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B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2004.

Third Semester

Electronics and Communication Engineering

EC 233 — ELECTROMAGNETIC FIELDS

Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Write Poisson's equation in vector notation.

2. Give integral expression for the force on a closed circuit that carries a current I in a magnetic field H.

3. Determine the potential difference between the points a and b which are at a distance of 0.5 m and 0.1 m respectively from a negative charge of 20×10^{-10} coulomb, $\epsilon_0 = 8.854$ PicoF/m.

4. State divergence theorem.

5. Differentiate self inductance and mutual inductance.

6. Explain the terms irrotational and solenoidal as applied to vector $\vec{F}$.

7. A ferrite material has $\mu_R = 50$, operate with sufficiently low flux densities and $B = 0.05$ T find H.

8. State Faraday's law of electromagnetic induction.

9. Sketch a toroid and label its parts.

10. Define ampere's circuit law.

PART B — (5 × 16 = 80 marks)

11. (i) Define Divergence, Gradient, Curl in spherical co-ordinate system with mathematical expression. (9)

(ii) Distinguish scalar and vector potential as applied to electric field. (3)

(iii) Given a vector field $a = 15i + 0j + 0k$. Find the scalar and vector potentials. (4)

12. (a) A circular disc of radius 'a' is charged uniformly with a charge density of σ coulombs/m². Find the electric intensity at a point 'h' from the disc along its central axis. (16)

Or

(b) (i) Define a magnetic circuit with a sketch and hence obtain the expression for its reluctance. (7)

(ii) A magnetic circuit employs an air core toroid with 500 turns, cross sectional area 6 cm² mean radius 15 cm and coil current 4 A. Determine the reluctance of the circuit, flux density and magnetic field intensity. (9)

13. (a) A very long two wire transmission line each wire of radius 'a' separated by a distance of 'd' is supported at a height 'h' above a flat conducting ground. Assuming both 'd' and 'h' to be much longer than 'a', find the capacitance per unit length of the line.

Or

(b) Derive the boundary conditions of the normal and tangential components of electric field at the interface of two media with different die electrics.

14. (a) (i) Explain the terms :

(1) magnetic field intensity

(2) magnetic moment

(3) magneto motive force and

(4) magnetic permeability. (8)

(ii) Find the magnetic flux density at a point on the axis of a circular loop of radius 'b' that carries a direct current I. (8)

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(i) Explain in detail the principle of torque on a solenoid situated in a uniform magnetic field. (7)

(ii) A solenoid 25 cm long, 1 cm mean diameter of the coil turns a uniformly distributed windings of 2000 turns. The solenoid is placed in uniform field of 2 tesla flux density. A current of 5 A is passed through the winding. Determine the (1) maximum force on the solenoid (2) maximum torque on the solenoid and (3) compute the magnetic moment on the solenoid. (9)

From the fundamental law, derive the generalized Maxwell's equations in integral form.

Or

(b) (i) Define poynting vector and prove that the electromagnetic power flow is the product of electric and magnetic field intensities. (8)

(ii) Explain the surge impedance in transmission circuit. (4)

(iii) A open wire transmission line has a capacitance of 6.5 nF/Km and inductance of 0.95 mH/km. Determine the surge impedance. (4)