

**II B. Tech I Semester Regular/Supplementary Examinations, January - 2023**  
**ELECTRO MAGNETIC FIELDS**  
 (Electrical and Electronics Engineering)

Time: 3 hours

Max. Marks: 70

Answer any **FIVE** Questions, each Question from each unit  
 All Questions carry **Equal** Marks

~~~~~

UNIT-I

- 1 a) State and explain Coulomb's law of electrostatic field in vector form. [7M]  
 b) Three equal point charges of  $2\mu\text{C}$  are in free space at  $(0,0,0)$ ,  $(2,0,0)$  and  $(0,2,0)$ , respectively. Find net force on  $Q_4=5\mu\text{C}$  at  $(2,2,0)$ . [5M]  
 c) Define the term electric field intensity  $E$ . [2M]

Or

- 2 a) State and explain Gauss law. List the applications of Gauss law. [7M]  
 b) Prove that electric field intensity is equal to the negative gradient of the potential, i.e.,  $E = -\nabla V$ . [7M]

UNIT-II

- 3 a) Derive the boundary conditions for the tangential and normal components of Electrostatic fields at the boundary between two perfect dielectrics. [8M]  
 b) Explain about convection and conduction currents. [6M]

Or

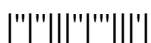
- 4 a) Explain about Ohm's law in point form. [7M]  
 b) Determine the capacitance of a capacitor consisting of two parallel metal plates 30cm by 30cm surface separated by 5mm in air with  $\epsilon_0 = 8.854 \times 10^{-12}$ . What is the energy stored by the capacitor if it is charged to a potential difference of 500V? [7M]

UNIT-III

- 5 a) Derive integral form of Ampere's circuital law and explain its applications? [7M]  
 b) Explain about force on a current element in a magnetic field. [7M]

Or

- 6 a) Deduce the Biot-Savart's law from Ampere's circuital law. [5M]  
 b) State Ampere's circuital law and apply it to determine the magnetic field intensity due to an infinite sheet of current density  $\vec{K} = K_y \hat{a}_y$  in  $z=0$  plane. [9M]



## UNIT-IV

- 7 a) Define the terms mutual inductance and self-inductance. [4M]  
b) Derive the expression for self-inductance of a toroid. [6M]  
c) Find the inductance of an ideal solenoid with 300 turns, length  $L=0.50\text{m}$  and a circular cross section of radius  $0.02\text{m}$ . [4M]

Or

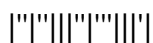
- 8 Find the mutual inductance between two toroidal windings which are closely wound on iron core of relative permeability 900. The mean radius of the core is  $5\text{cm}$  and radius of its cross-section is  $5\text{cm}$ . Each winding has also 800 turns. [14M]

## UNIT-V

- 9 a) Discuss the Maxwell's equations for time varying fields. [6M]  
b) Explain the concept of displacement current and obtain an expression for the Displacement current density. [8M]

Or

- 10 a) What is the Faraday's law of electromagnetic induction? Explain the significance of the terms transformer emf and generator emf. [8M]  
b) State Poynting theorem and derive the equation. [6M]



**II B. Tech I Semester Regular/Supplementary Examinations, January - 2023****ELECTRO MAGNETIC FIELDS**  
(Electrical and Electronics Engineering)

Time: 3 hours

Max. Marks: 70

Answer any **FIVE** Questions, each Question from each unitAll Questions carry **Equal** Marks

~~~~~

## UNIT-I

- 1 a) State and explain Gauss law with any one of the example. [9M]  
 b) A point charge,  $Q_1 = 2\mu\text{C}$  is at (2,3,6) and another charge,  $Q_2 = 5\mu\text{C}$  is at (0,0,0) in free space. Find the force on  $Q_1$  due to  $Q_2$ . [5M]

Or

- 2 a) Derive Poisson's and Laplace's equations starting from Gauss's law. [8M]  
 b) Two positive point charges are located at (1m, 2m, 0) and (2m, 4m, 0). At what points the field intensity due to charges is zero? [6M]

## UNIT-II

- 3 a) Explain the Boundary Conditions for Electrostatic Fields. [7M]  
 b) State and explain the different types of polarization. [7M]

Or

- 4 a) State the point form of Ohm's law. What is the analogous relation in the static electric field? [5M]  
 b) A parallel plate capacitor consists of two square metal plates with 50mm side separated by 10mm. A slab of sulphur ( $\epsilon_r = 4$ ) 6mm thick is placed on the lower plate and the air gap is of 4mm. Find the capacitance of the capacitor. [6M]  
 c) Define conductor and list its important features. [3M]

## UNIT-III

- 5 a) State and explain the Ampere's circuital law for steady currents. Mention its applications and limitations. [10M]  
 b) Write a brief note on Lorentz force equation. [4M]

Or

- 6 a) Explain about force on a straight and a long current carrying conductor in a magnetic field. [8M]  
 b) If a stationary charge is placed in a magnetic field, what is the force experienced by it? [3M]  
 c) State Lorentz law of force. [3M]



## UNIT-IV

- 7 a) Derive the expression for magnetic flux intensity due to solenoid of the coil. [7M]  
b) Explain the concept of self and mutual inductances. [7M]

Or

- 8 a) Determine the inductance of a solenoid of 2500 turns wound uniformly over a length of 0.25m on a cylindrical paper tube, 4cm in diameter and the medium is air. [6M]  
b) Derive the expression for energy stored and density in a magnetic field. [8M]

## UNIT-V

- 9 a) Derive Maxwell's fourth equation with suitable theorem. [6M]  
b) State and explain Faraday's laws of electromagnetic induction with its integral and point forms. [8M]

