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JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -2 EXAMINATION- 2026

BTech-VIII Semester [BI]

COURSE CODE(CREDITS): 18B1WBI831 (3) MAX. MARKS: 25

COURSE NAME: Computational Molecular Evolution

COURSE INSTRUCTOR: Dr. Tiratha Raj Singh MAX. TIME: 1 Hour 30 Minutes

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	Discuss the process of evolution through mechanisms, evidences, and various theories that were proposed during the process of the accumulation of this evidences.	1	2
Q2	For the amino acid Alanine (Ala), four synonymous codons have the following RSCU values: GCU = 1.6 ; GCC = 1.2 ; GCA = 0.8 ; GCG = 0.4. (a) Calculate the relative adaptiveness (w_i) for each codon. (b) A gene contains the codons: GCU, GCC, GCG. Calculate the CAI of this gene.	3	4
Q3	Explain the differences between positive selection, negative (purifying) selection, and neutral evolution with the help of an example.	2	3
Q4	Define pseudogenes. Explain their relationship with multigene families, and illustrate with a human pseudogene example, including its evolutionary constraints and divergence timeline.	3	3
Q5	Realize the significance of genetic code systems in biological evolution. What are the various mechanisms for the same? Compare the mitochondrial genetic code with the standard nuclear genetic code. Highlight key differences in codon assignments, translational machinery, and evolutionary adaptations, and explain the biological significance of these variations.	3	4
Q6	The amino acid Isoleucine (Ile) is encoded by three codons: AUU, AUC, AUA. In a gene, their observed counts are as follows: AUU = 18 ; AUC = 6 ; AUA = 6. Calculate the RSCU values for each codon.	3	4
Q7	What are the key assumptions of the Jukes-Cantor one-parameter model of nucleotide substitution? Why is the Jukes-Cantor model called a *one-parameter* model? Derive this one-parameter model for nucleotide substitutions.	3	5