GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC Electrical Engineering

Semester: IV

Subject Name: **Theory of Electromagnetics**

Sr. No	Course Content	Total Hrs.
1.	**Vector Analysis:** Scalars and vectors- Vector algebra, coordinate systems (Cartesian, cylindrical and spherical)- Dot product and cross product - Differential length, area and volume- Line, surface and volume integrals- Gradient, divergence and curl operators	8
2.	**Electrostatic Fields In Free Space:** Coulomb's law and electric field intensity-Electric fields due to continuous charge distribution-Field due to different configurations of charges -Electric flux density-Gauss law- Maxwell's equations (electrostatics)- application of Gauss law-Divergence, divergence theorem-Electric potential and potential difference-Gradient, relation between field intensity and electric potential, conservative field-An electric dipole and flux lines-Applications: Coulomb's torsional balance, corona phenomenon	8
3.	**Electric Fields in Material Space and Boundary Conditions:** Convection and conduction current densities-Conductor properties and boundary conditions-Polarization and dielectric constant-Boundary conditions for dielectric materials-Capacitance, computation of capacitance for various geometries-Energy density in electrostatic fields-Continuity equation and relaxation time-Poisson's and Laplace's equations, examples-Applications: Spraying of paints and pesticides, electrostatic precipitators, electron gun, printing, faraday cage, lightning, insulation design for high voltage equipments	6
4.	**Steady Magnetic Field:** Biot-Savart's law-Ampere's circuital law-Stokes' theorem-Magnetic flux and magnetic flux density-Magnetic field intensity due to various current configurations-Maxwells equations for static EM fields-The vector and scalar magnetic potentials-Applications: Magnetic prospecting, magnetic resonance imaging, overhead transmission lines	6
5.	**Magnetic Forces and Materials:** Lorentz force equation-Magnetic forces and torques-A magnetic dipole, magnetization and permeability-Classification of magnetic materials-Magnetic boundary conditions-Inductance and mutual inductance-	6

	Magnetic energy, magnetic circuits-Applications: ferrite cores, magnetic recording, magnetic shielding	
6.	**Time Varying Fields and Maxwell's Equations:** Faraday's law-Transformer and motional electromotive forces-Displacement current-Maxwell's equation in point form and integral form-Wave equation and diffusion equation-Time-harmonic fields-Skin and proximity effects- Applications: Transformers, rotating machines, magnetic brake, induction heating, watt hour meter, magnetic levitation, electromagnetic launcher, induction stirring and valves, Electromagnetic forming, eddy current testing of materials, electromagnetic propulsion of ships and submarines, magneto hydrodynamic (MHD) generator	8
7.	**Analytical and Numerical techniques:** **Analytical Method:** method of images-Advantages of numerical techniques-Types of numerical techniques-Finite difference method (FDM)-Finite Element method (FEM)-Application of numerical techniques	6

Text Books:

1. William Hart Hayt and John A. Buck. Engineering Electromagnetics , McGraw-Hill Education, 2006
2. Matthew N. O. Sadiku, Principles of Electromagnetics, fourth edition, Oxford university press, 2007
3. Nathan Ida, "Engineering Electromagnetics" Second edition, Springer, Indian Edition, 2005

References Books:

1. Ashutosh Pramanik, " Electromagnetism: theory and applications" PHI, second edition, New Delhi, 2008