

**M.Sc. PHYSICS
THIRD SEMESTER
PLASMA PHYSICS
MSP - 303B**
[USE OMR FOR OBJECTIVE PART]

**SET
A**

Duration: 1:30 hrs.

Full Marks: 35

Time: 15 mins.

(Objective)

Marks: 10

Choose the correct answer from the following:

1X10=10

- Which temperature is generally responsible for maintaining the Debye length?
 - Ion temperature
 - Electron and Ion temperature
 - Electron temperature
 - None of the above
- Which of the following is a characteristic property of plasma?
 - Definite shape and volume
 - Inability to conduct electricity
 - High sensitivity to magnetic field
 - High viscosity
- In a tokamak, what is the main purpose of a toroidal magnetic field?
 - To heat the plasma
 - To contain plasma within a torus-shaped vessel
 - To create turbulence in the plasma
 - To increase the density of the plasma
- If a charged particle is loosely bound to the magnetic field, which of the following statement is true?
 - Its motion becomes circular and stops propagating
 - Its velocity decreases
 - Its gyroradius increases
 - Its mass decreases
- The plasma frequency is proportional to which of the following?
 - Temperature
 - Pressure
 - Both A and B
 - Density
- Which of the following criteria for a gas to behave like plasma is incorrect?
 - $N_D \gg 1$
 - $\omega_p \tau > 1$
 - $\lambda_D \ll L$
 - None of the above
- In case of a curvature drift, which of the following option for total drift velocity is correct?
 - $V_D = \frac{mv_{\parallel}^2}{qB^2} \frac{R \times B}{R^2}$
 - $V_R + V_{\nabla B} = \frac{m}{qB^2} \frac{R \times B}{R^2} \left(v_{\parallel}^2 + \frac{v_{\perp}^2}{2} \right)$
 - $V_D + V_{\nabla B} = \frac{m}{qB^2} \frac{R \times B}{R^2} \left(\frac{v_{\perp}^2}{2} \right)$
 - $V_{\nabla B} = \frac{m}{qB^2} \frac{R \times B}{R^2} \left(v_{\parallel}^2 + \frac{v_{\perp}^2}{2} \right)$

8. What type of waves are Alfvén waves considered to be?
- a. Longitudinal
 - b. Transverse
 - c. Both A and B
 - d. None of the above
9. What happens to the mirror ratio when the magnetic field strength at the mirror ends increases?
- a. The mirror ratio increases
 - b. The mirror ratio decreases
 - c. The mirror ratio remains the same
 - d. The mirror ratio becomes infinite
10. Plasma beta is a ratio of?
- a. Kinetic pressure to Magnetic pressure
 - b. Magnetic pressure to kinetic pressure
 - c. Magnetic moment to kinetic pressure
 - d. Kinetic pressure to magnetic moment

(Descriptive)

Time : 1 hr. 15 mins.

Marks : 25

[Answer question no.1 & any two (2) from the rest]

1. Explain the concept of 'Frozen-in magnetic field'. In this connection state and establish Alfvén theorem. 5

2. Using Maxwell's velocity distribution show that the average thermal kinetic energy per plasma particle is equal to $\frac{3}{2}k_B T$. Hence give a kinetic interpretation of plasma temperature. 7+3=10

3. a. Explain the concept of Debye shielding and Debye sphere in plasma. 6+4=10
b. Describe the concept of plasma frequency and derive its expression.

4. a. What do you mean by adiabatic invariants in plasma? Write down the expressions of the adiabatic invariants. 2+8=10
b. Explain the concept of magnetic mirror and establish the relation between the pitch angle and mirror ratio.

5. a. Write down the complete set of fluid equations for a simple two-component plasma under warm plasma approximation. 3+5+2=10
b. Using hydrodynamic approach derive the equation of continuity for a fluid plasma.
c. Establish the equation of motion for a collisionless plasma described by a scalar pressure.

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