SEMESTER S7

METABOLIC ENGINEERING

Course Code	**PEBBT746**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	Knowledge in biochemistry, and cell biology	**Course Type**	Theory

Course Objectives:

1. To provide fundamental knowledge on the upcoming field of Metabolomics and metabolic engineering in the post-genomic era.
2. To introduce the redesign of metabolism to enable cells to produce new products

SYLLABUS

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Module No.	Syllabus Description	Contact Hours
1	Introduction to Metabolic Engineering Introduction to metabolic engineering: Essence of Metabolic engineering, Basic concepts of metabolic engineering; Overview of Cellular metabolism, Cellular metabolism, Transport processes, Fueling reactions, Biosynthetic reactions, Polymerization, and Growth energetics.	9
2	Metabolic Flux Analysis Metabolic flux analysis, Methods for metabolic flux analysis, Application of metabolic flux analysis, Amino acid production by bacteria, Metabolic flux analysis for glutamic acid and lysine biosynthetic networks, Fluxes in mammalian cell cultures, Flux analysis and design of culture media.	9
3	Metabolic Control Analysis Metabolic control analysis (MCA), Control coefficient and elasticity, Summation and Connectivity theorems, Determination of Flux control coefficients, MCA of Linear Pathways and Branched Pathways,	9

4	Applications of Metabolic Engineering Introduction to Omics: Functional genomics, proteomics, metabolomics, systems biology; Application of metabolic engineering: Enhancement of product yield, Alteration of nitrogen metabolism, Production of antibiotics, vitamins, polyketides, etc., Bioconversions, Case studies from Research Articles	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

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End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • A total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub-divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course, students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Remember the fundamental concepts of metabolic engineering and its importance in manipulating cellular metabolism.	**K1**
CO2	Assess the metabolic pathways using metabolic flux analysis.	**K3**
CO3	Analyze the metabolic control using metabolic control analysis (MCA) and apply the MCA theorems.	**K4**
CO4	Evaluate the applications of metabolic engineering and omics technologies in biotechnology	**K5**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3										2
CO2	3	3										2
CO3	3	3										2
CO4	3	3										2

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Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Metabolic Engineering: Principles and Methodologies,	G. N. Stephanopoulos, A. A. Aristidou, and J. Nielson	Academic Press, 1998.	1998
2	Pathway Analysis and Optimization in Metabolic Engineering	N. V. Torres and E. O. Voit,	Reprint., Cambridge University Press, 2011	2011
3	Metabolic Engineering in the Post-Genomic Era	B. Kholodenko	New edition Edn., Taylor & Francis, 2004	2004

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	An Introduction to Metabolic and Cellular Engineering.	Cortassa, S.	Singapore: World Scientific. 2012	2012
2	Metabolic Engineering. Germany: Springer. 2010	Jens Nielsen	Germany: Springer. 2010	2010

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