G 1541 (Pages : 3) Reg. No.....

Name.....

B.TECH. DEGREE EXAMINATION, MAY 2015

Fourth Semester

Branch : Electrical and Electronics Engineering

EE 010 404—ELECTROMAGNETIC THEORY (EE)

(New Scheme—2010 Admission onwards)

[Regular/Improvement/Supplementary]

Time : Three Hours Maximum : 100 Marks

Part A

Answer **all** *questions.*
Each question carries 3 *marks.*

1. What is cross product ? List its properties.
2. What is an equipotential surface ?
3. Explain electric current and current density ? How they are related to each other ?
4. Explain the meaning of $\overline{\nabla} \cdot B = 0$.
5. What is loss tangent and discuss its significance.

(5 × 3 = 15 marks)

Part B

Answer **all** *questions.*
Each question carries 5 *marks.*

6. Obtain an expression for the electric filed due to infinite line charge having density ρ placed along z-axis, at point p on y-axis at a distance d from the z-axis.
7. If an electric potential is given by $V = \frac{10}{r^2} \sin\theta \cos\phi$, find $\overline{D}$ at $p\left(2, \frac{\pi}{2}, 0\right)$.
8. Determine the resistance of the insulation of a coaxial cable of length L.
9. Calculate the inductance of a solenoid, 8 cm in length, 2cm in radius, having $\mu_r = 100$ and carrying 800 turns of wire.
10. Do the fields $\overline{E} = E_m \sin x \sin t\, \overline{a}_y$ and $\overline{H} = \frac{Em}{\mu_o} \cos x \cos t\, \overline{a}_z$ satisfy Maxwell's equations ?

(5 × 5 = 25 marks)

Turn over

Part C

Answer **all** *questions.*
Each full question carries 12 *marks.*

11. (a) State and explain divergence theorem. (5 marks)

(b) Find the electric field intensity at a point (0, 0, 5) *mt* due to two charges $Q_1 = 0.35\ \mu C$ at (0, 4, 0) *mt* and $Q_2 = -0.55\mu C$ at (3, 0, 0) *mt*.

(7 marks)

Or

12. (a) Derive the relation between cylindrical and spherical co-ordinate systems. Explain the transformations.

(7 marks)

(b) The vector $\overline{AB}$ in joining at A (1, 2, 3) to the point B. If the distance AB is 10 units and unit vector in the direction $\overline{AB}$ is $0.6\,\bar{a}_x + 0.64\bar{a}_y + 0.48\,\bar{a}_z$, then find the co-ordinates of B.

(5 marks)

13. (a) Derive an expression for the potential due to a dipole and hence find an expression for $\overline{E}$ field.

(6 marks)

(b) Find the work done in moving a charge of + 2 coulomb from (2, 0, 0) *mt* to (0, 2, 0) *mt* along the straight line path joining the two points, if the electric field intensity is $\overline{E} = (12x\,\hat{x} - 4y\,\hat{y})\,{}^{V}/_{mt}$.

Or

14. (a) Verify that the expression for the potential due to an electric dipole satisfies the Laplace equation.

(6 marks)

(b) Find the potential in the far field for the linear quadruple having three point charges located on the *z*-axis, Assume charges 2Q at $z = 0$, – Q at $z = a$ and – Q at $z = -a$.

(6 marks)

15. (a) Derive the expression for capacitance between coaxial cylinders. (7 marks)

(b) Explain the conditions fulfilled by a linearly polarized plane wave ? (5 marks)

Or

16. The region with $z < 0$ is characterized by $\epsilon_{r2} = 2$ and $z > 0$ by $\epsilon_{r1} = 5$.

If $\overline{D}_1 = 2\,\bar{a}_x + 5\bar{a}_y - 3\bar{a}_z\ n\ c\ /m^2$, find

(i) $\overline{D}_2$; (ii) $\overline{D}_{N_2}$; (iii) $\overline{D}_{tan_2}$; (iv) Energy density in each region ; (v) the angle that $\overline{D}_2$ makes with z-axis (vi) $\frac{|D_2|}{|D_1|}$; (vii) $\frac{|P_2|}{|P_1|}$.

(12 marks)

17. (a) State and explain Biot-Savart's law. (5 marks)

(b) An infinitely long straight wire carrying 200 A, and in its vicinity a circular loop of 50 mm diameter is located with the centre of the loop 0.5 m away from the straight conductor, the wire and loop are coplanar. The current in the loop and the wire are such that they produce fields opposing each other. For what value of current in the loop with the B field at its centre be zero ?

(7 marks)

Or

18. (a) Explain the concept of vector magnetic potential. (4 marks)

(b) Determine H for a solid cylindrical conductor at a radial distance of 3mm. Given : radius of the conductor = 6mm, Length = 1m. A current of 1 Amp is uniformly distributed over the cross section. Derive the formula used.

(8 marks)

19. (a) State and explain poynting theorem. (5 marks)

(b) Find the frequency at which conduction current density and displacement current density are equal in a medium where conductivity $\sigma = 2 \times 10^{-4}$ mho/mt and relative permittivity $\epsilon_r = 81$.

(7 marks)

Or

20. Derive the Maxwell's equations in point form and in integral form. Give their practical significance.

(12 marks)

[5 × 12 = 60 marks]