Ref. No. : SC/MATH/PG/DSE/TH/03/A6/2023

M. Sc. Mathematics Examination – 2023

(Second Year, First Semester)

DSE - 03 (A6)

(Mathematical Ecology)

Full Marks : 40 **Time : 2 Hours**

Use separate answer script for each Part

Part – I (16 marks)

Answer question no. 1 and any *Two* from the rest.

Q.1. (a) What is mutualism? Explain different types of mutualism. (1+2)
(b) What do you mean by persistence of species in ecological system? (1)

Q.2. With suitable assumptions write down Gause type general prey - predator mathematical model and discuss the qualitative behavior of the system for different functional responses as proposed by C. S. Holling. (1+5)

Q.3. What do you mean by ratio-dependent prey-predator interaction? Formulate a ratio-dependent prey-predator mathematical model with proper ecological justification and discuss the dynamic behaviour of the model. (2+4)

Q.4. (a) Write down the mathematical model of prey – predator interaction as proposed by De-Angelis and derives the condition for local asymptotic stability of the model. (3)

(b) With suitable assumptions write down the single species population model in a polluted environment. (3)

PART II (24 Marks)

(Answer ***any three*** from the following four questions)

1. (a) Discuss the food chain mathematical model formulation introduced by H.I. Freedman.

(b) Find the conditions for existence of the equilibrium points.

(c) Explian the behaviour of the solutions of the system near the xy plane. [1+3+4=8]

2. (a) Define functional response in a prey predator interaction model with respect to Holling's type I, II and III.

(b) Considering the above assumptions, formulate a three dimensional eco-epidemiological model describing the role of infection on the stability of the linear prey-predator system.

(c) Prove that on R^3_+ the solutions of the systems are uniformly bounded. [2+3+3=8]

3. (a) Demonstrate the Nutrient- Phytoplankton- Zooplankton model in detail.

(b) Find out the existence conditions of the equilibrium points of the system.

(c) Also, evaluate the necessary conditions for the stability of both the non-interior equilibriums. [2+2+4=8]

4. (a) With suitable assumptions,write down the classical Lvein's metapopulation model and also, discuss the key metapopulation concepts.

(b) Find the basic reproduction number of this system and also, provide the necessary biological phenomena elaborately. [5+3 = 8]