COURSE TITLE	**METABOLOMICS**
COURSE CODE	**01CB0503**
COURSE CREDITS	**3**

Objective:

1 To comprehensively analyze and quantify small molecules (metabolites) within biological systems.

Course Outcomes: After completion of this course, student will be able to:

1 Apply fundamental concepts of metabolomics, metabolites, and metabolic pathways in biological systems

2 Apply tools and databases to analyze and interpret metabolomics data.

3 Design metabolomics workflows to solve biological problems using appropriate tools and techniques.

4 Analyze metabolomics data to identify patterns and pathway relationships.

5 Evaluate the usefulness and limitations of metabolomics methods and tools.

Pre-requisite of course: Basic knowledge of Bioinformatics

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
2	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**INTRODUCTION** Introduction to metabolism, metabolic pathways, metabolite, metabolomics, Metabolic profiling and fingerprinting, Metabolic pathway analysis and metabolic networks	6
2	**APPROACHES** Methods/ approaches employed to study metabolism; Inter-relationship between genome, transcriptome, proteome and metabolome; Methods for measurement of metabolites level / concentration	7
3	**COMPUTATIONAL METHODS** Computational Methods to Interpret and Integrate Metabolomic Data, Metabolomics data processing workflow, Chemical ontologies, online metabolic databases (Human Metabolome Databases, KEGG, BioCyc), and pipelines	6

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Contents : Unit	Topics	Contact Hours
4	**APPLICATIONS** Applications of Metabolomics: Metabolic Pathway as a target for Drug-screening, Metabolomics approach for hazard identification in human health assessment of environmental chemicals, Clinical implications of Metabolomics. Plant metabolomics	9
Total Hours		**28**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Module 1 :** To identify the metabolite by navigating and retrieving specific metabolite information from Human Metabolome Databases, KEGG, BioCyc	2
2	**Module 1 :** To analyze metabolite data sets to identify metabolic pathways	2
3	**Module 1 :** To analyze simulated metabolomics data sets obtained from different experimental conditions (e.g., control vs. treatment	2
4	**Module 2 :** To identify metabolic signatures associated with the disease and interpret their biological significance using statistical analysis softwares	2
5	**Module 2 :** To identify and understand metabolic pathways such as glycolysis, TCA cycle, and fatty acid synthesis from software like BioCyc or KEGG	2
6	**Module 2 :** To analyze the concentration of metabolites in different samples and interpret the spectra to identify specific metabolites	2
7	**Module 2 :** To create a chemical ontology for a set of metabolites related to lipid metabolism, including categories such as fatty acids, triglycerides, and phospholipids Part1	2
8	**Module 3 :** To create a chemical ontology for a set of metabolites related to lipid metabolism, including categories such as fatty acids, triglycerides, and phospholipids Part2	2
9	**Module 3 :** To create a metabolic network using Cytoscape	2
10	**Module 3 :** Analyze the connectivity between metabolites and enzymes in a specific pathway like the pentose phosphate pathway. Part 1	2

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Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
11	**Module 4 :** Analyze the connectivity between metabolites and enzymes in a specific pathway like the pentose phosphate pathway. Part 2	2
12	**Module 4 :** To perform the differential analysis of Metabolites part 1	2
13	**Module 4 :** To perform the differential analysis of Metabolites part 2	2
14	**Module 4 :** To perform pathway enrichment analysis to identify metabolic pathways enriched with significant metabolites in a given data set	2
Total Hours		**28**

Textbook :

1 The handbook of Metabonomics and Metabolomics, Lindon, John C., Jeremy K. Nicholson, and Elaine Holmes, eds, Elsevier, 2011

References:

1 Metabolomics, , Metabolomics, , Ute Roessner, InTech, Published, 2010

2 Metabolomics - Fundamentals and Applications, Metabolomics - Fundamentals and Applications, Prasain, Jeevan K., InTech., 2016

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
20.00	30.00	20.00	10.00	10.00	10.00

Instructional Method:

1 The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

2 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.

3 Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

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Supplementary Resources:

1 https://nptel.ac.in/courses/102105086
2 https://www.classcentral.com/subject/metabolomics
3 https://www.ebi.ac.uk/training/online/courses/metabolomics-introduction/

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