MASTER OF SCIENCE EXAMINATION, 2017

(2nd Year, 1st semester)

PHYSICS

Theory of Plasma & Nonlinear Waves

PHY/TE/201

Time: Two hours Full Marks: 40

Use a separate Answer-script for each group

Group A

Answer any TWO questions

1. What do you mean by electron plasma oscillation? Derive an expression for electron plasma oscillation frequency. Estimate the plasma frequency of stellar interior plasma having density 10^{14} particles per m^3.

[2.5 + 5+2.5]

2 Describe the concept of Debye shielding in a plasma? With suitable approximation find the expression for Debye potential for a test charge q immersed in a plasma consisting of electrons and ions. Graphically show its variation with distance and compare with corresponding plot for a test charge placed in air. [2+5+3]

3. Consider the non-relativistic motion of a charged particle in crossed static uniform magnetic and electric fields. Assuming that E/B << c (velocity of light in free space) find the velocity of a moving frame in which electric field is zero. Describe the motion of the particle in this frame. What would be the corresponding motion in rest frame? [6+2+2]

4. Write one complete set of ideal MHD equations. Using these equations explain the concept of frozen-in magnetic field. Also explain the concept of magnetic pressure. [5+2.5+2.5]

GROUP – B

Answer any *TWO* questions.

5. Find out the dispersion relation for electron-plasma wave in an unmagnetized plasma. [10]

6. In the limit $T_i \ll T_e$ the ion-acoustic wave has the dispersion relation

$$\omega(k) = [\omega_{pi} k \lambda_{De}]/[1 + k^2 {\lambda_{De}}^2]^{1/2}$$

(a) Derive an expression for the phase velocity $v_{\emptyset}(k)$ and the group velocity $v_g(k)$ as a function of the wave number k.

(b) Discuss the result with respect to "acoustic behavior" at $k\lambda_{De} \ll 1$.

[6+4]

7. How to generate plasma in laboratories? Explain briefly the confinement issue of plasma in laboratory scale. [5+5]

8. Derive the dispersion relation of an electromagnetic ion wave in plasma along the applied magnetic field. [10]