Code No: 07A3EC04 **Set No. 1**

II B.Tech I Semester Regular Examinations, November 2008
ELECTROMAGNETIC FIELDS
(Common to Electrical & Electronic Engineering and Electronics & Control Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) State and explain Gauss's law.
   (b) Four concentrated charges $Q_1 = 0.3\ \mu$ c, $Q_2 = 0.2\ \mu$c, Q_3 = -0.3 μc, $Q_4 = 0.2$ μc 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. [6+10]

2. (a) Derive an expression for the electric field intensity due to an infinite length line charge along the z-axis at an arbitrary point Q (x, y, z).
   (b) A charge of -0.3μC is located at A (25, -30, 15) Cm and a second charge of 0.5 μ C is located at B (-10, 8, 12) Cm. Find the electric field strength, E at:
      i. The origin and
      ii. Point P (15, 20, 50) cm. [8+8]

3. (a) Explain duality between $\overline{D}$ and $\overline{J}$
   (b) Find the total current in a circular conductor of radius 4 mm if the current density varies according to $J = \frac{10^4}{r} A/m^2$. [6+10]

4. A steady current of 10 A is established in a long straight hollow aluminum conductor having inner and outer radius of 1.5 cm and 3 cm respectively. Find the value of B as function of radius. Also define the law used. [16]

5. (a) Show that the field strength at the end of a long solenoid is one - half of that at the centre.
   (b) Find an expression for field intensity at the centre of a circular wire carrying a current I in the anticlockwise direction. The radius of circle is 'r' and the wire in the x - y plane. [16]

6. (a) Derive an expression for force on a current element in a magnetic field.
   (b) If a point charge of 4 coulombs moves with a velocity of $5u_x + 6u_y - 7u_z$ m/s, find the force exerted, if the flux density is $5u_x + 7u_y + 9u_z$ wb/m^2. [8+8]

7. (a) Derive an expression for mutual inductance use Newmann's formulae.
   (b) Current in a coil is increased from zero to 15 amps at a uniform rate in 6 seconds. It is found that this coil develops self induced emf of 150 volts whereas an emf of 25 volt is produced in a neighbouring coil. Compute self inductance of the first coil and the mutual inductance between the two coils. [8+8]

8. (a) Discuss the physical interpretation of Maxwell's equations.

   (b) A parallel plate capacitor with plate area of 5 cm^2 and plate separation of 3mm has a voltage 50 Sin 10^3t volts applied to its plates. Calculate the displacement current, assuming $\varepsilon = 2\varepsilon_0$. [8+8]

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Code No: 07A3EC04 **Set No. 2**

II B.Tech I Semester Regular Examinations, November 2008
ELECTROMAGNETIC FIELDS
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Derive the concept of electric field intensity from Columb's law.
   (b) Derive an expression for electric field intensity at any point 'P' at a radial height 'h' from a finite line charge of λ c/m. extending along the z-axis from 32 to 33 distance 'P' in the x-y plane. [8+8]

2. Establish Gauss Law in point form and integral form hence deduce the Laplace's and Poissions's equations. [16]

3. A parallel plate capacitor has a plate area of 1.5 Sq.m. and a plate separation of 5 mm. There are two dielectrics in between the plates. The first dielectric has a thickness of 3 mm with a relative permittivity of 6 and the second has a thickness of 2 mm with relative permittivity 4. Find the capacitance . Derive the formula uses. [16]

4. A single-phase circuit comprises two parallel conductors A and B, each 1 cm diameter and spaced 1 m apart. The conductors carry current of +100 and -100 Amps. respectively. Determine the filed intensity at the surface of each conductor and also in space exactly midway between A and B. [16]

5. (a) Using Amperes circuital law, obtain an expression for the magnetic field intensity at any point due to a concentric cylindrical conductors, the inner and outer conductors carrying equal and opposite currents.
   (b) Using amperes circuital law, find H and B inside a long straight non magnetic conductor of radius 8 mm carrying a current density of 50 kA/m^2 [16]

6. (a) Show that T = m B also holds for the torque on a solenoid situate in a uniform magnetic field.
   (b) i. What is the maximum torque on a square loop of 1000 turns in a field of uniform flux density B Tesla? The loop has 10cm side and carries a current of 3A.
   ii. What is the magnetic moment of the loop? [8+8]

7. (a) Derive an expression for energy density in a magnetic field.
   (b) A magnetic circuit comprising a toroid of 500 turns and an area of 6cm^2 and mean radius of 15cm and carries a current of 4A. Find reluctance and flux assume μ_r=1. [8+8]

8. (a) Explain the Maxwell's equations for harmonically time varying fields.

