Seat No. _____

HK-003-0494007

B. Sc. / M. Sc. (Applied Physics) (Sem. IV)
(CBCS) Examination

April - 2023

Electrodynamics & Plasma Physics : Paper - XVI

(New Course)

Faculty Code : 003
Subject Code : 0494007

Time : $2\frac{1}{2}$ Hours / Total Marks : **70**

Instructions : (1) All questions are compulsory.
(2) Numbers on the right indicate marks.

1 (a) Write Answers : **4**

(1) Define Electrostatics.

(2) Write a statement and mathematical form of Coulomb's law.

(3) What is electric field intensity according to Coulombs law?

(4) Define Electric Flux Density.

(b) Write Answers of any one : **2**

(1) Point charge 1 mC and -2 mC m are located at (3, 2, -1) and (-1, -1, 4) respectively. Calculate the electric force on 10nC charge located at (0, 3, 1).

(2) Enlist the properties of electric field lines.

(c) Write Answers of any one : **3**

(1) Two-point charges of equal mass m, charge Q are suspended at a common point by two threads of negligible mass and length l, show that at equilibrium the inclination angle α of each thread to vertical is given by,

$Q^2 = 16\pi\varepsilon_0 mgl^2 \sin^2\alpha \tan\alpha$, if α is very small,

show that, $\alpha = \sqrt[3]{\dfrac{Q^2}{16\pi\varepsilon_0 mgl^2}}$.

(2) Define Faraday's law in electrostatics.
Derive relationship electric field intensity and electric flux density.

(d) Write Answers of any one : **5**

(1) Explain Gauss's law and its applications.

(2) Write a short note on electric scalar potential

2 (a) Write Answers : **4**

(1) Define Dielectric polarization

(2) Explain physical significance of Faraday's law.

(3) Write an expression for Bior-Savart's. law.

(4) What is an electrical potential? How it is related with electric field intensity.

(b) Write Answers of any one : **2**

(1) Explain Coulomb's law in terms of electric field intensity.

(2) Describe Poisson's equations.

(c) Write Answers of any one : **3**

(1) Planes z=0 and z=4 carry current K = –10 ax A/m and K= 10 az, respectively. Determine H at (a) (1, 1, 1) and (b) (0, -3, 10).

(2) What is Lorentz's force equation? Discuss it.

(d) Write Answers of any one : **5**

(1) Drive an expression of Maxwell's Equation: Ampere's Circuit Law.

(2) Write a note on Faraday's law of electromagnetic induction.

3 (a) Write Answers : **4**

(1) What do you mean by boundary value problems?

(2) What is an electric dipole? Why is it important to study?

(3) What is continuity equation?

(4) Figure-out the electrical polarization effect for polar and non-polar substance.

(b) Write Answers of any one : **2**

(1) Write application of Ampere's law for infinite line current.

(2) Enlist the Maxwell's equations for static and magnetic field.

(c) Write Answers of any one : **3**

(1) How the Electromagnetic Wave equation get modified in a linear homogeneous dielectric medium with ε and μ.

(2) Explain continuous charge distribution for different conditions.

(d) Write Answers of any one : **5**

(1) Write a note on Magnetic flux density.

(2) Write mathematical expression of Poynting's theorem and explain each term with necessary figures.

4 (a) Write Answers : **4**

(1) Define plasma as a state of matter.

(2) Draw a well labeled diagram of `Loss Cone'.

(3) Define quasi neutrality and collective behaviour of plasma.

(4) What are Whistler modes in plasma?

(b) Write Answers of any one : **2**

(1) Compute λ_D and N_D for A θ pinch; $n = 10^{23}\ m^{-3}$, $KT_e = 800$ eV.

(2) Compute λ_D and N_D for Earth's ionosphere; $n = n = 10^{12}\ m^{-3}$, $KT_e = 0.1$ eV.

(c) Write Answers of any one : **3**

(1) Discuss diamagnetic nature of plasma on the basis of Debye effect.

(2) Explain with suitable example: the nonexistence of plasma in natural way on earth.

(d) Write Answers of any one : **5**

(1) What is finite Larmor radius effect in Plasma?

(2) What is polarization drift in plasma? Obtain an expression for V_D.

5 (a) Write Answers : **4**

(1) What is magnetic mirror effect?

(2) What are three main criteria for plasma?

(3) What are plasma oscillations?

(4) Under what condition Larmor frequency of free electrons and plasma frequency becomes equal?

(b) Write Answers of any one : **2**

(1) Describe the significance of Whistler modes in Plasma.

(2) Describe the significance of Faraday rotation in Plasma.

(c) Write Answers of any one : **3**

(1) Explain the concept of Debye shielding in plasma and prove that plasma is diamagnetic in nature.

(2) Obtain an expression for the drift velocity of plasma particles under the application of time varying electric and uniform magnetic fields.

(d) Write Answers of any one : **5**

(1) Discuss various applications of plasma with suitable examples.

(2) Derive the fluid equation of motion for plasma and compare it with ordinary fluid equation.
