrals, Fourier transform, Fourier Sine & Cosine transforms and their inverses.

Z - Transform (ZT): Introduction, Definition, Standard properties, ZT of standard sequences and their inverses. Solution of difference equations.

Unit IV: Statistics and Probability

Measures of central tendency, Measures of dispersion, Coefficient of variation, Moments, Skewness and Kurtosis, Correlation and Regression, Reliability of Regression estimates.

Probability, Probability density function, Probability distributions: Binomial, Poisson, Normal, Test of hypothesis: Chi-square test.

Unit V: Vector Calculus

Vector differentiation, Gradient, Divergence and Curl, Directional derivative, Solenoidal and Irrotational fields, Vector identities. Line, Surface and Volume integrals, Green's Lemma, Gauss's Divergence theorem and Stoke's theorem.

Unit VI: Complex Variables

Functions of a Complex variable, Analytic functions, Cauchy-Riemann equations, Conformal mapping, Bilinear transformation, Cauchy's integral theorem, Cauchy's integral formula and Residue theorem.

Text Books:

1. Higher Engineering Mathematics by B.V. Ramana (Tata McGraw-Hill).
2. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).

Reference Books:

1. Advanced Engineering Mathematics, 10e, by Erwin Kreyszig (Wiley India).
2. Advanced Engineering Mathematics, 2e, by M. D. Greenberg (Pearson Education).
3. Advanced Engineering Mathematics, 7e, by Peter V. O'Neil (Cengage Learning).
4. Differential Equations, 3e by S. L. Ross (Wiley India).
5. Introduction to Probability and Statistics for Engineers and Scientists, 5e, by Sheldon M. Ross (Elsevier Academic Press).
6. Complex Variables and Applications, 8e, by J. W. Brown and R. V. Churchill (McGraw-Hill Inc.).

Numerical Methods & Computer Programming

Numerical Methods & Computer Programming

Unit 01 : Numerical Computations, Errors and Concept of root of equation (6hrs)

A) Basic principle of numerical computation. Floating point algebra with normalized floating point technique, Significant digits. Errors: Different types of errors, causes of occurrence and remedies to minimize them, Generalized error formula (Derivation and Numerical)

B) Concept of roots of an equation. Descartes' rule of signs, Intermediate value theorem, Roots of Polynomial Equations using Birge-Vieta method.

Unit 02: Solution of Transcendental and polynomial equation and Curve Fitting: (6hrs)

A) Solution of Transcendental and polynomial equation using Bisection, Regula- Falsi, Newton-Raphson method for single variable and two variables.

B) Curve fitting using least square approximation – First order and second order

Unit 03: Interpolation (6hrs)

Forward, Backward, Central and Divided Difference operators, Introduction to interpolation.

A) Interpolation with equal Intervals - Newton's forward, backward interpolation formula (Derivations and numerical), Stirling's and Bessel's central difference formula (Only numericals)

B) Interpolation with unequal Intervals- Newton's divided difference formula and Lagrange's interpolation (Derivations and numerical).

Unit 04: Numerical Differentiation and Integration (6hrs)

A) Numerical Differentiation using Newton's forward and backward interpolation formula (Derivation and numerical).

B) Numerical Integration: Trapezoidal and Simpson's rules as special cases of Newton-Cote's quadrature technique for single integral. Numerical on double integrals using Trapezoidal and Simpson's 1/3 rd rule.

Unit 05: Solution of linear simultaneous equation (6hrs)

A) Solution of linear simultaneous equation: Direct methods - Gauss elimination method, concept of pivoting – partial and complete. Gauss Jordan method, Iterative methods – Jacobi method and Gauss Seidel method.

