Register Number:

Date:

ST. JOSEPH'S COLLEGE(AUTONOMOUS), BENGALURU -27
M.Sc (MATHEMATICS) - IV SEMESTER
SEMESTER EXAMINATION: APRIL 2023
(Examination conducted in May 2023)
MTDE 0622 - MATHEMATICAL MODELLING

(For current batch students only)

Time: 2.5 Hours Max Marks: 70

This paper contains **TWO** printed pages.

Answer any SEVEN of the following. **[7x10=70]**

1. Discuss the characteristics of Mathematical Models.
2. Derive the linear growth and decay model in the case of population growth. Mention any one of the limitations of this model.
3. Derive the model to describe the diffusion of glucose in the blood stream.
4. Deduce the model to describe the Battle of Iwo Jima.
5. Derive the model for the projectile motion of a particle of mass m making an angle θ with the horizontal and hence determine the following:
   (i) Time of flight.
   (ii) Horizontal range.
   (iii) Greatest height.
   (iv) Maximum range on the horizontal.
6. Deduce the model for the unforced damping in the mass-spring-dashpot system.
7. (a) Determine the price per unit product and the numbers of product sold when the revenue is maximum where the number of products 'x' sold by a farm in a week is given by $p = 200 + 5x - x^2$ where p is the price per unit of the product.
   (b) Discuss the stability of the difference equation $x_{t+2} - 4x_{t+1} + 4x_t = 2^t$. **[5+5]**
8. (a) Using Gauss divergence theorem, evaluate $\int_S \int x^2 dydz + y^2 dzdx + z^2 dxdy$ where the surface S is bounded by $0 \leq x, y, z \leq a$.

(b) Derive the equation of continuity for heat flow. **[5+5]**

9. (a) Using Gauss divergence theorem, show that $\int_S \int curl\,\overrightarrow{F} \,.\, d\overrightarrow{S} = 0.$

   (b) Derive Euler's equation of motion for inviscid fluid. **[4+6]**

10. Derive the model for traffic wave propagation along a highway.

**********END**********