Roll No. ..... Total Pages : 3

**CMDQ/M-24** **5531**

# BIO-MATHEMATICS

Paper–MMATH 21-413

Time allowed : 3 Hours] [Maximum Marks : 80

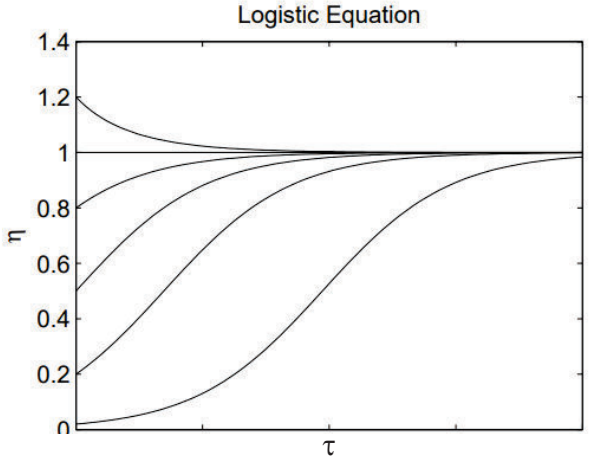
***Note :*** Attempt **five** questions in all, selecting **one** question from each unit. Question No. **1** is compulsory. All questions carry equal marks.

**Compulsory Question**

1. Attempt all questions:

   (i) Write the theoretical result of the Buckingham Pi Theorem.

   (ii) Write MATLAB script to produce the figure given below






   (iii) Derive forward Kolmogorov differential equations.

   (iv) Define SI model in detail.

   (v) Differentiate between genotype and phenotypes.

   (vi) Define homozygous and heterozygous.

   (vii) What is dynamic programming. Describe in detail.

   (viii) Define the term cooperativity.

**UNIT–I**

2. Derive : $N(t) = \dfrac{N_0}{\dfrac{N_0}{K} + \left(1 - \dfrac{N_0}{K}\right) e^{-rt}}$

3. Show that rabbits are an age structured population and follow the system

$$u_{1,n+1} = u_{2,n}$$

$$u_{2,n+1} = u_{1,n} + u_{2,n}$$

Prove that the ratio of adults to juveniles approaches the golden mean.

**UNIT–II**

4. Explain the difference between SIS and SIR model of infectious disease.

5. Derive the normal probability distribution of population growth.

**UNIT–III**

6. Explain the frequency – dependent selection model with suitable examples. Show that the stable polymorphic population, maintained by frequency–dependent selection, consists of $\frac{1}{3}$ hawks and $\frac{2}{3}$ doves.

7. Explain in detail:

   (a) Random mating.

   (b) Selfing.

   (c) Constancy of allele frequencies.

**UNIT–IV**

8. Explain competitive inhibition in detail.

9. What are the different methods of sequence alignment? How does dynamics programming play a role in solving the problem of sequence alignment?