B) Matrix Inversion using Gauss Jordan method

Unit 06: Solution of Ordinary Differential Equation (ODE) (6hrs)

A) Solution of First order Ordinary Differential Equation (ODE) using Taylor's series method, Euler's method, Modified Euler's method (Derivation and numerical). Runge-Kutta fourth order method (Numerical).
B) Solution of Second order ODE using 4th order Runge-Kutta method (Numerical)

Electrical Machines - I

Electrical Machines - I

Unit 01: Transformers: (6 Hrs)

Single phase Transformer: Concept of ideal transformer. Corrugated core transformer. Toroidal core Transformer, Useful and leakage flux, its effects. Resistance, leakage reactance and leakage impedance of transformer windings & their effects on voltage regulation and efficiency. Exact and approximate equivalent circuits referred to L.V. and H. V. side of the transformer. Phasor diagrams for no-load and on load conditions. Transformer ratings. Losses in a transformer, their variation with load, voltage & Frequency on no load losses Efficiency and condition for maximum efficiency. All day Efficiency. Auto transformers, their ratings and applications. Comparison with two winding transformers with respect to saving of copper and size.

Unit 02: (6 Hrs)

Transformers:

Polarity test. Parallel operation of single-phase transformers, conditions to be satisfied, loadsharing under various conditions. & Welding Transformer

Three Phase Transformers:

Standard connections of three phase transformers and their suitability for various applications, voltage Phasor diagrams and vector groups. Descriptive treatment of Parallel operation of three phase transformers Scott connection and V connections. Three winding (tertiary windings) transformers

Unit 03: D.C. Machines (Part-1): (6 Hrs)

Construction, main parts, magnetic circuits, poles, yoke, field winding, armature core, Armature windings: Simple lap and wave winding, commutator and brush assembly. Generating action, E.M.F equation, magnetization curve, Flashing of Generator. Motoring action. Types of DC motors, significance of back E.M.F, torque equation, working at no-load and on-load. Losses, power flow diagram and efficiency. Descriptive treatment of armature reaction.

Unit 04: D.C. Machines (Part-2): (6 Hrs)

Characteristics and applications of D.C. Shunt and Series Motors, Starting of DC motors, study of starters for series and shunt motor, solid state starters, speed control of various types of DC motors.

Commutation: Process of commutation, time of commutation, reactance voltage, different form

Unit 05: Three Phase Induction Motor: (6 Hrs)

Construction: Stator, Squirrel cage & wound rotors. Production of rotating mmf. Principle of working, simplified theory with constant air gap flux; slip, frequency of rotor emf and rotor currents, mmf produced by rotor currents, its speed w.r.t. rotor and stator mmf. Production of torque, torque-slip relation, condition for maximum torque, torque-slip Characteristics, effect of rotor resistance on torque-slip characteristics. Relation between starting torque, full load torque and maximum torque. Losses in three phase induction motor, power-flow diagram, Relation between rotor input power, rotor copper loss & gross mechanical power developed, efficiency.

Unit 06: Three Phase Induction Motor: (6 Hrs)

Induction motor as a generalized transformer; phasor diagram. Exact & approximate equivalent circuit. No load and blocked rotor tests to determine the equivalent circuit parameters and plotting the circle diagram. Computation of performance characteristics from the equivalent circuit and circle diagram. Performance curves. Necessity of starter for 3-phase induction motors. Starters for slip-ring and cage rotor induction motors, comparison of various

starters. Testing of three phase induction motor as per IS 325 & IS 4029.

Network Analysis

Unit 1 Types of Network, Mesh and Nodal analysis

Lumped and Distributed, Linear and Nonlinear, Bilateral and Unilateral, Time-variant and Time-invariant. Independent and Dependent (controlled) voltage and current sources. Concept of

voltage and current divider, Source transformation and shifting.

Network Equations: Network equations on Loop basis and Node basis, choice between Loop analysis and Nodal analysis.

Concept of super node and super mesh, mutual inductance, Dot convention for coupled circuits,

Concept of duality and dual networks.

Unit 2: Network Theorem

Superposition, Thevenin, Norton, Maximum Power Transfer Theorem, Reciprocity, Millman

theorems applied to electrical networks with all types of sources.

Graph Theory : Tree ,Co-tree, Incidence matrix ,F-cutset Matrix, Tie set B Matrix

Unit 3: Transients in RLC circuit

Solutions of differential equations and network equations using classical method for R-L, R-C

and R-L-C circuits, Initial and Final Condition (series and parallel).

