MATH-3.4

Sl.No. : **Total No. of Pages : 2**

III Semester M.Sc. Degree Examination, May -2026
(Scheme : Non-CBCS)
MATHEMATICS
Mathematical Modeling

Time : 3 Hours **Max. Marks : 80**

Instructions : *1) Answer any five full questions.*
2) All questions carry equal marks.

Q1) a) Explain the needs of mathematical modeling with any three examples.

b) Write a short note on classifications of mathematical modeling.

c) Velocity of a moving particle is given by $v=t^2-\frac{3x}{t}$; where v is velocity, x displacement and t is time. Find an expression for the displacement of the particle at any time t.

[6+6+4]

Q2) a) Construct a model for rectilinear motion of string.

b) Explain linear population growth model. Find the expression for doubling/ half-life period.

[8+8]

Q3) a) Explain the construction of spring and dashpot systems.

b) Discuss the stability of the equilibrium points for the prey-predator model $\frac{dx}{dt}=ax-bxy;\frac{dy}{dt}=-cy+dxy;a,b,c,d>0$.

[8+8]

Q4) a) Describe conventional combat models in detail.

b) Find the expressions for velocity and acceleration vectors along radial and transverse direction.

[8+8]

Q5) a) Show that velocity profile for irrotational flow of a fluid is a harmonic function.

b) Derive Euler -Lagrange equation for the variational problem involving two independent variables.

[8+8]

Q6) a) Describe a model for Glacier flow.

b) Derive Burger's equation for the convection diffusion process.

[8+8]

Q7) a) Show that in cylindrical polar co-ordinates

$$\nabla^2 \psi = \frac{1}{r}\frac{\partial}{\partial r}\left(r\frac{\partial \psi}{\partial r}\right) + \frac{1}{r^2}\frac{\partial^2 \psi}{\partial \theta^2} + \frac{\partial^2 \psi}{\partial z^2}$$

b) Distinguish between primary and secondary air pollutants.

c) Identify the various pollution sources of the following air contaminants.

i) Hydrocarbons

ii) Hydrogen sulphide

[8+4+4]

Q8) Using gradient diffusion model, derive an expression for air pollution and hence derive conservation of mass equation. **[16]**

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