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UNIT-I
INTRODUCTION TO COORDINATE SYSTEMS AND VECTOR ALGEBRA
10 MARKS QUESTIONS

1. The three vertices of a triangle are located at A(-1,2,5), B(-4,-2,-3), and C(1,3,-2). (a) Find the length of the perimeter of the triangle. (b) Find a unit vector that is directed from the midpoint of the side AB to the midpoint of the side BC. (c) Show that this unit vector multiplied by a scalar is equal to the vector from A to C and that the unit vector is therefore parallel to AC.

2. 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 points A and B are ten units apart, find the coordinates of point B.

3. A circle, centred at the origin with radius of 2 units, lies in the xy plane. Determine the unit vector in rectangular components that lies in the xy plane, is tangent to the circle at ($\sqrt{3}$, 1, 0), and is in the general direction of increasing values of y.

4. A vector field is specified as G= $24xya_x + 12(x^2+2)a_y + 18z^2a_z$. Given two points P (1,2,-1) and Q(2,1,3), find: (a) G at P; (b) a unit vector in the direction of G at Q; (c) a unit vector directed from Q towards P; (d) the equation of surface on which $|G|$ =60.

5. A field is given as G=$[25/(x^2+y^2)](xa_x + ya_y)$, Find: (a) a unit vector in the direction of G at P(3,4,-2); (b) the angle between G and a_x at P; (c) the value of double integral on the plane y=7.

6. Three vectors extending from the origin are given as r_1 = (7,3,-2), r_2=(-2,7,-3) and r_3=(0,2,3). Find: (a) a unit vector perpendicular to both r_1 and r_2; (b)a unit vector perpendicular to the vectors r_1-r_2 and r_2-r_3 ; (c) The area of the triangle defined by r_1 and r_2; (d)The area of the triangle defined by the heads of r_1,r_2, and r_3.

7. (a) Express the field D= $(x^2+y^2)^{-1}(xa_x+ya_y)$ in cylindrical components and cylindrical variables: (b) Evaluate D at the point where ρ=2, Φ=0.2π, and z=5, expressing the result in cylindrical and rectangular components.

8. Express in cylindrical components; (a) the vector from C(3,2,-7) to D(-1,-4,2); (b) a unit vector at D directed toward C; (c) a unit vector at D directed toward the origin.

9. The surfaces ρ=3, ρ=5,Φ=100°, Φ=130°, z=3, and z=4.5 define a closed surface. (a) Find enclosed volume; (b) Find the total area of enclosing surface; (c) Find the total length of the twelve edges of the surfaces; (d) Find the length of longest straight line that lies entirely within the volume.

10. Given point P(r=0.8, θ=30°, Φ=45°), and E= $1/r^2(\cos\Phi\ a_r + \sin\Phi/\sin\theta a_\Phi)$; (a) Find E at P; (b) Find $|E|$ at P; (c) Find a unit vector in the direction of E at P.

2 MARKS QUESTIONS

a) Define scalar and vector give examples?
b) State divergence theorem and stokes theorem?
c) What is the relation between electric flux density and electric field intensity?
d) Write about cross product and dot product?
e) What is DEL operator and write its applications?
f) Given the vectors $\mathbf{M} = -10\mathbf{a}_x + 4\mathbf{a}_y - 8\mathbf{a}_z$ and $\mathbf{N} = 8\mathbf{a}_x + 7\mathbf{a}_y - 2\mathbf{a}_z$, find: a) a unit vector in the direction of $-\mathbf{M} + 2\mathbf{N}$ b) magnitude of $-\mathbf{M} + 2\mathbf{N}$?
g) Define unit vector?
h) $\mathbf{E} = 3a_x + 4a_z$ and $\mathbf{F} = 4a_x - 10a_y + 5a_z$. (a) Find the component of $\mathbf{E}$ along $\mathbf{F}$. (b) Determine a unit vector perpendicular to both E and F.
i) Write the relation between unit vector in spherical and Cartesian co-ordinate systems?
j) Write the relation between unit vector in cylindrical and Cartesian co-ordinate systems?

