K25U 0178

Reg. No. : .....

Name : .....

Sixth Semester B.Sc. Degree (C.B.C.S.S. – OBE – Regular/Supplementary/ Improvement) Examination, April 2025
(2019 to 2022 Admissions)
DISCIPLINE SPECIFIC ELECTIVE IN PHYSICS
6B14PHY (5) : Plasma Physics

Time : 3 Hours Max. Marks : 40

SECTION – A

Short answer questions. Answer **all** questions. **Each** carries **one** mark.

1. In a plasma fluid, the Debye radius determines the effective range of _____ interactions.
2. The _____ frequency determines the oscillation frequency of electrons in plasma.
3. In plasma fluid theory, the _____ approximation assumes that plasma behaves like a continuous medium.
4. The continuity equation for plasma ensures the conservation of _____.
5. The time taken by a charged particle to complete one gyration in a magnetic field is called the _____ period.
6. In a uniform magnetic field, the charged particle follows a _____ trajectory. **(6×1=6)**

SECTION – B

Short essay questions. Answer **any six** questions. **Each** carries **two** marks.

7. Explain the concept of quasineutrality in plasma and its significance.
8. What is the concept of plasma frequency and how does it affect the behavior of plasma ?
9. Explain the concept of “temperature” of plasma and its significance.
10. Describe the basic types of charged particle motion in uniform and non-uniform magnetic fields.

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11. Discuss how the mirror ratio influences particle trapping.
12. How do electric and magnetic fields combine to determine the trajectory of a charged particle ?
13. Explain the fluid description of plasma.
14. What is the momentum equation for plasma and how is it derived ? **(6×2=12)**

SECTION – C

Answer **any four** questions. **Each** carries **three** marks.

15. Estimate the mean free path of electrons in a weakly ionized plasma of electron-atom collision cross-section q = 10^{-15} cm^2, temperature T_e = 1eV and plasma pressure 10^{-3} Torr. Take neutral particle temperature T_n = 0.1 eV, 1 Torr = 0.13 N/m^2.
16. A dc electric field E is applied at t = 0 to a plasma of electron density "η_0" and collision frequency ν. How would the current density evolve with time ?
17. Compute the density of an ideal gas at 0°C and 760 Torr pressure.
18. Compute λ_D and N_D for the earth's ionosphere, with n = $10^{12}m^{-3}$, KT_e = 0.1 eV.
19. Compute the Larmor radius for a 1-keV He^+ ion in the solar atmosphere near a sunspot, if parallel velocity is negligible (where B = 5×10^{-2} T).
20. Explain briefly about cold plasma. **(4×3=12)**

SECTION – D

Long essay. Answer **any two** questions. **Each** carries **five** marks.

21. Explain the concept of plasma as the fourth state of matter. Discuss its unique properties with relevant examples.
22. Explain the concept of Debye shielding in plasma physics.
23. Derive the equations of motion for a charged particle in a uniform magnetic field.
24. Explain how plasma can be treated as a fluid. Discuss the transition from kinetic theory to fluid theory, emphasizing the assumptions and limitations of the fluid model. **(2×5=10)**

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