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[25]

SARDAR PATEL UNIVERSITY

Sixth Semester B. Sc. Examination

Monday, 27th June-2022

Time: 10:00 A.M. To 12:00 P.M.

Subject: PHYSICS [US06CPHY04]

Electrodynamics and Plasma Physics

Total Marks: 70

Note: All the symbols have their usual meanings.

Q-1 To answer the MCQs choose the correct option. [10]

(1) Capacitor is a device which is used to store _____energy.
(a) electrical (b) solar (c) magnetic (d) light

(2) _____ is a non-polar molecule.
(a) NaCl (b) CO_2 (c) CO (d) He

(3) Dipole moment per unit volume is_____.
(a) polarization (b) electric force (c) electric torque (d) electric field

(4) Magnetic moment per unit volume is_____.
(a) magnetization (b)magnetic force (c) magnetic torque (d) magnetic field

(5) The Joule heating law is expressed by P=_____.
(a) IR^2 (b) IR (c) I^2R (d) V^2R

(6) The magnetic moment of particle is invariant in slowly varying _____field.
(a) magnetic (b) electrical (c) gravitational (d) electromechanical

(7) KT = 2 eV; so average kinetic energy E_{av}=____.
(a) ½ eV (b) 3/2 eV (c) 3 eV (d) 2 eV

(8) The crab Nebula is a rich source of plasma because_____.
(a) it contains magnetic field (b) it contains electric field
(c) it has huge temperature (d) it has large gravity

(9) Ion waves are basically___ velocity waves.
(a) constant (b) transient (c) linear (d) variable

(10) The plasma oscillations are basically_____frequency waves.
(a) variable (b) transient (c) linear (d) constant

Q-2 Do as directed. [08]

(A) Mention whether the following statements are True or False.

(1) Capacitance of a parallel plate capacitor is given by $C = \epsilon \frac{A}{d}$.

(2) A changing electric field induces a magnetic field.

(3) The magnetic flux through the Larmor orbit is constant.

(4) For ion waves the group velocity is equal to the phase velocity.

(B) Fill in the blanks.

(5) The Laplace equation in three dimensions using Cartesian coordinates is given by_____.

(6) When a diamagnetic sample is placed in a region of non uniform magnetic field, the diamagnet is _____.

(7) When ω does not depend on k, the group velocity $d\omega/dk$ is _____.

(8) In a relation $p=C\rho^{\gamma}$, γ = _____.

(P.T.O.)

Q-3 **Answer briefly Any Ten of the following questions.** **[20]**

(1) Write down any two properties of conductor.
(2) Define polar and non-polar molecules.
(3) Give boundary conditions for electrical displacement.
(4) Explain briefly magnetization.
(5) Differentiate between ferromagnetism and diamagnetism.
(6) Write down four equations of electrodynamics before Maxwell's theory.
(7) Define plasma.
(8) Why plasma is quasineutral?
(9) Enlist the three conditions which are satisfied by plasma.
(10) What are ion acoustic waves?
(11) Define plasma frequency.
(12) Which phenomenon is called "Langmuir's Paradox"?

Q-4 **Answer the following questions in detail. (Attempt any Four)** **[32]**

(1) Solve Laplace's equation using method of separation of variables with spherical polar coordinates.
(2) Give the solution of Laplace's equation in three dimensions and show that if a single point charge q is located outside the sphere then $V_{avg} = V_{centre}$.
(3) Discuss effect of magnetic field on atomic orbits with necessary equation.
(4) Deduce Neumann formula for the mutual inductance of the two current loops and discuss back emf.
(5) Explain in detail Debye shielding. Derive the formula for Debye length $\lambda_D = \left(\frac{KT_e}{4\pi ne^2}\right)^{1/2}$.
(6) Enlist applications of plasma in various branches. Discuss any three at length.
(7) Explain (i) equation of continuity and (ii) equation of state in plasma.
(8) Write a note on fluid drifts perpendicular to magnetic field $\vec{B}$.

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