



TECHNO INDIA UNIVERSITY
WESTBENGAL

Proposed Syllabus for 4-year B.Sc (Honours with or without research) (NEP)

2023

MICROBIOLOGY



Department of Microbiology

**Techno India University, West Bengal
EM-4, EM Block, Sector V, Bidhannagar,
Kolkata, West Bengal 700091**



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Credit Requirements for obtained different degree		
Degree	Year	Total Credit
Certificate in Microbiology	1	38
Diploma in Microbiology	2	80
B.Sc (Three Years) in Microbiology	3	120
B.Sc (Hons.) in Microbiology (with research)	4	160
B.Sc (Hons.) in Microbiology (without research)	4	160

B.Sc Microbiology
Course Curriculum for All Semesters

Semester III

Sl. No.	Course Code	Course Title	Contact Hrs. / Week			Credit	Page No.
			L	T	P		
Theory							
1.		Major: Biomolecules and Bioenergetics	2	1		3	
2.		Major: Microbial Physiology and Metabolism	2	1		3	
3.		Minor:	2	1	0	3	
4.		MDC:	2	1		3	
5.		AEC:	2			2	
6.		SEC: Microbial quality control in food & pharmaceutical industries	2	1		3	
Practical							
7.		Major: Biomolecules and Bioenergetics			1	1	
8.		Major: Microbial Physiology and Metabolism			1	1	
9.		Minor:			1	1	
Total Credit						20	



Semester III

Core Subject I:

Course Name : Biomolecules and Bioenergetics

Course Code:

Course Details:

Unit 1: Bioenergetics

First and second laws of Thermodynamics. Definitions of Gibb's Free Energy, enthalpy, and Entropy and mathematical relationship among them, Standard free energy change and equilibrium constant Coupled reactions and additive nature of standard free energy change, Energy rich compounds: Phosphoenolpyruvate, 1,3- Bisphosphoglycerate, Thioesters, ATP

Unit 2: Carbohydrates

Families of monosaccharides: aldoses and ketoses, trioses, tetroses, pentoses, and hexoses. Stereo isomerism of monosaccharides, epimers, Mutarotation and anomers of glucose. Furanose and pyranose forms of glucose and fructose, Haworth projection formulae for glucose; chair and boat forms of glucose, Sugar derivatives, glucosamine, galactosamine, muramic acid, N- acetyl neuraminic acid, Disaccharides; concept of reducing and non-reducing sugars, occurrence and Haworth projections of maltose, lactose, and sucrose, Polysaccharides, storage polysaccharides, starch and glycogen. Structural Polysaccharides, cellulose, peptidoglycan and chitin

Unit 3: Lipids

Definition and major classes of storage and structural lipids. Storage lipids. Fatty acids structure and functions. Essential fatty acids. Triacyl glycerols structure, functions and properties, Saponification Structural lipids. Phosphoglycerides: Building blocks, General structure, functions and properties. Structure of phosphatidylethanolamine and phosphatidylcholine, Sphingolipids: building blocks, structure of sphingosine, ceramide. Special mention of sphingomyelins, cerebroside and gangliosides Lipid functions: cell signals, cofactors, prostaglandins, Introduction of lipid micelles, monolayers, bilayers

Unit 4: Amino acids & Proteins



Functions of proteins, Primary structures of proteins: Amino acids, the building blocks of proteins. General formula of amino acid and concept of zwitterion. Titration curve of amino acid and its Significance, Classification, biochemical structure and notation of standard protein amino acids Ninhydrin reaction. Natural modifications of amino acids in proteins hydrolysine, cystine and hydroxyproline, Non protein amino acids: Gramicidin, beta-alanine, D-alanine and Dglutamic acid Oligopeptides: Structure and functions of naturally occurring glutathione and insulin and synthetic aspartame, Secondary structure of proteins: Peptide unit and its salient features. Biologically important peptides like glutathione, oxytocin-important functions. The alpha helix, the beta pleated sheet and their occurrence in proteins, Tertiary and quaternary, structures of proteins, Forces holding the polypeptide together, Human haemoglobin structure, Quaternary structures of proteins

Unit 5: Enzymes

General properties, Nomenclature and classification Structure of enzyme: Apoenzyme and cofactors (prosthetic group-TPP, coenzyme NAD, metal cofactors) Mechanism of action of enzymes: active site, transition state complex and activation energy. Lock and key hypothesis, and Induced Fit hypothesis.

Unit 6: Nucleic Acids

Miescher to Watson and Crick- historic perspective Purine, pyrimidine - definition and structure. Nucleoside, nucleotide: definition and structure. DNA & RNA: Chargaff's rule, Double helical structure. A-DNA, B-DNA & Z-DNA (structure and differences). Chemical Properties of DNA & RNA: Hydrolysis (acid, alkali), enzymatic hydrolysis

Unit 7: Vitamins

Classification and characteristics with suitable examples, sources and importance

SUGGESTED READING

1. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning
2. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone
3. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman
4. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company
5. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company,
6. Willey MJ, Sherwood, LM & Woolverton C J (2013) Prescott, Harley and Klein's Microbiology by. 9th Ed., McGrawHill
7. Voet,D. and Voet J.G (2004) Biochemistry 3rd edition, John Wiley and Sons

Course Name : Biomolecules and Bioenergetics(Practical)

Course Code:

Course Details:



