JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -1 EXAMINATION- 2026

M.Tech-I Semester (BT)

COURSE CODE (CREDITS): 18M1WBT133 MAX. MARKS: 15

COURSE NAME: Advances in Computational Systems Biology

COURSE INSTRUCTOR: Tiratha Raj Singh MAX. TIME: 1 Hour

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

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

(c) Use of calculator is allowed

Q.No	Question	CO	Marks
Q.1.	Consider a gene Y, activated by a transcription factor X. Once activated, gene Y produces protein Y at a constant production rate of $\beta = 8$ nM/min. Protein Y is removed from the cell through two processes: (1) Degradation – with a specific rate constant $\alpha_{deg} = 0.04$ min−1 (2) Dilution – due to cell growth, with a rate constant $\alpha_{dil} = 0.01$ min−1 Assuming that initially there is no protein Y in the cell, i.e., $Y(0) = 0$, calculate: (1) The total removal rate constant α. (2) The steady-state concentration (Yss) of protein Y. (3) The half-life ($T_{1/2}$) of protein Y. (4) The concentration of protein Y after exact 20 minutes. (5) The time required for protein Y to reach 90% of its steady-state concentration.	2	5
Q.2.	A biological system contains several interacting components such as genes, proteins, metabolites, and signaling molecules. Explain why studying these components as a network can provide more information than studying them individually.	1	2
Q.3.	Consider a gene regulatory network consisting of five genes: A, B, C, D, and E. The regulatory relationships are as follows: • Gene A activates B and C. • Gene B represses C and activates D. • Gene C activates E. • Gene D represses E. Represent the above regulatory relationships as a GRN, clearly indicating activation and repression using different types of arrows.	2	3
Q.4.	A cancer-associated transcription factor regulates several genes involved in cell proliferation, apoptosis, and metabolism. Explain how Systems Biology and multi-omics analysis can be used to study its role in cancer. Name TFs types and their various parameters.	1	3
Q.5.	What is a biological network? Give two examples of biological networks and mention what their nodes and edges represent.	1	2