II Year I Semester **L T P C**

Code: 20EE3003 **3 0 0 3**

ELECTRO MAGNETIC FIELD THEORY

Preamble: The purpose of this course is to understand and interpret the phenomenon pertinent to electrical engineering using electric and magnetic intensities.

Course Objectives

1. To understand and analyze the concepts of Coulombs Law, Gauss's law and Electric filed intensity
2. To understand the concept of capacitance.
3. To understand and analyze the concepts of Biot-Savart's law, Ampere's circuit law
4. To understand and analyze the concepts of Lorenz force equation, self and mutual inductances.
5. To understand the concepts of Faraday's laws, poynting theorem and Maxwell's equations for time varying fields.

Course Outcomes

1. Able to state and apply the Coulombs Law and Gauss's law and Calculate electric field and potentials using gauss's law
2. Able to compute capacitance of different configurations and to analyze the behaviour of dielectrics at different boundary conditions.
3. Able to state and apply the Biot-Savart law and Ampere's circuit law to calculate magnetic field intensity.
4. Able to Evaluate the magnetic force and dipole moment in magnetic field and analyze the self and mutual inductances and energy densities in a magnetic field.
5. Able to Evaluate pointing vector and Maxwell's equation for time varying fields.

CO – PO & CO – PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	1	-	-	-	-	1	1	1	-
CO2	2	3	-	-	-	-	1	-	-	-	-	1	1	1	-
CO3	3	3	-	-	-	-	1	-	-	-	-	1	1	1	-
CO4	2	3	-	-	-	-	1	-	-	-	-	1	1	1	-
CO5	3	3	-	-	-	-	1	-	-	-	-	1	1	1	-

1 – Weak, 2 – Moderate and 3 – Strong

Unit – I: Static Electric fields and its applications **15 Hours**

Types of charge distributions. Line, surface and volume integrals, - Coulomb's law- Electric field intensity- Electric field intensity due to a line and a surface charge-, Gauss' law-Maxwell's first equation in integral and point form,Divergence and curl of electrostatic field - -Applications of Gauss' law-.

Unit – II: Conductors, Dielectrics and Capacitors **15 Hours**

Electric potential- properties of potential function and potential gradient, Current density-conduction and convection current density- Ohm's law in point form- continuity equation-conductors and dielectric material- behavior of conductors in an electric field- boundary conditions-polarization-Electric dipole, Potential and torque due to electric dipole- capacitance-capacitance of parallel plate, spherical and co-axial capacitors, composite dielectrics. Energy stored and density static electric field- Laplace and Poisson's equations.

Unit – III: Steady State Magnetic Fields **10 Hours**

Biot-savart's law, Magnetic field intensity (MFI)- MFI due to a straight current carrying filament, circular, square and solenoid. Relation between magnetic flux, magnetic flux density and MFI- Maxwell's second equation div(B)=0- Ampere's circuital law. MFI due to infinite sheet of current and a long current carrying filament, circular loop, rectangular loop, and square loop. Stokes's theorem -point form of Ampere's circuital law- Maxwell's third equation curl(H)=J.

Unit – IV: Magnetically Coupled Circuits and Inductance **10 Hours**

Magnetic force, Lorentz's force equation- Force on long current carrying conductor in a magnetic field- force between two straight, long and parallel current carrying conductors-magnetic dipole and dipole moment-Torque on current loop placed in a magnetic field- self and mutual inductance of a solenoid, toroid, co-axial cable. Energy stored and density in a magnetic field.

Unit – V: Time varying Electromagnetic fields **10 Hours**

Time varying fields, Modification of Ampere's law, - Faraday's laws of electromagnetic induction-Integral and point forms- Maxwell's fourth equation. Modification of Maxwell's equation for time varying fields, Numerical problems. Poynting theorem and Poynting vector.

Text Books:

1. Engineering Electromagnetics, W.H. Hayt Jr. McGraw Hill – New York .
2. Elements of Electromagnetics, M.N.O. Sadiku, Oxford press, 2002.
3. Introduction to Electro-dynamics, David J.Griffiths, PHI.

Reference Books:

1. EM Waves and Radiating Systems, E.C. Jordan, PHI, 1997.
2. Electromagnetics with applications, Kraus and Fleisch, McGraw Hill, 1999
3. Nathan Ida: Engg. Electromagnetics, Springer 2nd Edition, 2005