Code No: R21024 **R10** SET - 1

II B. Tech I Semester, Supplementary Examinations, Nov – 2012
ELECTRO MAGNETIC FIELDS
(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
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1. a) State and prove Gauss's law as applied to an electric field and determine the field due to an infinite line charge.
   b) Show that the electric filed intensity at any point inside a hollow charged spherical conductor is zero.

2. a) In a certain region the potential is given by $V = x^2 + 5y^2 + 4z^2$. Find the electric field intensity at a point (1, -2, 3) m.
   b) Show that the torque on a physical dipole $\overline{P}$ in a uniform electric filed $\overline{E}$ is given by $\overline{P} \times \overline{E}$. Extend this result to a pure dipole.
   c) Explain behavior conductors in an electric field.

3. a) State and prove the conditions on the tangential and normal components of electric flux density and electric field intensity, at the boundary between the dielectrics.
   b) An aluminum conductor is 304.8m long and has a circular cross section with a diameter of 0.8 inches. If there is a dc voltage of 2.0V between the ends find (i) the current density (ii) the current (iii) the Power dissipated.

4. a) State and explain Biot-Savart's law and derive the expression for the magnetic field at a point due to an infinitely long conductor carrying current.
   b) A circuit is having a direct current of 5 amps form a regular hexagon inscribed in a circle of radius 1 m. Calculate the magnetic flux density at the center of the circular hexagon. Assume the medium to be free space.

5. a) What are the limitations of Ampere's current law? How this law can be modified to time varying field.
   b) A square loop 10 cm on a side has 500 turns that are closely and tightly wound and carries a current of 120 A. Determine the magnetic flux density at the centre of the loop.

6. a) What is a magnetic dipole? How does a magnetic dipole differ from an electric Dipole? Explain about magnetic dipole moment.
   b) Derive the expression for force between two long parallel current carrying conductors placed in a magnetic field.

7. a) Explain the concept of vector and scalar magnetic potentials.
   b) Derive the Neumann's formulae for the calculation of self and mutual inductances.

8. a) Explain about Poynting vector.
   b) Find the frequency at which conduction current density and displacement current density are equal in a medium with $\sigma = 2\text{x}10^{-4}$ mho/m and ϵ_R=81.
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Code No: R21024 **R10** SET - 2

II B. Tech I Semester, Supplementary Examinations, Nov – 2012
ELECTRO MAGNETIC FIELDS
(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
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1. a) State and explain Coulomb's law to determine force between two point charges.
   b) Find the electric field intensity at a point P_1 (0, 1, 2) m due to charge Q_1=300 nC, located at P_2 (2, 0, 3) m in free space.

2. a) Discuss the behavior of conductors in an electric field.
   b) Develop an expression for potential difference at any point between two spherical shells in terms of the applied potential. Use Laplace equation.

3. a) Derive an expression for capacitance between two concentric spherical shells.
   b) Derive the expression for continuity equation.

4. a) Find the expression for the magnetic flux density, 'B' at a distance 'h' above the centre of a rectangular loop of wire 'b' meters on one side and 'a' meters on the other side. The loop carries a current of one ampere.
   b) A single turn circular coil of 50 m in diameter caries a current of 28x10^4 amperes. Determine the magnetic field intensity H at a point on the axis of coil and 100 m from the coil. The μ_r of free space is unity.

5. a) Show that $\nabla \times \vec{H} = \vec{J}$.
   b) Find the vector magnetic field intensity H at a point P (2.5, 2, 3) m caused by a current filament of 12 A in $\hat{a}_z$ direction on the z-axis extending from 0 to 6.

6. a) Two conducting filaments extend along the 'x' and 'y' axes, carrying currents I_1 and I_2 in the a_x and a_y directions, respectively. Find the differential force exerted on the differential current element $I_2\, dl_2$ at (0,1,0) m by the differential element $I_1\, dl_1$ at (1,0,0) m.
   b) Derive the expression for torque exerted on a current-carrying loop placed in a magnetic field.

7. a) Derive the expression for magnetic vector potential?
   b) Explain about the Vector Poisson's equation for steady magnetic field.

8. a) Explain the concept of displacement current and obtain an expression for the displacement current density.
   b) Explain the terms: (i) Motional EMF (ii) Static EMF
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Code No: R21024 **R10** SET - 3

II B. Tech I Semester, Supplementary Examinations, Nov – 2012
ELECTRO MAGNETIC FIELDS
(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
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1. a) A very thin, finite, and uniformly charged line of length 10m carries a charge of 10 μC/m. Calculate the electric field intensity in a plane bisecting the line at $\rho = 5$ m.
b) Determine the electric field intensity due to infinite line charge, at a point perpendicular to its plane and at a given distance from the line charge from first principles.