Unit 4: Laplace Transform

Basic Properties of Laplace Transform, Laplace Transform of Basic R, L and C components,

Solutions of differential equations and network equations using Laplace transform method for

RL, R-C and R-L-C circuits (series and parallel), Inverse Laplace transforms, transformed

networks with initial conditions. Analysis of electrical circuits with applications of step, pulse,

impulse & ramp functions, shifted & singular functions the convolution integral,application of initial and final value theorem.

Unit 5 Two port network and Filters

Two Port Network: Z, Y, H and transmission parameters,

Interrelations between parameters.

Introduction to passive filters, low pass filters, high pass filters and m-derived LPF and HPF

filters and design.

Unit 6 Network Functions:

Poles and Zeros: Terminal pairs or ports, network functions for the one port and two ports, the calculation of network functions, general networks. Poles and zeros of network functions,

Restrictions on poles and zeros locations for transfer functions and driving point function, Time -domain behavior from the pole and zero plot. Stability of active networks. Parallel Resonance, Resonance frequency, Quality factor, Current and resonance.

Fundamentals of Micro-Controllers and Applications

Unit 01 :

Introduction to concept of microcontroller, Intel 8051 Functional block diagram, Functions of pins of 8051, Memory organization of 8051, PSW and Flag Bits, Stack and Stack pointer.

Overview of special function registers, Data transfer instructions and programs in assembly language.

Unit 02 :

Arithmetic and logical instructions and programs in assembly language. Boolean and Program

Branching instructions and programs in assembly language. Addressing modes of 8051.

Unit 03 :

8051 Programming in C , Data types in C . Ports of 8051, their use, and programming in C (Byte Level and Bit-level). Time delay programming in C.

Timers and counters in 8051, Timer modes 0,1,2 and its programming in C and counter-programming.

Unit 04 :

Interrupt structure of 8051 and SFR associated with interrupts Programming of External hardware interrupts in C. Interfacing of ADC 0809 with 8051.

Unit 05 :

Serial port Structure in 8051. Programming of Serial port for transferring and receiving data in C in mode 1.

Introduction to GSM module, AT commands, Programming to send and read SMS.

Unit 06 :

Measurement of electrical parameters such as voltage, current (Theoretical Treatment only).

Interfacing of Stepper motor with 8051 and its programming in C. Interfacing and programming of single Key, LED, and Relay with 8051 in C.

Power System I

Power System-I

Unit 01: Structure of Electrical Power Systems and Tariff [6Hrs]

A) Structure of Electrical Power Systems: Structure of electrical power system, Different factors associated with generating stations such as Connected load, Maximum demand, Demand factor, Average load, Load factor, diversity factor, Plant capacity factor, Reserve capacity, Plant use factor, Load curve, Load duration curve, Concept of baseload and peak load stations, Advantages of interconnected grid system, Fitting of available generating station into the area load duration curve. [4 Hrs]

B) Tariff: Introduction of Tariff, Tariff setting principles, desirable characteristics of tariff, various consumer categories and implemented tariff such as two part tariff, three part tariff (Numerical on two part and three part tariff), Time of day tariff for H.T and L.T industrial and commercial consumers, Introduction to Availability based tariff (ABT), kVAh tariff (Descriptive treatment only). [2 Hrs]

Unit 02 Major Electrical Equipment's in Power Station & Underground Cables [6Hrs]

A) Major Electrical Equipment's in Power Station: Descriptive treatment of ratings of various equipment used in power station, Special features, field of use of equipment like alternators, necessity of exciters, various excitation systems such as dc excitation, ac excitation and static excitation systems, Power transformers, voltage regulators, bus-bars, current limiting reactors, circuit breakers, protective relays. Current transformers, potential transformers, Lightning arresters, Earthing switches, isolators, Carrier current

equipment's (P.L.C.C), Control panels, battery rooms, metering and other control room equipment in generating station. [3Hrs]

B) Underground Cables: Construction of Cables, Classification of cables, XLPE cables, Capacitance of single core and three core cable, Dielectric stresses in single core cable, Grading of cables, inter sheath grading, capacitance grading. [3Hrs]

Unit 03: Mechanical Design of Overhead lines and Insulators: [6Hrs]

A) Mechanical Design of Overhead lines: Main components of overhead lines, Various types of line supports, Conductor spacing, Length of span, Calculation of sag for equal and unequal supports and effect of ice and wind loading. [3Hrs]

