


VIT

Vellore Institute of Technology

Final Assessment Test – November 2025

Course: TBIT401L - Systems Biology

Class NBR(s): 1114

Time: Three Hours

Slot: A2+TA2+TAA2

Max. Marks: 100

- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

COs	CO Statements
CO1	Interpret biological information with data analysis.
CO2	Evaluate and handle various bioinformatics tools.
CO3	Build group and compare data to gain information about single molecules compared to similar molecules.
CO4	Explain how genomic, transcriptomic and proteomic techniques work, and discuss their strengths and limitations.
CO5	Analyze results of biological studies by making use of bioinformatics techniques. Develop basic scripts and pipelines for automating and repeating analysis.

BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)

Answer ALL Questions
(10 X 10 = 100 Marks)

- What is flux balance analysis (FBA)? Discuss how you can utilize FBA to obtain metabolic phenotype of a cell (e.g., *E. coli*) under certain conditions. Provide example illustration of the procedure in your answer. CO1 BL4
- Explain with a case study, how to analyse cell cycle and differentiation using pseudotime scale data during single cell RNA-seq (scRNA-seq) data analysis. CO2 BL3
- Explain the working principle of bacterial chemotaxis movement. Include the illustration of PPI and signalling required for the movement. CO5 BL1
- What is sign-sensitive delay and how feed forward loops (FFLs) are related to it? Discuss with input-output dynamics. CO2 BL1
- How do activators and repressors regulate gene expression at the transcriptional level? [5] CO4 BL2
 - Discuss the analytical framework to check if two or more proteins are interacting. [5]

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| 6. | a) Discuss Barkai-Leibler model of exact adaption. | [4] | CO3 | BL2 |
| | b) What is autoregulation? Discuss how autoregulation impacts gene regulatory network (GRN). | [6] | | |
| 7. | What is Paracrine and endocrine signalling? Discuss how hormone signalling (e.g., plant auxin response) can be analysed with scRNA-seq data. | | CO2 | BL2 |
| 8. | a) List down with illustrations the types of conformational proofreading. | [5] | CO3 | BL1 |
| | b) What are Cis-regulatory elements (CREs)? Explain the Key characteristics of Cis-Regulatory Elements. | [5] | | |
| 9.a) | Discuss with dynamics how the Incoherent FFL shows fold change detection (FCD). Point out how FCD can be identified from dynamic measurements. | | CO1 | BL4 |
| | OR | | | |
| 9.b) | Provide example of biological logic gates involving AND, OR and NAND circuits. | | CO1 | BL4 |
| 10.a) | Explain how fold change detection, exact adaptation and chemotaxis are related. | | CO4 | BL3 |
| | OR | | | |
| 10.b) | Discuss role of optimal expression of protein and how it relates to balancing cost of synthesis with its functional benefit. | | CO4 | BL3 |

⇐⇐⇐ R/K/TY ⇐⇐⇐