DECEMBER 2023 **U/ID 32515/UEM5A**

Time : Three hours Maximum : 75 marks

PART A — (10 × 2 = 20 marks)

Answer any TEN questions.

1. What is mathematical modeling?

2. Give some examples of mathematical models.

3. What is mathematical modeling of an equation?

4. A colony of bacteria increases according to the law of uninhibited growth. How long will it take for the size of the colony to double a second time (quadruple)?

5. Define compartment model.

6. What is meant by simple epidemic model?

7. Define SIS model.

8. Write the equations governing a susceptible 3 infected susceptible (SIS) Model.

9. What is the need of difference equations in mathematical modelling?

10. Show the homogeneous linear difference equation with constant coefficients.

11. Define Harrod Model.

12. Write the assumptions considered in Cobweb model.

PART B — ($5 \times 5 = 25$ marks)

Answer any FIVE questions.

13. Show the characteristics of mathematical model.

14. X wishes to invest in a stock with a 10% return annually. How much money will he have at the end of the year?

15. Show that the excess temperature of the body over that of the surrounding medium decays continuously.

16. A body at temperature 40°C is kept in a surrounding of constant temperature 20°C. It is observed that its temperature falls to 35°C in 10 minutes. Find how much more time will it take for the body to attain a temperature of 30°C.

17. Solve SIS model when β is a known function of t.

18. Solve the difference equations $x_{t+2} - 4x_{t+1} + 3x_t = t$.

19. For the model $Y_t = I_t + C_t, C_t = C + mY_t, rI_t = Y_{t+1} - Y_t$. Find Y_t, I_t, C_t.

PART C — ($3 \times 10 = 30$ marks)

Answer any THREE questions.

20. A carpenter produces and sells his own furniture. Pine tables are sold for 650 $, cherry tables for 750 $ and maple tables for 850 $. What is the carpenter's annual revenue?

21. The oil is heated to 70°C. It cools to 50°C after 6 minutes. Calculate the time taken by the oil to cool from 50°C to 40°C given the surrounding temperature Ts = 25°C.

22. Draw some trajectories for the competition model $\frac{dx}{dt} = x\,(1 - 0.1y), \frac{dy}{dt} = -y\,(1-0.1x)$.

23. Obtain the solution of a linear difference equation in matrix form.

24. Prove that the national income at different times form a geometric progression.