B) Overhead Line Insulators: Types of insulators, its construction and their applications such as Pin type, Suspension type, Strain type, Shackle type, Post insulators, bushing. Potential distribution over suspension insulators, String efficiency, (Numerical on string efficiency and up to four discs only), Methods of improving string efficiency (Descriptive treatment only). [3Hrs]

Unit 04: Resistance and Inductance of Transmission Line: [6Hrs]

Resistance of transmission line, Skin effect and proximity effect, Factors responsible for production of these effects, Internal and external flux linkages of single conductor, Inductance of single phase two wire line, Necessity of transposition, Inductance of three phase line with symmetrical and unsymmetrical spacing with transposition, Concept of G.M.R and G.M.D, Inductance of bundled conductors

Unit 05: Capacitance of Transmission Line: [6Hrs]

Electric potential at single charged conductor, Potential at conductor in a group of charged conductors, Capacitance of single phase line, Capacitance of single phase line with effect of earth's surface on electric field, Concept of G.M.R and G.M.D for capacitance calculations, need of transposition for capacitance calculations, Capacitance of three phase line with symmetrical and unsymmetrical spacing with transposition. Capacitance of single circuit and double circuit three phase line with symmetrical and unsymmetrical spacing considering transposition (without considering earth effect).

Unit 06: Performance of Transmission Line [6Hrs]

Classification of lines based on length and voltage levels such as

short, medium and long lines, Performance of short transmission lines with voltage current relationship and phasor diagram, Representation of medium lines as 'Nominal Π ' and 'Nominal T' circuits using R,L and C parameters, Ferranti effect, Representation of 'T' and ' Π ' models of lines as two port networks, Evaluation and estimation of generalized circuit constants (ABCD) for short and medium lines, Estimation of efficiency and regulation of short and medium lines.

Digital Electronics

ESC 401 Digital Electronics

5 Credits

Module 1

Fundamentals of Digital Systems and logic families: Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri - state logic.

Module 2

Combinational Digital Circuits: Standard representation for logic functions K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, DeMultiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

Module 3

Sequential circuits and systems: A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T and D types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops,

special counter IC's, asynchronous sequential counters, applications of counters.

Module 4

A/D and D/A Converters: Digital to analog converters: weighted resistor/converter, R-2RLadder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using Voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs.

Module 5

Semiconductor memories and Programmable logic devices:

Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

Suggested books:

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

Electrical Machines - II

Electrical Machines - II

Module 1: Fundamentals of AC machine windings

Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single-turn coil – active portion and overhang; full- pitch coils, concentrated winding, distributed winding, winding axis, 3D visualization of the above winding types, Air-gap MMF distribution with fixed current through winding- concentrated and distributed, Sinusoidally distributed

winding, winding distribution factor

Module 2: Pulsating and revolving magnetic fields

Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement, Magnetic field produced by a single winding - fixed current and alternating current
Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees,

Addition of pulsating magnetic fields, Three windings spatially shifted by 120 phase balanced currents), revolving magnetic field.

Module 3: Induction Machines

Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum

Torque. Equivalent circuit. Phasor Diagram, Losses and Efficiency. Blocked rotor test, No- Load test, Determination of Parameters and power flow diagram. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-Fed Induction Machines.

Module 4: Single-phase induction motors

Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications. Methods of starting using auxiliary winding, development of equivalent circuit. No-Load and Blocked Rotor tests.

Module 5: Special Machines

Basics of Hysteresis motor, Switched Reluctance motor, Stepper motor, Brushless DC motor
Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V-curves. Salient pole machine - two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division.

Electrical and Electronics Measurement

Electrical and Electronics Measurement

Module 1: Measurement and Error (8 Hours)

Measurement and Error: Definition, Accuracy and Precision, Significant Figures, Types of Errors.

Standards of Measurement: Classification of Standards, Electrical Standards, IEEE Standards. Types of measuring instrument: Ammeter and Voltmeter: Derivation for Deflecting Torque of; PMMC, MI (attraction and repulsion types), Electro Dynamometer and Induction type Ammeters and Voltmeters. Energy meters and wattmeter.: Construction, Theory and Principle of operation of Electro-Dynamometer and Induction type wattmeter, compensation, creep, error, testing, Single Phase and Poly phase Induction type Watt-hour meters. Frequency Meters: Vibrating reed type, electrical resonance type, Power Factor Meters.

