

Branch Name:	M.Sc. Biotechnology / Microbiology
Program Code:	SC201 / SC202
Course Name:	Regulatory Control of Metabolic Pathways
Course Code:	3SC2000102
Pre-requisite Course:	

Course Objectives:

- To understand Concept of Metabolic Regulation.
- To understand Carbohydrates metabolism.
- To understand Nitrogen and Sulfur metabolism.
- To understand lipid and Nucleotides metabolism.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
4	--	--	4	50	50	--	--	100

Subject Contents:

Unit	Content	Lectures	Weightage
1	Metabolic Regulation • Major Modes of Gene Regulation • Negative & Positive control of transcription • Regulation of Enzyme activity: Reversible Non-covalent inhibition. (Allosteric) & Reversible Covalent Modification of Enzymes • Regulation of glycolysis and gluconeogenesis • Regulation of Citric acid cycle • Regulation of Bacterial Chemotaxis	15	25%
2	Carbohydrate Metabolism • Metabolism of sugars other than glucose • Fermentation Pathways. Lipid metabolism • Oxidation of Fatty Acids: α-, β- & ω- mode of Fatty Acid Oxidation and their energetics	15	25%
3	Amino acid Metabolism • Overview of amino acid biosynthesis, biosynthesis of six essential amino acid from oxaloacetate and pyruvate, synthesis of tryptophan, phenylalanine, and Tyrosine Nucleotide metabolism • Degradation of nucleotides. Quorum sensing: Mechanism & Examples	15	25%
4	Nitrogen and Sulfur metabolism • Nitrogen and Sulfur metabolism • Biological Nitrogen fixation: The Nitrogen Fixation process, Symbiotic Nitrogen Fixation, Inorganic Nitrogen Metabolism, Assimilation of Inorganic Nitrogen, Regulation of Nitrogen fixation	15	25%

	- General Reactions of Amino Acids: Amino Acid Decarboxylases, Amino Acid Deaminases, Amino Acid Transaminases (Aminotransferases), Amino Acid Racemases, Role of pyridoxal-5'-Phosphate in Enzymatic Reactions with Amino Acids, The Stickland Reaction. - Sulfur Metabolism: Sulfate assimilation, Sulfide formation and sulphide consumption by bacteria, Dissimilatory sulfate reduction, Microbial sulphur oxidation.		
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Textbooks:

- Microbial Physiology by Albert G. Moat and John W. Foster. Third edition, John Wiley and Sons; 2002
- Lehninger-Principles of Biochemistry by David L. Nelson and Michael M. Cox. Fifth Edition, W.H. Freeman and Company; 2008.
- Brooks Biology of Microorganisms, 8th Edition, (International Edition - 1997) by Michael T. Madigan, John M. Martinko and Jack Parker, Prentice Hall International Inc.

Reference Books:

- The Physiology and Biochemistry of Prokaryotes by David White. Second Edition, Oxford University Press; 2000.
- Biochemistry by Geoffrey L. Zubay. Fourth Edition, Addison-Wesley educational publishers Inc., 2008
- Microbial lipids edited by C. Ratledge and SG Wilkinson, second edition, Academic Press; 1988.
- Biochemical Calculations by Irwin Segel., John Wiley and Sons, California, USA, 2004.
- Guide to Protein Purification by M. P. Deutcher., Academic Press, San Diego, USA, 1993.

List of Open-Source Software/learning website:

- <https://nptel.ac.in/courses/104105076>
- <https://www.lecturio.com/medical-courses/metabolic-control.course#/>
- <https://microbiologyonline.ifas.ufl.edu/programs/courses/metabolic-regulation/>
- <https://www.coursera.org/learn/energy-metabolism>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Identify, describe, and interpret the fundamental mechanisms governing gene expression and regulation in microbial systems, including transcriptional control, quorum sensing, and chemotactic responses.	1 Remember 2 Understand
CLO2	Explain, utilize, and examine regulatory mechanisms of enzyme activity, including allosteric interactions and covalent modifications, in the control of central metabolic pathways.	2 Understand 3 Apply 4 Analyze
CLO3	Explain, apply, and critically analyze carbohydrate metabolic pathways, including alternative sugar utilization and fermentation processes, in relation to cellular energy requirements.	2 Understand 3 Apply 4 Analyze
CLO4	Apply, analyze, and assess lipid and protein metabolic processes, including fatty acid oxidation pathways and amino acid biosynthesis and degradation, with respect to metabolic efficiency and regulation.	3 Apply 4 Analyze 5 Evaluate
CLO5	Explain, analyze, and critically evaluate nitrogen and nucleotide metabolism, including biological nitrogen fixation and amino acid transformations, in the context of cellular and environmental significance.	2 Understand 4 Analyze 5 Evaluate
CLO6	Analyze, evaluate, and formulate integrated metabolic networks and control pathways and pathways involving sulfur metabolism and interrelated biochemical pathways, demonstrating systems-level understanding.	4 Analyse 5 Evaluate 6 Create

Mapping of CLO s with POs & PSOs

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2	PSO3
CLO1	3	1			1	1											1	1	2
CLO2		2			2	1												1	1
CLO3		2			2	1											1		1
CLO4		2			2	1												1	
CLO5	3	2			2	1								1			1	1	
CLO6	3	3			2	3								1			1	1	

3: High, 2: Medium, 1: Low