

B. E. ELECTRICAL AND ELECTRONICS ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - IV

ELECTROMAGNETIC FIELD THEORY

Course Code	18EE45	CIE Marks	40
Number of Lecture Hours/Week	2:2:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives:

- To study different coordinate systems for understanding the concept of gradient, divergence and curl of a vector.
- To study the application of Coulomb's Law and Gauss Law for electric fields produced by different charge configurations.
- To evaluate the energy and potential due to a system of charges.
- To study the behavior of electric field across a boundary between a conductor and dielectric and between two different dielectrics.
- To study the magnetic fields and magnetic materials.
- To study the time varying fields and propagation of waves in different media. ■

Module-1

Vector Analysis: Scalars and Vectors, Vector algebra, Cartesian co-ordinate system, Vector Components and unit vectors. Scalar field and Vector field. Dot product and Cross product, Gradient of a scalar field. Divergence and Curl of a vector field. Co – ordinate systems: cylindrical and spherical, relation between different coordinate systems. Expression for gradient, divergence and curl in rectangular, cylindrical and spherical co-ordinate systems. Numerical.

Electrostatics: Coulomb's law, Electric field intensity and its evaluation for (i) point charge (ii) line charge (iii) surface charge (iv) volume charge distributions. Electric flux density, Gauss law and its applications. Maxwell's first equation (Electrostatics). Divergence theorem. Numerical. ■

Module-2

Energy and Potential: Energy expended in moving a point charge in an electric field. The line integral. Definition of potential difference and potential. The potential field of a point charge and of a system of charges. Potential gradient. The dipole. Energy density in the electrostatic field. Numerical.

Conductor and Dielectrics: Current and current density. Continuity of current. Metallic conductors, conductor's properties and boundary conditions. Perfect dielectric materials, capacitance calculations. Parallel plate capacitor with two dielectrics with dielectric interface parallel to the conducting plates. Numerical. ■

Module-3

Poisson's and Laplace Equations: Derivations and problems, Uniqueness theorem.

Steady magnetic fields: Biot - Savart's law, Ampere's circuital law. The Curl. Stokes theorem. Magnetic flux and flux density. Scalar and vector magnetic potentials. Numerical. ■

Module-4

Magnetic forces: Force on a moving charge and differential current element. Force between differential current elements. Force and torque on a closed circuit. Numerical.

Magnetic Materials and Magnetism: Nature of magnetic materials, magnetisation and permeability. Magnetic boundary conditions. Magnetic circuit, inductance and mutual inductance. Numerical. ■

Module-5

Time Varying Fields and Maxwell's Equations: Faraday's law, Displacement current. Maxwell's equations in point form and integral form. Numerical.

Uniform plane wave: Wave propagation in free space and in dielectrics. Pointing vector and power considerations. Propagation in good conductors, skin effect. Numerical. ■

Course Outcomes: At the end of the course the student will be able to:

- Use different coordinate systems, Coulomb's Law and Gauss Law for the evaluation of electric fields produced by different charge configurations.
- Calculate the energy and potential due to a system of charges & Explain the behavior of electric field across a boundary conditions.
- Explain the Poisson's, Laplace equations and behavior of steady magnetic fields.
- Explain the behavior of magnetic fields and magnetic materials.
- Assess time varying fields and propagation of waves in different media. ■

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of three sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Text Books:

1	Engineering Electromagnetics	William H Hayt et al	McGraw Hill	8 th Edition, 2014
2	Principles of Electromagnetics	Matthew N. O. Sadiku	Oxford	6 th Edition, 2015

Reference Books:

1	Fundamentals of Engineering Electromagnetics	David K. Cheng	Pearson	2014
2	Electromagnetism -Theory (Volume -1) -Applications (Volume-2)	Ashutosh Pramanik	PHI Learning	2014
3	Electromagnetic Field Theory Fundamentals	Bhag Guru et al	Cambridge	2005
4	Electromagnetic Field Theory	Rohit Khurana	Vikas Publishing	1 st Edition, 2014
5	Electromagnetics	J. A. Edminister	McGraw Hill	3 rd Edition, 2010
6	Electromagnetic Field Theory and Transmission Lines	Gottapu Sasibhushana Rao	Wiley	1st Edition, 2013