Code No: R21029 **R10** SET - 1

II B. Tech I Semester Supplementary Examinations, Jan - 2015
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 Gauss law.
   b) Derive an expression for electric field intensity at an arbitrary point due to a line charge placed along the Z-axis and that is extending from negative infinity to positive infinity.

2. a) Develop an expression for potential difference at any point between spherical shells in terms of the applied potential employing Laplace equation.
   b) Derive an expression for potential due to a dipole at an arbitrary point.

3. a) Prove that the derivative of the energy stored in an electrostatic field with respect to volume is ½ D.E, where D and E are electric flux density and electric field intensity respectively
   b) Derive the expression for the capacitance of a spherical capacitor.

4. a) Show that $\nabla.B = 0$.
   b) Derive the expression for magnetic field intensity $\vec{H}$ at an arbitrary point on the x-axis due to a current carrying conductor placed along the z-axis which is extending from origin to infinity.

5. a) Derive the Maxwell's third equation and explain its importance.
   b) Find the magnetic field intensity at centre of a square of sides equal to 10 m and carrying a current equal to 75 A.

6. a) Derive the equation of force exerted on a long current carrying conductor when it is placed in a magnetic field.
   b) Derive the Lorentz force equation.

7. a) Calculate the self inductance per unit length of a long solenoid.
   b) Derive an expression for energy stored in a magnetic field.

8. a) State the pointing theorem and explain its applicability.
   b) Derive the Maxwell's fourth equation and explain its significance.
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Code No: R21029 **R10** SET - 2

II B. Tech I Semester Supplementary Examinations, Jan - 2015
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) Show that $\nabla.D = \rho_v$.
   b) Derive an expression for the electric field intensity at an arbitrary point due to a system of point charges in a given space.

2. a) Derive Poisson's and Laplace equations starting from point form of Gauss Law.
   b) Explain the behavior conductors in an electric filed.

3. a) State and prove the boundary conditions at the boundary between two dielectrics?
   b) Derive the expression for capacitance of a parallel plate capacitor.

4. a) Derive an expression for the magnetic flux density at center of a circular current loop.
   b) Find the field intensity at a point on the axis, 8 m from the center of a circular coil of area 120 cm^2 and carrying a current of 70 A.

5. a) Derive Ampere's circuital law and state its applications.
   b) A circular loop located on $x^2 + y^2 = 16$, $z = 0$ carries a direct current of 20 A along a_φ direction. Determine H at (0, 0, 7) and (0, 0, -7).

6. a) Derive expression for torque on a current carrying square loop present in a magnetic field.
   b) Explain about magnetic dipole and dipole moment.

7. a) Derive an expression for mutual inductance between a straight long wire and a square loop wire in the same plane.
   b) A solenoid of 10 cm in length consists of 1000 turns having the cross section radius of 1 cm. Find the inductance of solenoid. What is the value of current required to maintain a flux of 1 milli-Wb in the toroid. Take $\mu_r = 1500$.

8. a) Derive the Maxwell's equations in time varying fields.
   b) Distinguish between statically induced e.m.f and dynamically e.m.f. Also explain their significance
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Code No: R21029 **R10** SET - 3

II B. Tech I Semester Supplementary Examinations, Jan - 2015
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 Electric field intensity and electric potential and derive relationship between them.
   b) Derive an expression for electric field intensity at a distance h along the Z-axis due to an infinite sheet of charge placed in the Z=0 plane .

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 $0 <= r <= b$.
   b) In spherical coordinates V=0 for r=0.3 and V=150 for r=2 m. Find the potential function. Use Laplace's equation.

3. a) Derive the continuity equation.
   b) Explain the difference between conduction and convection current densities.

4. a) State and explain Biot-Savart's law.
   b) A filamentary current of 20A is directed in from infinity to the origin on the positive x axis, and then back out to infinity along the position y-axis. Use the Biot-Savarts law of find $\overline{H}$ at P (0, 0,1) ?

5. a) Explain the point form of Ampere's circuital law.
   b) A square loop 15 cm on a side has 600 turns that are closely and tightly wound and carries a current of 150 A. Determine the magnetic flux density at the centre of the loop.

6. a) Derive the expression for force between two long and parallel current carrying conductors placed in a magnetic field.
   b) The magnetic field in a certain region is B=40a_x mWb/m^2. A conductor that is 2m in length lies in the z- axis and carries a current of 5A in the a_z direction. Calculate the force on the conductor.

7. A solenoid is 50cm long, 2cm in diameter, and contains 1500 turns. The cylindrical core has a diameter of 2cm and a relative permeability of 75. The coil is coaxial with a second solenoid, also 50cm long, but with a 3 cm diameter and 1200 turns. Calculate: i) L for the inner solenoid ii) L for the outer solenoid iii) M between the two solenoids.

8. a) Derive the expression for displacement current and explain its significance.
   b) A parallel plate capacitor with plate area of 8cm^2 and plate separation of 5 mm has a voltage $90sin\ 10^3$t V applied to its plates. Calculate the displacement current assuming $\varepsilon = 3\varepsilon_0$.
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Code No: R21029 **R10** SET - 4

II B. Tech I Semester Supplementary Examinations, Jan - 2015
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) What is electric potential? Explain the properties of potential function.
   b) Four point charges of 500 µC each are placed at the corners of a square of $3\sqrt{2}$ m side. The square is located in the z = 0 plane between x = $\pm 3\sqrt{2}$ m and y = $\pm 3\sqrt{2}$ m in free space. Find the force on a point charge of 30 µC at (0, 0, 4) m.

2. a) Derive Laplace's and Poisson's equations.
   b) Derive an expression for torque on a dipole placed in an electric field.

3. a) Derive ohm's law in point form.
   b) Discuss the dielectric-dielectric boundary conditions in the static electric fields.

4. a) A thin ring of radius 5 cm is placed on the plane z=0 cm so that its centre is at (0,0,0 cm). If the ring carries 1 A along $\hat{a}_\varphi$. Find $\bar{H}$ at (i) A(0,0,1cm) and (ii) B(0,0,-1cm).
   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) Derive the Maxwell's third equation and explain its significance.
   b) Discuss applications of Amperes current law for symmetrical surface infinite sheet current.

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 $\bar{F}$ if (a) $\bar{B} = 2\hat{a}_x - 3\hat{a}_y + 5\hat{a}_z$ mT (b) $\bar{E} = 2\hat{a}_x - 3\hat{a}_y + 5\hat{a}_z$ kV/m.
   b) Derive an expression for magnetic field intensity at a point along the axis due to a circular current carrying loop placed in a magnetic field.

7. Obtain an expression for the self-inductance of a toroid of a circular cross-section, with *N* closely spaced turns.

8. a) State and prove Poynting theorem.
   b) State the Faraday's laws of electromagnetic induction and derive the expressions for the transformer and motional e.m.f.s.
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