Printed Page:- 04 **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 (2022-2023 **)**

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. Select the correct option that describe the working principle of a metabolic engineering study in a proper manner. (CO1) 1

(a) DBTL

(b) TDBL

(c) BDTL

(d) LBDT

1-b. Which technique is commonly used to develop black box models? (CO1) 1

(a) Artificial neural networks

(b) Linear regression

(c) Principal component analysis (PCA)

(d) Decision trees

1-c. A specialized type of metabolic flux analysis which utilizes linear thermodynamic constraints in addition to mass balance constraints to generate thermodynamically feasible fluxes and metabolite activity profiles is ____(CO2) 1

(a) Thermodynamic based MFA

(b) Linear programming based MFA

(c) Non-Linear programming based MFA

(d) None of the above

1-d. Which of the following is a requirement for C13 MFA? (CO2) 1

(a) Use of radioactive isotopes

(b) Use of C13-labeled substrates

(c) Use of enzymes to catalyze reactions

(d) Use of fluorescence detection

1-e. Which of the following detector in Gas Chromatography works based on the change in the thermal conductivity. (CO3) 1

(a) Flame Ionisation Detector

(b) Electron capture

(c) Atomic absorption detector

(d) Katharometer

1-f. An expression for the experimentally determined change in flux through a pathway in response to a regulatory hormone or second messenger. (CO3) 1

(a) Elasticity coefficient

(b) Response coefficient

(c) Drag control coefficient

(d) Metabolic control

1-g. These circuits use a bistable switch to control the expression of metabolic enzymes, allowing for the stable maintenance of two different metabolic states.(CO4) 1

(a) Toggle switches

(b) feedforward circuits

(c) feedback circuits

(d) boolean circuits

1-h. The abbreviation ROOM stands for.....(CO4) 1

(a) Regulation on/off minimization

(b) Revised on/off minimization

(c) Regulatory on/off maxmization

(d) Regulatory on/off minimization

1-i. Which of the following techniques is commonly used in pathway engineering? (CO5) 1

(a) CRISPR-Cas9 gene editing

(b) Polymerase chain reaction (PCR)

(c) Western blotting

(d) Gel electrophoresis

1-j. Which of the following is an example of a classical strain improvement technique? (CO5) 1

(a) Directed evolution

(b) CRISPR-Cas9 gene editing

(c) Recombinant DNA technology

(d) Serial passaging

2. Attempt all parts:-

2.a. State simple diffusion.(CO1) 2

2.b. Define differential regulation by isoenzymes. (CO2) 2

2.c. What is the difference between closed and open systems? (CO3) 2

2.d. Give the expression and circuit diagram for OR gate. (CO4) 2

2.e. Which are the substrates utilized by yeast, *Sacharomyces cerevisiae* for bioethanol production. (CO5) 2

SECTION B **30**

3. Answer any <u>five</u> of the following:-

3-a. State four basic types of reactions involved in our body. (CO1) 6

3-b. Describe active transport and the various carrier proteins involved in it. (CO1) 6

3-c. What is the role of mass spectrometry in C13 MFA analysis? (CO2) 6

3-d. What are the challenges associated with modeling C13 MFA analysis data? (CO2) 6

3.e. How will you build the stochiometric matrix when you have three metabolites corresponding to five fluxes? (CO3) 6

3.f. Write the commands utilized in MATLAB for drawing a helix. (CO4) 6

3.g. Exemplify mixed and sequential bioconversions. (CO5) 6

SECTION C **50**

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

4-a. Elaborate Jacob Monod model and its regulation for *Lac* operon model. (CO1) 10

4-b. *Candida utilis* cells convert glucose to CO_2 and H_2O during growth. The cell composition is CH 1.84 O 0.55 N 0.2 plus 5% ash. Yield of biomass from 10

substrate is 0.5 g $^{-1}$. Ammonia is used as nitrogen source. (a) What is the oxygen demand with growth compared to that without? (b) *C. utilis* is also able to grow with ethanol as substrate, producing cells of the same composition as above. On a mass basis, how does the maximum possible biomass yield from ethanol compare with the maximum possible yield from glucose? (CO1)

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

5-a.	How can a flux cone be used to analyze the feasibility of metabolic pathways? What are some common software tools used for FBA analysis? (CO2)	10
5-b.	What is a stoichiometric matrix? What are some applications of stoichiometric matrix analysis in metabolic engineering? (CO2)	10

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

6-a.	How the chemical derivatization of the sample in GC-MS is required? List the differences between purge and trap GC-MS and their respective importance in metabolic engineering. (CO3)	10
6-b.	Elucidate the method of metabolic flux measurement using metabolomics. (CO3)	10

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

7-a.	Describe in detail the boolean logical gates and how these can be combined with one another to change the output. (CO4)	10
7-b.	How MOMA can be employed in flux balance analysis? (CO4)	10

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

8-a.	Explain the concept of systems metabolic approach and the categories which includes them. (CO5)	10
8-b.	How can omics technologies be utilized to improve strain selection and improvement? (CO5)	10