Module 2: Measurement of Resistance, Inductance and Capacitance: (8 Hrs)

Resistance: Measurement of Low Resistance by Kelvin's Double Bridge, Measurement of Medium Resistance, Measurement of High Resistance, Measurement of Resistance of Insulating Materials, Portable Resistance Testing set (Megohmmeter), Measurement of Insulation Resistance when Power is ON, Measurement of Resistance of Earth Connections. Inductance: Measurement of Self Inductance by Ammeter and Voltmeter, and AC Bridges (Maxwell's, Hay's, & Anderson Bridge), Measurement of Mutual Inductance by Felici's Method, and as Self Inductance. Capacitance: Measurement of Capacitance by Ammeter and Voltmeter, and AC Bridges (Owen's, Schering & Wien's Bridge), Screening of Bridge Components and Wagnor Earthing Device.

Module 3: (8 Hrs)

Galvanometer: (5 Hrs) Construction, Theory and Principle of operation of D'Arsonval, Vibration (Moving Magnet & Moving Coil types), and Ballistic

Galvanometer, Influence of Resistance on Damping, Logarithmic decrement, Calibration of Galvanometers, Galvanometer Constants, Measurement of Flux and Magnetic Field by using Galvanometers. Potentiometer: Construction, Theory and Principle of operation of DC Potentiometers (Crompton, Vernier, Constant Resistance, & Deflection Potentiometer), and AC Potentiometers (Drysdale-Tinsley & Gall-Tinsley Potentiometer).

Module 4 :(8 Hrs)

Current Transformer and Potential Transformer :(3 Hrs)

Construction, Theory, Characteristics and Testing of CTs and PTs. Electronic Instruments for Measuring Basic Parameters:(2 Hrs) Amplified DC Meters, AC Voltmeters using Rectifiers, True RMS Voltmeter, Considerations for choosing an Analog Voltmeter, Digital Voltmeters (Block Diagrams only), Q-meter Oscilloscope:(3 Hrs) Block Diagrams, Delay Line, Multiple Trace, Oscilloscope Probes, Oscilloscope Techniques, Introduction to Analog and Digital Storage Oscilloscopes, Measurement of Frequency, Phase Angle, and Time Delay using Oscilloscope

Engineering Mathematics - III

207005: Engineering Mathematics - III

Credit 04 + 01 = 05

Unit I Linear Differential Equations (LDE) and Applications

LDE of nth order with constant coefficients, Complementary Function, Particular Integral, General method, Short methods, Method of variation of parameters, Cauchy's and Legendre's DE, Simultaneous and Symmetric simultaneous DE. Modeling of Electrical circuits.

Mapping of Course Outcomes for Unit I CO1: Solve higher order linear differential equation using appropriate techniques for modelling, analyzing of electrical circuits and control systems.

Unit II Transforms

Fourier Transform (FT): Complex exponential form of Fourier

series, Fourier integral theorem, Fourier Sine & Cosine integrals, Fourier transform, Fourier Sine and Cosine transforms and their inverses.

Z - Transform (ZT): Introduction, Definition, Standard properties, ZT of standard sequences and their inverses. Solution of difference equations.

Mapping of Course Outcomes for Unit II CO2: Apply concept of Fourier transform & Z-transform and its applications to continuous & discrete systems, signal & image processing and communication systems.

Unit III Numerical Methods

Interpolation: Finite Differences, Newton's and Lagrange's Interpolation formulae, Numerical Differentiation.

Numerical Integration: Trapezoidal and Simpson's rules, Bound of truncation error,

Solution of Ordinary differential equations: Euler's, Modified Euler's, Runge-Kutta 4th order methods and Predictor-Corrector methods.

Mapping of Course

Outcomes for Unit III CO3: Obtain Interpolating polynomials, numerically differentiate and integrate functions, numerical solutions of differential equations using single step and multi-step iterative methods used in modern scientific computing.

Unit IV Vector Differential Calculus

Physical interpretation of Vector differentiation, Vector differential operator, Gradient, Divergence and Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, Vector identities.

