FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: **Bachelor of Technology (Electrical Engineering)**

Semester: **IV**

Course Code: **202050401**

Course Title: **Electromagnetic Fields**

Course Group: **Basic science/Professional Core Course**

Course Objectives: Study of electromagnetic fields is essentially required study of electric charges at rest and in motion. Electromagnetic principles act as the fundamentals for detailed and thorough study of electrical engineering and are crucial 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 & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Theory		J/V/P*		Total
Lecture	Tutorial	Practical		Internal	External	Internal	External	
3	2	0	4	50 / 18	50 / 17	25/9	25 / 9	150 / 53

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr.	Contents	Hours
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

Opp. Shastri Maidan, Beside BVM College, Vallabh Vidyanagar, Dist: Anand, Gujarat - 388120
(O): 02692-238001 | Email: adminoffice@cvmu.edu.in | www.cvmu.edu.in

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**
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**

List of Practicals / Tutorials:

1	Vector algebra: addition, subtraction, multiplication of vectors, cross product, dot product.
2	Various coordinate system: Cartesian, Cylindrical and Spherical. Transformation from one coordinate system to other.
3	Calculate electric field intensity, electric flux density, force between charges.
4	Electric field due to line, surface and volume charge densities.
5	Calculate potential difference, gradient and divergence
6	Verify Poisson's and Laplace equations for electric potential and field.
7	Calculate capacitance in different configurations of capacitor.
8	Numerical related to Biot-Savart law and Ampere's law.
9	Calculate magnetic field and magnetic flux density.
10	Calculate force between current carrying conductors.

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

Opp. Shastri Maidan, Beside BVM College, Vallabh Vidyanagar, Dist: Anand, Gujarat - 388120
(O): 02692-238001 | Email: adminoffice@cvmu.edu.in | www.cvmu.edu.in

4	A. Pramanik, "Electromagnetism-Problems with Solutions, PHI, 2012
5	S.P. Seth, "Elements of Electromagnetic fields", Dhanpat Rai & Co, 2013
6	The Feynman Lectures on Physics: Volume II: The New Millennium Edition, Pearson.

Supplementary learning Material:	
1	https://nptel.ac.in/downloads/108104087/ by Prof. Pradeep Kumar, IIT, Kanpur
2	https://nptel.ac.in/downloads/115101005/ by Prof. D.K. Ghosh, IIT , Bombay
3	https://nptel.ac.in/downloads/115104088/ by Prof. Manoj K. Harbola, IIT, Kanpur
4	Matlab experiments manual by Dr. M. H. Bakr http://www.ece.mcmaster.ca/faculty/talia/EM_2FH3_downloads/assignments/Matlab_Manual_2FH3_Bakr.pdf

Pedagogy:

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods
- Seminar/Poster Presentation
- Industrial/ Field visits
- Course Projects

Internal Evaluation: The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						**R**: Remembering; **U**: Understanding; **A**: Applying; **N**: Analyzing; **E**: Evaluating; **C**: Creating
R	**U**	**A**	**N**	**E**	**C**	
40%	20%	20%	20%	0%	0%	

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.

Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Apply vector calculus to electric and potential fields due to various charge distributions	**30**
CO-2	Calculate electric potential, electric field intensity/strength, electric flux density, capacitance using Poisson's and Laplace's equations	**25**

Opp. Shastri Maidan, Beside BVM College, Vallabh Vidyanagar, Dist: Anand, Gujarat - 388120
(O): 02692-238001 | Email: adminoffice@cvmu.edu.in | www.cvmu.edu.in

CO-3	Derive the expressions for force and torque 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 apply them to diverse engineering problems	**10**

Curriculum Revision:	
Version:	2.0
Drafted on (Month-Year):	June-2022
Last Reviewed on (Month-Year):	
Next Review on (Month-Year):	June-2025

Opp. Shastri Maidan, Beside BVM College, Vallabh Vidyanagar, Dist: Anand, Gujarat - 388120
(O): 02692-238001 | Email: adminoffice@cvmu.edu.in | www.cvmu.edu.in