

PG CBCS
M.Sc. Semester-IV Examination, 2022
MATHEMATICS
PAPER: MTM 403
(MAGNETO HYDRO-DYNAMICS & STOCHASTIC PROCESS & REGRESSION)
Full Marks: 40 **Time: 2 Hours**

Write the answer for each unit in separate sheet

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.

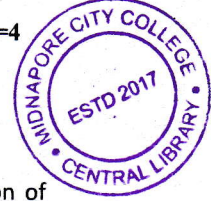
MTM 403.1: MAGNETO HYDRO-DYNAMICS

GROUP-A

1. Answer any two question:

2×2=4

- a) Define the term magnetic diffusivity.
- b) State Ferraro's law of isorotation.
- c) Write down the statement of Alfven's theorem
- d) Define magnetic pressure and write its significance for the motion of conducting fluid.



GROUP-B

2. Answer any two questions:

2×4=8

- a) Write down the basic equations of mageto-hydrodynamics and hence deduce the magnetic induction equation in MHD flows.
- b) Prove that in a steady non-uniformly rotating star, the angular velocity must be constant over the surface traced out by the rotation of the magnetic lines of force about the magnetic field axis.
- c) Define magnetic energy and further, find the rate of change of magnetic energy in magneto-hydrodynamic.
- d) Deduce magnetic induction equation.

GROUP-C

3. Answer any one questions:

8×1=8

- a) Define Couette flow. Give the mathematical formulation of mageto-hydrodynamic Couette flow and derive its velocity and magnetic field expression.

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[2]

b) 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.

MTM 403.2: STOCHASTIC PROCESS & REGRESSION

GROUP-A

1. Answer any two questions:

2x2=4

- a) Define doubly stochastic matrix.
- b) What is Ergodic process?
- c) Define multiple correlation and partial correlation.
- d) Write the transition matrix for the problem of random walk between reflecting barriers.



GROUP-B

2. Answer any two questions:

2x4=8

- a) Prove that for a Markov chain, state j is persistent iff $\sum_{n=0}^{\infty} p_{jj}^{(n)} = \infty$.
- b) State and prove Chapman-Kolmogorov equation.
- c) Derive the equation of the plane of regression containing three variables.
- d) Let $\{1/n : n \geq 0\}$ be a Markov chain with three states 0, 1, 2 and with

transition matrix $\begin{pmatrix} 3/4 & 1/4 & 0 \\ 1/4 & 1/2 & 1/4 \\ 0 & 3/4 & 1/4 \end{pmatrix}$ and the initial distribution $P(X_0 =$

$i) = 1/3, i = 0, 1, 2$. Find

(i) $P(X_2 = 2, X_1 = 1 | X_0 = 2)$

(ii) $P(X_3 = 1, X_2 = 2, X_1 = 1, X_0 = 2)$

[3]

GROUP-C

3. Answer any one questions:

1x8=8

a) State birth and death process. Find the differential-difference equation for birth and death process. 2+6

b) Establish First Entrance Theorem. Consider the Markov chain on the state space $\{1, 2, 3, 4\}$ with transition probability matrix

$$\begin{bmatrix} 1/3 & 2/3 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 1 & 0 & 2/3 & 1/3 \\ 0 & 0 & 1 & 2/3 \end{bmatrix}$$

Draw the graph corresponding to this Markov chain.

Identify the states as transient, persistent, ergodic. 3+1+4