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Question Paper Code : 20974

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2023.

Third Semester

Electrical and Electronics Engineering

EE 3301 – ELECTROMAGNETIC FIELDS

(Regulations – 2021)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define vector field.
2. List two applications of Gauss's law.
3. Write the Poisson's equation.
4. Relate electric field intensity and electric flux density.
5. State Biot-Savarts law.
6. State Amperes circuit law.
7. What is mutual inductance of coils?
8. State Faradays law.
9. What is group velocity?
10. Define skin depth.

PART B — (5 × 13 = 65 marks)

11. (a) Determine the divergence of the vector field. $\vec{P} = x^2 yz \vec{a}_x + xz \vec{a}_z$. (13)

Or

- (b) Given the two points $A (x = 5, y = 7, z = 3)$ and $B = (r = 6, \theta = 40^\circ, \phi = 220^\circ)$. Find

(i) Spherical co-ordinate of A. (7)

(ii) Cartesian co-ordinate of B. (6)

12. (a) A cylindrical capacitor consists of an inner conductor of radius 'a' and an outer conductor, whose inner radius is 'b'. The space between the conductors is filled with a dielectric permittivity ϵ_r and length of the capacitor is L. Find the value of the capacitance. (13)

Or

- (b) If $V = x - y + xy + 4z$ V, Find

(i) E at (4,4,4) (7)

(ii) Energy stored in a cube of side 1 m centered at the origin. (6)

13. (a) Derive the boundary conditions, for the EM wave in magnetic field to travel between two different mediums. (13)

Or

- (b) Derive the magnetic field intensity at a point P due to a finite straight conductor, carrying a current I. (13)

14. (a) Derive displacement current from circuital analysis and from Ampere circuital law. (13)

Or

- (b) Derive and explain Maxwell's equations both in integral and point forms. (13)

15. (a) Derive pointing vector in integral and point form from Maxwell's equation. (13)

Or

- (b) Derive wave equation and explain the properties of uniform plane waves in free space. (13)

PART C — ($1 \times 15 = 15$ marks)

16. (a) Find the total charge inside a volume having charge density as $10 z^2 e^{-0.1x} \sin \pi y \text{ C/m}^3$. The volume is defined between $-2 \leq x \leq 2$, $0 \leq y \leq 1$ and $3 \leq z \leq 4$. (15)

Or

- (b) Determine, whether the following potential fields satisfy the Laplace's equations:

(i) $V = x^2 - y^2 + z^2$ (5)

(ii) $V = r \cos \varphi + z$ (5)

(iii) $V = r \cos \theta + \varphi$ (5)