Code No: RT21025 **R13** SET - 1

II B. Tech I Semester Supplementary Examinations, June - 2015
ELECTRO MAGENETIC FIELDS
(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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PART-A

1. a) State Coulomb's Law.
b) What is meant by equipotential lines.
c) What is the difference between conduction and convection current density.
d) State Biot-Savart's law.
e) Write the expression for Lorentz force equation and write its significance.
f) Define self-inductance and write its expression.
g) State Faraday's laws of electromagnetic induction. (3M+3M+3M+3M+4M+3M+3M)

PART-B

2. a) Derive Poisson's and Laplace's equations.
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 $x = \pm\frac{3}{\sqrt{2}}$ m and $y = \pm\frac{3}{\sqrt{2}}$ m in free space. Find the force on a point charge of 30 μC at (0,0,4) m.

3. a) Derive the boundary conditions between media having dielectric and conductor.
b) For a physical dipole in the z-direction, located at the origin in free space, find the potential at a point $(r, \theta, \phi = \frac{\pi}{2})$ (in spherical coordinates).
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Code No: RT21025 **R13** SET - 1

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 circuit carrying a direct current of 5A forms a regular hexagon inscribed in a circle of radius 0f 1m. Calculate the magnetic flux density at the center of the hexagon. Assume the medium to be free space.

5. a) 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.
   b) A point charge of value 18 nC has a velocity of 5000 km/sec in a direction of $\hat{a}_v = (-0.04\hat{a}_x - 0.05\hat{a}_y + 0.2\hat{a}_z)$. Calculate the magnitude of the force exerted on the charge by the field: (i) $\overline{B} = (-3\hat{a}_x + 4\hat{a}_y + 6\hat{a}_z)$ mT (ii) $\overline{E} = (-3\hat{a}_x + 4\hat{a}_y + 6\hat{a}_z)$ kV/m (iii) $\overline{B}$ and $\overline{E}$ acting together.

6. a) Obtain the expression for inductance of a toroid.
   b) A solenoid of 500 turns has a length of 50 cm and the radius of 10cm. A steel rod of circular cross section is fitted in the solenoid coaxially. Relative permeability of steel is 3000. A DC current of 10 A is passed through solenoid. Compute the inductance of the system and energy stored in the system

7. a) State and explain the Poynting theorem
   b) Write the Maxwell's equations in point and integral form for time varying fields?

Code No: RT21025 **R13** SET - 2

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(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

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2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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PART-A

1. a) Write the properties of potential function.
b) Define electric potential.
c) Write the properties of electric dipole.
d) State Ampere's circuital law.
e) What is a magnetic dipole? How it is different from electric dipole.
f) Define mutual inductance between the coils and write its expression.
g) What is difference between statically and dynamically induced EMF?
(3M+3M+3M+3M+3M+3M+4M)

PART-B

2. a) Derive an expression for electric flux density *D* due to infinite sheet of charge placed in z = 0 plane using Gauss's law.
b) A very thin , finite, and uniformly charged line of length 10 m carries a charge of 10μC/m. Calculate the electric field intensity in a plane bisecting the line at ρ = 5 m.

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 continuity equation.

4. a) State Biot - Savart's law for the magnetic field B due to a steady line current in free space.
b) Find B due to a straight conductor length '*l*' m and steady current 'I' A at a distance of '*y*' m from the center of the line current.

5. a) Describe Lorentz's force equation?
b) A single-phase circuit comprises two parallel conductors A and B, each 1 cm diameter and spaced 1 meter apart. The conductors carry currents of +100 and -100 amperes respectively. Determine the magnetic field intensity at the surface of each conductor and also exactly midway between A and B.

6. a) Derive the expression for inductance of a solenoid.
b) A toroidal coil of 500 turns is wound on a steel ring of 0.5 m mean diameter and 0.02 m^2 cross sectional area. An excitation of 4000 A/m produces a flux density of 1 Tesla. Find the inductance of the coil.

