D 031

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2003.

Third Semester

Electronics and Communication Engineering

EC 233 — ELECTROMAGNETIC FIELDS

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Transform a vector $\vec{A} = y\ \hat{I}_x - x\ \hat{I}_y + z\ \hat{I}_z$ 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 $J = \left(10^4 / r\right)$ A/m^2.

9. Define self inductance and mutual inductance.

10. The magnetic field intensity in free space is given as $\vec{H} = H_0 \sin\theta\ \hat{a}_y$ A/m, where $\theta = w t - \beta z$ and β is a constant quantity. Determine the displacement current density.

PART B — (5 × 16 = 80 marks)

11. Derive an expression for the Electric field intensity at a point P due to an Electric dipole. Hence, define Electric dipole moment. (16)

12. (a) (i) Find the force on a point charge q located at (0, 0, h) m due to charge of surface charge density $\rho_S C/m^2$ uniformly distributed over the circular disc $r \le a$, $z = 0$, m. (12)

(ii) Find the nature of the field given by determining the divergence and curl $F_1 = 30\hat{I}_x + 2xy\hat{I}_y + 5xz^2\hat{I}_z$. (4)

Or

(b) (i) State Divergence Theorem. (4)

(ii) A vector field $D = \left(\frac{5r^2}{4}\right)\hat{I}_r$ is given in spherical co–ordinates. Evaluate both sides of divergence theorem for the volume enclosed between r = 1 and r = 2. (12)

13. (a) Derive Maxwell's curl equations from Ampere's law and Faraday's law. Express the equations in phasor form for time harmonic fields. (16)

Or

(b) Using Energy method find the internal inductance of conductors with uniform current distribution in a coaxial transmission line. (16)

14. (a) Assuming static conditions derive the boundary relations for Magnetic fields. (16)

Or

(b) Solve one dimensional Laplace equation to obtain the field inside a parallel plate capacitor, and also find the expression for the surface charge density at two plates. (16)

15. (a) Write down Maxwell's equation in integral form and point form and give their physical interpretation. (or) (16)

(b) Derive the Poynting Vector from Maxwell's equation and explain. (16)