II Year –I SEMESTER

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ELECTROMAGNETIC FIELD THEORY 23ES3T02

Pre-requisite: Concepts of Differential Equations, Vector Calculus and Analysis.

Course Objectives:

- To study the production of electric field and potentials due to different configurations of static charges.
- To study the properties of conductors and dielectrics, calculate the capacitance of Different configurations. Understand the concept of conduction and convection current Densities.
- To study the magnetic fields produced by currents in different configurations, application of Ampere's law and the Maxwell's second and third equations.
- To study the magnetic force and torque through Lorentz force equation in magnetic field environment like conductors and other current loops.
- To develop the concept of self and mutual inductances and the energy stored.
- To study time varying and Maxwell's equations in different fourth equation for the induced EMF.

Course Outcomes:

At the end of the course, students will be able to,

CO1: Compute electric fields and potentials using Gauss law/ solve Laplace's or Poisson's equations for various electric charge distributions.

CO2: Analyse the behavior of conductors in electric fields, electric diploe and the capacitance and energy stored in dielectrics.

CO3: Calculate the magnetic field intensity due to the current carrying conductor and understanding the application of Ampere's law, Maxwell's second and third law.

CO4: Estimate self and mutual inductances and the energy stored in the magnetic field.

CO5: Understand the concepts of Faraday's laws, Displacement theorem and Poynting vector.

UNIT – I

Electrostatics

Rectangular & Cylindrical Coordinate Systems, Del & Curl operators, Divergence and Stoke's theorems (definitions only). Coulomb's law and Electric field intensity (EFI), EFI due to Continuous charge distributions (line and surface charge), Electric flux density, Gauss's law (Maxwell's first equation, $\nabla . D = \rho v$), Applications of Gauss's law, Electric Potential, Work done in moving a point charge in an electrostatic field (second Maxwell's equation for static electric fields, $\nabla \times E = 0$), Potential gradient, Laplace's and Poison's equations.

UNIT - II

Conductors – Dielectrics and Capacitance

Ohm's law in point form, Behavior of conductors in an electric field, Polarization, dielectric constant and strength, Continuity equation and relaxation time, Boundary conditions between conductor to dielectric, dielectric to dielectric and conductor to free space, Capacitance of parallel plate, coaxial and spherical capacitors, Energy stored and density in a static electric field.

Signature								
Name	Dr.B.Muthuvel Chairman BOS	Dr.N.Sumathi Member	Dr.K. Siva Kumar, Member	Dr.M.Gopichand NaikMember	Mr.T.Veerababu, Member	Dr.K.Bapayya Naidu,Member	Dr.JVG Ramarao,Member	Prof.ANVJ Raja Gopal, Member

UNIT - III

Magneto statics, Ampere's Law and Force in magnetic fields:

Biot-Savart's law and its applications viz. Straight current carrying filament, circular, square, rectangle and solenoid current carrying wire – Magnetic flux density and Maxwell's second Equation ($\nabla . \vec{B} = 0$), Ampere's circuital law and its applications viz. MFI due to an infinite sheet, long filament, solenoid, toroidal current carrying conductor, point form of Ampere's circuital law, Maxwell's third equation ($\nabla \times H = J$).

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, Magnetic torque, and moment.

UNIT - IV

Self and mutual inductance:

Self and mutual inductance – determination of self-inductance of a solenoid, toroid, coaxial cable and mutual inductance between a straight long wire and a square loop wire in the same plane – Energy stored and energy density in a magnetic field.

UNIT - V

Time Varying Fields:

Faraday's laws of electromagnetic induction, Maxwell's fourth equation($\nabla \times \vec{E} = -db/dt$) integral and point forms of Maxwell's equations, statically and dynamically induced EMF, Displacement current, Modification of Maxwell's equations for time varying fields, Poynting theorem and Poynting vector.

Textbooks:

1."Elements of Electromagnetics" by Matthew N O Sadiku, Oxford Publications, 7th edition, 2018.
2."Engineering Electromagnetics" by William H. Hayt & John. A. Buck Mc. Graw -Hill, 7th Editon.2006.

Reference Books:

1. "Introduction to Electro Dynamics" by D J Griffiths, Prentice-Hall of India Pvt. Ltd, 2nd edition.
2. "Electromagnetic Field Theory" by Yaduvir Singh, Pearson India, 1st edition, 2011.
3. "Fundamentals of Engineering Electromagnetics" by Sunil Bhooshan, OxfordUniversity Press, 2012.
4. Schaum's Outline of Electromagnetics by Joseph A. Edminister, MahamoodNavi, 4th Edition,2014.

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/108/106/108106073/
2. https://nptel.ac.in/courses/117103065

Signature								
Name	Dr.B.Muthuvel, Chairman BOS	Dr.N.Sumathi Member	Dr.K.Siva Kumar, Member	Dr.M.Gopichand NaikMember	Mr.T.Veerababu, Member	Dr.K.Bapayya Naidu,Member	Dr.JVG Ramarao,Member	Prof ANVJ Raja Gopal, Member