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

II B. Tech I Semester Regular/Supplementary Examinations, October/November - 2019
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. (2M)
   b) Write the difference between convection current density and conduction current density. (2M)
   c) State Ampere's circuit law. (2M)
   d) Compare electric force and magnetic force. (3M)
   e) Define coefficient of coupling. (2M)
   f) Write Maxwell's equations in point form. (3M)

PART -B

2. a) Derive the expression for electric field intensity due to sheet of charge. (7M)
   b) Explain about Poisson's equation and Laplace equation. (7M)

3. a) Derive the expression for capacitance of parallel-plate capacitor. (7M)
   b) An electric dipole located at the origin in free space has a moment $p = 3\mathbf{a}_x - 2\mathbf{a}_y + \mathbf{a}_z$ nC.m. (i) Find V at P(2, 3, 4) (ii) Find V at $r = 2.5$, $\theta = 30^0$, $\phi = 40^0$. (7M)

4. a) Derive the expression for magnetic field intensity due to infinitely long straight filament carrying a direct current I. (7M)
   b) Explain about magnetic flux and magnetic flux density. (7M)

5. a) Explain the concept of magnetic dipole. (7M)
   b) A charged particle of mass 1 kg and charge 2 C starts at the origin with zero initial velocity in the region where $\mathbf{E} = 3\,\mathbf{a}_z$ V/m. Find (7M)
   (i) the force on the particle
   (ii) the time it takes to reach point P(0, 0, 12m)
   (iii) Its velocity and acceleration at P.

6. a) Obtain an expression for the self-inductance of a toroid of circular cross section with 'N' closely spaced turns. (7M)
   b) A solenoid with length 10 cm and radius 1 cm has 450 turns. Calculate its inductance. (7M)

7. a) A parallel plate capacitor with plate area of 5 cm^2 and separation of 3 mm has a voltage 50 sin 10^3tV applied to its plates. Calculate the displacement current assuming $\varepsilon = 2\varepsilon_0$. (7M)
   b) Explain about Dynamically induced EMFs. (7M)
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Code No: R1621024 **R16** SET - 2

II B. Tech I Semester Regular/Supplementary Examinations, October/November - 2019
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) Write Laplace equation in both Cartesian and cylindrical coordinates. (2M)
   b) Calculate the capacitance of a parallel plate capacitor having a mica dielectric, $\varepsilon_r = 6$, a plate area of 10 in^2, and a separation of 0.01 in. (3M)
   c) Define magnetic flux density. (2M)
   d) Define magnetic dipole moment. (2M)
   e) Define internal inductance and external inductance. (2M)
   f) Write Maxwell's equations in integral form. (3M)

PART -B

2. a) State and explain coulomb's law with necessary equations. (7M)
   b) Find the electric field intensity at P(1,1,1) caused by four identical 3 nC charges located at $P_1(1,1,0)$, $P_2(-1,1,0)$, $P_3(-1,-1,0)$ and $P_4(1, -1, 0)$. (7M)

3. a) Derive the expression for capacitance of a spherical capacitor. (7M)
   b) An electric dipole of 100 $\mathbf{a_z}$ pC.m is located at the origin. Find V and **E** at points (i) (0, 0, 10) and (ii) (1, π/3, π/2) (7M)

4. a) A square conducting loop 3 cm on each side carries a current of 10 A. Calculate the magnetic field intensity at the center of the loop. (7M)
   b) Using Ampere's circuit law, determine the expression for **H** due to uniform sheet of surface current $\mathbf{K} = K_y \mathbf{a_y}$ in the z = 0 plane. (7M)

5. a) Discuss about force between differential current elements. (7M)
   b) Explain about torque on a current loop placed in magnetic field. (7M)

6. a) A long solenoid with length *l* and a radius R consists of N turns of wire, a current *I* passes through the coil. Find the energy stored in the system. (7M)
   b) Calculate the self inductances of and the mutual inductances between two coaxial solenoids of radius R_1 and R_2, $R_2 > R_1$, carrying currents I_1 and I_2 with n_1 and n_2 turns/m, respectively. (7M)

