17. Explain the motion of projectile.

18. Find the radial component and transverse component of velocity and acceleration.

19. Explain about Markov chains with examples.

20. Explain the regular solids.

S.No. 3142 **P 16 MAE 1 B**

(For candidates admitted from 2016–2017 onwards)

M.Sc. DEGREE EXAMINATION, NOVEMBER 2022.

Mathematics — Elective

MATHEMATICAL MODELING

Time : Three hours Maximum : 75 marks

PART A — ($10 \times 2 = 20$)

Answer ALL questions.

1. Solve $\frac{dx}{dt} = ax + k$.

2. Write the Logistic law.

3. Write the model with removal and immigration.

4. What are the assumptions for Domar Macro model?

5. Solve the linear, differential equation of the second order $mx''+cx'+kx = 0$.

6. Write the time period of circular motion of satellites.

7. Define Prey-Predator model.

8. Define z-transform.

9. Define complete graph and directed graph.

10. State the structure theorem.

PART B — $(5 \times 5 = 25)$

Answer ALL questions, choosing either (a) or (b).

11. (a) Derive the linear differential equation of the first order of a simple compartment model.

Or

(b) Derive the simple Harmonic motion equation.

12. (a) Explain competition models.

Or

(b) Show that $\underset{t\to\infty}{Lt}\, S(t) = 0, \underset{t\to\infty}{Lt}\, I(t) = n + 1$ with usual notations for a simple Epidemic model.

13. (a) Derive $e = \dfrac{h_{max} - h_{min}}{2a + h_{max} - h_{min}}$ for Elliptic motion of satellites.

Or

(b) Derive the equation of the common cantenary.

14. (a) Obtain the complementary function by using matrices.

Or

(b) Explain improvement of planets through elimination of recessives.

15. (a) State and prove Euler's formula for polygonal graphs.

Or

(b) Explain one-way traffic problem.

PART C — $(3 \times 10 = 30)$

Answer any THREE questions.

16. Find the orthogonal trajectories of the following family of curves.

(a) $y = mx$, where m is parameter

(b) Family of confocal conics $\dfrac{x^2}{a^2 + \lambda} + \dfrac{y^2}{b^2 + \lambda} = 1$, where λ is a parameter.

(c) Polar coordinates $r = 2a\cos\theta$ where $a > 0$ is a parameter. Also replace $r\dfrac{d\theta}{dr}$ by $\dfrac{-1}{\left(r\dfrac{d\theta}{dr}\right)}$.