Code No: R1621024 **R16** SET - 1

II B. Tech I Semester Regular Examinations, October/November - 2017
ELECTROMAGNETIC 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 **FOUR** Questions from **Part-B**

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PART –A

1. a) State Gauss law and list its limitations. (2M)
   b) Differentiate conduction and convection current densities. (2M)
   c) State and explain the Biot-Savart's law. (2M)
   d) Find the expression for Force on a straight and a long current carrying conductor placed in a magnetic field. (3M)
   e) Differentiate self and mutual inductance. (2M)
   f) What is the Faraday's law of induction? What is the significance of the terms transformer e.m.f and generator e.m.f.? (3M)

PART -B

2. a) Derive an expression for the Electric field intensity due to a finite length line charge along the Z-axis at an arbitrary point **Q**(x,y,z) (7M)
   b) An infinite length of uniform line charge has ρ_L= 10pC/m and it lies along the Z-axis. Determine electric field **E** at (4,3,3). (7M)

3. a) Derive the boundary conditions for conductor to dielectric interface for static electromagnetic fields. (7M)
   b) If the magnetic field is $\mathbf{H}= 0.01/\mu_0\mathbf{a}_x$ A/m, what is the force on a charge of 1.0 pC moving with a velocity of $10^6\mathbf{a}_x$ m/s. (7M)

4. a) Explain about Oesterd's experiment and its applications. (7M)
   b) Compare the concepts of scalar and vector magnetic potentials. (7M)

5. a) Define Torque. Derive the expression for torque on a current loop placed in a magnetic field. (7M)
   b) A current of 10 A flows in each of two conducting wires parallel to each other. The separation between the wires is 2 cm. Find the force per unit length of one of the wires. (7M)

6. a) Derive an expression for mutual inductance between a straight long wire and a square loop wire in the same plane. (7M)
   b) Calculate the inductance of a solenoid of 2000 terns wound uniformly over a length of 0.5m in a cylindrical paper tube of 0.04m in diameter the medium is air. (7M)
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7. a) Starting from Faraday's law of electromagnetic induction, derive the Maxwell equation $\nabla X \boldsymbol{E} = -\frac{\partial \boldsymbol{B}}{\partial t}$ (7M)

   b) State and prove the Poynting theorem. (7M)

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SET - 2

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

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PART –A

1. a) State Coulomb's law. (2M)
   b) Explain the behavior of conductors in an electric field. (2M)
   c) Define magnetic flux density and write the Maxwell's equation related to it (2M)
   d) A conductor of 6m long , lies along z-direction with a current of 2A. Find the force experienced by the conductor if **B**=0.08 $\mathbf{a}_x$Tesla. (3M)
   e) Explain the concept of inductance in a toroid. (2M)
   f) Write Maxwell's equation in integral as well as differential forms. (3M)

PART -B

2. a) Prove that the electric field intensity is the negative gradient of potential. (7M)
   b) Derive Poisson's and Laplace's equations from the fundamentals. (7M)

3. a) Derive the boundary conditions for dielectric to dielectric interface for static electromagnetic fields. (7M)
   b) Derive an expression for equation of continuity (7M)

4. a) State Ampere's circuital law. Specify the conditions to be met for determining magnetic field strength H, based on Ampere's circuital law. (7M)
   b) Given $\mathbf{E}=E_m\sin(\omega t-\beta z)\,\mathbf{a}_y$in free space. Find the D, B and H. (7M)

5. a) Derive Lorentz force equation and explain its significance (7M)
   b) Derive the expression for Torque on a current loop placed in a magnetic field. (7M)

6. a) Derive the expression for self inductance of solenoid. (7M)
   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 μ_r= 1500. (7M)

7. a) Derive the expression for displacement current density and explain its significance. (7M)
   b) Explain in detail about Poynting vector. (7M)
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Code No: R1621024 **R16** SET - 3

II B. Tech I Semester Regular Examinations, October/November - 2017
ELECTROMAGNETIC 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 **FOUR** Questions from **Part-B**

