A000174(028)

B. Tech. (Hon's) (First Semester) Examination Nov.-Dec. 2023

(New Scheme)

FUNDAMENTAL of COMPUTATIONAL BIOLOGY

(Artificial Intelligence)

Time Allowed : Three hours

Maximum Marks : 100

Minimum Pass Marks : 40

Note : *Question (a) from all the unit is compulsory and carries 4 marks. Attempt any **two** one question whiever is applicable from each unit apart from Q. 1. All questions carries equal marks. Draw neat labelled diagrams wherever necessary. Scientific calculators and graph papers can be used for numerical problems.*

Unit-I

1. (a) Define a vector and provide an example of a two dimensional vector.   4

(b) What do you understand by mathematics modelling? Write the steps involved in its creation along with suitable example. 8

(c) Describe the different phases of growth in bacteria. What is the concept of generation time?

Suppose a researcher is studying the growth of a particular bacterial strain in a lab environment. The researcher observed that the bacterial population doubled every 30 minutes. Calculate the growth rate constant (k) and the generation time for this bacterial strain. 8

(d) Define product production and substrate decay in the context of biological processes. Describe the Monod equation and its significance in modeling microbial growth and substrate utilization. What are the key parameters in the Monod equation, and how are they related? 8

Unit-II

2. (a) Write the characteristics associated with a cancerous cell. 4

(b) Explain the concept of enzyme kinetics and the Michaelis-Menten equation. How do substrate

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concentration and enzyme properties affect the reaction rate in enzyme catalyzed reactions. 8

(c) Discuss the concept of predator-prey dynamics in biological systems and how it is modeled using the Lotka-Volterra equations.

A predator-prey system consists of foxes and rabbits. The fox population grows at a rate of 0.03 per week, and the rabbit population decreases at a rate of 0.02 per week due to predation. If there are initially 200 foxes and 500 rabbits, calculate the population size of both species after 6 weeks using the Lotka-Volterra model. 8

(d) Discuss the different models associated with the spread of infectious diseases. 8

Unit-III

3. (a) Write short notes on surface plots. 4

(b) Discuss different plots used to represent distributions. Write MATLAB codes to plot these distributions. 16

(c) In detail, explain different plots that can be used to represent biological data. 16

Unit-IV

4. (a) Explain ficks law of diffusion. 4

   (b) What do you mean by respiration? Write down mathematical modelling of respiration process? 8

   (c) Explain different types of fluids and discuss their flow properties. 8

   (d) Write down the mathematical ODE equation for each component in the following network. 8
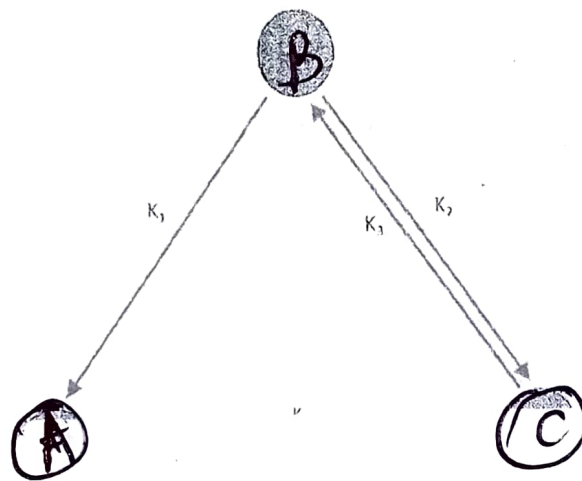
Unit-V

5. (a) Explain the process of genetic drift. 4

   (b) Consider the process of glycolysis and explain the metabolic flux analysis. 16

   (c) What do you understand by evolution? Write down different theories of evolution and explain how mutations can be used to explain evolutionary process. 16