Major Test

PHL657: Plasma Physics

Max. Marks: 50 **Date: 29th April 2008** **Time: 2 Hours**

Attempt all the questions.

1. a) Why the ion acoustic velocity v_s is described in terms of electron temperature and ion mass? **2**

b) Define β and describe $\beta = 1$ plasma. **1+2**

c) What is Rayleigh-Taylor instability? **2**

2. Derive the dispersion relation for a two-stream instability occurring when there are two cold electron streams with equal and opposite $\vec{v}_0$ in a background of fixed ions. Each stream has a density $n_0/2$. **6**

3. The electron-neutral collision cross section for 2-eV electrons in an ideal gas He is about $6\pi a_0^2$, where $a_0 = 5.3\times10^{-9}$ cm is the radius of the first Bohr orbit of the hydrogen atom. A positive column with no magnetic field has p = 1 Torr of He at room temperature and T_e = 2 eV. Compute the electron diffusion coefficient in m^2/sec, assuming that $\overline{\sigma v}$ averaged over the velocity distribution is equal to σv for 2-eV electrons. **6**

4. Ion cyclotron wave is studied in a hydrogen plasma having electron temperature as 2 eV under a perpendicular magnetic field of 0.02 Tesla. If the frequency is 2.5 MHz, what would be the wavelength of the wave? **4**

5. Write down the dispersion relation for an ion acoustic wave in a finite ion temperature plasma and explain physically the origin of two terms involved. **2+2**

6. Explain sheath and derive an equation for a planar sheath. **2+2½**

7. Write down dispersion relation for an extraordinary wave in a homogeneous plasma along with an explanation to the terms involved. Discuss the cutoffs and resonances with the help of dispersion curves only. **2+3½**

8. Derive the Boltzmann relation for the electrons and discuss its physical meaning. **2+1½**

9. Define Alfven wave with the help of appropriate geometry and explain what happens physically in an Alfven wave. **2+4**

10. A microwave of frequency 2.45 GHz is sent through a plasma of density $(1/9)\times10^{12}/cm^3$. What will be the skin depth? **3½**