Or

- 10 a) State and explain Maxwell's equations in integral and point form for general time-varying fields. [7M]  
b) Discuss in brief about statically and dynamically induced EMF. [7M]



**II B. Tech I Semester Regular/Supplementary Examinations, January - 2023****ELECTRO MAGNETIC FIELDS**  
(Electrical and Electronics Engineering)

Time: 3 hours

Max. Marks: 70

Answer any **FIVE** Questions, each Question from each unitAll Questions carry **Equal** Marks

~~~~~

## UNIT-I

- 1 a) Explain about Maxwell's two equations for Electrostatic fields. [6M]  
 b) Justify when the Poisson's equation is Laplace's equation. [3M]  
 c) State the Coulomb's law in SI units and indicate the parameters used in the equations with the help of a diagram. [5M]

Or

- 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). [6M]  
 b) State Gauss's law. Using divergence theorem and Gauss's law, relate the density D to the volume charge density  $\rho_v$ . [8M]

## UNIT-II

- 3 a) State the continuity equation and discuss its physical interpretation. [5M]  
 b) Derive an expression for the capacitance of Parallel plate capacitor. [5M]  
 c) What are dielectrics? Explain qualitatively the reason for their conductivity being zero. [4M]

Or

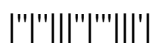
- 4 Discuss in brief about boundary conditions between conductor to dielectric, dielectric to dielectric and conductor to free space. [14M]

## UNIT-III

- 5 a) Derive the expression Maxwell's equation  $\nabla \cdot \vec{B} = 0$ . [5M]  
 b) State and explain Biot-Savart's law. [4M]  
 c) Explain about Lorentz force equation. [5M]

Or

- 6 a) State Ampere's circuital law and apply it to determine the magnetic field intensity due to an infinitely long current filament. [8M]  
 b) Define the following: [6M]  
 (i) Magnetic force  
 (ii) Magnetic Field Intensity  
 (iii) Magnetic flux density



## UNIT-IV

- 7 a) Derive the expressions for the self-inductances of a solenoid and toroid. [12M]  
b) What is the Neumann formula for mutual inductance? [2M]

Or

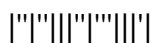
- 8 a) Current in a coil is increased from 0 to 10 Amps at a uniform rate in 5 sec. It is found that this coil develops self-induced emf of 100V whereas an emf of 20V is induced in a neighboring coil. Compute self-inductance of the first coil and mutual inductance between the two coils. [8M]  
b) Discuss the concept of self and mutual inductances. [6M]

## UNIT-V

- 9 a) Define displacement current and derive the equation? [6M]  
b) Explain Faraday's law of electromagnetic induction and derive the expression for induced emf. [8M]

Or

- 10 a) State and explain Faraday's laws of electromagnetic induction. [6M]  
b) Explain the Maxwell's equations for harmonically time varying fields. [8M]



**II B. Tech I Semester Regular/Supplementary Examinations, January - 2023****ELECTRO MAGNETIC FIELDS**  
(Electrical and Electronics Engineering)

Time: 3 hours

Max. Marks: 70

Answer any **FIVE** Questions, each Question from each unitAll Questions carry **Equal** Marks

~~~~~

## UNIT-I

- 1 a) Using Gauss law, derive expressions for electric field intensity due to line and a surface charge distribution. [10M]  
c) Show that the field intensity of a line charge satisfies the conservative property. [4M]

Or

- 2 a) State and prove Gauss's law. List the limitations of Gauss's law. [8M]  
b) A point charge of 15nC is situated at the origin and another point charge of 12nC is located at the point (3,3,3) m. Find  $\vec{E}$  and  $V$  at the point (0,-3,-3). [6M]

## UNIT-II

- 3 a) Find the expression for electric field intensity and potential due to electric dipole situated at the origin. [7M]  
b) What is dipole moment? Obtain expression for the potential and field due to an electric dipole. [7M]

Or

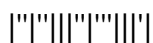
- 4 a) Derive boundary conditions in the presence of dielectrics. [7M]  
b) Explain about Torque on an electric dipole in an electric field. [7M]

## UNIT-III

- 5 a) Explain about force between two straight long and parallel current carrying conductors. [9M]  
b) Describe the magnetic field due to a current element. [5M]

Or

- 6 a) Discuss the application of Ampere's circuital law for symmetrical surface infinite sheet current. [7M]  
b) The point charge  $Q=18nC$  has a velocity of  $5 \times 10^6$  m/s in the 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  $\vec{B} = -3\hat{a}_x + 4\hat{a}_y + 6\hat{a}_z$ . [7M]



## UNIT-IV

- 7 a) Explain in detail about self and mutual inductances. [8M]  
b) A toroidal coil of 500 turns is wound on a steel ring of 0.5m mean diameter and  $2 \times 10^{-3} \text{ m}^2$  cross-sectional area. An excitation of  $4000 \text{ Am}^{-1}$  produces a flux density of 1T. Find the inductance of the coil. [6M]

Or

- 8 a) Derive an expression for energy density in a magnetic field. [7M]  
b) A magnetic circuit comprising a toroid of 500 turns and an area of  $6 \text{ cm}^2$  and mean radius of 15cm and carries a current of 4A. Find reluctance and flux assume  $\mu_r=1$ . [7M]

## UNIT-V

- 9 a) State the Faraday's law in differential form. How it is derived in integral form? [7M]  
b) Show that  $\nabla \times \mathbf{E} = - \frac{\partial \mathbf{B}}{\partial t}$  [7M]

Or

- 10 a) Explain how the concept of displacement current was introduced by Maxwell to account for the production of magnetic field in empty space. [7M]  
b) Discuss the physical interpretation of Maxwell's equations. [7M]

