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Question Paper Code : 80492

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

Third Semester

Electrical and Electronics Engineering

EE 2202/EE 34/10133 EE 303/080280017 — 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 — ($10 \times 2 = 20$ marks)

1. State the Stoke's theorem.

2. Obtain in the cylindrical co-ordinate system the gradient of the function

   $f(r, \theta, z) = 5r^4 z^3 \sin\theta + \cos\theta + z^2$.

3. State the properties of electric flux lines.

4. A dielectric slab of flat surface with relative permittivity 4 is disposed with its surface normal to a uniform filed with flux density 1.5 C/m^2. The slab is uniformly polarized. Determine polarization in the slab.

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. Distinguish between transformer emf and motional emf.

8. What is displacement current?

9. Mention the properties of uniform plane wave.

10. Define loss tangent.

PART B — ($5 \times 16 = 80$ marks)

11. (a) (i) Find the electric field at a point $P(0, 0, 6)$ due to a point charge Q_1 of $0.35\ \mu$ C placed at (0, 5, 0) and Q_2 of $-0.6\ \mu C$ placed at (5, 0, 0). (8)

(ii) Obtain in the Spherical Co-ordinate system the gradient of the function $f(r, \theta, \Phi) = 25\ r^4 \sin\theta \cos\Phi + 2\cos\theta + 5r\sin\Phi$. (8)

Or

(b) (i) State and derive divergence theorem. (10)

(ii) Show that in Cartesian coordinates for any vector A, $\nabla \cdot (\nabla^2 A) = \nabla^2 (\nabla \cdot A)$. (6)

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) State and explain Ampere's circuital law and show that the field strength at the end of a long solenoid is one half of that at the centre. (16)

Or

(b) (i) State and explain Biot-Savart's law. (6)

(ii) Derive an expression for the force between two long straight parallel current carrying conductors. (10)

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) Briefly explain about the wave incident

(i) Normally on perfect conductor. (8)

(ii) Obliquely to the surface of perfect conductor. (8)

Or

(b) (i) Write note on standing wave ratio. (8)

(ii) A circular loop conductor lies in plane $z = 0$ and has a radius of 0.1 m and resistance of 5 ohms. Given $B = 0.2 \sin 103t\ a_z$, determine current in the loop. (8)

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