

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION- 2025

B.Tech-VIII Semester (BI)

COURSE CODE (CREDITS): 18B1WBI831 (3)

MAX. MARKS: 35

COURSE NAME: Computational Molecular Evolution

COURSE INSTRUCTORS: Dr. Tiratha Raj Singh

MAX. TIME: 2 Hours

*Note: (a) All questions are compulsory.*

*(b) The candidate is allowed to make Suitable numeric assumptions wherever required for solving problems. Calculator is permitted.*

Q.No	Question	CO	Marks
Q1	What is the key assumption of Kimura's Neutral Theory of Molecular Evolution? If the mutation rate per generation is $\mu=1 \times 10^{-8}$ per nucleotide and the population size $N=10^6$ , calculate the number of neutral mutations fixed per generation.	CO-4	4
Q2	Two species show a genetic divergence of 0.12 substitutions per site. If the mutation rate is $1 \times 10^{-9}$ per site per year, estimate the time since they diverged.	CO-3	2
Q3	Define $K_a$ and $K_s$ . What does a $K_a/K_s$ ratio of $>1$ , $=1$ , and $<1$ indicate in terms of selection pressure working on the involved biological sequences?	CO-4	3
Q4	What is exon shuffling, and why is it important in evolution? Explain how can exon shuffling lead to domain evolution in proteins? What are various kinds of exon shuffling available. Explain in detail.	CO-5	4
Q5	Why are overlapping and nested genes significant in molecular evolution? How a nested gene in virus is different from higher organisms?	CO-5	4
Q6	Suppose a gene has 5 codons: AAA, AAA, AAG, AAG, AAG and Lysine codons are AAA and AAG. From reference set it is given that AAA = 60% and AAG = 40%. Calculate CAI for the gene.	CO-4	4
Q7	Compare out of Africa and multiregional hypothesis for the evolution of human and mitochondrial genomes. Give suitable evidences and proof to provide the justification for these hypotheses.	CO-5	3
Q8	Explain the evolutionary tree applications in molecular evolution. What are various kinds of methods available to calculate the same. Discuss any one method with a real example of nucleotide sequences from different organisms.	CO-3,4	4
Q9	Compare codon capture and ambiguous intermedia theories. What type of introns are available? Explain introns evolution through a mechanism.	CO-2,3	3
Q10	Discuss the role of natural selection in the process of evolution. Discuss basic to advance level mechanisms to prove that life on planet earth is a result of evolution in a gradual manner.	CO-1-3	4