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Question Paper Code : 21498

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Third Semester

Electrical and Electronics Engineering

EE 2202/EE 34/EE 1201 A/080280017/10133 EE 303 — ELECTROMAGNETIC THEORY

(Regulations 2008/2010)

(Common to PTEE 2202 — Electromagnetic Theory for B.E. (Part-Time) Second Semester Electrical and Electronics Engineering — Regulations 2009)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. How are the unit vectors defined in cylindrical coordinate systems?

2. State Stoke's theorem.

3. Show that $\nabla \bullet E = 0$ in the case of a point charge.

4. At the boundary between copper and aluminium the electric field lines makes an angle of 45° with the normal to the interface. Find the angle of emergence. The conductivity of copper and aluminium are $5.8 \times 10^5 \, S/cm$ and $3.5 \times 10^5 \, S/cm$, receptively.

5. Write the expression for the inductance per unit length of a long solenoid of N turns and having a length "l" mtr carrying a current of I amperes.

6. State: Ampere's circuital law.

7. What type of voltage is induced in a loop which is rotating about the y-axis in a magnetic field of flux density $\vec{B} = B_0 \sin \omega t \vec{i}$ Tesla?

8. Write the relation showing the energy required to establish a magnetic field by a quasi-stationary current system.

9. Mention the properties of uniform plane wave.

10. Define loss tangent.

PART B — (5 × 16 = 80 marks)

11. (a) Derive electric field intensity at the given point due to line charge of infinite length. (16)

Or

(b) (i) A circular ring of radius 'a' carries a uniform charge L C/m and is placed on the XY plane with the axis same as z axis. Find the electric field intensity. (8)

(ii) If $G(r) = 10e^{-2z}(r\, a_r + a_z)$, determine the flux of G(r) out of entire surface of the cylinder r = 1. (8)

12. (a) (i) State and explain Coulomb's law and deduce the vector form of force equation between two point charges. (6)

(ii) At an interface separating dielectric $1(\varepsilon_{r1})$ and dielectric $2(\varepsilon_{r2})$, show that the tangential component of $\vec{E}$ is continuous across the boundary, whereas the normal component of $\vec{E}$ is discontinuous at the boundary. (10)

Or

(b) (i) A circular disc of radius 'a' m is charged uniformly with a charge density of $\rho_s\, C/m^2$. Find the electric potential at a point P distant 'h' m from the disc surface along its axis. (8)

(ii) Find the value of capacitance of a capacitor consisting of two parallel metal plates 30 cm × 30 cm surface area, separated by 5 mm in air. What is the total energy stored by the capacitor if the capacitor is charged to a potential difference of 1000V? What is the energy density? (8)

13. (a) (i) Derive the expression for the magnetic field intensity inside and outside a co-axial conductor of inner radius 'a', outer radius 'b' and carrying a current of 'I' amperes in the inner and outer conductors. (10)

(ii) Calculate the self inductance of infinitely long solenoid. (6)

Or

(b) (i) Derive the expression for the magnetic vector potential in the cases of an infinitely long, straight conductor in free space. (8)

(ii) Consider the boundary between two media. Show that the angles between the normal to the boundary and the conductivities on either side of the boundary satisfy the relation : $\frac{\tan\theta_1}{\tan\theta_2} = \frac{\sigma_1}{\sigma_2}$. (8)

14. (a) Derive Maxwell's equation from Faraday's law and Ampere's Law in integral Form, differential form and vector form. (16)

Or

(b) (i) Compare field theory and circuit theory. (8)

(ii) A conducting loop of radius 10 cm lies in the z = 0 plane. The associated $H = 10 \sin(120 \pi t)\overline{a}_2 \ \ MWb/m^2$. Calculate the voltage induced in the loop. (5)

(iii) State Faraday's law of electromagnetic induction. (3)

15. (a) Derive the relationship between electric field and magnetic field. Derive the wave equation for magnetic field in phasor form. (16)

Or

(b) Define Brewster angle and derive its expression. (16)