

Subject Code: 02MB1453
Subject Name: Microbial Metabolism
M. Sc. Semester - II

Objective: To offer extensive information about central & peripheral metabolic pathways and developing the perception about bioenergetics and metabolic engineering.

Credits Earned: 6 Credits

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

- Identify and understand various biosynthesis & breakdown pathways of Biomolecules.
- Summarize various types of biochemical reactions and metabolic regulations.
- Illustrate and analyse bioenergetics associated with metabolism.
- Analyse various methods of metabolic engineering and metabolic overproduction for different industrial purposes.

Pre-requisite of course: Cell Biology and Fundamental Biochemistry.

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	IA (M)	CSE (I)	Viva (V)	Practical	
5	0	2	6	50	30	20	25	25	150

Contents:

Unit	Topics	Contact Hours
1	Carbohydrate Metabolism: Carbohydrate uptake; Phosphotransferase system, Glycolysis: ED pathway, EMP pathway, PPP Pathway; Gluconeogenesis; Fates of Pyruvate; Citric acid cycle: Branched TCA, Glyoxylate cycle; ETC & its components; Utilization of sugars other than glucose and complex polysaccharides; Regulation of Glycolysis & TCA, Bioenergetics of Carbohydrate metabolism. Comparison of Carbohydrate metabolism in different organisms.	15
2	Amino acid & Protein Metabolism: Proteases, Breakdown of proteins, peptides & Amino Acids; Nitrogen fixation, Ammonia & Sulphur assimilation, GS-GOGAT reaction; Amino acid reactions: Oxidation, Transamination, Deamination, Decarboxylation; Amino acid biosynthesis; Stickland reaction; The Urea Cycle.	15
3	Fatty Acid & Lipid Metabolism: Classification & Applications of Lipases, Breakdown of Fatty acid by β -oxidation (Saturated & Unsaturated); Biosynthesis of Fatty Acids, Phospholipids & Isoprenoids; Regulation of Fatty Acid Metabolism.	15
4	Metabolic Regulation: Overview of cellular Bioenergetics; Regulation of metabolism: Regulation of protein synthesis; Regulation of enzyme activity; Metabolite Over Production & Metabolic engineering.	15
Total Hours		60

References:

8. **Fundamentals of Biochemistry**, (2016) 5th Edition, Donald Voet, Judith G. Voet, W. Pratt; Wiley publishers.
9. **The Physiology and Biochemistry of Prokaryotes** (2012) 4th Edition by David White, James Drummond & Clay Fuqua. Oxford University Press.
10. **Bacterial Physiology and Metabolism** (2008) by Byung Hong Kim & Geoffrey Michael Gadd, Cambridge University Press.
11. **Microbial Physiology**, (2002) 3rd edition by Albert G. Moat and John W. Foster., John Wiley and Sons.
12. **Physical biochemistry: Principles and applications** (2009), 2nd Edition, by David Sheeham; John Wiley and Sons.
13. **Physical biochemistry: Applications to Biochemistry & Molecular Biology**, (1982), by David Freifelder; W. H. Freeman.
14. **Lehninger's Principles of Biochemistry**, 6th edition, (2013) by David L. Nelson and Michael M. Cox; W. H. Freeman.

Suggested Theory distribution:

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

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create
20%	25%	25%	15%	10%	5%

Instructional Method:

- j. 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, etc.
- k. The internal evaluation will be done on the basis of continuous evaluation of students in the class-room in the form of attendance, assignments, verbal interactions etc.
- l. Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory.

List of Experiments
Sr. No. Experiments

1. Effect of Carbon source on growth of *E. coli*. (Mono, Di, Polysaccharides; Non carbohydrate sources)
2. Effect of Nitrogen source on growth of *E. coli*. (Organic Nitrogen (Amino acids, peptides & proteins) Inorganic Nitrogen Sources)
3. Growth of *E. coli* on Lipid sources
4. Comparison of growth and metabolism of *E. coli*, *Pseudomonas* sp. and *Bacillus* sp.
5. Isolation & Characterization of Nitrogen Fixers; Nitrate Reducers; Ammonia oxidizers, Ureolytic Organisms.
6. Cultivation of Facultative and Obligate Anaerobic microorganisms.
7. Amino Acid Producing organisms (*Corynebacterium glutamicum*)