7. a) Starting from Faraday's law of electromagnetic induction, derive $\nabla \times E = -\frac{\partial \vec{B}}{\partial t}$.
b) State and prove Poynting theorem.
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Code No: RT21025 **R13** SET - 3

II B. Tech I Semester Supplementary Examinations, June - 2015
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Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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PART-A

1. a) Define electrostatic field intensity,
   b) Write the equations of Laplace's and Poisson's equations.
   c) State Ohm's law in point form and write its significance.
   d) Write the application of ampere's law.
   e) Define Magnetic dipole moment and write its significance.
   f) Write the expressions for self-inductance for a solenoid and toroid.
   g) State Poynting Theorem. (3M+3M+4M+3M+3M+3M+3M)

PART-B

2. a) State and explain Coulomb's law expressing the force between point charges in free space as a vector.
   b) Using Gauss's law, show that the electric field due to an infinite straight line of uniform charge density λ C/m along the z-axis in free space is $\left(\lambda/2\pi\varepsilon_0 r\right)a_r$.

3. a) Derive an expression for capacitance of a parallel plate capacitor with two dielectric media.
   b) Point charges of 1 μC and -1 μC are located at (0,0,1) m and (0,0,-1) m respectively in free space. (i) Find the potential at (0,3,4) m. (ii) Recalculate the same potential, treating the dipole as a pure dipole.
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Code No: RT21025 **R13** SET - 3

4. 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 $B = \frac{\mu_0 nI}{2\pi R}\tan\left(\frac{\pi}{n}\right)$ at center, where I is the current. Show also when 'n' is infinitely increased, the expression is reduced to $B = \frac{\mu_0 I}{2R}$.

5. a) Derive the expression for force between two parallel current carrying conductors, if currents are in the same direction?
   b) 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 *F* if (i) $\overline{B} = (2\hat{a}_x - 3\hat{a}_y + 5\hat{a}_z)$ mT (ii) $\overline{E} = (2\hat{a}_x - 3\hat{a}_y + 5\hat{a}_z)$ kV/m.

6. a) Derive the expression for energy density in a magnetic field.
   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 mWb in the toroid. Take μ_r = 1500.

7. a) Explain the faraday's laws of electromagnetic induction and derive the expression for induced EMF.
   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.

Code No: RT21025 **R13** SET - 4

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Time: 3 hours Max. Marks: 70

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2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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PART-A

1. a) State Gauss law.
b) What is the difference between electric field and electric potential?
c) What is polarization? Name different types of polarization.
d) Define magnetic flux and magnetic flux density and write the relationship between them.
e) Write the expressions for Force on a straight and a long current carrying conductor in a magnetic field when the current in the conductors is in same direction and opposite directions.
f) Write the expressions for energy stored and energy in a magnetic field.
g) What is the significance of Poynting vector? [3+3+3+3+4+3+3]

PART-B

2. a) Derive the relation between electric field intensity and electric potential.
b) Find the work done in moving a charge of 2coulombs from (2, 0, 0) m to (0, 2, 0) along a straight line path joining the two points, if the electric field is $\vec{E} = (2x\hat{a}_x - 4y\hat{a}_y)$ V/m.

3. a) The parallel plates of a capacitor are 0.05 m apart and are charged to a surface density of 25×10^{-6} C/m^2. The dielectric constant of 0.002m layers of $\varepsilon_r = 3$ and that of 0.003m layer has $\varepsilon_r = 4$. Calculate $\overline{E}$ and $\overline{D}$ for each dielectric and also polarization of each plate.
b) State and prove the boundary conditions at the boundary between two dielectrics?

4. a) Derive the expression for magnetic field intensity at the center of a circular wire?
b) A filamentary current of 15 A 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) Derive the expression for torque exerted on a current-carrying loop by a magnetic field.
b) Two long parallel conductors carrying currents 100A and 150A respectively. If the conductors are separated by 20mm, find the force/meter length of each conductor, if the current flow is in opposite direction?

6. a) Drive the expression for mutual inductance between a straight long wire and a square loop wire in the same place.
b) Calculate the inductance of a solenoid of 2000 terns wound uniformly over a length of 0.5m an a cylindrical paper tube of 0.04m in diameter the medium is air.

7. a) Explain the terms: (i) Motional EMF (ii) Static EMF
b) Show that for a capacitor the conduction current in the wire equals the displacement current in the dielectric if subjected to a time changing field.
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