MAY 2023 **U/ID 32515/UEM5A**

Time : Three hours Maximum : 75 marks

PART A — ($10 \times 2 = 20$ marks)

Answer any TEN questions.

1. Write a short note on realism of models.

2. Write any two simple situations requiring mathematical model.

3. How do you classify mathematical model according to the purpose?

4. When will we use ordinary differential equation in a mathematical modeling?

5. Write the mathematical model for interest compounded continuously.

6. Define competition model.

7. What do you mean SIS model with constant number of carriers?

8. In the equation $\log C = \log C_o - KEt/2.303$, what does C_o stand?

9. Integrate $\frac{dT}{dt} = (\beta(n+1)-\gamma)\, I - \beta\, I^2$.

10. State population growth model.

11. If B is not a root of $g(\lambda) = D$ find the particular solution of $a_0\, x_{t+n} + \ldots + a_n\, x_t = \phi(t)$.

12. Write any two assumption for the Harrod model.

PART B — (5 × 5 = 25 marks)

Answer any FIVE questions.

13. Write the procedure for solving problems through mathematical model.

14. A fish population which is growing according to logistic law is harvested at a constant H. Show that $\frac{dN}{dt} = r\, N\left(1-\frac{N}{K}\right) - H$.

15. Draw some trajectories for the model

$\frac{dx}{dt} = x(1-0.1)y; \frac{dy}{dt} = -\, y(1-0.1x)$.

16. What is meant by compartment model? Explain simple compartment model.

17. Discuss prey-predator models.

18. Solve the simultaneous equations

$$x_{n+1} - x_n + 2y_{n+1} = 0$$
$$y_{n+1} - y_n - 2x_n = 2^n$$

19. For the model $y_t = I_t + C_t;\ C_t = C + my$, $rI_t = y_{t+1} - y_t$, find C_t, I_t, Y_t and discuss stability of equilibrium position.

PART C — (3 × 10 = 30 marks)

Answer any THREE questions.

20. Explain population growth model

21. Show that the logical model can be written as $\frac{1}{N}\frac{dN}{dt} = r\left[\frac{K-N}{K}\right]$

22. Show that the model represented by

$$\frac{dx}{dt} = x(30 - 60 - 5y);$$

$\frac{dy}{dt} = y(12 - 40 - 3y)$, $x \geq 0, y \geq 0$, has no position of equilibrium and that only the first species will survive.

23. Discuss the solution of the matrix difference equations $P(t+1) = AP(t)$, where $P(t)$ is a probability vector and A is a matrix.

24. Explain how mathematical modeling, applied to actuarial science?