PG/IVS/MTM/402(U-1&2)/24
(New)

M.Sc. 4th Semester Examination, 2024

APPLIED MATHEMATICS

PAPER – MTM-402(U-1&2)(New)

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* : 20]

GROUP – A

1. Answer any *two* questions : 2×2

(*a*) What is the difference between random uncertainty and non-random uncertainty ?

(*b*) Define the height of a fuzzy set, convex fuzzy set and fuzzy number.

(*c*) Suppose (10, 14, 19) is a triangular fuzzy number. Write its membership function and draw its diagram.

(*d*) Simplify the following expression
$2(5, 6, 8, 12) + 3(-1, 3, 4) - 5[-3, 2] + 8$.

GROUP – B

2. Answer any *two* questions : 4×2

(*a*) For the following three interval numbers
$[1, 4]$, $[2, 5]$ and $[3, 8]$
show by Zadeh's extension principle that the distributive law does not hold.

(*b*) Using α-cut method, show that
$2(-1, 5, 7) + 3\ (0, 3, 4) = (-2, 19, 26)$

(*Continued*)

(*c*) State and illustrate the Bellman and Zadeh's principle for fuzzy LPP.

(*d*) Prove De Morgan's laws for fuzzy sets.

GROUP – C

3. Answer any *one* question : 8×1

(*a*) State Zadeh's extension principle. Using Zadeh's extension principle, prove that $[1,3] + [5,8] = [6,11]$.

(*b*) Convert the following fuzzy LPPs to equivalent crisp LPP by Verdegay's approach.

Maximum $z = x_1 + 3x_2$

subject to $2x_1 + 4x_2 \leq 4$ to 8

$2x_1 + 3x_2 \leq 1$ to 3

$0.2x_1 + 2x_2 \leq 9$ to 11

$x_j \geq 0,\ j = 1,2.$

MTM– 402(Unit-2)

(*Magneto Hydro-Dynamics*)

[*Marks* : 20]

GROUP – A

1. Answer any *two* questions : 2×2

(*a*) Describe the working principle of MFD submarines.

(*b*) Define Lorentz force.

(*c*) Define the terms 'permittivity' and 'drift velociy'.

(*d*) Define magnetic Reynolds number and explain its physical significance.

GROUP – B

2. Answer any *two* questions : 4×2

(*a*) Write down the Maxwell's electromagnetic field equations of moving media and hence deduce the magnetic induction equation.

(*b*) State and prove Ferraro's law of isorotation.

(*c*) Show that for B to be a force free magnetic field at all times it has to satisfy the integrability condition $B\times(\nabla\alpha.\nabla)B=0$, in addition to satisfying the basic equation of force-free magnetic field (symbols have their usual meaning).

(*d*) Define the terms Alfven's velocity and Alfven's waves. Hence, derive the speed of propagation is $\sqrt{c^2+V_A^2}$ for magneto hydrodynamic wave, where symbols have their usual meaning.

GROUP – C

3. Answer any *one* question : 8×1

(*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

(*b*) (*i*) Define magnetic energy and further, find the rate of change of magnetic energy in magneto-hydrodynamic.

(*ii*) Give the mathematical formulation of MHD flow past a porous plate and derive its velocity expression. 3 + 5

[Internal Assessment – 10 Marks]
