

Ex/SC/MATH/PG/DSE/TH/03/A6/2024

MASTER OF SCIENCE EXAMINATION, 2024

(Second Year, First Semester)

MATHEMATICS

PAPER : DSE - 03 (A6)

(Mathematical Ecology)

Full Marks : 40

Time : 2 Hours

*Answer **any four** questions. (4×10)*

1. (a) Define functional response and numerical response function in a prey-predator system.
(b) What do you mean by Holling-type response functions?
(c) Write down mathematical formulations for different types of response functions. Also give their biological justification. (3+2+5)
2. With suitable assumptions, formulate a suitable mathematical model as proposed by Holling-Tanner. Derive the conditions for existence of different equilibrium points. Also discuss the qualitative behavior of the system. (3+2+5)
3. (a) What do you mean by ratio-dependent prey-predator interaction?
(b) Write down the mathematical model of prey-predator model as proposed by De-Angelis. Hence discuss the local asymptotic stability of the model.

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[Turn Over]

(2)

- (c) With suitable assumptions, write down the single species population model in a polluted environment. (2+2+4+2)
4. Describe a three-species simple food chain model. Derive suitable conditions for the existence of different equilibrium points. Determine the condition for which the interior equilibrium point of the proposed system will be stable. (3+3+4)
5. (a) Formulate a three-dimensional modified Gause type prey-predator model by incorporating the impact of viral infection on the prey population.
(b) How can you exhibit that the interior equilibrium of the system does exist?
(c) Discuss the local asymptotic stability of the system and compare briefly the stability zones of the classical Gause model and the modified model. (3+2+5)
6. (a) Formulate Levin's meta-population model and discuss the essential concepts associated with the model.
(b) Find the basic reproduction number R_0 of Levin's system. Also describe the inter-connections of bifurcation arising as R_0 crosses the critical value. (5+5)

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