1. Properties of water, Concept of pH and buffers, preparation of buffers and Numerical problems to explain the concepts
2. Numerical problems on calculations of Standard Free Energy Change and Equilibrium constant
4. Qualitative/Quantitative tests for carbohydrates, reducing sugars, non reducing sugars
5. Qualitative/Quantitative tests for lipids and proteins
6. Study of protein secondary and tertiary structures with the help of models
7. Study of different types of DNA with the help of models

Course Name :Microbial Physiology and Metabolism

Course Code:

Course Details:

Unit 1 Microbial Growth and Effect of Environment on Microbial Growth

Definitions of growth, measurement of microbial growth, Batch culture, Continuous culture, generation time and specific growth rate, synchronous growth, diauxic growth curve Microbial growth in response to environment -Temperature (psychrophiles, mesophiles, thermophiles, extremophiles, thermodurics, psychrotrophs), pH (acidophiles, alkaliphiles), solute and water activity (halophiles, xerophiles, osmophilic), Oxygen (aerobic, anaerobic, microaerophilic, facultative aerobe, facultative anaerobe), barophilic. Microbial growth in response to nutrition and energy – Autotroph/Phototroph, heterotrophy, Chemolithoautotroph, Chemolithoheterotroph, Chemoheterotroph, Chemolithotroph, photolithoautotroph, Photoorganoheterotroph, Peptidoglycan biosynthesis pathway

Unit 2 Nutrient uptake and Transport

Passive and facilitated diffusion Primary and secondary active transport, concept of uniport, symport and antiport Group translocation Iron uptake

Unit 3 Chemoheterotrophic Metabolism - Aerobic Respiration

Concept of aerobic respiration, anaerobic respiration and fermentation Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway TCA cycle Electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterial ETC, electron transport phosphorylation, uncouplers and inhibitors

Unit 4 Chemoheterotrophic Metabolism- Anaerobic respiration and fermentation

Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate /nitrite and nitrate/ammonia respiration; fermentative nitrate reduction) Fermentation - Alcohol fermentation and Pasteur effect; Lactate fermentation (homofermentative and heterofermentative pathways), concept of linear and branched fermentation pathways



Unit 5 Chemolithotrophic and Phototrophic Metabolism

Introduction to aerobic and anaerobic chemolithotrophy with an example each. Hydrogen oxidation (definition and reaction) and methanogenesis (definition and reaction) Introduction to phototrophic metabolism - groups of phototrophic microorganisms, anoxygenic vs. oxygenic photosynthesis with reference to photosynthesis in green bacteria, purple bacteria and cyanobacteria

Unit 6 Nitrogen Metabolism - an overview

Introduction to biological nitrogen fixation, nitrogenase-mode of action and regulation, ammonia assimilation, assimilatory nitrate reduction, dissimilatory nitrate reduction, denitrification.

SUGGESTED READING

1. Madigan MT, and Martinko JM (2014). Brock Biology of Microorganisms. 14th edition. Prentice Hall International Inc.
2. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons
3. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India
4. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag
5. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press.
6. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education

Course Name : Microbial Physiology and Metabolism (Practical)

Course Code:

Course Details:

1. Study and plot the growth curve of E. coli by turbidometric and standard plate count methods.
2. Calculations of generation time and specific growth rate of bacteria from the graph plotted with the given data
3. Effect of temperature on growth of E. coli
4. Effect of carbon and nitrogen sources on growth of E. coli
5. Effect of salt on growth of E. coli
6. Enrichment of phototrophic bacteria from natural sources

Skill Enhancement

Course Name : Microbial quality control in food & pharmaceutical industries (Theory)

Course Code:

Course Details:



Unit 1 Microbiological Laboratory and Safe Practices

Good laboratory practices - Good laboratory practices, Good microbiological practices Biosafety cabinets –Working of biosafety cabinets, using protective clothing, specification for BSL-1, BSL-2, BSL-3. Discarding biohazardous waste – Methodology of Disinfection, Autoclaving & Incineration.

Unit 2 Determining Microbes in Food / Pharmaceutical Samples

Culture and microscopic methods - Standard plate count, Most probable numbers, Direct microscopic counts, Biochemical and immunological methods: Limulus lysate test for endotoxin, gel diffusion, sterility testing for pharmaceutical products Molecular methods - Nucleic acid probes, PCR based detection, biosensors.

Unit 3 Pathogenic Microorganisms of Importance in Food & Water

Enrichment culture technique, Detection of specific microorganisms - on XLD agar, Salmonella Shigella Agar, Manitol salt agar, EMB agar, McConkey Agar, Saboraud Agar Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centres (COB, 10 min Resazurin assay)

Unit 4 HACCP for Food Safety and Microbial Standards

Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitations Microbial Standards for Different Foods and Water – BIS standards for common foods and drinking water

SUGGESTED READING

1. Harrigan WF (1998) Laboratory Methods in Food Microbiology, 3rd ed. Academic Press
2. Garg N, Garg KL and Mukerji KG (2010) Laboratory Manual of Food Microbiology I K International Publishing House Pvt. Ltd.
3. Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer
4. Baird RM, Hodges NA and Denyer SP (2005) Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices, Taylor and Francis Inc.

Course Name : Microbial quality control in food & pharmaceutical industries (Practical)

Course Code:

Course Details:

Evaluation will be done internally on assignment and powerpoint presentation.