

**GUJARAT UNIVERSITY**  
**B.E Sem IVth (Electrical)**  
**Sub: Engineering Electromagnetics**  
**Question Bank**

Q.1	What are scalars and vectors? Do vectors obey commutative, associative and distributive laws? With the help of suitable example explain dot product and cross product of vectors
Q.2	Explain cartesian, cylindrical and spherical co-ordinate system
Q.3	With the help of a suitable example explain how a vector in Cartesian system can be converted into (i) Cylindrical system (ii) Spherical system
Q.4	Explain Coulomb's law. A charge $Q_1 = -20 \mu\text{C}$ is located at $P(-6,4,6)$ and a charge $Q_2 = 50 \mu\text{C}$ is located at $R(5,8,-2)$ in free space. Find the force exerted on $Q_2$ by $Q_1$ in vector form. The distance given are in metres
Q.5	Derive the formula for electric field intensity at a point on the y-axis due to line charge which lies on the z-axis
Q.6	Derive the formula for electric field intensity at a point on the z-axis due to sheet charge which lies on the $z = 0$ plane
Q.7	Define electric flux and electric flux density. State the formula for electric flux density due to line charge and sheet charge. Also give the relationship between electric flux density and electric field intensity
Q.8	Two co-axial conducting cylinders having inner radius of 'a' and outer radius of 'b' metres have a charge distribution of $\rho_s$ on the outer surface of inner cylinder. Use Gauss' law to find 'D' in all the regions
Q.9	Discuss the application of Gauss' law to differential volume element and hence discuss the concept of divergence. State the forms of divergence in Cartesian, cylindrical and spherical systems
Q.10	What is work done? Explain how will you find the work done in carrying a point charge of 'Q' coulombs from initial position 'A' to final position 'B' in an electric field 'E'
Q.11	Define absolute potential and potential difference. Explain how will you find potential and potential difference due to several point charges
Q.12	Explain potential gradient. Prove that $E = -\text{grad } V$
Q.13	What is an electric dipole? Derive the formula for electric field intensity and electric potential due electric dipole
Q.14	What is current and current density? State the relationship between I and J and between J and $\rho_v$ . Also derive the continuity equation
Q.15	Write a short note on boundary conditions between conductor and free space
Q.16	Write a short note on boundary conditions between two perfect dielectrics
Q.17	Derive Poisson's and Laplace's equation
Q.18	Explain Uniqueness theorem
Q.19	State Biot Savart's law. Derive the formula for incremental magnetic field intensity due to differential current element
Q.20	State Ampere's circuital law. Using Ampere's circuital law find 'H' due to co-axial cable in all the regions

Q.21	Discuss the application of Ampere's circuital law to differential surface element and hence prove that $\text{curl } \mathbf{H} = \mathbf{J}$
Q.22	Explain Stoke's theorem. Also state Maxwell's equations in integral form and point form
Q.23	Explain in detail scalar and vector magnetic potentials
Q.24	Explain Lorentz force equation. A point charge of $Q = -1.2\text{C}$ has velocity $\mathbf{v} = (5\mathbf{a}_x + 2\mathbf{a}_y - 3\mathbf{a}_z)$ m/s. Find the magnitude of force exerted by (a) $\mathbf{E} = -18\mathbf{a}_x + 5\mathbf{a}_y - 10\mathbf{a}_z$ V/m (b) $\mathbf{B} = -4\mathbf{a}_x + 4\mathbf{a}_y + 3\mathbf{a}_z$ T (c) Both are present simultaneously
Q.25	Write a short notes on magnetic boundary conditions
Q.26	What is self inductance and mutual inductance? Derive the formula for inductance of a solenoid.
Q.27	Transform the vector field $\mathbf{W} = 10\mathbf{a}_x - 8\mathbf{a}_y + 3\mathbf{a}_z$ to cylindrical co-ordinate system at point P(10,-8,6) and into spherical co-ordinate system at point Q (7,8,10)
Q.29	Find $\mathbf{E}$ at P(1,5,2)m in free space if a point charge of $6 \mu\text{C}$ is located at (0,0,1), the uniform line charge density $\rho_L = 180 \text{ nC/m}$ along the x-axis and uniform sheet charge with $\rho_s = 25 \text{ nC/m}^2$ over the plane $z = -1$ .
Q.30	Three concentric spherical surfaces have radii $r = 3, 5$ and $7 \text{ m}$ respectively have uniform charge densities of $200, -50$ and $\rho_x \mu\text{C/m}^2$ respectively. Find (a) $\mathbf{D}$ at $r = 2\text{m}, 4\text{m}$ and $6\text{m}$ . Find $\rho_x$ if $\mathbf{D} = 0$ at $r = 7.32\text{m}$
Q.31	An electrostatic field is given by $\mathbf{E} = -8xy\mathbf{a}_x - 4x^2\mathbf{a}_y + \mathbf{a}_z$ V/m. The charge of $6\text{C}$ is to be moved from B(1,8,5) to A(2,18,6). Find the work done in each of the following cases (i) The path selected is $y = 3x^2 + z, z = x + 4$ (ii) The straight line from B to A
Q.32	If $\mathbf{V} = 2x^2y + 20z - 4/(x^2+y^2)$ V. Find $\mathbf{D}, \mathbf{E}$ and $\rho_v$ at P(6,-2.5,3)
Q.33	Find the total current in outward direction from a cube of $1\text{m}$ with one corner at the origin and edges parallel to the co-ordinate axis if $\mathbf{J} = 2x^2\mathbf{a}_x + 2xy^3\mathbf{a}_y + 2xy\mathbf{a}_z$
Q.34	Determine whether or not the following potential fields satisfy Laplace's equation (a) $V = x^2 - y^2 + z^2$ (b) $V = r\cos\Phi + z$ (c) $V = r\cos\theta + \Phi$
Q.35	Given that the general vector is $\mathbf{H} = 2.5\mathbf{a}_\theta + 5\mathbf{a}_\phi$ in spherical co-ordinates, find the curl of $\mathbf{H}$ at $(2, 30^\circ, 0)$