

Question Bank For PG Course

Mathematics

Paper-9B(ii)

Special Paper: Applied Mathematics

MATHEMATICAL MODELS IN ECOLOGY: PGMT-IXB

Question 1

What are the different parts of ecology?

Question 2

What are the Biotic components of Ecosystem?

Question 3

Which of the following statements is/are false?

- i) Dynamical model may be deterministic or stochastic.
- ii) State variables are chosen to determine the current state of a system
- iii) Dynamical modelling is not possible in continuous time.

Question 4

What is a conservation equation?

Question 5

Why stochastic models are needed for modelling of any ecological system ?

Question 6

What are the basic postulates for developing continuous time models of single-species population ?

Question 7

Define the asymptotic stability of a fixed

point x^* of the equation $\frac{dx}{dt} = f(x)$.

Question 8

Write down the Gompertz equation for time dependent growth rate in Malthus population model.

Question 9

What condition, called Allee effect, represents a population having a maximum intrinsic growth rate at intermediate density?

Question 10

What is the critical value H_c of H , the constant rate per unit time of removal of members, in a constant rate Harvesting model?

Question 11

When the system $\frac{dx_1}{dt} = f(x_1, x_2), \frac{dx_2}{dt} = g(x_1, x_2)$ defined on $D \subset \mathbb{R}^2$ is cooperative?

Question 12

Cattle, deer and sheep rely on bacteria to breakdown plant cellulose into digestive sub-units. What type of interaction is this?

Question 13

What is Fibonacci sequence?

Question 14

Define Bifurcation values.

Question 15

Investigate the qualitative behaviour of the solution of the system using Poincare' – Bendixson theorem

$$\begin{aligned}\frac{dx}{dt} &= x \left(1 - \frac{x}{30} \right) - \frac{xy}{x+10} \\ \frac{dy}{dt} &= y \left(\frac{x}{x+10} - \frac{1}{y} \right)\end{aligned}$$

Question 16

What is the intrinsic growth rate or per capita growth rate in a continuous time model of single-species population?

Question 17

Which is the simplest model for finding the half-life of a decaying population such as radioactive decay?

Question 18

In the Logistic Model equation of population growth

$$\frac{dx}{dt} = r x \left(1 - \frac{x}{k} \right)$$

What is the significance of k?

Question 19

What is the importance of linearization of an autonomous first-order differential equation $\frac{dx}{dt} = f(x)$?

Question 20

Define the asymptotic stability of a fixed point x^* of the difference equation

$$x_{n+1} = f(x_n), x(t_0) = x_0.$$

Question 21

What is a Cobweb diagram?

Question 22

A drug is administered every 6 hours. Let $D(n)$ be the amount of the drug in the blood system at the n th interval. The body eliminates a certain fraction p of the drug during each time interval. If the initial drug administered is D_0 , find $D(n)$ and $\lim_{n \rightarrow \infty} D(n)$.

Question 23

Write down the discrete time logistic delay equation.

Question 24

What is the Bendixson's negative criterion for the two-dimensional system

$$\frac{dx}{dt} = F(x, y)$$

$$\frac{dy}{dt} = G(x, y) \text{ where } F \text{ \& } G \text{ are}$$

continuously differentiable function of (x, y) defined on some simply connected domain $D \subset \mathbb{R}^2$?

Question 25

Find the period of oscillation

of prey and predator

population sizes of Lotka –

Volterra system $\frac{dx}{dt} = \lambda x -$

$b x y$

$\frac{dy}{dt} = -\mu y + c x y .$

Question 26

When the system $\frac{dx_1}{dt} =$

$f(x_1, x_2)$

$\frac{dx_2}{dt} = g(x_1, x_2)$ defined on D

$\subset \mathbb{R}^2$ is said to be cooperative?

Question 27

Define Green House effect.

Question 28

What is Ethology?

Question 29

Find the nature of stability of the

equilibrium (x^*, y^*) when the eigen

values λ of the system of linear

equations

$\frac{du}{dt} = F_x(x^*, y^*) u + F_y(x^*, y^*) v$

$\frac{dv}{dt} = G_x(x^*, y^*) u + G_y(x^*, y^*) v$

have negative real parts.

Question 30

What is meant by Genome?