Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 70432

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Fourth Semester

Electronics and Communication Engineering

EC 6403 – ELECTROMAGNETIC FIELDS

(Regulation 2013)

(Common to : PTEC 6403 – Electromagnetic Fields for B.E. (Part-Time) - Electronics and Communication Engineering – Third Semester (Regulations – 2014))

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State divergence theorem.

2. Define electric dipole.

3. Write the equation for energy stored in electrostatic field in terms of field quantities.

4. What is the practical application of method of images?

5. Define magnetic scalar potential.

6. Write the relation between magnetic flux and magnetic flux density.

7. Calculate the mutual inductance of two inductively tightly coupled coils with self-inductance of 25 mH and 100 mH.

8. Give the expression for Lorentz force equation.

9. What are the Maxwell's equations for free space medium?

10. In a medium the electric field intensity is $E = 10\,sin(1000t - 10x)a_y V/m.$ Calculate the displacement current density $\left(\varepsilon_r = 80,\ \varepsilon_0 = 8.854 \times 10^{-12} F/m\right).$

PART B — (5 × 13 = 65 marks)

11. (a) Define the potential difference and electric field. Give the relation between potential and field intensity. Also Derive an expression for potential due to infinite uniformly charged line and also derive potential due to electric dipole. (13)

Or

(b) (i) State and prove Gauss law and explain any one of applications of Gauss law. (7)

(ii) Given two vectors $\vec{A} = 3\hat{a}_x + 4\hat{a}_y - 5\hat{a}_z$ and $\vec{B} = -6\hat{a}_x + 2\hat{a}_y + 45\hat{a}_z$, determine the unit vector normal to the plane containing the vectors $\vec{A}$ and $\vec{B}$. (6)

12. (a) Derive an expression for capacitance of a coaxial cable. (13)

Or

(b) (i) Derive an expression for Polarization *'P'*. (3)

(ii) State and explain the electric boundary conditions between two dielectrics materials. (10)

13. (a) An infinitely long, straight conductor with a circular cross section of radius 'b' carries a steady current 'I'. Determine magnetic flux density both inside and outside the conductor. (13)

Or

(b) (i) Derive the expression for vector magnetic potential in terms of current density. (10)

(ii) For a current distribution in free space, (3)

$$A = \left(2x^2y + yz\right)a_x + \left(xy^2 - xz^2\right)a_y - \left(6xyz - 2x^2y^2\right)a_z (Wb/m).$$

Calculate magnetic flux density.

14. (a) (i) A steady current with normal component J_n is flowing across the interface between the two conducting media of conductivities σ_1 and σ_2 and permittivities $\in_1$ and $\in_2$ respectively. Show that there must be a surface charge density on the interface. Find its magnitude. (5)

(ii) Find the magnetic field of current in a straight circular cylindrical conductor of radius "a", and express the magnetic field as a vector in terms of current density $\vec{J}$. (8)

Or

(b) A composite conductor of cylindrical cross section used in overhead lines is made of a steel inner wire of radius R_i and an annular outer conductor of radius R_o, the two having electrical contact. Find the magnetic field within the conductors and the internal self inductance per unit length of the composite conductor. (13)

15. (a) Starting from Maxwell's equation derive the equation for E field in the form of wave in free space. (13)

Or

(b) Explain the condition and propagation of uniform plane waves in good conductors and derive the wave constants. (13)

PART C — (1 × 15 = 15 marks)

16. (a) Apply Lorentz force equation, to derive the force on a differential current element.

Or

(b) Illustrate with an example, to apply Poisson's and Laplace equation.

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