UNIT –II
STATIC ELECTRIC FIELD

10 MARKS QUESTIONS

1. (a) State and explain Coulomb's law indicating clearly the units of quantities in the equation of force?
    (b) State and prove Gauss's law and write limitations of Gauss's law?
2. A charge Q_0 located at the origin in free space, produces a field for which $E_2 = 1kv/m$ at point P (-2, 1,-1). (a) Find Q_0, Find E at M (1, 6, 5) in (b) Cartesian coordinates (c) Cylindrical coordinates?
3. Four positive point charges 10^{-12} coulomb each are situated in X-Y plane at points (0, 0), (0, 1) (1, 1) and (1, 0) m. Find the electric field and potential at (3/4, 3/4) and (1, 1)?
4. (a) Derive the expression for the electric field intensity due to line charge?
    (b) Four concentrated charges $Q_1 = 0.3\ \mu C$, $Q_2 = 0.2\ \mu C$, $Q_3 = -0.3\ \mu C$, $Q_4 = 0.2\ \mu C$ are located at the vertices of a plane rectangle. The length of rectangle is 5 cm and breadth of the rectangle is 2 cm. Find the magnitude and direction of resultant force on Q_1?
5. (a) Derive torque expression when dipole placed in an electric field?
    (b) Derive Maxwell's second equation?
6. (a) Derive the expression for electric field intensity at a point due to electric dipole?
    (b) Derive an expression for electric potential due to point charge?
7. Four point charges each of $10\mu C$ are placed in free space at the points (1, 0, 0), (-1, 0, 0), (0, 1,0) and (0, -1, 0) m respectively. Determine the force on a point charge of $30\mu C$ located at a point (0, 0, 1) m?
8. (a) Derive Maxwell's first equation?
    (b) Derive the expression for electric field intensity due to infinite sheet charge?
9. Find an expression for electrical field intensity due to infinite line charge?
10. Four positive point charges 10-9 coulomb each are situated in x-y plane at points (0, 0), (0, 1), (1, 1) and (1, 0) m. Find the electric field and potential at (½, ½)?

2 MARK QUESTIONS

a) What is the relation between electric flux density and electric field intensity?

b) Define dipole and dipole moment?

c) State gauss's law, write its applications and limitations?

d) Write Maxwell's first equation in integral and point form?

e) State vector form of coulomb's law?

f) Write Maxwell's first equation in integral and point form?

g) Derive relation between electric potential and electric field intensity?

h) Define absolute Electric potential, Potential difference?

i) Write the expression for electric field intensity due to infinite line charge?

j) State coulomb's law and explain the terms?

UNIT –III
CONDUCTORS, DIELECTRICS AND CAPACITANCE
10 MARKS QUESTIONS

1. (a) Derive the continuity equation. What is its physical significance?
   (b) Derive the point form of ohms law?
2. Explain the boundary conditions of two perfect dielectrics materials?
3. Explain the boundary conditions between conductor and free space?
4. Explain the phenomenon of polarization when a dielectric slab is subjected to an electric field?
5. (a) Derive the expression for capacitance of the spherical condenser?
   (b) Find the current in circular wire, if the current density is $\bar{J} = (1 - e^{-100\tau})\, a_z$ A/m^2. The radius of the wire is 2mm?
6. (a) Derive the expression for capacitance of a co-axial cable?
   (b) A parallel plate capacitor has a plate area of 1.5m^2 and a plate separation of 5mm. Three are two dielectrics in between the plates. The first dielectric has a thickness of 3mm with a relative permittivity of 6 and the second has a thickness of 2mm with a relative permittivity of 4. Find the capacitor?
7. (a)Derive the expression for parallel plate capacitor?
   (b) What is the energy stored in a capacitor made of two parallel metal plates each of 30 cm^2 area separated by 5mm in air. $\varepsilon_o = 8.854 \times 10^{-12}$. The capacitor is charged to potential difference of 500v?
8. At the boundary between glass $\varepsilon_r = 4$ and air, the lines of electric field make an angle of 40^0 with normal to the boundary. If electric flux density in the air is $0.25\mu C/m^3$. Determine the orientation and magnitude of electric flux density in the glass?

