

Total No. of Questions: 6

Total No. of Printed Pages:3

Enrollment No.....



Faculty of Engineering  
End Sem Examination May-2023  
EE3CO29 / EE3CO05 / EX3CO05  
Electromagnetic Theory

Programme: B.Tech.

Branch/Specialisation: 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. Divergence theorem is applicable for \_\_\_\_\_. 1  
(a) Static field only (b) Time varying field only  
(c) Both (a) & (b) (d) Electric field only
- ii. Which of the following is related with Stoke's Theorem? 1  
(a) A surface integral and a volume integral  
(b) A line integral, a surface integral and a volume integral  
(c) A line integral and a volume integral  
(d) A line integral and a surface integral
- iii. Potential gradient is a- 1  
(a) Vector quantity (b) Scalar quantity  
(c) Constant (d) None of these
- iv. The Poisson's equation is derived from- 1  
(a) Laplace equation (b) Point form of Gauss law  
(c) Thevenin's law (d) Kirchhoff's law
- v. The magnetic field due to a copper rod carrying direct current is- 1  
(a) The magnetic field is inside the rod  
(b) The magnetic field is outside the rod  
(c) Both inside and outside the rod  
(d) Neither inside nor outside
- vi. The unit of self-inductance is- 1  
(a)  $\text{Wb/A}^2$  (b)  $\text{H/m}$  (c)  $\text{Wb/m}^2$  (d)  $\text{Wb/A}$

P.T.O.

[2]

- vii. What is relative permittivity? **1**  
 (a) Equal to the absolute permittivity  
 (b) Ratio of actual permittivity to absolute permittivity  
 (c) Ratio of absolute permittivity to actual permittivity  
 (d) Equal to the actual permittivity
- viii. Which of the following is the expression for Lorentz force? **1**  
 (a)  $qE$  (b)  $q(v \times B)$  (c)  $ma + qE$  (d)  $qE + q(v \times B)$
- ix. When the phase angle between the  $E_x$  and  $E_y$  component is  $0^\circ$  or  $180^\circ$ , the polarisation is- **1**  
 (a) Elliptical (b) Circular  
 (c) Linear (d) Perpendicular
- x. An electromagnetic wave incident on a perfect conductor is- **1**  
 (a) Fully transmitted (b) Partially transmitted  
 (c) Entirely reflected (d) None of these
- Q.2 i. State divergence's theorem and its application. **2**  
 ii. Explain the scalar form of electrical potential. **3**  
 iii. Express vector  $\vec{B}$  in Cartesian coordinate systems. **5**  
 Given  $\vec{B} = \frac{10}{r} \vec{a}_r + r \cos \theta \vec{a}_\theta + \vec{a}_\phi$ , then find vector  $\vec{B}$  at  $(-3, 4, 0)$ .
- OR iv. Write down the expressions of divergence and curl in three coordinate system. **5**
- Q.3 i. State gauss's law. **3**  
 ii. Consider an infinite line charge with density  $\rho_L$  C/m, along z-axis. **7**  
 Obtain the work done if a point charge  $Q$  is moved from  $r=a$  to  $b$  along radial path.
- OR iii. State and derive electric boundary condition for the following: **7**  
 (a) A dielectric to dielectric medium  
 (b) Free space to conductor
- Q.4 i. Write magnetic boundary condition. **4**  
 ii. Derive Biot-savart's law and Ampere's circuit law. **6**
- OR iii. Derive an expression to find energy stored in magnetic field. **6**
- Q.5 i. What is complex permittivity and skin depth? **4**

[3]

- ii. Derive Maxwell's equation in integral form. **6**
- OR iii. Write EMF equation of a moving conduction loop in time varying field. **6**
- Q.6 Attempt any two: **5**  
 i. Write short note about linear, circular and elliptic polarization. **5**  
 ii. State brewster angle. **5**  
 iii. Write short note about standing wave ratio. **5**

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## Marking Scheme

### EE3CO29-EE3CO05-EX3CO05 Electromagnetic Theory

Q.1	i)	Divergence theorem is applicable for _____ C. Both Static Field and Time Varying Field	1
	ii)	Which of the following is related with Stoke's Theorem? D. A line integral and a surface integral	1
	iii)	Potential gradient is a A. Vector Quantity	1
	iv)	The Poisson's equation is derived from - B. Point form of Gauss law	1
	v)	The magnetic field due to a copper rod carrying direct current is C. Both inside and outside the rod	1
	vi)	The unit of self-inductance is: D. Wb/A	1
	vii)	What is relative permittivity? B. Ratio of actual permittivity to absolute permittivity	1
	viii)	Which of the following is the expression for Lorentz force? D. $q\mathbf{E} + q(\mathbf{v} \times \mathbf{B})$	1
	ix)	When the phase angle between the $E_x$ and $E_y$ component is $0^\circ$ or $180^\circ$ , the polarisation is C. Linear	1
	x)	An electromagnetic wave incident on a perfect conductor is C. Entirely Reflected	1
Q.2	i.	State divergence's theorem and its application. Statement 1 mark Application 1 mark	2
	ii.	Explain the scalar form of Electrical potential Explanation 3 marks	3
	iii.	Express vector $\vec{B}$ in Cartesian coordinate systems. Given $\vec{B} = \frac{10}{r} \vec{a}_r + r \cos \theta \vec{a}_\theta + \vec{a}_\phi$ , then find vector $\vec{B}$ at (-3,4,0)	5

Expression 5 marks

OR	iv.	Write down the expressions of divergence and curl in three coordinate system.	5
		Divergence 2.5 marks Curl 2.5 marks	
Q.3	i.	State gauss's law. Statement 2 marks	3
	ii.	Consider an infinite line charge with density $\rho_L$ C/m, along z-axis. Obtain the work done if a point charge Q is moved from $r=a$ to $b$ along radial path. Expression of electrostatic force 3 marks Work done 5 marks	7
OR	iii.	State and derive electric boundary condition for (1) a dielectric to dielectric medium (2) free space to conductor Statement 2 marks (1) a dielectric to dielectric medium 3 marks (2) free space to conductor 3 marks	7
Q.4	i.	Write magnetic boundary condition. Statement 2 marks Expression 2 marks	4
	ii.	Derive Biot-savart's law and Ampere's circuit law. Biot-savart's law 3 marks Ampere's circuit law 3 marks	6
OR	iii.	Derive an expression to find energy stored in magnetic field. Per step 2 marks	6
Q.5	i.	What is complex permittivity and skin depth.	4

[2]

[3]

complex permittivity 2 marks

skin depth 2 marks

ii. Derive Maxwell's equation in integral form. **6**

Per step 2 marks

OR iii. Write emf equation of a moving conduction loop in time varying **6**

Field

Per step 2 marks

Q.6 Attempt any two:

i. Write short note about, circular and elliptic polarization. **5**

Each 2.5 marks

ii. State brewster angle. **5**

5 Marks

iii. Write short note about standing wave ratio. **5**

5 Marks

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