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Question Paper Code : 70466

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

Third Semester

Electrical and Electronics Engineering

EE 6302 — ELECTROMAGNETIC THEORY

(Common to : PTEE 6302 – Electromagnetic Theory for B.E. (Part-Time) Electrical and Electronics Engineering – Second Semester (Regulations 2014))

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is Electric field intensity?

2. State Gauss's Law.

3. What is the electric field intensity at a distance of 20 cm from a charge of $2\mu C$ in vacuum?

4. Calculate the capacitance per Km between a pair of parallel wires each of diameter 1cm at a spacing of 50cms.

5. What is vector magnetic potential?

6. Define Biot-Savart's law.

7. Moist soil has conductivity of 10^{-3} S/m and $\varepsilon_r = 2.5$, determine the displacement current density if $E = 6.0 \times 10^{-6} \sin 9.0 \times 10^{9} t (V/m)$.

8. State Faraday's law.

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 × 13 = 65 marks)

11. (a) (i) State and Prove Divergence theorem. (8)

(ii) Transform $4\hat{a}_x - 2\hat{a}_y - 4\hat{a}_z$, at (2, 3, 5) to cylindrical coordinates. (5)

Or

(b) (i) Derive the expression for electric field intensity due to uniformly charged circular disc of $\sigma c/m^2$. (8)

(ii) Find the force on a charge Q_1 of $20\,\mu C$ at (0, 1, 2)m due to Q_2 of 300 μC at (2, 0, 0)m. (5)

12. (a) (i) Develop an expression for the capacitance of parallel plate capacitor having two different dielectric media. (8)

(ii) Explain the potential at a point in an electric field. Derive the electric field intensity at any point in a field due to a point charge. (5)

Or

(b) (i) Write Laplace's equation in cartesian co-ordinates. And obtain the solution when V is function of x only for the boundary condition $V = V_1$ at $x = x_1$ and $V = V_2$ at $x = x_2$. (8)

(ii) Calculate the potential at a point P(0, 0) m due to point charges Q_1 and Q_2. $Q_1 = 10^{-12}$ Coulomb is located at (0.5, 0)m and $Q_2 = -10^{-11}$ Coulomb is located at (–0.5, 0)m. (5)

13. (a) (i) Obtain an expression for magnetic flux density and magnetic field intensity at any point along the axis of a circular coil. (9)

(ii) Distinguish between scalar and vector magnetic potential. (4)

Or

(b) (i) An air co-axial transmission line has a solid inner conductor of radius 'a' and a very thin outer conductor of inner radius 'b'. Determine the inductance per unit length of the line. (9)

(ii) Compare the different magnetic materials. (4)

14. (a) Derive the Maxwell's equations both in integral and point forms. (13)

Or

(b) (i) Explain the relation between field theory and circuit theory in detail. (6)

(ii) A circular loop conductor having a radius of 0.15m is placed in X-Y plane. This loop consists of a resistance of 20Ω. If the magnetic flux density is B = 0.5 $\sin 10^3 \hat{a}_x$ Tesla, Find the current through the loop. (7)

15. (a) (i) Derive wave equation from Maxwell's equations, (6)

(ii) Derive Poynting vector. (7)

Or

(b) Describe with related figures and expressions, plane wave reflection and refraction. (13)

PART C — (1 × 15 = 15 marks)

16. (a) A 9375 MHz uniform plane wave is propagating in a material medium of $\varepsilon = 2.56$. If the amplitude of the electric field intensity of loss less medium is 500 V/m. Calculate phase constant, propagation constant, velocity, wavelength and intrinsic impedance.

Or

(b) A parallel plate capacitor with plate area of 5 cm^2 and plate separation of 3 mm has a voltage 50 sin 10^3 tV applied to its plates. Calculate the displacement current assuming $\varepsilon = 2\varepsilon$.