(b) A faraday's copper disc 0.3m diameter is rotated at 60 rps on a horizontal axis perpendicular to and through the centre of disc, the axis laying in a horizontal field of 20μTesla. Determine emf measured between the brushes. [8+8]

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Code No: 07A3EC04 **Set No. 3**

II B.Tech I Semester Regular Examinations, November 2008
ELECTROMAGNETIC FIELDS
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) State and explain Coulomb's law of electrostatic field in vector form.
   (b) It is required to hold four equal point charges to each in equilibrium at the corners of a square. Find the point charge, which will do this if placed at the center of the square. [8+8]

2. (a) For a pure dipole pa_z C- m at the origin in free space, find the potential at a point A $(r, \theta, \phi = \frac{\pi}{2})$
   (b) What is the electric field at (x=0, y=0, z=5m) due to a pure dipole $1a_z$ μc-m at the origin? [8+8]

3. (a) State and prove the conditions at the boundary between two dielectrics.
   (b) Determine the resistance of insulation in length 'L' of co-axial cable as inner and outer radii are 'a' and 'b' respectively. [8+8]

4. A conductor is in the form of a Regular polygon of n sides inscribed in a circle of radius R. Show that the expression for B at the center for a current is given by $|B| = \left(n\mu_0 {}^{I}/_{2\pi R}\right) Tan^{\pi}/_{n}$. [16]

5. (a) Describe the application of Amperes circuital law to an unsymmetrical field.
   (b) In the cylindrical region $0 < r < 0.8m$, $J = 3e^{-5r}a_z$ A/m^2. Determine H = $H_\phi a_\phi$ every where. [16]

6. Find the torque which will be produced on a rectangular current loop if placed to a magnetic field B show that T = m × B also holds for the system. [16]

7. Find the mutual inductance between two toroidal windings which are closely wound on iron core of relative permeability 900. The mean radius of the core is 5cm and radius of its cross-section is 5cm. Each winding has also 800 turns. [16]

8. (a) Explain Faraday's law of electromagnetic induction and derive the expression for induced emf.
   (b) Find the conduction and displacement current densities in a material having conductivity of 10^{-3} S/m and ε_r= 2.5, if the electric field in material is, E = 5.8×10^{-6} sin (9×10^9 t) V/m. [8+8]

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Code No: 07A3EC04 **Set No. 4**

II B.Tech I Semester Regular Examinations, November 2008
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain coulomb's law.
   (b) Two small identical conducting spheres have charge of 2nC and - 0.5nC respectively. when they are placed 4 cm apart what is the force between them. If they are brought into contact and then separated by 4 cms what is the force between them. [6+10]

2. Show that the torque acting on an dipole of movement p due to an electric field E is p×E Compute the torque for a dipole consisting of 1 μc charges in an electric field $E = 10^3 (z\overline{ax} - \overline{ay} - \overline{az})$ separated by 1 mm and located on the z-axis at the origin. [16]

3. (a) Calculate the capacitance of a parallel plate capacitor with following details.
   Plate area = 150 sq.cm.
   Dielectric $\varepsilon_{r1} = 3$, d12 = 4mm
   Dielectric $\varepsilon_{r2} = 5$, d12 = 6 mm
   If 200 V is applied across the plates what will be the voltage gradient across each dielectric.
   (b) The permittivity of the dielectric of parallel plate capacitor increases uniformly from one plate to the other. If A is the surface areas of the plate and d is the thickness of dielectric, derive an expression for capacitance. [8+8]

4. Two narrow circular coils A and B have a common axis and are placed 10 cms apart. Coil A has 10 turns of radius 5cm with a current of 1A passing through it. Coil B has a single turn radius 7.5 cms. If the magnetic field at the centre of coil A is to be zero, what current should be passed through coil B. [16]

5. (a) Define and establish Amperes circuital law for electromagnetic field.
   (b) An H due to current source is given by H = (y cos ax) a_x + (y.e^x) a_z. Describe the current density over the yz- plane. [16]

6. Justify the equation T = m × B for a circular coil carrying a steady current I is placed such that its plane lie in the x-y plane and also parallel to the direction of a uniform magnetic field B. [16]

7. (a) Explain the difference between magnetic vector potential and magnetic scalar potential

(b) Current in a coil is increased from 0 to 10 Amps at a uniform rate is 5 sec. It is found that this coil develops self induced emf of 100V where as an emf of 20V is reduced in a neighbouring coil. Compute self inductance of the first coil and mutual inductance between the two coils. [8+8]

8. (a) Derive the expression for one of the Maxwell's equation $\nabla \times E = -\frac{\partial B}{\partial t}$

(b) Find the frequency at which conduction current density and displacement current density are equal in a medium with $\sigma = 2 \times 10^{-4}$ mho/m and ε_r=81. [8+8]

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