Mapping of Course Outcomes for Unit IV CO4: Perform vector differentiation & integration, analyze the vector fields and apply to electro- magnetic fields & wave theory.

Unit V Vector Integral Calculus & Applications

Line, Surface and Volume integrals, Work-done, Green's Lemma, Gauss's Divergence theorem, Stoke's theorem. Applications to problems in Electro-magnetic fields.

Mapping of Course Outcomes for Unit V CO4: Perform vector differentiation & integration, analyze the vector fields and apply to electro- magnetic fields & wave theory.

Unit VI Complex Variables

Functions of a Complex variable, Analytic functions, Cauchy-Riemann equations, Conformal mapping, Bilinear transformation, Cauchy's integral theorem, Cauchy's integral formula and Residue theorem.

Mapping of Course Outcomes for Unit VI CO5: Analyze Complex functions, Conformal mappings, Contour integration applicable to electrostatics, digital filters, signal and image processing.

Learning Resources

Text Books:

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill.
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publication, New Delhi.

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, 10th Edition.
2. M.D. Greenberg, "Advanced Engineering Mathematics", Pearson Education, 2nd Edition.
3. Peter. V and O'Neil, "Advanced Engineering Mathematics", Cengage Learning, 7th Edition.
4. S.L. Ross, "Differential Equations", Wiley India, 3rd Edition.
5. S. C. Chapra and R. P. Canale, "Numerical Methods for Engineers", McGraw-Hill, 7th Edition.
6. J. W. Brown and R. V. Churchill, "Complex Variables and Applications", McGraw-Hill Inc, 8th Edition.

Mathematics-IV

Subject Code KAS302/KAS402

Mathematics-IV

(PDE, Probability and Statistics)

Module I: Partial Differential Equations

Origin of Partial Differential Equations, Linear and Non Linear Partial Equations of first order,

Lagrange's Equations, Charpit's method, Cauchy's method of Characteristics, Solution of Linear Partial Differential Equation of Higher order with constant coefficients, Equations reducible to linear partial differential equations with constant coefficients.

Module II: Applications of Partial Differential Equations:

Classification of linear partial differential equation of second order, Method of separation of variables, Solution of wave and heat conduction equation up to two dimension, Laplace equation in two dimensions, Equations of Transmission lines.

Module III: Statistical Techniques I:

Introduction: Measures of central tendency, Moments, Moment generating function (MGF) , Skewness, Kurtosis, Curve Fitting , Method of least squares, Fitting of straight lines, Fitting of second degree parabola, Exponential curves ,Correlation and Rank correlation, Regression
Analysis: Regression lines of y on x and x on y , regression coefficients, properties of regressions coefficients and non linear regression.

Module IV: Statistical Techniques II:

Probability and Distribution: Introduction, Addition and multiplication law of probability, Conditional probability, Baye's theorem, Random variables (Discrete and Continuous Random variable) Probability mass function and Probability density function, Expectation and variance,
Discrete and Continuous Probability distribution: Binomial, Poission and Normal distributions.

Module V: Statistical Techniques III:

Sampling, Testing of Hypothesis and Statistical Quality Control: Introduction , Sampling Theory (Small and Large) , Hypothesis, Null hypothesis, Alternative hypothesis, Testing a Hypothesis, Level of significance, Confidence limits, Test of significance of difference of means, T-test, F-test and Chi-square test, One way Analysis of Variance (ANOVA).Statistical Quality Control (SQC) , Control Charts , Control Charts for variables (X and

R Charts), Control Charts for Variables (p , np and C charts).

Text Books

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003(Reprint).
3. S. Ross: A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.

Reference Books

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
2. T. Veerarajan : Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi.
3. R.K. Jain and S.R.K. Iyenger: Advance Engineering Mathematics; Narosa Publishing House, New Delhi.
4. J.N. Kapur: Mathematical Statistics; S. Chand & Sons Company Limited, New Delhi.
5. D.N. Elhance, V. Elhance & B.M. Aggarwal: Fundamentals of Statistics; Kitab Mahal Distributers, New Delhi

Sensor and Instrumentation

Unit- I:

Sensors & Transducer: Definition, Classification & selection of sensors, Measurement of displacement using Potentiometer, LVDT & Optical Encoder, Measurement of force using strain gauge, Measurement of pressure using LVDT based diaphragm & piezoelectric sensor.