7. a) In free space $\mathbf{E} = 20 \cos(\omega t - 50x)\ \mathbf{a_y}$ V/m. calculate (i) $\mathbf{J_d}$ (ii) **H** (c) ω (7M)
   b) State and explain poynting theorem. (7M)
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Code No: R1621024 **R16** SET - 3

II B. Tech I Semester Regular/Supplementary Examinations, October/November - 2019
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) Find div **D** at the origin if $\mathbf{D} = e^{-x} \sin y\, \mathbf{a_x} - e^{-x} \cos y\, \mathbf{a_y} + 2z\, \mathbf{a_z}$. (3M)
   b) What is meant by boundary conditions? How they are useful? (2M)
   c) Plane y = 0 carries a uniform current of 30 $\mathbf{a_z}$ mA/m. Determine the magnetic field intensity at (1, 10, -2). (3M)
   d) Write Lorenz force equation. (2M)
   e) Define self inductance. (2M)
   f) What is poynting vector? (2M)

PART -B

2. a) State and explain Gauss law. Write the applications of it. (7M)
   b) A charge of -0.3 μC is located at A(25, -30, 15) (incm) and a second charge of 0.5 μC is at B(-10, 8, 12) cm . Find E at (a) the origin (b) P(15,20, 50) cm. (7M)

3. a) Discuss about behavior of conductors in an electric field. (7M)
   b) Derive the expression for energy density in electrostatic field. (7M)

4. a) Determine **H** at P(0.4, 0.3, 0) in the field of an 8-A filamentary current directed inward from infinity to origin on the positive x axis, and then outward to infinity along the y axis. (7M)
   b) Using ampere's circuit law, determine the magnetic field intensity due infinitely long coaxial transmission line. (7M)

5. a) Explain about force on a differential current element. (7M)
   b) Derive the expression for magnetic field produced by magnetic dipole. (7M)

6. a) Explain about Mutual Inductance between two coupled inductors. (7M)
   b) A very long solenoid with 2 X 2 cm cross section has an iron core (μ_r = 1000) and 4000 turns/meter. If it carries a current of 500 mA, find (7M)
   (i) Its self-inductance per meter
   (ii) The energy per meter stored in its field.

7. a) Explain about Faraday's laws of electromagnetic induction. (7M)
   b) In air, $\mathbf{E} = \frac{\sin\theta}{r}\cos(6 \times 10^7 t - \beta r)\, \mathbf{a}_\phi$ V/m. Find β and **H**. (7M)
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Code No: R1621024 **R16** SET - 4

II B. Tech I Semester Regular/Supplementary Examinations, October/November - 2019
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. (2M)
   b) Write the equation of continuity. (2M)
   c) Write Maxwell's second equation. (2M)
   d) What is ampere's force law? Explain. (3M)
   e) Define mutual inductance. (2M)
   f) What is displacement current? (3M)

PART -B

2. a) Determine an expression for the volume charge density associated with each **D** field following: (7M)
   (i) $\mathbf{D} = \frac{4xy}{z}\mathbf{a}_x + \frac{2x^2}{z}\mathbf{a}_y - \frac{2x^2y}{z^2}\mathbf{a}_z$; (ii) $D = z\sin\phi\,\mathbf{a}_\rho + z\cos\phi\,\mathbf{a}_\phi + \rho\sin\phi\,\mathbf{a}_z$
   b) What is potential gradient? Explain. (7M)

3. a) Define electric dipole. Derive the expression for electric field due to electric dipole. (7M)
   b) Derive the boundary conditions of electric filed for perfect dielectric materials. (7M)

4. a) State and explain Biot-savart's law. (7M)
   b) Derive the expression for magnetic field intensity due to an infinite line current using Ampere's circuit law. (7M)

5. a) Discuss about Force on a moving charge due to electric field and magnetic field. (7M)
   b) A charged particle moves with a uniform velocity $4\mathbf{a}_x$ m/s in a region where $E = 20\,\mathbf{a}_y$ V/m and $B = B_0\,\mathbf{a}_z$ Wb/m^2. Determine B_0 such that the velocity of the particle remains constant. (7M)

6. a) Derive the expression for energy in a magnetostatic field. (7M)
   b) Calculate the self inductance per unit length of an infinitely long solenoid. (7M)

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