MASTER OF SCIENCE EXAMINATION, 2018

(2nd Year, 2nd Semester)

MATHEMATICS

Unit - 4.5 (B - 2.31)

(Plasma Mechanics - II)

Full Marks : 50 Time : Two Hours

The figures in the margin indicate full marks.

Notations / Symbols have their usual meanings.

Answer Question No. 1 and any *three* from the rest.

1. (a) Define refractive index surface. If the dispersion relation of a wave is $f\left(w, k_x, k_y, k_z\right) = 0,$ find the equation of the refractive index surface.

   (b) Find the equation of the wave normal surface for waves propagating in a cold homogeneous magnetoplasma.

   (c) Define Cut-off and resonance. Starting from the appropriate dispersion relation, discuss the existence of electron cyclotron resonance and ion cyclotron resonance.

   (d) Define wave packet and group velocity. When a plasma medium is said to be dispersive or normally dispersive ?

[*Turn over*]

2. Derive the dispersion relation for longitudinal waves in a warm field-free plasma. 10

3. Starting from the appropriate dielectric tensor for waves in a cold homogeneous magnetoplasma, derive the dispersion relation in the form :

$$\tan^2\theta = -\frac{P\left(n^2-R\right)\left(n^2-L\right)}{\left(Sn^2-RL\right)\left(n^2-P\right)}$$ 10

4. Starting from the appropriate basic equations, derive the dispersion relation of the Alfvén wave. 10

5. Starting from the appropriate basic equations, derive the dispersion relation of the ion acoustic wave propagating along x-direction in a collisionless unmagnetized two component electron ion plasma in the following form :

$$k^2 = \omega_{pi}^2 \int_{-\infty}^{\infty} \frac{\partial f_{ix0}/\partial v_x}{v_x - v_\phi}\, dv_x + \omega_{pe}^2 \int_{-\infty}^{\infty} \frac{\partial f_{ex0}/\partial v_x}{v_x - v_\phi}\, dv_x .$$

10

6. Starting from the appropriate dispersion relation, discuss (a) longitudinal waves for high frequency approximation limit and (b) longitudinal waves for low frequency approximation limit. 10