JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION- 2024

M.Tech-I Semester (BT)

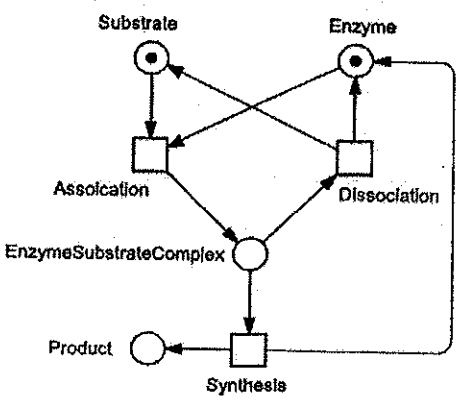
COURSE CODE (CREDITS): 18M1WBT133 (3) MAX. MARKS: 35

COURSE NAME: Advances in Computational Systems Biology

COURSE INSTRUCTORS: Dr. Tiratha Raj Singh MAX. TIME: 2 Hours

Note: (a) All questions are compulsory. Calculator is permitted.

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

Q.No	Question	Marks
Q1	A transcription factor (activator) binds to the promoter region of a gene and activates its expression. The gene expression rate is modeled by the Hill function: $f(A)=V_{max}.A^n/K^n+A^n$ where: • *f(A)*: the rate of gene expression as a function of the activator concentration A. • V_{max}: the maximum rate of gene expression (V_{max}=10). • *K*: the concentration of the activator at which the expression rate is half-maximal (K=5). • *n*: the Hill coefficient (n=2). 1. Calculate the gene expression rate *f(A)* when A=3 and A=10. 2. Explain the effect of the Hill coefficient (n) on the sensitivity of gene activation.	6
Q2	Signify the modeling of a biological network through Petri nets. Discuss all the components of a Petri net. What are various types of Petri nets used in biological pathway modelling? Annotate the given Petri net model:  	6

Q3	Realize the significance of metabolic networks in systems biology. What are various representations and key components of metabolic networks? Discuss their importance in pathway level analysis with an example through systems approach. Explain the metabolic pathway through a set of reactions and generate a Stoichiometry matrix for these reactions with 5 substances (reactants and products) and 4 reactions.	6
Q4	Which computational methods are used to infer PPIs in the genomic context? Explain any one method with an example of real biological data.	4
Q5	What is electronic cell in systems biology? Explain its features, working environment and applications in systems as well as synthetic biology. Demonstrate through an erythrocyte example.	4
Q6	Solve the given reaction through SBML approach: $$E + S \underset{k_{off}}{\overset{k_{on}}{\rightleftharpoons}} ES \xrightarrow{k_{cat}} E + P$$ Assume all the parameters and their quantities as per the requirements or use in a unary way.	5
Q7	Discuss the significance of pathways in biological networks through Omics approach in a research-based setting. Explain how signal transduction pathways (STPs) could play a very crucial role in this cascade? Justify your answer with a real STP example.	4