Sub Code: R2321022

R23

Set No. 1

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY-GURUJADA VIZINAGARAM
II B. Tech I Semester Regular Examinations, November – 2024
ELECTROMAGNETIC FIELD THEORY
(EEE)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part A, Part B.
Part A is compulsory, Answer all questions.
In Part B, Answer any one question from each unit.
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PART-A **(20 Marks)**

1	a)	Clarify the concept of potential gradient and its importance in a physical context.	[2]
	b)	What does Electric Field Intensity (EFI) refer to? In what way is it mathematically defined?	[2]
	c)	Write the expression for torque experienced by an electric dipole in a uniform electric field.	[2]
	d)	Write the mathematical expression for the dipole moment of an electric dipole.	[2]
	e)	State the Lorentz force equation	[2]
	f)	State Biot-Savart's law	[2]
	g)	List the factors that affect the inductance of a coil.	[2]
	h)	State the formula for the self-inductance of a solenoid	[2]
	i)	Define displacement current	[2]
	j)	Write the expression for the Poynting vector	[2]

PART-B **(50 Marks)**

Unit-1

2	a)	State and explain Stoke's theorem and the divergence theorem. Derive the mathematical form of each theorem and discuss their significance in vector calculus.	[5]
	b)	Describe the cylindrical and spherical coordinate systems in detail.	[5]
		(OR)	
3	a)	State and derive Laplace's and Poisson's equations. Discuss their significance in electrostatics, boundary conditions, and their influence on electric fields in various charge configurations.	[5]
	b)	Define electric potential and derive the relationship between electric field intensity and electric potential.	[5]

Unit-2

4	a)	Derive the expression for the capacitance of a parallel plate capacitor, considering the effects of dielectric materials.	[5]
	b)	Derive Ohm's law in point form, and discuss its significance in the context of electrical circuits and materials.	[5]
		(OR)	
5	a)	Derive the expression for current density in terms of charge density and drift velocity. Discuss how the drift velocity affects current flow in a conductor.	[5]
	b)	Discuss the applications of coaxial and spherical types of capacitors.	[5]

Unit-3

6	a)	Define the magnetic dipole moment and derive the expression for the torque experienced by a magnetic dipole in a uniform magnetic field.	[5]
	b)	Derive the expression for the potential energy and explain how it changes as the orientation of the dipole changes with respect to the magnetic field direction.	[5]

(OR)

7	a)	Derive the expression for the force per unit length between two long, parallel current-carrying conductors.	[5]
	b)	Define the Lorentz force and derive its expression for a charged particle moving in a magnetic field.	[5]

Unit-4

8	a)	Explain the relationship between inductance, magnetic field strength, and magnetic flux. Derive the relationship mathematically and discuss its significance in electromagnetic applications.	[5]
	b)	Derive the formula for the self-inductance of a coaxial cable. Discuss how the inner and outer radii, as well as the permeability of the medium, influence the inductance.	[5]

(OR)

9	a)	Derive the expression for the energy stored in an inductor in terms of current and inductance. Explain the physical significance of this energy and how it relates to the magnetic field in the inductor.	[5]
	b)	Explain the concept of mutual inductance and discuss its applications in transformers. Include a brief description of how mutual inductance is utilized in energy transfer between coils.	[5]

Unit-5

10	a)	Describe two practical applications of Faraday's law of electromagnetic induction in modern technology. Explain the underlying principles and significance of each application.	[5]
	b)	Derive Maxwell's equations in both integral and differential forms. Explain the physical significance of each equation and how they collectively describe classical electromagnetism.	[5]

(OR)

11	a)	Define the Poynting vector and derive its expression.	[5]
	b)	Differentiate statically induced EMF and dynamically induced EMF. Provide mathematical expressions for both and discuss their applications	[5]

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