

NITDGP/BTECH/Reg/Even/2021-22

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR
Even Semester End-term Examination, 2021-22

Course Code: PHO441

Course Name: Quantitative Biology

Question Paper No.: NITDGP/PHO441/1

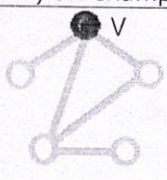
Full Marks: 30

Time: 90 Minutes

Date of Exam: 29/04/2022

Instructions: There are 7 questions in both the groups. Answer ANY 6 questions from EACH group.

Materials to be supplied: NA

Question No.	Body of the Question	Marks	Mapped CO
GROUP: A			
1	Define assortativity for networks. Draw a disassortative network.	2	CO2
2	Draw the network that has following incidence matrix. <div style="display: flex; align-items: center; justify-content: center;"> <div style="margin-right: 10px;"> A B C D </div> <div style="margin-right: 10px;"> (</div> <div style="display: flex; flex-direction: column; align-items: center;"> <div>E1</div> <div>1</div> <div>1</div> <div>0</div> <div>0</div> </div> <div style="margin-right: 10px;"> </div> <div style="margin-right: 10px;"> E2 0 1 1 0 </div> <div style="margin-right: 10px;"> </div> <div style="margin-right: 10px;"> E3 1 0 1 0 </div> <div style="margin-right: 10px;"> </div> <div style="margin-right: 10px;"> E4 1 0 0 1 </div> <div style="margin-right: 10px;">)</div> </div>	2	CO2
3	Differentiate between Random networks and Scale-free networks based on their degree distributions.	2	CO4
4	Define Incoherent FFL architecture and give (draw) an example.	2	CO1
5	Calculate the Local Clustering Coefficient around the black node v. 	2	CO2
6	For a Wheel with n nodes, what will be the number of edges?	2	CO4
7	What is Hysteresis, in the context of Bistable Gene Switches?	2	CO1
GROUP: B			
8	Define complete graph. Calculate the number of nodes in a complete graph, if the number of edges is 45.	3	CO2
9	Draw all possible 3 gene motifs considering only positive gene regulation. Identify 3 gene Feedback loop in the motifs.	3	CO4
10	Draw and explain an illustrative bifurcation diagram for Genetic Toggle Switch marking the parameter, variable, stable/unstable fixed points, bifurcation points and the bistable region.	3	CO1, CO3
11	Draw the L-Arabinose utilization FFL architecture in <i>E.coli</i> , and create the Truth Table for regulation.	3	CO1
12	Starting from the equations of Genetic Toggle Switch, $\frac{du}{dt} = \frac{A}{1+v^2} - u, \quad \frac{dv}{dt} = \frac{B}{1+u^2} - v$ demonstrate Linear Stability Analysis to determine stability of the fixed point $u = 0.26, v = 4.67$. Parameters considered, $A = 6, B = 5$.	3	CO4, CO3
13	Explain AND logic and OR logic for dual gene regulation.	3	CO2
14	For a GRN with 6 genes, the regulations are as follows: A activates B, while B represses A. B also represses C, but activates D. C autoactivates. D activates A, C and E. E represses F. Draw the network and find out the adjacency matrix (consider activation as 1 and repression as -1).	3	CO1

Course Outcomes

CO1: To see living systems from the perspective of engineering, physics, mathematics and computer science

CO2: To understand systems based approaches in biological sciences

CO3: To use web-based resources that will help them in modelling complex biological processes

CO4: To choose an appropriate modelling technique for a complex biological system