G 1557 (Pages : 4) Reg. No.....

Name.....

B.TECH. DEGREE EXAMINATION, MAY 2016

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. Express $\bar{A} = x\,\bar{a}_y + y\,\bar{a}_x + z\,\bar{a}_y$ at P (–1, 4, 3) in cylindrical form.
2. Define monopole and dipole.
3. Explain current continuity equation.
4. What is magnetic torque ? Explain.
5. State and explain Faraday's law of electromagnetic induction.

(5 × 3 = 15 marks)

Part B

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

6. A uniform line charge of infinite length with $\rho_L = 18\text{nC/m}$ lies along z-axis. Find $\bar{E}$ at (6, 8, 2) m.
7. A line charge of 10 nC/m is uniformly distributed along a circular ring of radius 2 m. Calculate the potential at a point on the axis of the ring 5 m from the plane of the ring.
8. Explain the boundary conditions at the boundary of two perfect dielectrics.
9. Derive an expression for the torque on a solenoid situated in a uniform magnetic field.
10. Derive an expression for Maxwell's equations law in integral form, derived from Faraday's law.

(5 × 5 = 25 marks)

Turn over

Part C

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

11. (a) Define absolute potential. If potential function in free space is $V = 10\,xyz + x^2y$. What will be the flux density vector in this region at P (1, 2, – 1) ?

(6 marks)

(b) A circular ring charge lies in $z = 0$ plane with centre at the origin. If the uniform charge density of $Q_L = 10$ nC/m is residing on it, find the point charge Q at the origin which would produce the same electric field at (0, 0, 5) m.

(6 marks)

Or

12. (a) The electric field at a point P (1, –1, 2) is $\bar{E} = 100\,\bar{a}_x + 40\,\bar{a}_y + 10\,\bar{a}_z$ volt/meter. The point P (1, –1, 2) lies on the conductor-free space boundary. Find the normal component of $\bar{D}$ field and tangential component of $\bar{D}$ field in free space at point P.

(6 marks)

(b) Three point charges Q coulombs are placed at the corner of an equilateral triangle of side l. Calculate the point charge to be placed at the centre of the triangle such that all the charges are in equilibrium.

(6 marks)

13. (a) Calculate the field and potential both inside and outside of two concentric spheres of radii a and b.

(6 marks)

(b) State and explain Laplace and Poisson's equations in relation with electrostatic field.

(6 marks)

Or

14. (a) If $V = 50x^2yz + 20\,y^2$ in free space, find :

(i) V at P (1, 2, 3) and (ii) E_p. (6 marks)

(b) A point charge of 16 nC is located at Q (2, 3, 5) in free space, and a uniform line charge of 5 nC/m is at the intersection of planes $x = 2$ and $y = 4$. If the potential at the origin is 100 Volts, find the potential at P (4, 1, 3).

(6 marks)

15. (a) Obtain the point form of the current continuity equation and explain its significance.

(6 marks)

(b) Three parallel pates are separated by 5 mm, 4 mm and 2 mm and filled with $\epsilon_r = 2, 4$ and 5 respectively. If the area of the plated are 10 cm^2, calculate the effective capacitance.

(6 marks)

Or

16. (a) Clearly explain the concept of polarization of dielectrics and its significance. (5 marks)

(b) Two conducting sphere shells have radii of a = 2 cm and b = 5 cm. The interior is a perfect dielectric with $\epsilon_r = 10$:

(i) Find the capacitance.

(ii) If a portion of the dielectric is now removed so that $\epsilon_r = 1$ for $0 < \theta < \pi/6$ and $\epsilon_r = 10$ for $\pi/6 < \theta < \pi$, find the capacitance.

(7 marks)

17. (a) Find the magnetic field intensity at the center of a square loop of side L carrying a current of magnitude I.

(6 marks)

(b) The magnetic flux passing perpendicular to the plane of a coil is varying according to the relation $\phi_B = 6t^2 + 7t + 1$. What is the magnitude of e.m.f. induced in the coil when t = 2 sec ?

(6 marks)

Or

18. (a) State and prove Stoke's theorem for magnetic field. (5 marks)

(b) Show that $\bar{B}$ field at the ends is half of that at the center of a long solenoid. Hence find $\bar{B}$ for a toroid of radius R.

(7 marks)

19. (a) Explain the significance of Poynting vector. (5 marks)

(b) A plane wave is incident normally on a large sheet of copper. If the frequency and peak $\bar{E}$ of the incident wave is 100 MHz and IV/*m* respectively, find the power absorbed per unit area by the copper sheet.

(7 marks)

Or

20. The electric field intensity in a perfect dielectric medium is given as

$\bar{E} = E_0 \cos(wt - kz)\,\bar{a}_x$ V/m, where E_0 is its peak value, and k is a constant.

Determine :

(a) The magnetic field intensity in the region.

(b) The direction of power flow.

(6 + 6 = 12 marks)

[5 × 12 = 60 marks]