Registration No.: | | | | | | | | | | |

Total Number of Pages: 02

Course: M.Sc.I
Sub Code: FMCC503

5th Semester Regular Examination: 2024 - 25
SUBJECT: MATHEMATICAL MODELLING & SIMULATION
BRANCH(S): M.Sc.I (MC)
Time: 3 Hours
Max Marks: 70
Q.Code : R293

Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right-hand margin indicate marks.

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Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) Write at least two applications of mathematical modeling.
b) Define Signed graph and Weighted graph.
c) Explain balance graph.
d) Describe how differential equations are applied in Mathematical Modeling.
e) Why should we study the motion under central forces.
f) Describe the Working model of carbon dating.
g) Why we need to study mathematical modelling through difference equation.
h) Write the effects of immigration and emigration on population size.
i) Describe Seven bridge problem.
j) Explain Genetic Graphs.

Part-II

Q2 **a)** Using Populational growth model, find the relation between doubling, tripling, and quadrupling times for a population. **(5)**

b) What is the rate of interest compounded continuously if a bank's rate of interest is 10% per annum? **(5)**

Q3 **a)** Develop a model for a simple compartment method. **(5)**

b) Develop a model for a radioactive decay substance. **(5)**

Q4 For a particle moving in a circular orbit of radius a, find expressions for its velocity and acceleration components. **(10)**

Q5 Deduce Kepler's three laws of planetary motion. **(10)**

Q6 Solve the following difference equation. **(10)**

i) $x_{t+2} - x_{t+1} + x_t = 0$

ii) $x_{t+2} - 4x_{t+1} + 3x_t = t$

Q7 A signed graph G is said to have an idealised party structure if the vertices of G can be partitioned into classes so that all edges joining the vertices in the same class have + sign and all edges joining vertices in different sets have negative sign. **(10)**

a) Give an example of a signed graph which does not have an idealised party structure.

b) Give an example of a graph which is not balanced but which has an idealised party structure.

Q8 A machine can be in any one of the states a, b, and c. The transitions between states are governed by the transition probability matrix. **(10)**

$$\begin{array}{c} \\ a \\ b \\ c \end{array}\begin{array}{c} \begin{array}{ccc} a & b & c \end{array} \\ \begin{bmatrix} 1 & 0 & 0 \\ 1/2 & 0 & 1/2 \\ 1/3 & 1/3 & 1/3 \end{bmatrix} \end{array}$$

Draw the weighted digraph and find the limiting probabilities for the machine to be found in each of the three states.

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