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Eng.

Subject: Physics

Sardar Patel University
B.Sc. Semester VI Examination

Course Title: Electrodynamics and Plasma Physics

Course Code: US06CPHY24

Date: 19/07/2021

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

Total Marks: 70

Note:

- (A) All the notations have their usual meaning.
 (B) **Bold letter** in equation denotes vector quantity.
 (C) Figures in the parenthesis at the right side of the questions indicate the marks.

Que 1: Choose the most correct option for the following multiple choice questions. [10]
 (Attempt All)

- 1) Capacitance of the capacitor is purely
 - (a) Independent quantity
 - (b) Algebraic quantity
 - (c) Geometrical quantity
 - (d) Trigonometric quantity
- 2) Which is basic property of Conductor?
 - (a) A conductor is not an equipotential surface
 - (b) Inside the Conductor $E = 0$; $\rho \neq 0$
 - (c) Inside the Conductor $E \neq 0$; $\rho \neq 0$
 - (d) Inside the Conductor $E = 0$; $\rho = 0$
- 3) Unit of capacitance can be written as
 - (a) Volt X Coulomb
 - (b) Volt / Coulomb
 - (c) Coulomb / Volt
 - (d) Volt / Coulomb²
- 4) Ampère's law can be written as
 - (a) $\text{Curl } \mathbf{H} = \mathbf{J}_f$
 - (b) $\text{Curl } \mathbf{H} = 0$
 - (c) $\text{Curl } \mathbf{B} = \mu_0 \mathbf{H}$
 - (d) $\text{Divergence } \mathbf{H} = \mathbf{J}_f$
- 5) Ohm's Law can be written as
 - (a) $\mathbf{J} = \mathbf{E} / \sigma$
 - (b) $\mathbf{J} = \sigma \mathbf{E}$
 - (c) $\mathbf{J} = \rho \mathbf{E}$
 - (d) $\mathbf{J} = \mathbf{E} / \rho$
- 6) The famous ferromagnetic trio is
 - (a) Diamond, Nickel, Cobalt
 - (b) Iron, Nickel, Carbon
 - (c) Iron, Nickel, Cobalt
 - (d) None of the above (NOTA)
- 7) Plasma Parameter can be written as:
 - (a) $N_D = 1$
 - (b) $N_D \neq 1$
 - (c) $N_D \gg \gg 1$
 - (d) $N_D \ll \ll 1$



- 8) For ion waves, the group velocity is _____ to the phase velocity.
 (a) Less than
 (b) Greater than
 (c) Equal to
 (d) None of the above (NOTA)
- 9) The neutral fluid will interact with ions and electrons only through
 (a) Pressure
 (b) Reaction
 (c) Collision
 (d) Mixing
- 10) The Conversion factor in plasma is $1 \text{ eV} = \text{_____}^\circ\text{K}$.
 (a) 11600
 (b) 16100
 (c) 1160
 (d) 1610



Que 2: Do as directed. (Attempt All)

[08]

Fill in the Blanks.

- 1) _____ is the general solution of Laplace's equation in one dimension.
 2) In the case of empty space ($M=0$), the relation between B and H is _____.
 3) The Fluid theory is good approximation for motions _____ to B .
 4) Under the force of gravity, there is a Drift $V_g = \text{_____}$.

State whether True or False

- 5) The dipole moment per unit volume is called paramagnetism.
 6) $V=IR^2$ is the equation for the Joule Heating law.
 7) The solar corona is a tenuous plasma with temperature up to 200 eV.
 8) In particular, ω does not depend on k , so the group velocity $\frac{d\omega}{dk}$ is zero.

Que 3: Give short answer of the following questions. (Any Ten)

[20]

- 1) Give the definition of e.m.f.
- 2) Mention any two basic properties of the conductor.
- 3) Write down the required formula for atomic polarizability.
- 4) Draw the schematic figures of magnetic dipole for Gilbert model and Ampère model.
- 5) Mention the formula in integral form for Ampère Law in magnetized materials.
- 6) What is meant by paramagnetism?
- 7) Write down criteria for plasmas.
- 8) Write the formula for flux rule for motional e.m.f.
- 9) Explain: what is plasma?
- 10) Is plasma quasineutral? Why?
- 11) Explain in brief: Langmuir's paradox.
- 12) Write the equation of convective derivative for plasma.

Que-4 Answer in detail the following long questions. (Attempt any Four)

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- 1) Solve the Laplace's equation using method of separation of variables with spherical polar coordinates.
- 2) What happens when dipole is placed in uniform electric field E? Derive $\nabla \cdot \mathbf{D} = \rho_f$
- 3) Discuss with necessary equation the effect of magnetic field on atomic orbit.
- 4) Discuss motional emf and derive formula for flux rule.
- 5) Explain in detail: Debye Shielding. Derive the formula for Debye length λ_D . Explain Plasma density.
- 6) Obtain Larmor radius when a charged particle is moving in uniform magnetic field and show that the trajectory is helix.
- 7) Discuss: stress tensor for plasma.
- 8) Discuss fluid drift parallel to magnetic field B and Discuss: Plasma approximation.

