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SARDAR PATEL UNIVERSITY

BSc Examination 2016

Semester: VI

Subject: Physics Course: US06CPHY04

Electrodynamics and Plasma Physics

Date: 04-04-2016, Monday Time: 02.30 pm to 05.30 pm Total Marks: 70

INSTRUCTIONS:

1 Attempt all questions.
2 The symbols have their usual meaning.
3 Figures to the right indicate full marks.

Q-1 Multiple Choice Questions: [Attempt all] **10**

(i) The dipole moment per unit volume is called _____.

(a) Polarization (b) Ionization
(c) Magnetization (d) Distortion

(ii) The electric displacement is given as _____.

(a) $D = -\nabla \times E$ (b) $D = -\nabla \times E + V$
(c) $D = \epsilon_0 E + P$ (d) $D = P - \epsilon_0 V$

(iii) ____ is a polar molecule.

(a) O_2 (b) H_2O
(c) CO_2 (d) H_2

(iv) The torque on a magnetic dipole is given as _____.

(a) $N = m \cdot B$ (b) $N = m \times B$
(c) $N = m \cdot P$ (d) $N = m \times P$

(v) The auxiliary field is _____.

(a) $H = \frac{1}{\mu_0} B - M$ (b) $H = \frac{1}{\mu_0}(B - M)$
(c) $H = \mu_0 B - M$ (d) $H = \mu_0(B - M)$

(vi) The trajectory of a charged particle in the **E** $\perp$ **B** field is a _____.

(a) Linear (b) Elliptical
(c) Helix (d) Circular

(vii) The magnetic moment of the gyrating particle to be _____.

(a) $\mu = \frac{1}{2} m v_\perp^2 / B$ (b) $\mu = m v_\perp^2 / B$

(c) $\mu = -\frac{1}{2} m v_\perp^2 / B$ (d) $\mu = -m v_\perp^2 / B$

(viii) The conversion factor in plasma is 1 eV = _____ °K.

(a) 11600 (b) 16100
(c) 1160 (d) 1610

(ix) The neutral fluid will interact with the ions and electrons only through _____.

(a) Mixing (b) Pressure
(c) Reaction (d) Collision

(x) The fluid theory is a good approximation for motions perpendicular to _____.

(a) **E** (b) **E** x **B**
(c) **B** (d) None of these

Q-2 **Answer the following questions in short. (Attempt any ten)** **20**

(1) Write Poisson's equation. When Poisson's equation reduces to Laplace's equation?

(2) Write Laplace's equation in the spherical coordinates.

(3) Find the capacitance of two concentric spherical metal cells, with radii a and b.

(4) Explain magnetization.

(5) Deduce Faraday's law.

(6) Define electromotive force.

(7) Define Plasma.

(8) Give the three conditions must be satisfy by the plasma.

(9) Write equation of the drift and net current density of plasma in the gravitational field.

(10) Which phenomenon is called Langmuir's Paradox?

(11) Give the equation of convective derivative.

(12) Enlist the assumptions to derive an expression for plasma frequency.

Q-3 **(a)** Define conductor and discuss basic properties of conductor in detail. **6**

(b) Derive the equation for the electrostatic pressure at any point on a charge conductor. **4**

OR

Q-3 **(a)** Discuss bound charges and show that total potential is given as **6**

$$V(r) = \frac{1}{4\pi\epsilon_0}\oint \frac{\sigma_b}{r}da' + \frac{1}{4\pi\epsilon_0}\oint \frac{\rho_b}{r}d\tau'.$$

(b) Write a note on induced dipoles. **4**

Q-4 Define diamagnets, paramagnets and ferromagnets. Discuss the effect of a magnetic field on atomic orbits in detail and show that a change in the orbital speed (i.e. the change in dipole moment) is $\Delta m = -\frac{e^2R^2}{4m_e}B$. **10**

OR

Q-4 Derive expression of vector potential for a piece of magnetized material in terms of bound currents $\mathbf{J}_b$ and $\mathbf{K}_b$. Give the physical interpretation of bound currents. **10**

Q-5 **(a)** Discuss Debye's shielding in detail. **6**

(b) Enlist the applications of plasma physics. **4**

OR

Q-5 **(a)** Discuss motion of a single charged particle in the uniform magnetic field B. Obtain the expression for the Larmor radius. **6**

(b) Write a note on Grad-B drift. **4**

Q-6 **(a)** Discuss fluid drift perpendicular to magnetic field **B**. **6**

(b) Write notes on (i) equation of continuity and (ii) equation of state. **4**

OR

Q-6 **(a)** Define plasma frequency and derive expression for the plasma frequency. **6**

(b) Derive expression for the velocity of sound waves in a neutral plasma. **4**

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