No. of Printed Pages : **2**

Sl. No.

21MAT3C11L

M.Sc. I Semester Degree Examination, April/May - 2023

MATHEMATICS

Mathematical Modelling

Time : 3 Hours Maximum Marks : 70

Note : *Answer* ***any five*** *questions. Question No.* ***1*** *is* ***compulsory****. Each question carries* ***equal*** *marks.*

1. (a) Apply Mathematical modelling process to describe radioactive decay phenomena.

(b) Using ordinary differential equations, explain the diffusion of glucose or medicine in the blood stream. **7+7**

2. (a) What is prey-predator model ? Describe mathematically.

(b) Use system of first order ordinary differential equation to discuss the simple epidemic model. **7+7**

3. (a) Use the knowledge of second order ODE to model the circular motion of satellites.

(b) A satellite wishes to orbit the earth at a height of 100 km. (approximately 60 miles) above the surface of the earth. Determine the speed, acceleration and orbital period of the satellite. (Given : Mearth $= 5.98 \times 10^{24}$ kg, Rearth $= 6.37 \times 10^{6}$ m) **7+7**

4. (a) Write a note on Cobweb model for demand and supply.

(b) Solve the following difference equations.

(i) $y_{n+3} - 2y_{n+1} + 4y_n = 0$

(ii) $y_{n+2} - 2\cos \propto y_{n+1} + y_n = \cos \propto n$ **6+8**

5. (a) Write a note on applications of directed graphs in detection of cliques.

(b) Using graph theory concept explain classical seven bridge problem. **7+7**

P.T.O.

6. (a) Examine the voltage drop in an electrical circuit using ordinary differential equations.

(b) Suppose that the population x(t) and y(t) satisfy the model given by the following system of equations $\frac{dx}{dt} = 1 - xy$, $\frac{dy}{dt} = x - y$ Determine all the critical points of the system and discuss the type and stability of each of these critical points. **7+7**

7. (a) Derive the method to obtain the complementary function of a difference equation by matrices.

(b) Discuss the method of representing the directed graphs into a matrix form. **7+7**

8. (a) A growing city had a population of 500000 in 2005. In 2010, the population was 760000. Assume exponential growth.

(i) Express the population after t years as a function of t ?

(ii) predict the population in 2025 ?

(iii) In what year will the population reach 1 Million ?

(b) Develop a mathematical model for diabetic-mellitus using ordinary differential equations.

(c) Obtain the mathematical model for analysing the rectilinear motion of an elastic string. **5+5+4**

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