



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering (PDDC)
Subject Code:
Semester-II
Subject Name: Electromagnetic Fields

Type of course: Basic Science Course

Prerequisite: NA

Rationale: Study of electromagnetic fields is basically concerned with study of charges at rest and in motion. Electromagnetic principles serve as basic fundamentals for detailed and in-depth study of electrical engineering and are indispensable for analysis of various electrical, electro-mechanical and electronic systems. This subject would cover the behavior of static and dynamic, electric and magnetic fields.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Review of Vector Analysis Introduction, scalars and vectors, unit vector, vector addition and subtraction, position and distance vectors, dot product, cross product, scalar triple product, vector triple product, components of a vector, Cartesian co-ordinate system, Circular cylindrical co-ordinate system, Spherical co-ordinate system, transformation from one co-ordinate to other co-ordinate systems	04
2	Static Electric Fields Coulomb's law, Electric field intensity, Electric field due to point and line charges, Line surface and volume charge distributions, Gauss' law and its applications, Divergence theorem, Absolute Electric potential, Potential difference, Potential gradient, Calculation of potential difference for different configurations, Electric dipole, Electrostatic energy and energy density	08
3	Conductors, Dielectrics and Capacitance Current and current density, Ohm's law in point form, Continuity equation, Conductor-dielectric boundary condition, Dielectric-dielectric boundary condition, Polarization in dielectrics, Capacitance, Capacitance of two wire line	06
4	Poisson's and Laplace's equations Poisson's equation, Laplace's equation, Uniqueness theorem, Solution of Poisson's and Laplace's equation, Application of Poisson's and Laplace's equations	04
5	Steady Magnetic Fields Biot Savart's law, Ampere's law, Curl operation, Stoke's theorem, Magnetic flux and magnetic flux density, Scalar and vector magnetic potentials, Steady magnetic field produced by current carrying conductors	08



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6	Magnetic forces, materials and inductance Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and Permeability, Magnetic boundary conditions, Magnetic circuit, Inductance and mutual inductances	06
7	Time varying fields and Maxwell's equations Faraday's law, Transformer and motional electromotive forces, Displacement current, Maxwell's equations in integral and point form, Time varying potentials	06

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30	30	20	10	10	00

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. W. H. Hayt, J. A. Buck, "Engineering Electromagnetics", McGraw Hill Education
2. M.N.O. Sadiku, S.V. Kulkarni, "Principles of Electromagnetics", 6th edition, Oxford University Press
3. A Pramanik, "Electromagnetism- Theory and Applications" PHI Learning Pvt. Ltd. ,New Delhi, 2009
4. A. Pramanik, "Electromagnetism-Problems with Solutions, PHI, 2012
5. S.P. Seth, "Elements of Electromagnetic fields", Dhanpat Rai & Co, 2013

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Apply vector calculus to electric and potential fields due to various charge distributions	30
CO-2	Compute potential, Electric fields, Electric flux density, Capacitance using Poisson's and Laplace's equations	25
CO-3	Derive forces and torques in magnetic fields, forces due to current carrying conductors and their inter-relationship with magnetic field	35
CO-4	Analyze Maxwell's equations in different forms (point & integral) and	10



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	apply them to diverse engineering problems	
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Suggested Resource Material for Assignments/Tutorials/Experiments

Suggested learning material and Assignments/Tutorials are available on the following links:

- <https://nptel.ac.in/downloads/108104087/> by Prof. Pradeep Kumar, IIT, Kanpur
- <https://nptel.ac.in/downloads/115101005/> by Prof. D.K. Ghosh, IIT , Bombay
- <https://nptel.ac.in/downloads/115104088/> by Prof. Manoj K. Harbola, IIT, Kanpur
- Transcripts and video lectures of Prof. Harishankar Ramachandran, IIT, Madras
<https://nptel.ac.in/courses/108106073/>
- Matlab experiments manual by Dr. M. H. Bakr
http://www.ece.mcmaster.ca/faculty/talia/EM_2FH3_downloads/assignments/Matlab_Manual_2FH3_Bakr.pdf