Total No. of Questions: 6 *Total No. of Printed Pages:3*

Enrollment No.....

Faculty of Engineering
End Sem Examination May-2024
EC3CO08 / EE3CO29 Engineering Electromagnetics / Electromagnetic Theory

Programme: B.Tech. Branch/Specialisation: EC/EE/EX

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

Q.1 i. In Stokes' Theorem, what does the line integral on the left-hand side represent? **1**
(a) Flux of the vector field across a surface
(b) Curl of the vector field
(c) Divergence of the vector field
(d) Gradient of the vector field

ii. In the Divergence Theorem, what does the integral of the divergence of a vector field represent? **1**
(a) Flux of the vector field across a surface
(b) Curl of the vector field
(c) Line integral of the vector field
(d) Gradient of the vector field

iii. Gauss's law is a consequence of- **1**
(a) Ampere's law (b) Faraday's law
(c) Kirchhoff's law (d) Maxwell's equations

iv. Dielectric constant is also known as- **1**
(a) Electric constant (b) Magnetic constant
(c) Permeability (d) Impedance

v. Mutual inductance between two coils depends on: **1**
(a) The number of turns in each coil
(b) The separation between the coils
(c) The material of the coils
(d) All of these

vi. The unit of self-inductance is: **1**
(a) Henry (H) (b) Farad (F) (c) Ohm (Ω) (d) Tesla (T)

vii. The Lorentz force equation is given by: **1**
(a) $F = q(E + v \times B)$ (b) $F = q(E - v \times B)$
(c) $F = q(E / B)$ (d) $F = q(E - B)$

viii. The magnitude of the force experienced by a charged particle moving with velocity v in a magnetic field B is given by: **1**
(a) $F = qvB$ (b) $F = qv/E$ (c) $F = qB/E$ (d) $F = q/B$

ix. At Brewster's angle, the reflected light is- **1**
(a) Completely polarized (b) Completely depolarized
(c) Partially polarized (d) Completely absorbed

x. A low Standing Wave Ratio indicates: **1**
(a) High efficiency
(b) Poor transmission line performance
(c) Low radioactivity
(d) Weak magnetic field

Q.2 i. What is divergence theorem? **2**

ii. Define the Laplacian operator for scalar and vector fields. **3**

iii. Explain Stokes' theorem and its application in relating line integrals of vector fields to surface integrals. **5**

OR iv. Define cartesian, polar, cylindrical, and spherical coordinate systems. Discuss their applications in engineering. **5**

Q.3 i. Define an electric dipole. Discuss its behaviour in an external electric field. **2**

ii. Discuss methods for solving Laplace's equation in different geometries and boundary conditions. **8**

OR iii. Define dielectric constant (ε) and discuss its role in determining the behavior of electric fields in materials. How does it affect the capacitance of a capacitor? **8**

Q.4 i. Define permeability and distinguish between absolute permeability and relative permeability. **3**

ii. State Biot-Savart's law in its integral form. Find the magnetic induction at any point on the line through the centre and perpendicular to the plane's circular current loop. **7**

OR iii. Define a solenoid and a toroid. Discuss their construction, magnetic field patterns, and applications in electromagnetism **7**

Q.5 i. State Faraday's law of electromagnetic induction. Explain how a changing magnetic field induces an electromotive force (emf) in a circuit. **4**

ii. Develop the concept of displacement current using Maxwell's equations. **6**

OR iii. Define skin depth and explain its importance in the penetration of electromagnetic waves into a conducting medium. How does conductivity affect the skin depth? **6**

Q.6 Attempt any two:

i. Define Brewster angle and explain its significance. **5**

ii. Define Standing Wave Ratio (SWR) and explain its significance in the analysis of transmission lines. Discuss how SWR is calculated and its relationship to the efficiency of power transmission. **5**

iii. Define linear, circular, and elliptical polarization of electromagnetic waves. Explain how these polarization states are generated and provide examples of physical phenomena where each type of polarization is observed. **5**

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Marking Scheme
Engineering Electromagnetics (T) - EC3CO08 (T)

Q.1	i)	b) Curl of the vector field	**1**
	ii)	a) Flux of the vector field across a surface	**1**
	iii)	d) Maxwell's equations	**1**
	iv)	a) Electric constant	**1**
	v)	d) All of the above	**1**
	vi)	a) Henry (H)	**1**
	vii)	$F = q(E + v \times B)$	**1**
	viii)	a) $F = qvB$	**1**
	ix)	a) Completely polarized	**1**
	x)	a) High efficiency	**1**

Q.2	i.	What is Divergence theorem? Statement -1 marks Concept -1 marks	**2**
	ii.	Define the Laplacian operator for scalar and vector fields. Statement -1 marks scalar and vector fields -2 marks	**3**
	iii.	Explain Stokes' Theorem and its application in relating line integrals of vector fields to surface integrals. Statement and concept -2 marks Application -3 marks	**5**
OR	iv.	Define Cartesian, polar, cylindrical, and spherical coordinate systems. Discuss their applications in engineering. Definitions -3 marks Applications - 2 marks	**5**
Q.3	i.	Define an electric dipole and discuss its behaviour in an external electric field. Definition —1 marks Behaviour – 1 marks	**2**
	ii.	Discuss methods for solving Laplace's equation in different geometries and boundary conditions. Laplace's equation -3 marks geometries and boundary conditions - 5 marks	**8**
OR	iii.	Define dielectric constant (ε) and discuss its role in determining the behaviour of electric fields in materials. How does it affect the capacitance of a capacitor? Define dielectric constant -2 marks Behaviour of electric fields in materials - 4 marks Affect the capacitance of a capacitor - 2 marks	**8**

Q.4	i.	Define permeability and distinguish between absolute permeability and relative permeability. Definition -1 marks Distinguish -2 marks	**3**
	ii.	State Biot Savart Law in its integral form. Find the magnetic induction at any point on the line through the centre and perpendicular to the plane's circular current loop. Statement -2 marks Derivation -5 marks	**7**
OR	iii.	Define a solenoid and a toroid. Discuss their construction, magnetic field patterns, and applications in electromagnetism Statement -2 marks Application -2 marks Construction -3 marks	**7**

Q.5	I.	State Faraday's law of electromagnetic induction. Explain how a changing magnetic field induces an electromotive force (emf) in a circuit. Statement -2 marks Explanation-2 marks	**4**
	II.	Develop the concept of displacement current using Maxwell's equations. Definition- 2 marks Derivation-4 marks	**6**
OR	III.	Define skin depth and explain its importance in the penetration of electromagnetic waves into a conducting medium. How does conductivity affect the skin depth? Definition- 2 marks Explanation-4 marks	**6**

Q.6			
	i	Define Brewster angle and explain its significance. Definition- 2 marks Explanation-3 marks	**5**

ii Define standing wave ratio (SWR) and explain its significance in the analysis of transmission lines. Discuss how SWR is calculated and its relationship to the efficiency of power transmission. **5**

Definition- 1 marks
Calculated -2 marks
Relationship- 2 marks

iii Define linear, circular, and elliptical polarization of electromagnetic waves. Explain how these polarization states are generated and provide examples of physical phenomena where each type of polarization is observed. **5**

Definition- 2 marks
Explanation-3 marks

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