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PART –A

1. a) Define electric field intensity and electric flux density. (2M)
   b) Show that the displacement current in the dielectric of parallel-plate capacitor is equal to the conductor current in its leads. (3M)
   c) Derive the magnetic fields due to a circular loop of conductor. (3M)
   d) Find the expression for force between two straight long and parallel current carryingconductors. (2M)
   e) A solenoid with air core has 1000 turns of wire. Its length is 800 mm and core radius is 60mm. Then find the inductance of it. (2M)
   f) Define Poynting theorem and Pointing vector. (2M)

PART -B

2. a) State Guass law. Explain any two applications of Guass law in detail. (7M)
   b) Determine the electric field intensity due to infinite line charge, at a point perpendicular to its plane and at a gives distance from the line charge from first principle. (7M)

3. a) Derive an expression for capacitance of a parallel plate capacitor containing two dielectrics with the dielectric interface parallel to the conducting plates. (7M)
   b) Find the capacitance of two parallel plates 30cmX30cm separated by 5 mm in air. And also find the energy stored by the capacitor if it is charged to a potential difference of 500 volts. (7M)

4. a) state Ampere's circuital law and explain any two applications of it. (7M)
   b) A circular loop located on $x^2 + y^2 = 9$, $Z = 0$ carries a direct current of 10 A along $\boldsymbol{a}_\varphi$. Determine Hat (0,0,4) and (0,0,-4). (7M)

5. a) Explain the concepts of magnetic dipole and dipole moment in detail. (7M)
   b) In a magnetic flux density of $B=\mathbf{a}_x+3\mathbf{a}_y Wb/m^2$, a current element $10\mathbf{a}_z$ mA-m is placed. Find the force on the current element. (7M)

6. a) Derive the expression for energy density in a magnetic field. (7M)
   b) Obtain an expression for the self-inductance of a toroid of a circular cross-section, with *N* closely spaced turns. (7M)
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7. a) Derive Maxwell's equations for time varying fields from their basics. (7M)

   b) A conducting circular loop of radius 20 cm lies in the z=0 plane in a magnetic field B =10cos **377t** $\mathbf{a_z}$mWb/m^2. Calculate the induced voltage in the loop. (7M)

Code No: R1621024 **R16** SET - 4

II B. Tech I Semester Regular Examinations, October/November - 2017
ELECTROMAGNETIC FIELDS
(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 **FOUR** Questions from **Part-B**

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PART –A

1. a) What are the applications of Laplace's and Poison's equations? (2M)
   b) State the boundary conditions between two dielectrics (2M)
   c) State Ampere's circuital law and explain any one of its applications. (3M)
   d) Find the expression for the torque on a current loop placed in a magnetic field. (2M)
   e) A solenoid with 300 turns is 300 mm long and 30 mm in diameter. If the current flowing is 500mA, find the inductance. (2M)
   f) What is the inconsistency in Ampere's law? How it is rectified by Maxwell? (3M)

PART -B

2. a) State and explain Gauss law in differential form and also list the limitations of Gauss's law. (7M)
   b) A circular ring of charge with radius 5m lied in z = 0 plane with centre at origin. If the line charge density is 10 nC/m. Find E at the point (0, 0, 6) m. (7M)

3. a) Derive the expressions for energy stored and energy density in a static electric field. (7M)
   b) Find the capacitance of two parallel plates 30cmX30cm separated by 6 mm in air. And also find the energy stored by the capacitor if it is charged to a potential difference of 600 volts. (7M)

4. a) Derive the expression for magnetic field intensity due to a straight current carrying filament. (7M)
   b) Derive Ohm's law in point form and explain (7M)

5. a) Derive the expression for Torque on a current loop placed in a magnetic field. (7M)
   b) A toroid coil of 600 turns has a mean radius of 50cm and radius for the winding of 4cm. Find the value of average self-inductance with an iron core of μ_r=900. (7M)

6. a) Drive the expression for mutual inductance between a straight long wire and a square loop wire in the same plane. (7M)
   b) Derive the expression for energy density in a magnetic field. (7M)

7. a) Explain how the concept of displacement current was introduced by Maxwell to account for the production of magnetic field in the empty space. (7M)
   b) Compare Maxwell Equations for free space and sinusoidal variations. (7M)
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