COURSE CONTENT

ELECTRO MAGNETIC FIELDS

I Semester: EEE

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
2530223	Core	3	0	0	3	40	60	100
Contact Classes:45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes:45		

Prerequisites: Mathematics & Physics.

Course Overview:

This course introduces the basics of electromagnetic fields, including electric and magnetic fields, conductors and dielectrics, Maxwell's equations, and electromagnetic wave propagation. It helps students understand how electric and magnetic fields behave and interact in electrical and communication systems.

Course Objectives:

1. Understand the fundamental principles of static electric fields.
2. Describe the properties of conductors and dielectrics influence electric field behavior.
3. Apply the principles of the Biot-Savart Law and Ampere's Circuital Law.
4. Analyze the relationship between time-varying electric and magnetic fields.
5. Understand the generation, propagation, and characteristics of electromagnetic waves in different media.

Course Outcomes: After Completion of the Course, Students should be able to

1. Apply Coulomb's law, Gauss's law, and the electric potential concept to solve for electric field intensity for various charge distributions.
2. Explain the physical basis for the boundary conditions at conductor-dielectric interfaces.
3. Determine the forces and magnetic boundary conditions governing the field behavior.
4. Analyze field interactions and distinguish between static and time-varying field behavior in practical electromagnetic systems.
5. Justify wave behavior under various material conditions.

UNIT - I: Static Electric Field: Review of conversion of a vector from one coordinate system to another coordinate System, 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.

UNIT - II: Conductors, Dielectrics and Capacitance: Current and current density, Ohms Law in Point form, Continuity equation, Boundary conditions of conductors and dielectric materials. Capacitance, Capacitance of a two-wire line, Poisson's equation, Laplace's equation.

UNIT - III: Static Magnetic Fields and Magnetic Forces: Biot-Savart Law, Ampere Circuital Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors. Force on a moving charge, Force on a differential current element, Force between differential current elements, Magnetic boundary conditions.

UNIT - IV: Time Varying Fields and Maxwell's Equations: Faraday's laws of Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces.

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

TEXT BOOKS:

1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.
2. W. Hayt, "Engineering Electromagnetics", McGraw Hill Education, 2012.

REFERENCE BOOKS:

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

ELECTRONIC RESOURCES:

1. https://www.electrical4u.com/electrostatics/
2. **https://www.allaboutcircuits.com/textbook/direct-current/chpt-5/electric-fields-capacitance/**
3. **https://www.electrical4u.com/magnetostatics/**
4. **https://www.electrical4u.com/maxwells-equations/**
5. **https://www.electrical4u.com/electromagnetic-waves/**
6. **https://archive.nptel.ac.in/courses/108/106/108106073/**

MATERIALS ON LINE:

1. Course template
2. Tutorial question bank
3. Tech talk and Concept Video topics
4. Open-ended experiments
5. Definitions and terminology
6. Assignments
7. Model question paper–I
8. Model question paper–II
9. Lecture notes
10. E-Learning Readiness Videos (ELRV)