2. a) A uniform charge density of ρ_v C/m^2 exists throughout the volume of a sphere of radius '*b*' meters. Using Poisson's equation, find the value of electric filed intensity and potential at any point inside the sphere for which $0 \le r \le b$.
b) Derive Poisson's and Laplace equations starting from point form of Gauss Law.

3. a) Derive the point form of Ohm law for conductors.
b) Derive an expression for the capacity of a spherical capacitor consisting of two concentric spheres of radii a and b, the dielectric medium between the two spheres being air. Henceforth show that the same expression can be written as $C = \frac{\varepsilon_0}{d}\sqrt{A_a A_b}$, where A_a and A_b are the surface areas of the two spheres with radii a and b respectively.

4. a) Derive an expression for magnetic flux density at a point due to a current in a straight conductor of infinitely long straight conductor.
b) A long solenoid has a radius of 2 cm and a length of 1.2 m. If the number of turns per unit length is 200 and the current is 12 A, calculate the magnetic flux density i) at the Center and ii) at the ends of the solenoid.

5. a) Discuss the application of Amperes circuital law for unsymmetrical surfaces.
b) A circular loop located on $x^2 + y^2 = 9$, $z = 0$ carries a direct current of 10 A along a_φ direction. Determine H at (0, 0, 5) cm and (0, 0, -5) cm.

6. a) A point charge of value -40 nC is moving with a velocity of 6000 km/sec in a direction specified by the unit vector $\hat{a}_v = -0.48\hat{a}_x - 0.6\hat{a}_y + 0.64\hat{a}_z$. Using Lorentz's force equation, find the force $\overline{F}$ if (a) $\overline{B} = 2\hat{a}_x - 3\hat{a}_y + 5\hat{a}_z$ mT (b) $\overline{E} = 2\hat{a}_x - 3\hat{a}_y + 5\hat{a}_z$ kV/m.
b) Two infinitely long parallel conductors are separated by a distance 'd'. Find the force per unit length exerted by one of the conductor on the other if the currents in the two conductors are I_1 and I_2.

7. a) Explain the characteristics and applications of permanent magnets.
b) Derive the expression for inductance of a solenoid.

8. a) Show that power loss in a conductor is given as product of voltage and current using Poynting theorem.
b) Verify the fields $\vec{E} = E_m sin(\ x)\, sin(\ t)\,\hat{a}_y$ and $\vec{E} = \frac{E_m}{\mu_o} cos(\ x)\, cos(\ t)\,\hat{a}_z$ satisfy Maxwell's equations or not.
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Code No: R21024 **R10** SET - 4

II B. Tech I Semester, Supplementary Examinations, Nov – 2012
ELECTRO MAGNETIC FIELDS
(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
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1. a) Define electrostatic potential. Discuss the properties of electrical potential function.
b) Three equal positive charges of 4 nC each are located at three corners of a square side 20 cm. Determine the magnitude and direction of the electric field at the variant corner of the square.

2. a) Derive an expression for torque due to a dipole that is present in an electric field.
b) Measurement made in the atmosphere show that there is an electric field which varies widely from time to time particularly during thunderstorms. Its average values on the surface of earth at a height of 1550 m were found to be 100 V/m and 25 V/m directed downward towards the earth respectively. Calculate: i) the mean space charge in the atmosphere between 0 and 1500 m altitude ii) Surface charge density on the earth.

3. a) Two parallel conducting plates 5cm apart and situated in air are connected to a source of constant potential difference of 80kV. Find the electric field intensity between the plates if it is within permissible value? If a mica sheet ($\varepsilon_r = 5$) of thickness 2cm is introduced between the plates, determine the field intensity in air and mica.
b) Derive an expression for Capacitance due to two concentric spherical conductors.

4. a) An air cored toroid having a cross sectional area of 6 cm^2 and mean radius 15 cm is wound uniformly with 500 turns. Determine the magnetic flux density and the field intensity.
b) A conductor in the form of regular polygon of "n" sides, inscribed in a circle of radius "R". Show that the expression for magnetic flux density $B = \frac{\mu_0 nI}{2\pi R}\tan(\frac{\pi}{n})$ at the centre, where I is the current.

5. a) State and explain Ampere's circuital law and derive the same in point differential form.
b) Find the magnetic field intensity at centre of a square of sides equal to 5 m and carrying a current equal to 10 A. Derive the formula used.

6. a) State and explain Lorentz's force equation?
b) A single-phase circuit comprises two parallel conductors A and B, each 5 cm diameter and spaced 10 meter apart. The conductors carry currents of +50 and -50 amperes respectively. Determine the magnetic field intensity at the surface of each conductor and also exactly midway between A and B.

7. a) Obtain the expression for inductance of a toroid.
b) Derive the expression for energy density in a magnetic field.

8. a) Starting from Faraday's law of electromagnetic induction, derive $\nabla \times E = -\frac{\partial \vec{B}}{\partial t}$.
b) From the Maxwell's equations, derive the expression for Poynting vector. Also, explain the applications of the Poynting vector.
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