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Question Paper Code : 77124

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2015.

Third Semester

Electrical and Electronics Engineering

EE 6302 — ELECTROMAGNETIC THEORY

(Regulation 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Given $A = 4a_x + 6a_y - 2a_z$ and $B = -2a_x + 4a_y + 8a_z$. Show that the vectors are orthogonal.

2. Express in matrix form the unit vector transformation from the rectangular to cylindrical co-ordinate system.

3. What is the practical significance of Lorentz's Force?

4. Find the electric field intensity in free space if D = 30 a_x C/m^3.

5. Find the force of interaction between two charges $4*10^{-8}$ and $6*10^{-5}$ spaced 10 cm apart in kerosene ($\varepsilon_r = 2.0$).

6. Find the maximum torque on an 100 turns rectangular coil of 0.2 m by 0.3 m, carrying current of 2 A in the field of flux density 5 Web./m^2.

7. Define mutual inductance and self inductance.

8. Distinguish between transformer emf and motional emf.

9. Compare the equi-potential plots of uniform and non-uniform fields.

10. What is the wavelength and frequency of a wave propagation in free space when $\beta = 2$?

PART B — (5 × 16 = 80 marks)

11. (a) (i) State and prove Gauss Law. (8)

(ii) Obtain an expression for electric field intensity due to a uniformly charged line of length 'l'. (8)

Or

(b) (i) Show that over the closed surface of a sphere of radius b, $ds = 0$. (6)

(ii) Show that the vector $E = (6xy + z^3)a_x + (3x^2 - z)a_y + (3xz^2 - y)a_z$ is irrotational and find its scalar potential. (10)

12. (a) (i) A positive point charge 100×10^{-12} C is located in air at $x = 0$, 0.01m and another such charge at $x = 0, y = -0.1$ m. What is the magnitude and direction of E? (6)

(ii) Obtain an expression for the capacitance of a parallel plate capacitor with two dielectrics of relative permittivity ε_1 and ε_2 respectively interposed between the plates. (10)

Or

(b) Explain the polarization and thus obtain electric field intensity and potential of a dipole. (16)

13. (a) (i) Obtain an expression for magnetic flux density and magnetic field intensity at any point due to a finite length conductor (8)

(ii) State and prove magnetic boundary conditions. (8)

Or

(b) Obtain an expression for inductance and torque on a long solenoid coil. (16)

14. (a) Derive the set of Maxwell's equations with solutions in integral form from fundamental laws for a good conductor. (16)

Or

(b) (i) Explain the relation between field theory and circuit theory and thus obtain an expression for ohm's law. (8)

(ii) Compare and explain in detail conduction and displacement currents. (8)

15. (a) (i) State Poynting theorem and thus obtain an expression for instantaneous power density vector associated with electromagnetic field. (12)

(ii) A plane wave travelling in air is normally incident on a block of paraffin with $\varepsilon_r = 2.2$. Find the reflection coefficient. (4)

Or

(b) Obtain an expression for electromagnetic wave propagation in lossy dielectrics. (16)