GUJARAT UNIVERSITY
B.E. EC SEM IV EC

Question Bank of Electromagnetic Theory

1. With neat & clean sketches explain Cylindrical Coordinate system. Give the table for the dot product of unit vectors in Cylindrical & Cartesian Coordinate systems with due justification.
2. With neat & clean sketches explain Spherical Coordinate system. Give the table for the dot product of unit vectors in Spherical & Cartesian Coordinate systems with due justification.
3. Define dot product & cross product for the vectors & give applications of the same.
4. Define the term vector field. A vector field is specified as $\mathbf{G} = 24xy\,\mathbf{a_x} + 12(x^2 + 2)\,\mathbf{a_y} + 18\,z^2\,\mathbf{a_z}$. For given points P (1,2,-1) & Q(-2,1,3). Determine i) G at point P ii) A unit vector directed from P to Q.
5. Given vectors $\mathbf{A} = 3\mathbf{a_x} + 4\mathbf{a_y} + \mathbf{a_z}$ and $\mathbf{B} = 2\mathbf{a_y} - 5\mathbf{a_z}$, find the angle between A and B. also find the unit vector from point A to point B.
6. Express in cylindrical components: (a) the vector from C(3,2,-7) to D(-1,-4,2); (b) a unit vector at D directed towards C; (c) a unit vector at D directed toward the origin.
7. The vector from the origin to point A is given as (6, -2, -4) and the unit vector directed from the origin toward point B is (2, -2, 1)/3. If point A and B are ten units apart, find the coordinates of point B.
8. Transform the given vector $\mathbf{A}=10\,\mathbf{a_z}$ into cylindrical & spherical coordinates at Point P (r=4, θ=110°, Ø=120°).
9. Explain Coulomb's Law and Field Intensity with suitable example.
10. Define electric field intensity. Derive the expression for the intensity of electric field due a line charge along the Z direction with uniform charge density ρ_L c/m.
11. Define volume charge density. And calculate the total charge for given, $\rho_v=[e^{(-2r)}]/r^2$ for universe.
12. Find the total charge inside given $\rho_v = 3л \cos2\theta \cos2\varphi\, r^2$ for Universe.
13. Derive equation to find the energy stored in the field of a system of charges.
14. A uniform line charge density of 20 nC/m lies on the Z-axis between Z=1 and Z=3 m. No other charge is present. Find electric field intensity at point P(4,0,0) & Origin.
15. Define the potential, Del operator &
16. Three infinite uniform sheets of charges are located in the free space as Follows: 3 nC/m2 at z = -4, 6 nC/m2 at z = 1, and -8 nC/m2 at z = 4. Determine the E at the point P (4, 2, -3) & Q (-1, -5, 2).
17. Discuss gauss's law & its application to differential volume element.
18. State & explain divergence theorem.
19. An electric field is expressed in rectangular coordinates by $\mathbf{E} = 6x^2\,\mathbf{a_x} + 6y\,\mathbf{a_y} + 4\,\mathbf{a_z}$ V/m for points M (2, 6, -1) & N (-3, -3, 2). Determine potential at V_N if V = 2 at point P(1,2,-4).
20. Derive the expression for the electric field intensity at a distant point in free space for the dipole & define the term dipole moment.
21. Define volume charge density & divergence. And obtain volume charge density ρ_v at the point specified by P($\rho = 2$, Ø = 110°, z = -1) for given

$\mathbf{D} = (2\,\rho\,z^2\ \sin 2\emptyset)\,\mathbf{a_\rho} + (\rho\,z^2 \sin 2\emptyset)\,\mathbf{a_\emptyset} + (2\,\rho^2\,z \sin 2\emptyset)\,\mathbf{a_z}$.

21 Derive Laplace's and Poisson's equations and states their key pplications.

22 Write detail note on uniqueness theorem.

23 Derive the expression for the electric field intensity for the given boundary condition V= 0 for $\emptyset = 0^\circ$ & V= V_0 at $\emptyset = \alpha^\circ$ also obtain the value of volume charge density at point P(1,2,3).

24 Assuming the potential function V varies as a function of ρ in cylindrical coordinates systems ,obtain the solution of Laplace equation and deduce the value of capacitance of a coaxial capacitor

25 Explain in details the Electrostatic boundary conditions between perfect dielectrics.

26 State and explain Biot-Savart's law.

27 Write short note stoke's theorem.

28 What is Curl ? Derive the expression for curl of magnetic field intensity.

29 Define the term magnetization & explain magnetic boundary conditions.

30 For given $\mathbf{G}=\sin\theta(\mathbf{a_r} + \mathbf{a_\theta} + \mathbf{a_\emptyset})$, determine curl of at point P(4,90°,45°).

31 Define the term curl. For given vector field, $\mathbf{F} = x^2y\mathbf{a_x}-2x\mathbf{a_y}+(3z^2+xy)\mathbf{a_z}$, determine curl of F at point P(1,2,3).

32 Evaluate both side of stoke's theorem for the field $\mathbf{H}$ = $(6\ r \sin\emptyset)\,\mathbf{a_r} + (18\ r \sin\theta \cos\emptyset)\,\mathbf{a_\emptyset}$, surface specified by r=4, $0 \le \theta \le 0.1\ \pi$, $0 \le \emptyset \le 0.3\ \pi$.

33 Describe Lorentz equation & derive the expression for the force exerted between differential current elements.

34 State Maxwell's equations in point form & explain physical significance of the equations.

35 State Maxwell's equations in integral form & explain physical significance of the equations.

36 Write a short note on the followings,
1. Boundary condition for perfect dielectric materials.
2. Propagation in good conductor.

37 Explain plane waves in free space.

38 Write a short note on the followings.
1. Ampere's circuital law.
2. Scalar & Vector magnetic potential.

39 Write short notes on the followings.
1. The retarded potentials
2. Propagation in good Conductor.

40 State and prove Poynting theorem relating to the flow of energy at a point in space in an electromagnetic field.