Unit-II:

Measurement of temperature using Thermistor, Thermocouple & RTD, Concept of thermal imaging, Measurement of position using Hall effect sensors, Proximity sensors:

Inductive & Capacitive, Use of proximity sensor as accelerometer and vibration sensor, Flow Sensors: Ultrasonic & Laser, Level Sensors: Ultrasonic & Capacitive.

Unit -III:

Virtual Instrumentation: Graphical programming techniques, Data types, Advantage of Virtual Instrumentation techniques, Concept of WHILE & FOR loops, Arrays, Clusters & graphs, Structures: Case, Sequence & Formula nodes, Need of software based instruments for industrial automation.

Unit-IV:

Data Acquisition Methods: Basic block diagram, Analog and Digital IO, Counters, Timers, Types of ADC: successive approximation and sigma-delta, Types of DAC: Weighted Resistor and R-2R Ladder type, Use of Data Sockets for Networked Communication.

Unit V:

Intelligent Sensors: General Structure of smart sensors & its components, Characteristic of smart sensors: Self calibration, Self-testing & self-communicating, Application of smart sensors: Automatic robot control & automobile engine control.

Digital Circuits

EC104 Digital Circuits

1 Digital Principle : Analog vs Digital, Number system, Computer Codes, Digital Signals, Waveforms Positive and Negative logic, Logic Gate : basic, universal and others, Truth Table, Logic functions, IC Chips, Timing Diagram, Electrical analogy.

2 Boolean laws and theorems : Logic functions, Conversion of logic functions into truth table and vice versa. SOP and POS forms of representation, Canonical form, minterms and maxterms, Simplification of logic functions by theorems and Karnaugh's map, don't care conditions.

3 Analysis and synthesis of Combinational logic circuits:

Comparators, Multiplexers, Encoder, Decoder, 7 Segment Display, Half Adder and Full Adder, Subtractors, Serial and Parallel Adders,

4 Sequential circuit blocks and latches : Flip-Flops-Race around condition, Master-Slave and Edge triggered SR, JK, D and T Flip Flop, Shift registers, Counters-Synchronous and Asynchronous: Design of ripple counter

5 Timing circuit : Multivibrators, Monostable and Astable timer: LM555

6 Integrated circuit logic families : RTL, DTL, TTL, CMOS, IIL/I2L (In-tegrated Injection logic and Emitter Coupled logic).

7 Use of building blocks : Designing larger systems such as Digital-to-Analog Converters (DAC) : Weighted resistors and R-2R, Analog-to-Digital(ADC)- converter, counter and succession.

Name of Authors / Books /Publishers

- 1 "Digital Fundamentals", Floyd and Jain., Pearson
- 2 "Digital Logic and Computer Design", M.Morris Mano, Pearson
- 3 "Fundamentals of Digital Circuits", A.Anand Kumar, PHI
- 4 "Digital Systems", Ronald J.Tocci, Neal S.Widmer, Pearson

Analog Communication

EC107 Analog Communication

1. Introduction to the communication system : Block diagram of communication system and comparative study of analog and digital communication.

2 Modulation(upward frequency translation) and demodulation (downward frequency translation) and the need for modulation: broad classification of modulation [linear (amplitude-AM) and exponential (frequency-FM and phase-PM)]

3 Generation of double side band (DSB) with carrier, double side band with suppressed carrier (DSB-SC) and single side band with suppressed carrier: De-modulation of double side band with carrier -incoherent detector or envelope detector, peak diode detector, coherent or synchronous detection of DSBSC and single side band with suppressed carrier.

4 Superhetrodyne Receivers : Characteristics , Intermediate

Frequency and its advantages, image rejection of the Receiver.

