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Question Paper Code : 51432

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2014.

Third Semester

Electrical and Electronics Engineering

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

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

(Regulation 2008/2010)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. State: Stoke's Theorem.

2. Obtain in the Cartesian Co-ordinate System the Gradient of the function: $f(r,\theta,z) = 5r^4z^3 \sin\theta$.

3. Calculate the capacitance of a parallel plate capacitor having an electrode area of 100cm^2. The distance between the electrodes is 4mm and the dielectric used has a permittivity of 3.5. The applied potential is 100 Volts.

4. State Poisson's and Laplace's Equation.

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. A parallel plate capacitor has an electrode area of 10cm^2. The separation between the plates is 5 mm. A voltage of 10 sin 100 πt is applied across its plates. Calculate its displacement current. Assume air dielectric.

8. State: Poynting Theorem.

9. What is Voltage standing Wave Ratio?

10. Obtain the depth of penetration in copper at 2MHz, given the conductivity of copper $\sigma = 5.8 \times 10^7$ S/m and its permeability = 1.26 μH/m.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Obtain the Curl in the spherical Co-ordinate system. (8)

(ii) Transform the vector $A = 3i - 2j - 4k$ at $p(x = 2, y = 3, z = 3)$ to Cylindrical Co-ordinate. (8)

Or

(b) Derive the Laplace's Equation. Obtain the Laplacian's operator in the cylindrical coordinate system. (6+1 0)

12. (a) (i) Four point charges of $10\mu C$ each are placed at the corners of square of side 1 m. Determine the value of the charge that is to be placed at the centre of the square so that this system of charges is brought to equilibrium. (8)

(ii) Find the Electric Potential at any point given the electric field:

$$E = \frac{2r}{\left(r^2 + a^2\right)^2}\bar{r}$$

The boundary conditions are : at $r = \infty$, V = 0 and at r = 0 and V = 100. (8)

Or

(b) (i) Find the capacitance between two parallel conductors. The radius of conductor is 'r' separated by a distance 'd' mtrs. Both wire are carrying the current in opposite direction. (8)

(ii) Conducting cylinders at $\rho = 2cm$ and $\rho = 6cm$ are at potentials of $100V$ and $0V$ respectively. The region between the cylinders is filled with an inhomogeneous perfect dielectric for which $\varepsilon_R = 0.3/(\rho + 0.04)$.

Find (i) $D(\rho)$ (ii) $E(\rho)$ (iii) $V(\rho)$ (iv) Capacitance per metre length. (8)

13. (a) (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 angels between the normal to the boundary and the magnetic flux densities on either side of the boundary satisfy the relation: $\frac{\tan\theta_1}{\tan\theta_2} = \frac{\mu_1}{\mu_2}$.

where μ_1 and μ_2 are the permeabilities of the respective media and θ_1 and θ_2 are the angles. (8)

Or

(b) Derive the expression for the magnetic field intensity inside and outside a coaxial conductor of inner radius "a", outer radius "b", and carrying a current of "I" amperes in the inner and outer conductors. (16)

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) (i) A transmission line having a characteristic impedance of 75 Ω is terminated in an impedance of 200+j 200 Ω. If the line is 2.1 λ long and lossless, determine its input impedance. (6)

(ii) A co-axial line has an inner conductor of radius 0.1 cm and an inductance of $0.5\mu H/m$. Find the values of the characteristic impedance, capacitance and the radius of the outer conductor of the line at 100MHz, if the dielectric constant of the sponge material used as insulation in between the inner and outer conductor is 3. Calculate the velocity of the propagation and wavelength and phase constant in this case. (10)

Or

(b) Derive the Expression for an intrinsic impedance, propagation constant and velocity of a Plane Electromagnetic wave when propagated in

(i) a perfect medium (8)

(ii) Conducting media and Good conductor. (8)