SATHYABAMA UNIVERSITY

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Course & Branch: B.E - ECE/E&C/ETCE
Title of the paper: Engineering Electromagnetics
Semester: III Max. Marks: 80
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Time: 3 Hours
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PART – A (10 x 2 = 20)

Answer All the Questions

1. Transform a vector A = $y\hat{I}_x - x\hat{I}_y + z\hat{I}_z$ into cylindrical co-ordinates.

2. In what situations do we mostly use method of moments? On what does the accuracy depend in evaluating the fields by using the method of moments?

3. Define Magnetic dipole moment. Sketch the field due to a magnetic dipole.

4. State Gauss's law for the magnetic field and give it's physical interpretation.

5. What is the expression for the torque experienced by a current carrying loop, placed in a magnetic field?

6. What is meant by hysteresis? Draw the hysteresis loop.

7. Express Laplace equation in cylindrical and in Cartesian co-ordinate system.

8. Find the total current in a circular conductor of radius 4 mm if the current density varies according to $J = (10^4/r)$ A/m^2.

9. Define self inductance and mutual inductance.

10. The magnetic field intensity in free space is given as $H = H_o \sin \theta \, \hat{a}_y$ A/m, Where $\theta = \omega t - \beta z$ and β is a constant quantity. Determine the displacement current density.

PART – B (5 x 12 = 60)

Answer All the Questions

11. Express the field $\vec{D} = (x^2 + y^2)\text{-}1 \, (x\vec{a}_x + y\vec{a}_y)$ in cylindrical components and Evaluate both sides of the divergence theorem for the region bounded by $\rho = 2$, $0 \le \Phi \le 0.2\pi$ and $z = 5$.

(or)

12. A circular ring of radius a carries a uniform charge ρ_L coulombs C/m and is placed on the xy – plane with axis the same as the z axis. Show that E(0,0,h) = $\dfrac{\rho_L ah}{2\varepsilon_0[h^2 + a^2]^{3/2}} \vec{a}_z$

13. An infinitely long filamentary wire carries a current of 2A in the +z direction. Calculate

(i) B at (-3, 4, 7)

(ii) The flux through the square loop described by $2 \le \rho \le 6$, $0 \le z \le 4$, $\Phi = \pi/3$. Find $\vec{H}$ at (i) A(2,3,0).

(or)

14. Conductor surfaces are located at p = 1 cm and p = 2cm in free space. The volume 1 cm < p < 2 cm contains the fields Ho = 2/p cos(6 x 10^8 πt - 2πz) A/m and E_P = 240 pi/p cos (6x 108pi t – 2 pi z) v/m. Show that two fields satisfy $\nabla X \vec{E} = \dfrac{-\partial B}{\partial t}$

15. A plane wave propagating through a medium with $\varepsilon_r = 48 \mu_r = 2$ has $\vec{E} = 0.5e^{-z/3} Sin(10^8 t - \beta z)\vec{a}xV/m.$ Find (i) β (ii) H field (iii) Loss tangent (iv) Wave Impedance.

(or)

16. Two differential current elements $I_1\Delta L_1 = 3 \times 10^{-6}$ a_y A.m at $P_1(1,0,0)$ and $I_2\Delta L_2 = 3 \times 10^{-6}(-0.5a_x + 0.4a_y + 0.3a_z)$ A.m at $P_2(2,2,2)$ are located in free space. Find the vector force extended on i) $I_2\Delta L_2$ by $I_1\Delta L_1$ ii) $I_1\Delta L_1$ by $I_2\Delta L_2$

17. Given the potentially V = $\frac{100}{z^2+1}\rho Cos\phi V.$

(i) Find the electric field $\vec{E}at(3, \pi/3, 2).$

(ii) Calculate the work done in moving a 10 - μC charge from point A(1, π/3, 5) to B(4, π/2, 6).

(or)

18. Find the gradient of the scalar field $W = 10rSin^2\theta \cos\phi$.

19. Discuss briefly the following.
    (a) Finite difference method of flux plotting
    (b) Finite element method
    (c) Conformal mapping

(or)

20. (a) Derive the formula for a co-axial spherical capacitor of length L, inner radius a and outer radius b.
    (b) The electric field in free space is given by

$$\vec{E} = \frac{\sin\theta}{r} Cos(6X10^7 t - \beta r)\vec{a}\phi \text{ V/m}$$

    (i) Find H.
    (ii) Calculate β