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QUESTION BANK (DESCRIPTIVE)

Subject with Code : Electro Magnetic Field (18EE0203)   **Course & Branch**: B.Tech - EEE
Year & Sem: II-B.Tech & I-Sem   **Regulation:** R18

UNIT-I
INTRODUCTION TO COORDINATE SYSTEMS AND VECTOR ALGEBRA

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=100º, Φ=130º, 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, $\boldsymbol{\theta}$=30º, Φ=45º), and E= $1/r^2(cosΦa_r+sinΦ/sin\boldsymbol{\theta}a_Φ)$; (a) Find E at P; (b) Find $|E|$ at P; (c) Find a unit vector in the direction of E at P.

UNIT –II
ELECTROSTATICS

1. (a) State and explain Coulomb's law indicating clearly the units of quantities in the equation of force? 5M

   (b) State and prove Gauss's law and write limitations of Gauss's law? 5M

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, and 5) in (b) Cartesian coordinates. (c) Cylindrical coordinates. 10M

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)? 10M

4. (a) Derive the expression for the electric field intensity due to line charge? 5M

   (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? 5M

5. (a) Derive Laplace and Poisson's equation? 5M

   (b) Find electric potential due to electric dipole? 5M

6. (a) Derive the expression for electric field intensity at a point due to electric dipole? 5M

   (b) Derive an expression for electric potential due to point charge? 5M

7. (a) Derive Maxwell first equation? 5M

   (b) Derive the expression for torque on electric dipole in the presence of uniform electric field? 5M

8. 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? 10M

9. Derive electrical field intensity due to charged circular ring? 10M

10. a) Write the condition for Laplace equation? 2M

    b) What is the relation between electric flux density and electric field intensity? 2M

    c) Define dipole moment? 2M

    d) Define an electric dipole? 2M

    e) State vector form of coulombs law? 2M

UNIT –III

CONDUCTORS AND DIELECTRICS

1. (a) Derive the continuity equation. What is its physical significance?   5M
   (b) Derive the point form of ohms law?   5M
2. Explain the boundary conditions of two perfect dielectrics materials?   10M
3. Explain the boundary conditions between conductor and free space?   10M
4. Explain the phenomenon of polarization when a dielectric slab is subjected to an electric field?   10M
5. (a) Derive the expression for capacitance of the spherical condenser?   5M
   (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?   5M
6. (a) Derive the expression for capacitance of a co-axial cable?   5M
   (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?   5M
7. (a) Derive the expression for parallel plate capacitor?   5M
   (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?   5M
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 0.25µC/m^3. Determine the orientation and magnitude of electric flux density in the glass?   10M
9. A parallel plate capacitor consists of two square metal plates with 500mm side and separated by 10mm. a slab of sulphur ($\varepsilon_r = 4$) 6mm thick is placed on the lower plate and air gap of 4mm. find capacitance of capacitor?   10M
10. a) Define polarization in dielectric materials?   2M
    b) Write the relation between current I and current density J?   2M
    c) Write the equation for energy stored in capacitor?   2M
    d) Define Dielectric Strength?   2M
    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?   2M

UNIT –IV

MAGNETO STATICS

1. Derive the expression for torque produced on a closed current carrying when placed in a magnetic field? 10M
2. Using Biot-savart's law. Find $\vec{H}\ and\ \vec{B}$ due conductor of finite length? 10M
3. Find the magnetic field intensity $\bar{H}$ due to co-axial cable? 10M
4. (a) Write down Maxwell's third equation in point and integral form? 5M
   (b)Find magnetic field intensity $\bar{H}$ due to solenoid carrying current I and having length L= 4m? 5M
5. (a) State and explain Biot-savart's law? 5M
   (b) Explain Maxwell's second equation? 5M
6. (a) State and explain ampere's circuital law? 5M
   (b) Derive the expression for the force between two current carrying wires? 5M
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? 5M
   (b) Explain about Magnetic Dipole Moment? 5M
8. Using Biot-savart law or Amperes law find $\vec{H}$ due conductor of infinite length? 10M
9. (a) Explain relationship between magnetic torque and moment? 5M
   (b) Derive an expression for the force between two current carrying wires? 5M
10. a). Define Magnetic dipole moment? 2M
    b). Write Lorentz force equation? 2M
    c) State point form of Amperes law? 2M
    d) State Ampere's circuital law? 2M
    e) State Biot-savats law? 2M

11. (a) What is vector magnetic potential? Derive vector poison's equation? 5M
    (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? 5M
12. Derive the expression for self inductance of solenoid and toroid? 10M
13. (a) A coil of 500 turns is wound on a closed iron ring of mean radius 10cm and cross section of 3 cm^2. Find the self inductance of the winding if the relative permeability of iron is 800? 5M
    (b) Explain the difference between self inductance and mutual inductance? 5M
14. (a) Derive the expression for inductance of a co-axial cable? 5M
    (b) Compute the energy density in free space on account of field having $\vec{H}$ = 1000 A /m? 5M
15. (a) A coil of 1000 turns is wound on a Toroidal iron ring of mean radius 10cm and cross section of $3cm^2$. Find the self inductance of the winding if the relative permeability of iron is 800? 5M
    (b) Explain scalar magnetic potential and its limitations? 5M
16. Find the mutual inductance between a long, straight wire and square loop lying in same plane? 10M
17. Derive an expression for the force between two straight long and parallel conductors? 10M
18. Derive the expression for Neuman's formula? 10M
19. Explain the concept of energy stored in magnetic fields? 10M
20. a) Define self inductance? 2M

b) Define mutual inductance? 2M
c) Define inductance? 2M
d) What is the inductance of Solenoid? 2M
e) What is the inductance of Toroid? 2M

UNIT –V

TIME VARYING FIELDS

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