

Branch Name:	Electrical Engineering
Program Code:	ET109
Course Name:	Electromagnetic Fields (Professional Elective-I)
Course Code:	2ET1090506T
Pre-requisite Course:	Elements of Electrical Engineering

Course Objectives:

1. To apply electric and magnetic fields for simple configurations under static conditions.
2. To understand Maxwell's equation in different forms and different media.
3. To understand the theorems related to vector analysis and basic laws of electromagnetism.

Teaching and Examination Scheme:

Credit	Teaching Scheme Hours per week				Evaluation Scheme (Marks)								Total (Marks)
					Theory (Marks)				Practical (Marks)				
	L	T	P	Total	SEE		CCA		SEE		CCA		
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
3	3	-	-	3	24	60	16	40	-	-	-	-	100

Course Contents:

Sr. No.	Topic	Total Hours	Weightage (%)
1	Review of Vector Calculus: Vector algebra-addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical), Vector calculus-differentiation, partial differentiation, integration, vector operator del, gradient, divergence and curl, integral theorems of vectors, Conversion of a vector from one coordinate system to another.	07	15
2	Static Electric Field: 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.	07	15
3	Conductors, Dielectrics and Capacitance: Current and current density, Ohms law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials, Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson's equation, Laplace's equation, Solution of Laplace and poison's equation, Application of Laplace's and poison's equations.	07	15
4	Static Magnetic Fields: Biot-Savart law, Ampere law, Magnetic flux and magnetic flux density, Scalar and vector magnetic potentials, Steady magnetic fields produced by current carrying conductors.	06	14

5	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 circuits, inductances and mutual inductances.	06	14
6	Time Varying Fields and Maxwell's Equations: Faraday's law for electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional electromotive forces. Boundary conditions.	06	13
7	Electromagnetic Waves: Derivation of wave Equation, Uniform plane waves, Maxwell's equation in phasor form, Wave equation in phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect, Pointing theorem.	06	14

Text Books:

1. M. N. O. Sadiku, "Elements of Electromagnetic", Oxford University Publication, 5th edition-2013.
2. A. Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2nd edition-2009.

Reference Books:

1. A. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India, 2nd edition-2011.
2. G.W. Carter, "The electromagnetic field in its engineering aspects", Longmans, 5th edition-2014.
3. W.J. Duffin, "Electricity and Magnetism", McGraw Hill Publication, 7th edition-2018.
4. W. Hayt, "Engineering Electromagnetics", McGraw Hill Education, 3rd edition-2008.
5. B. D. Popovic, "Introductory Engineering Electromagnetics", Addison-Wesley Educational Publishers, 5th edition-2017.
6. E.G. Cullwick, "The Fundamentals of Electromagnetism", Cambridge University Press, 4th edition-2017.

ICT/MOOCs Reference:

1. <https://nptel.ac.in/courses/108/104/108104087/>
2. <https://nptel.ac.in/courses/115/104/115104088/>
3. <https://nptel.ac.in/courses/108/102/108102119/>
4. <https://nptel.ac.in/courses/108/106/108106152/>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Understand the theorems related to vector analysis and basic laws of electromagnetism.	2 Understanding
CLO2	Apply electric and magnetic fields for simple configurations under static conditions.	3 Applying
CLO3	Analyses time varying electric and magnetic fields.	4 Analyzing
CLO4	Understand Maxwell's equation in different forms and different media.	2 Understanding
CLO5	Predict the propagation of EM waves.	4 Analyzing

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CLO1	H	M	L			L	L					H	L	M	M	L
CLO2	H	H	M	M								M	M	M	M	
CLO3	H	H	H	M								M	H	M		L
CLO4	H	H	H	H								M	M	L		M
CLO5	M	M	L	M									M	L		

H: High, M: Medium, L: Low