110

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATIONS- 2026

M.Tech.-II Semester (Biotechnology)

COURSE CODE (CREDITS): 14M11BT215 (3) MAX MARKS: 35

COURSE NAME: Metabolic Engineering

COURSE INSTRUCTOR: Dr. Saurabh Bansal/Dr. Garlapati MAX. TIME: 2 Hours

Note: *(a) All questions are compulsory.*

(b) Do all the questions given in each section at the same place.

Q. No.	Question	Marks
	Section-A	
Q1	Illustrate and briefly explain the three steps for systematically investigating in vivo metabolic fluxes and their control?	5
Q2	Elaborate on the procedure utilised for metabolic flux analysis with ^{13}C-labelling experiments. Mention the different applications of ^{13}C-labelling in biological engineering?	5
Q3	What is the necessity for going to metabolic control analysis? Write about the flux control coefficients, elasticity coefficients, summation and connectivity theorems associated with the MCA?	5
	Section-B	
Q4 a)	What is meant by metabolic burden?	1
Q4 b)	What is catabolite repression?	1
Q4 c)	What is SILAC used for?	1
Q5	A metabolic engineer overexpressed a pathway enzyme, but product yield decreased significantly. Explain possible reasons.	3
Q6	Suggest strategies to reduce metabolic burden in engineered microbes.	2
Q7	Explain how transcriptomics and proteomics complement each other in systems biology.	3
Q8	A recombinant strain of *E. coli* has been engineered to produce butanol from glucose. Despite successful pathway insertion, the final butanol yield	4

	remains significantly lower than theoretical predictions. Metabolomic analysis shows accumulation of acetyl-CoA and NADH imbalance. **Hypothetical Pathway** Glucose → Pyruvate → Acetyl-CoA → Acetoacetyl-CoA → Butyryl-CoA → Butanol Identify the most probable metabolic bottleneck in the engineered pathway. Also, propose two genetic engineering strategies to improve carbon flux toward butanol.	
Q9	Explain transcriptional attenuation and riboswitches as RNA-based regulatory systems.	3
Q10	Explain the workflow of DNA microarray analysis.	2