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PG (CBCS)
M.SC. Semester- IV Examination, 2026
APPLIED MATHEMATICS
PAPER: MTM 402B
(MAGNETO HYDRO-DYNAMICS)

Full Marks: 20 **Time: 1 Hour**

The figures in the right-hand margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

GROUP-A

1. Answer any **TWO** questions: 2×2 = 4

   a) Describe the working principle of MHD power generator.
   b) Define **Lorentz force** in the context of MHD flow.
   c) What is meant by magnetic flux and magnetic diffusion?
   d) Define Hartmann number and explain its significance.

GROUP-B

2. Answer any **TWO** questions: 2×4 = 8

   a) Describe applications of MHD flow in engineering and astrophysics.
   b) Write down the Maxwell's electromagnetic field equations of moving media and hence deduce the magnetic induction equation.
   c) State and prove Alfven's theorem.
   d) Define 'Hall current' and write down its key effects in magneto-hydrodynamic.

GROUP-C

3. Answer any **ONE** question: 1×8 = 8

   a) A viscous, incompressible conducting fluid of uniform density are confined between a channel made by an infinitely conducting horizontal plate $z = -L$ (lower) and a horizontal infinitely long non-conducting plate $z = L$ (upper). Assume that a uniform magnetic field H_0 acts perpendicular to the plates. Both the plates are in rest. Find the velocity of the fluid and the magnetic field. Draw a sketch of the velocity profiles for various values of the Hartmann number. 6+2

(P.T.O.)

b) (i) For a conducting fluid in a magnetic field, show that the magnetic body force per unit volume, i.e. $\mu(\nabla \times H) \times H$ is equivalent to a tension μH^2 per unit area along the lines of force, together with a hydrostatic pressure $\frac{1}{2}\mu H^2$, where symbols have their usual meaning.

(ii) Explain the concept of Alfvén waves in magneto-hydrodynamics and describe their significance in plasma physics. 5+3

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