

**M.Sc. 4th Semester Examination, 2025**

**APPLIED MATHEMATICS**

**PAPER—MTM-402(U-1 & 2)**

*Full Marks : 50*

*Time : 2 hours*

**Answer all questions**

*The figures in the right hand margin indicate marks*

*Candidates are required to give their answers in their own words as far as practicable*

**MTM-402(Unit-1)**

*(Fuzzy Mathematics)*

*[Marks : 25]*

**GROUP — A**

**1. Answer any two questions : 2×2**

- (a) Define fuzzy set. Also, define union, intersection of two fuzzy sets and complement of a fuzzy set.

*( Turn Over )*

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(b) Define the product of two interval numbers.  
Hence find the value of  $\sqrt{[4,8]}$ .

(c) Find the closed interval for  $\alpha$ -cuts for fuzzy set  $A$  whose membership function is given by

$$\mu_A(x) = \begin{cases} \frac{x-1}{4} & \text{if } -2 < x \leq 0 \\ \frac{2-x}{2} & \text{if } 0 < x \leq 2 \\ 0 & \text{otherwise} \end{cases}$$

(d) Differentiate between a possibility measure and a probability measure with examples.

### GROUP – B

2. Answer any *two* questions : 4 × 2

(a) Using the addition rule for fuzzy numbers show that  $4 + 7 = 11$  for real numbers.

- (b) Use Verdegay's approach write the following fuzzy LPP in a parametric programming problem :

$$\text{Maximize } z = 3x_1 + 8x_2 + 10x_3 + 11x_4$$

$$\text{subject to } x_1 + 2x_2 + x_3 + x_4 \leq 5 \text{ to } 8$$

$$8x_1 + 4x_2 + 2x_3 + 2x_4 \leq 13$$

$$9x_1 + 2x_2 + 6x_3 + 5x_4 \leq 10 \text{ to } 12$$

$$x_j \geq 0; j=1,2,3,4.$$

- (c) State and explain Bellman-Zadeh's principle of decision-making in fuzzy environment. How is this principle applied in solving fuzzy linear programming problems? Illustrate with a brief example.
- (d) Suppose  $A = (1, 2, 4)$  and  $B = (2, 4, 5)$  be triangular fuzzy numbers. Compute the extended addition, extended multiplication and show that multiplication of these two fuzzy numbers is not a triangular fuzzy number.

GROUP - C

3. Answer any *one* question : 8 × 1

(a) Write Zadeh's extension principle for addition for two numbers. Using this addition rule for fuzzy numbers, prove that  $[3, 6] + [1, 8] = [4, 14]$ .

(b) Describe the Werner's method for solving the following fuzzy LPP.

Maximize  $z = cx$   
subject to  $(Ax)_i \leq \tilde{b}_i, i = 1, 2, \dots, m$   
 $x_j \geq 0$ .

Use this method to convert the following fuzzy LPP to a crisp LPP :

Maximize  $z = 5x_1 + 3x_2 + 4x_3 + 9x_4$   
subject to  $2x_1 + 2x_2 + 3x_3 + x_4 \leq \tilde{15}$   
 $x_1 - 5x_2 + 3x_3 + 2x_4 \leq \tilde{40}$   
 $2x_1 + 6x_2 - 3x_3 + 9x_4 \leq \tilde{60}$   
 $x_j \geq 0; j = 1, 2, 3, 4$ .

Assuming the tolerance as 5, 10, 20.

[ Internal Assessment - 5 Marks ]

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**MTM-402(Unit-2)**

*(Magneto Hydro-Dynamics)*

[Marks : 25]

**GROUP – A**

1. Answer any *two* questions : 2 × 2
- (a) State the working principle of 'MFD flowmeter' and 'MFD submarines'.
  - (b) Discuss the terms 'magnetic diffusivity' and 'drift velocity'.
  - (c) Define 'Hartmann number' and explain its significance.
  - (d) Write down the Maxwell's electromagnetic field equations of moving media.

**GROUP – B**

2. Answer any *two* questions : 4 × 2
- (a) Find the equations of motion of a conducting fluid in the context of mageto-hydrodynamics flow.

- (b) State and prove Alfvén's theorem.
- (c) Define magnetic energy and further, show that the rate of change of magnetic energy is the sum of loss of magnetic energy per unit volume and the work done by the material against the force exerted by the magnetic field on the current during motion.
- (d) Explain the concept of Alfvén waves in magneto-hydrodynamics and describe their significance in plasma physics.

GROUP – C

3. Answer any *one* question : 8 × 1

- (a) (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  $\mu H^2$  per unit area along the lines of force,

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together with a hydrostatic pressure  $\frac{1}{2}\mu H^2$ , where symbols have their usual meaning.

(ii) Define 'Hall current' and write down its key effects in magneto-hydrodynamic. 5+3

(b) Define 'Couette flow' and write down the mathematical formulation of the magneto-hydrodynamic Couette flow and derive its velocity and magnetic field expressions. 1+2+5

**[ Internal Assessment — 5 Marks ]**

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