Printed Page:- **Subject Code**:- **ABT0602**

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: VI - THEORY EXAMINATION (20 ..... - 20.....)

Subject: Metabolic Engineering

Time: 3 Hours **Max. Marks: 100**

General Instructions:

IMP: *Verify that you have received the question paper with the correct course, code, branch etc.*

1. *This Question paper comprises of* ***three Sections -A, B, & C.*** *It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.*

2. *Maximum marks for each question are indicated on right -hand side of each question.*

3. *Illustrate your answers with neat sketches wherever necessary.*

4. *Assume suitable data if necessary.*

5. *Preferably, write the answers in sequential order.*

6. *No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.*

SECTION-A 20

1. Attempt all parts:-

1-a. What is the primary purpose of conducting a heat balance in metabolic reactions? (CO1, K2) 1

(a) To estimate the energy required for substrate transport

(b) To calculate the temperature effects on enzyme activity

(c) To ensure that energy input and output in the system are balanced

(d) To assess the amount of energy consumed by the cell

1-b. How does cumulative feedback regulation function in metabolic pathways? (CO1, K2) 1

(a) It activates enzymes to increase product synthesis

(b) It inhibits enzyme activity based on the accumulation of multiple products

(c) It prevents the degradation of intermediate metabolites

(d) It speeds up the transport of metabolites

1-c. E.S should be zero for (CO2, K2) 1

(a) stochiometrically balanced reactions

(b) stochiometrically unbalanced reactions

(c) Both

(d) None

1-d. Identify the most appropriate method to ascertain the critical branch points in a metabolic pathway (CO2, K2) 1

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(a) Genetic analysis
(b) Growth kinetics
(c) metabolic flux analysis
(d) metabolic variability analysis

1-e. Identify the nuclei that has spin quantum number I=0 from the following. (CO3, K3) 1

(a) 16O8
(b) 15N7
(c) 11B5
(d) 3H11

1-f. NMR requires the application of _____ (CO3, K3) 1

(a) magnetic field
(b) electric field
(c) Both
(d) None

1-g. Executing in the command window the following code returns a = [1:3]' ; size(a) (CO4, K2) 1

(a) error message
(b) 1 3
(c) 3 1
(d) 31

1-h. What is the output of AND gate if A and B are the inputs? (CO4, K2) 1

(a) A+B
(b) AB
(c) (A+B)'
(d) A'+B'

1-i. Pathway engineering involves.....(CO5, K2) 1

(a) Manipulating and optimizing metabolic pathways
(b) Analyzing the genetic basis of metabolism
(c) Modifying the structure of enzymes
(d) Studying the kinetics of metabolic reactions

1-j. The optimization of metabolic pathways in pathway engineering often involves: (CO5, K2) 1

(a) Iterative cycles of experimentation and modeling
(b) Random mutagenesis of genes
(c) Targeted gene knockouts
(d) Increasing the overall metabolic flux

2. Attempt all parts:-

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2.a.	What factors influence the permeability of a cell membrane? (CO1, K2)	2
2.b.	What do you understand by C13 MFA recursive function? (CO2, K2)	2
2.c.	What kind of tracers can be used in C13 MFA ? (CO3, K2)	2
2.d.	Write the full form for the abbreviation MOMA and ROOM. (CO4, K2)	2
2.e.	Why amino acid production is important ? (CO5, K2)	2

SECTION-B 30

3. Answer any five of the following:-

3-a.	Write short note on yield coefficients of biomass and product synthesis (CO1, K2)	6
3-b.	Explain the differences between cumulative and sequential feedback inhibition (CO1, K2)	6
3-c.	Discuss the steps involved in isotope labeling experiments for metabolic flux analysis. (CO2, K2)	6
3-d.	What are the limitations of isotopic steady state metabolic flux analysis and how can these be addressed? (CO2, K2)	6
3.e.	Discuss the strategy employed in building stoichiometric matrix from three series reactions. (CO3, K3)	6
3.f.	Explain in detail the three logical gates, describing their truth table and circuit diagram (CO4, K3)	6
3.g.	Assess the effectiveness of sequential bioconversion versus mixed bioconversion in biorefineries. (CO5, K4)	6

SECTION-C 50

4. Answer any one of the following:-

4-a.	Illustrate Jacob Monod model and its regulation for Lac operon model. (CO1, K3)	10
4-b.	Illustrate the permeability of cellular membranes and how it affects metabolite transport. (CO1 K3)	10

5. Answer any one of the following:-

5-a.	What do you understand by C13 MFA analysis? How does C13 MFA analysis help in quantifying metabolic fluxes in a cell using GC-MS? (CO2, K2, K3)	10
5-b.	Explain the concept of a stoichiometric matrix and its role in systems biology. Provide an example of how a stoichiometric matrix can be used to analyze metabolic networks. (CO2, K2, K3)	10

6. Answer any one of the following:-

6-a.	How will you design and analyze isotopically labelled experiments? (CO3, K3, K5)	10
6-b.	Explain why GC-MS is considered the gold standard in analytical methods, and discuss the significance of chemical derivatization in GC-MS analysis. (CO3, K3)	10

7. Answer any one of the following:-

7-a.	Explain in detail how integrated and dynamic flux balance analysis is performed. (CO4, K2)	10

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7-b.	Analyze how ROOM is different from MOMA? Elaborate the advantages and limitation sof both the algorithms (CO4, K3)	10

8. Answer any <u>one</u> of the following:-

8-a.	How can omics technologies (genomics, transcriptomics, proteomics, metabolomics) be used to analyze and apply strain selection and improvement? (CO5, K3, K4)	10
8-b.	Why Sacharomyces cerevisiae is considered promising candidate for ethanol production? Describe the pathway utilized in the microbe. (CO5, K3, K4)	10

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