ELECTROMAGNETIC FIELDS

Course Code	19EE3404	Year	II	Semester	II
Course Category	Program Core	Branch	EEE	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisite	Nil
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Define, understand** and **explain** concepts on electrostatics, magnetostatics and time varying fields.
CO2	**Apply** basic laws and theorems to determine the electrostatic and magneto static fields.
CO3	**Analyze** different parameters of static electric and magnetic fields.
CO4	**Calculate** capacitance and inductance of common conductor configurations and energy stored.
CO5	**Analyze** time varying fields and compute the energy stored in electromagnetic fields.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (H:High, M: Medium, L:Low)

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

Syllabus

Unit No.	Contents	Mapped CO
I	**Static Electric Field – I** Coulomb‘s law, Electric field intensity, Electrical field due to point charges, Line Charges (Derivations Only) – Infinite, Finite and Circular Ring, Surface charges (Derivations Only) – Infinite sheet and Circular Disk. Electric Flux Density, Gauss law and applications of Gauss’s Law to Point Charges, Infinite Line Charge, Infinite Sheet of Charge, Co-axial cable, Spherical shell and Uniformly charged sphere. Divergence and Divergence theorem. Energy expended in moving a charge in an electric field, Absolute Electric potential, Potential difference, Calculation of potential difference for point charges, Potential Gradient.	CO1, CO2, CO3
II	**Static Electric Field – II**	

	Poisson‘s and Laplace‘s equations, Solution of Laplace equations in one variable Electric dipole, Dipole moment, potential and electric filed due to an electric dipole, Torque on an Electric dipole in an electric field. Electrostatic Energy and Energy density. Current and current density, Ohms Law in Point form, Continuity of current equation. Electric field inside dielectric material - concept of Polarization, Boundary conditions between conductor dielectric and two dielectric materials. Capacitance, Capacitance of parallel plate, Spherical, Co-axial capacitors and parallel plates with Composite Dielectric.	CO1, CO2, CO3, CO4
III	**Static Magnetic Fields** Biot - Savart Law, Magnetic Field Intensity (MFI), MFI due to straight current carrying filament, circular, square and solenoid current carrying loops. Magnetic flux and flux density. Ampere circuital Law, Applications of Ampere’s circuital law to infinite sheet of current and a long current carrying filament. Point form of Ampere’s circuital law.	CO1, CO2, CO3
IV	**Magnetic Forces and Inductance** Force on a moving charge, Lorentz force equation, Force on a differential current element, Force between differential current elements, Magnetic boundary conditions, Magnetic dipole and dipole moment, a differential current loop as a magnetic dipole, Torque on a current loop placed in a magnetic field Inductances and mutual inductances, 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 energy density in a magnetic field.	CO1, CO2, CO3, CO4
V	**Time Varying Fields** Faraday‘s law for Electromagnetic induction, Displacement current, Point form and Integral form of Maxwell‘s equations, Uniform plane waves, Wave equation, solution of wave equation, wave propagation through good dielectric, good conductor, skin depth, Poynting Theorem.	CO1, CO5

Learning Resources

Text Books

1. Mathew N. O. Sadiku “Elements of Electromagnetics,” Oxford University Press, 2018
2. William H. Hayt, Jr. .John A. Buck, M Jaleel Akhtar “Engineering Electromagnetics”, McGraw-Hill, 9thEdition, 2020

Reference Books

1. A. Pramanik, “Electromagnetism - Theory and applications”, PHI Learning Pvt. Ltd, 2nd edition, New Delhi, 2008.
2. A. Pramanik, “Electromagnetism-Problems with solution”, Prentice Hall India, 2012.
3. John D Kraus, *“Electromagnetics*”, McGraw Hill, 2003.

e- Resources & other digital material

1. https://nptel.ac.in/courses/108/106/108106073/#
2. https://ocw.mit.edu/resources/res-6-001-electromagnetic-fields-and-energy-spring-2008/