GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

ELECTRO MAGNETIC FIELDS

Course Code: GR15A2034 L:3 T:1 P:0 C:4
II Year I Semester

Prerequisites: Knowledge of Basic Electrical and Electronics Engineering (BEE), Vector Algebra.

Course Objectives: At the end of the course the student is expected to

- To acquire the knowledge of Electromagnetic field theory that allows the student to have a solid theoretical foundation to be able in the future to design emission, propagation and reception of electro- magnetic wave systems
- To identify, formulate and solve fields and electromagnetic waves propagation problems in a multi- disciplinary frame individually or as a member of a group
- To provide the students with a solid foundation in engineering fundamentals required to solve problems and also to pursue higher studies

Course Outcomes

- Ability to solve the problems in different EM fields
- Ability to design a programming to generate EM waves subjected to the conditions
- Applications of EM Waves in different domains and to find the time average power density
- Ability to Solve Electromagnetic Relation using Maxwell Formulae
- Ability to Solve Electro Static and Magnetic to Static circuits using Basic relations
- Ability to Analyze moving charges on Magnetic fields
- Ability to Design circuits using Conductors and Dielectrics

Unit–I

Electrostatics: Electrostatic Fields Coulomb's Law ,Electric Field Intensity (EFI) EFI due to a line and a surface charge, Work done in moving a point charge in an electro static field, Electric Potential, Properties of potential function, Potential gradient, Guass's law ,Application of Guass's Law, Maxwell's first law, div (D) =ρ_v. ,Laplace's and Poison's equations, Solution of Laplace's equation in one variable. Electric dipole, Dipole moment, Potential and EFI due to an electric dipole, Torque on an Electric dipole in an electric field.

Unit–II

Dielectrics &Capacitance: Behaviour of conductors in an electric field, Conductors and Insulators, Electric field inside a dielectric material, Polarization, Dielectric-Conductor and Dielectric-Dielectric boundary conditions, Capacitance, Capacitance of parallel plates, Spherical, Co-axial capacitors with composite dielectrics, Energy stored and energy density in a static electric field, Current density, Conduction and Convection Current densities, Ohm's law in point form. Equation of continuity.

Unit–III

Magneto Statics: Static magnetic fields Biot-Savart's law, Magnetic Field Intensity (MFI),MFI due to a straight current carrying filament, MFI due to circular, square and solenoid current Carrying wire, Relation between magnetic flux and magnetic flux density –Maxwell's second Equation, div(B)=0.
Ampere's Law &Applications: Ampere's circuital law and its applications viz. MFI due to an infinite sheet of current and a long current carrying filament–Point form of Ampere's Circuital law. Maxwell's third equation, Curl (H) =Jc.

Unit–IV

Force in Magnetic fields: Magnetic force Moving charges in a Magnetic field, Lorentz force equation, Force on a current element in a magnetic field, Force on a straight and a long current carrying conductor in a magnetic field, Force between two straight long and parallel current carrying conductors, Magnetic dipole and dipole moment, A differential current loop as a magnetic dipole, Torque on a current loop placed in a magnetic field. Scalar Magnetic potential and its limitations, Vector magnetic potential and its properties, Vector magnetic potential due to simple configurations, Vector Poisson's equations. Self and Mutual inductance, Neumann's formulae, Determination of self- inductance of a solenoid and toroid and mutual inductance between a straight long wire and a square loop wire in the same plane, Energy stored and density in a magnetic field. Introduction to Permanent magnets, their characteristics and applications.

Unit–V

Time Varying Fields: Time varying fields – Faraday's laws of electromagnetic induction, its integral and point forms, Maxwell's fourth equation, Curl (E) =-dB/dt, statically and dynamically induced EMFs, Simple Problems, Modification of Maxwell's equations for time varying fields, Displacement current.

Teaching Methodologies

1. EMF PPTs
2. Assignments uploaded in website
3. Software: MATLAB.

Text Book

1. "Engineering Electro Magnetics" by William H. Hayt& John. A. Buck Mc.Graw-Hill Companies, 7thEditon.2009.
2. "Electro Magnetic Fields" by Sadiku, Oxford Publications

Reference Books

1. "Introduction to Electro Dynamics" by DJ Griffiths, Prentice-Hall of India Pvt.Ltd. 2ndEdition.
2. "Electro Magnetics" by JP Tewari.
3. "Electro Magnetics" by J.D Kraus McGraw-Hill Inc.4th edition 1992.
4. "Electro magnetism" by Ashutosh Pramanik, PHI Publishers.