# M.A./M.Sc. Examination 2019

**Semester - IV**

**Mathematics**

**Optional Course: MMO-41(A07) (New Syllabus)**

**( Magnetohydrodynamics-II )**

**Time: Three Hours** **Full Marks: 40**

Questions are of value as indicated in the margin.
Notations and symbols have their usual meanings.
Answer ***any four*** questions.

1. Consider the propagation of MHD waves in an electron-ion magnetoplasma. Using the appropriate momentum balance equations for the charged particles, obtain the generalized Ohm's law. Hence reduce its form in the limit of small Larmor radius approximation, and for propagation in magnetospheric plasmas. 7+2+1

2. a) Define the characteristic lengths and frequencies associated with the propagation of MHD waves in a conducting medium. 4
   b) Derive the reduced forms of MHD equations in electron-ion plasmas. 6

3. a) Discuss the notions of "magnetic viscosity" and "magnetic Reynolds number". 2+2
   b) Deduce the law of conservation of energy of MHD waves in a conducting fluid, and show that it can be expressed in the following integral form (Neglect the effect of fluid resistivity).
   $$\int_V \left( \frac{1}{2}\rho v^2 + \frac{P}{\gamma - 1} + \frac{B^2}{2\mu_0} \right) dV = \text{constant}.$$ 6

4. Write short notes on the following:
   a) Diffusion of magnetic field lines. 5
   b) Magnetic pressure. 5

5. a) Explain what are Alfvén and magnetosonic waves in a compressible, conducting fluid immersed in a magnetic field. 6
   b) Discus about the occurrence and characteristics of whistlers waves in atmospheric plasmas. 4

6. Show that the linear dispersion relation for MHD waves in a magnetized electron-ion plasma in which ions are immobile can be obtained in the form
   $$-\omega^2 v + \left(C_S^2 + V_A^2\right)(k \cdot v)k + (k \cdot V_A)\left[(k \cdot V_A)v - (V_A \cdot v)k - (k \cdot v)V_A\right] = 0.$$
   Hence discuss the case of propagation perpendicular to the magnetic field. 7+3

———