

# GUJARAT TECHNOLOGICAL UNIVERSITY

M.SC. INDUSTRIAL BIOTECHNOLOGY(IB) - SEMESTER - 3 EXAMINATION - WINTER - 2024

**Subject Code: 1330104**

**Date: 22 Nov 2024**

**Subject Name: Metabolic Engineering**

**Time: 10:30 AM TO 01:00 PM**

**Total Marks: 70**

**Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Draw neat and clean diagrams as required.

- Q.1 Write a note on following: (Marks-10X2=20)**
1. How is stoichiometry applied in cellular reactions
  2. What is flux balance analysis (FBA)?
  3. Over determined and underdetermined systems in the context of material balance
  4. How do enzymes contribute to the regulation of metabolic pathways
  5. Gene knockout
  6. Explain the concept of material balances.
  7. How is synthetic biology related to bioprocess design
  8. BIOBRICKS
  9. Gibson Assembly
  10. What does steady-state assumption mean
- Q.2 Answer the following (Any 2 out of 3): (Marks-2X10=20)**
1. Discuss how enzymes, substrates, and regulatory molecules interact to control metabolic pathways. Provide examples of how enzyme regulation affects the overall pathway output.
  2. Explain the principles behind TALENs and CRISPR-Cas technologies, their application in pathway manipulation, and how they differ from or improve upon traditional methods of genomic modification.
  3. Discuss the challenges faced when modifying a single gene, and why multiple genomic modifications (e.g., gene knock-ins/knockouts, promoter engineering) are often required to achieve significant changes in metabolite production.
- Q.3 Answer the following (Any 6 out of 8): (Marks-6X5=30)**
1. Using an example, explain how substrate concentration affects metabolic pathways.
  2. How can multi-factor authentication (MFA) be utilized to enhance the efficiency of production pathways.
  3. Discuss how synthetic biology tools can be applied to design new metabolic pathways.
  4. Compare the functions of MOMA (Minimization of Metabolic Adjustment) and iFBA (Integrated Flux Balance Analysis).
  5. What are the essential elements of pathway manipulation strategies aimed at increasing metabolite production

6. How does promoter engineering enhance the flow of metabolites through targeted pathways?
7. Explain the significance of hierarchical control in cellular metabolic regulation.
8. Provide an overview of the steps in glycolysis and the TCA cycle, and explain how these pathways can be engineered to increase the production of intermediates such as pyruvate and succinate.

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