9. A parallel plate capacitor consists of two square metal plates with 500mm side and separated by 10mm. a slab of sulphur (ε_r= 4) 6mm thick is placed on the lower plate and air gap of 4mm. find capacitance of capacitor?

10. (a) Derive Poisson's equation and write the procedure for finding solution of Poisson's equation?

   (b) Derive Laplace's equation?

2MARKS QUESTIONS

a) Define polarization in dielectric materials?

b) Write the relation between current I and current density J?

c) Write the equation for energy stored in capacitor?

d) Define Dielectric Strength?

e) A conductivity of a wire is 5000 mho/m and it is subjected to an electric field of 0.1 volts/m, then what is the current density (J) in a wire?

f) Define dielectric constant?

h) Find the value of relative permitivity when electric susceptibility if 39?

i) In a certain region, D = 420 nC/m^2 and ε = 5.2ε_0. Find χ_e $\vec{E}$, and P?

j) In a certain region (ε = 5 ε_0), V = 10 ρz sinϕ. Find D?

UNIT –IV

STATIC MAGNETIC FIELDS

1. Derive the expression for torque produced on a closed current carrying when placed in a magnetic field?

2. Using Biot-savart's law. Find $\vec{H}$ and $\vec{B}$ due conductor of finite length?

3. Find the magnetic field intensity $\bar{H}$ due to co-axial cable?

4. (a) Write down Maxwell's third equation in point and integral form?

   (b)Find magnetic field intensity $\bar{H}$ due to solenoid carrying current I and having length L= 4m?

5. (a) State and explain Biot-savart's law?

   (b) Explain Maxwell's second equation?

6. (a) State and explain ampere's circuital law?

   (b) Derive the expression for the force between two current carrying wires?

7. (a) A circular loop is located on X^2+Y^2=9 and Z=0 carries a direct current of 10A along $\overline{a_\phi}$ direction. Determine $\bar{H}$ at (0, 0, 5) m?

   (b) Explain about Magnetic Dipole Moment?

8. Using Biot-savart law or Amperes law find $\vec{H}$ due conductor of infinite length?

9. (a) Explain relationship between magnetic torque and moment?

   (b) Derive an expression for the force between two current carrying wires?

10. (a) What is vector magnetic potential?

   (b) A toroid has air core and has a cross sectional area of 10mm^2 it has 1000 turns and its mean radius is 10mm. find its inductance?

11. Derive the expression for self-inductance of solenoid and toroid?
   (b) Derive the expression for inductance of a co-axial cable?

2M QUESTIONS

a) Define Magnetic dipole moment?
b) Write Lorentz force equation?
c) State point form of Amperes law?
d) State Ampere's circuital law?
e) Define self-inductance?
f) State Biot-savats law?
g) Define mutual inductance and write its SI units?
h) What co-efficient of coupling and how it relates mutual and self-inductances?
i) What is scalar magnetic potential?
j) What is vector magnetic potential?

UNIT –V

TIME VARYING FIELDS AND MAXWELL'S EQUATIONS

1. State and prove poynting theorem?
2. Write Maxwell's equation in good conductors for time varying fields and static fields both in differential and integral form?
3. Explain faradays law of electromagnetic induction and there from derive maxwell's equation in differential and integral form?
4. (a) A copper wire carries current of 1A. Determine displacement current in the wire at 1 MHz for copper $\varepsilon=\varepsilon_o$ and $\sigma=5.8 \times 10^7$?
   (b) Explain pointing vector and its significance?
5. Derive the equation of Continuity for time varying fields?
6. Derive an expression for motional and transformer induced emf?
7. What is displacement current? Explain physical significance of displacement current?
8. Derive expressions for integral and point forms of poynting Theorem?
9. Explain faradays law of electromagnetic induction and derive the expression for induced e.m.f?

2 MARKS QUESTIONS

a) Define skin depth?
b) Define displacement current?
c) State Faraday's law of electromagnetic induction?
d) Write Maxwell equations in time varying fields?
e) Define pointing vector?
f) Write Maxwell's equations for static electric field?
g) Write integral form of Maxwell equations?
h) Write point form of Maxwell equations?
i) Write Maxwell equations for static magnetic fields?

j) What is meant by dynamically induced e.m.f?