5 Generation of FM signals(direct and indirect methods) and Demodulation.

6 Noise: Different types of Noise, SNR in AM, FM and PM System and use of emphasis Circuit in FM for SNR optimization.

7 Analog pulse modulation : PAM, PWM, PPM and demodulation; comparative study of various analog pulse modulation

Analog Circuits

EC105 Analog Circuits

UNIT-1

Small signal amplifiers: CB, CE, CC configurations, hybrid model for transistor at low frequencies, RC coupled amplifiers, mid-band model, gain and impedance, comparisons of different configurations, Emitter follower, Darlington pair (derive voltage gain, current gain, input, and output impedance). Hybrid-model at high frequencies (pi - model).

UNIT- 2

Multistage Amplifiers: Cascade and Cascode amplifiers, Calculations of gain, impedance, and bandwidth. Design of multistage amplifiers. Feedback Amplifiers: Feedback concept, Classification of Feedback amplifiers, Properties of negative Feedback amplifiers, Impedance considerations in different configurations. Analysis of feedback Amplifiers.

UNIT-3

Field Effect Transistor: Introduction, Classification, FET characteristics, The operating point, Biasing, FET small-signal Model, Enhancement and Depletion type MOSFETs, FET Amplifier configurations (CD, CG, and CS).

UNIT 4

Oscillators: Barkhausen criterion, Sinusoidal Oscillators, the RC phaseshift oscillator, resonant circuit Oscillators, a general form of

the oscillator circuit, the Wien -bridge oscillator, Crystal oscillators, Hartley, Colpitt's and Clapp's Oscillator.

UNIT 5

Power Amplifiers: Power dissipations in transistors, Amplifiers Classification, (Class-A, Class-B, Class-C, Class-AB) Efficiency analysis, Push-Pull and Complementary Push-pull amplifiers Cross over distortion and Harmonic distortion in Push-Pull amplifier. Tuned amplifiers (single, double, and stagger tuned amplifier).

Semiconductor Physics and Devices

EC106 Semiconductor Physics and Devices

1 Basics of Semiconductor Physics : Semiconductor carrier modelling- Bonding model, Energy band model, Carriers, Band gap, Carrier properties (Effective mass, Intrinsic carrier concentration, Doping), Density of states, Fermi function, Equilibrium carrier concentration (formula for n and p and np product), Charge neutrality relationship, Determination of Fermi level, Carrier concentration, Temperature dependence.

Carrier Action - Drift, Mobility, Drift Current, Resistivity, Diffusion Current, Total current, Relation between the diffusion constants and mobility (Einstein's relationship), Recombination-Generation (Band-to-Band, R-G Centres, Auger, Impact Ionization). Equation of state, Continuity equation, Minority Carrier Diffusion Equation.

2 PN Junction Diode : Step junction, Built-in potential, Depletion width, Depletion Approximation, Electrostatic relationship (Charge density, Depletion width, Potential, Electric field) for $V_a = 0$, $V_a > 0$ and $V_a < 0$, Ideal Diode Equation (Qualitative and Quantitative derivation : Band Model, Assumptions, Approximation, Boundary condition), Deviation from Ideal (R-G Current, Series resistance, High Level Injection), Junction Breakdown (Avalanche and Zener), Reverse Bias Junction Capacitance, forward Bias Diffusion Capacitance, Qualitative understanding of Turn on and Turn-off transients. Zener Diode, Tunnel diode, Varactor diode, Schottky diode.

3 Physics and technologies of BJT : Operational considerations, Modes and Configurations, Performance Parameters (Emitter Efficiency, Base Transport Factor, Common Base Current Gain, Common Emitter Current Gain and their derivation for an ideal transistor, Deviation from ideal (Base Width Modulation Punch Through, Avalanche Breakdown, Geometrical effects, R-G current),

Small signal modelling.

4 Physics and technologies of FET : JUNCTION FET (Theory of operation, I-V relationship), MOS CAPACITOR (Energy Band diagram, Gate-Voltage relationship, Capacitance-Voltage characteristics), MOSFET (Theory of operation, Threshold voltage, I-V characteristics), NON IDEAL MOS (M-S work function difference, oxide charges, threshold adjustment and considerations)

5 Introduction to UJT, SCR, Triac and Diac (Construction, Working, Characteristics and Application), UJT Relaxation oscillator.

Optoelectronic Devices : Photo diodes (PIN and Avalanche), Solar cell, LED, Solid State LASER diodes.

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