ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

Syllabus for 4-Year UG Honours in B.Sc. (Microbiology) as Major in consonance with Curriculum framework w.e.f. AY 2025-26

Prepared by Acharya Nagarjuna University, Guntur

COURSE STRUCTURE (for Semester I to II)

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
I	I	1	Introduction to Microbiology and Microbial Diversity	3	3
			Introduction to Microbiology and Microbial Diversity-Practical	2	1
		2	Principles of Bacteriology and Microbial Techniques	3	3
			Principles of Bacteriology and Microbial Techniques-Practical	2	1
	II	3	Fundamentals of Biochemistry and Analytical techniques	3	3
			Fundamentals of Biochemistry and Analytical techniques-Practical	2	1
		4	Microbial Physiology	3	3
			Microbial Physiology-Practical	2	1
II	III	5	Cell biology and Genetics	3	3
			Cell biology and Genetics-Practical	2	1
		6	Molecular biology and bacterial Genetics	3	3
			Molecular biology and bacterial Genetics-Practical	2	1
		7	r DNA Technology, Bioinformatics and Biostatistics	3	3
			r DNA Technology, Bioinformatics and Biostatistics-Practical	2	1
	IV	8	Basics of Immunology	3	3
			Basics of Immunology-Practical	2	1
		9	Medical Microbiology	3	3
			Medical Microbiology-Practical	2	1
		10	Agricultural Microbiology	3	3
			Agricultural Microbiology-Practical	2	1
III	V	11	Food Microbiology	3	3
			Food Microbiology-Practical	2	1

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
		12 A	Industrial Microbiology	3	3
			Industrial Microbiology-Practical	2	1
		OR			
		12 B	Fermentation Technology	3	3
			Fermentation Technology-Practical	2	1
		13 A	Environmental microbiology	3	3
			Environmental microbiology-Practical	2	1
		OR			
		13 B	Mushroom Cultivation	3	3
			Mushroom Cultivation-Practical	2	1
	VI	14 A	Clinical microbiology	3	3
			Clinical microbiology-Practical	2	1
		OR			
		14 B	Veterinary microbiology	3	3
			Veterinary microbiology-Practical	2	1
		15 A	QA & QC in Food and Pharmaceutical Industry	3	3
			QA & QC in Food and Pharmaceutical Industry-Practical	2	1
		OR			
		15 B	Microbial Biotechnology	3	3
			Microbial Biotechnology-Practical	2	1
IV	VII	16	Microbial Biochemistry and Analytical Techniques	3	3
			Microbial Biochemistry and Analytical Techniques-Practical	2	1
		17	Virology	3	3
			Virology-Practical	2	1
		18	Biology of Eukaryotic Microorganisms	3	3
			Biology of Eukaryotic Microorganisms-Practical	2	1
		19 A	Marine Microbiology	3	3
			Marine Microbiology-Practical	2	1
		OR			
		19 B	Organic Farming	3	3
			Organic Farming-Practical	2	1
	VIII	20	Microbial Metabolism	3	3
			Microbial Metabolism-Practical	2	1
		21	Molecular genetics of microorganisms	3	3
			Molecular genetics of microorganisms-Practical	2	1

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
		22	Immunology	3	3
			Immunology-Practical	2	1
		23 A	Biofertilization Technology	3	3
			Biofertilization Technology-Practical	2	1
		OR			
		23 B	Cellular microbiology	3	3
			Cellular microbiology-Practical	2	1

Note: In the III Year (during the V and VI Semesters), students are required to select a pair of electives from one of the Two specified domains. For example: if set 'A' is chosen, courses 12 to 15 to be chosen as 12 A, 13 A, 14 A and 15 A. To ensure in-depth understanding and skill development in the chosen domain, students must continue with the same domain electives in both the V and VI Semesters.

SEMESTER-I

COURSE 1: INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY

Theory **Credits: 3** **3 hrs/week**

I. Course Objectives:

1. To understand the historical development of microbiology, major contributions of key scientists, microbial classification systems, and the scope of microbiology.
2. To learn the general characteristics of bacteria, Archaea, Actinomycetes, and Viruses including the replication of Bacteriophage T2 and HIV.
3. To comprehend the general characteristics of microalgae, focusing on key genera like *Chlorella*, *Dunaliella*, and *Spirulina*.
4. To gain knowledge on general characteristics of fungi, with special emphasis on *Saccharomyces* and *Aspergillus.*
5. To understand the general characters and importance of protozoa, with focus on representative genera like *Amoeba* and slime molds.

II. Course Outcomes: On completion of this course students will be able to

1. Explain the important historical milestones, describe classification systems, differentiate prokaryotic and eukaryotic microorganisms, and list applications of microbiology.
2. Explain the general characters and significance of prokaryotic microorganisms and viruses, and describe the replication mechanisms of Bacteriophage T2 and HIV.
3. Describe the general characters and applications of microalgae and explain their economic importance.
4. Describe morphology of fungi, reproductive mechanisms and explain the economic importance of fungi.
5. Explain the general characters of protozoa and their significance in ecosystems, medicine, and scientific research.

III. Syllabus of Theory:

Unit 1: History and classification of Microbiology

10hrs

1.1 Development of microbiology as a discipline, Spontaneous generation vs. biogenesis, Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Alexander Fleming, Ivanowsky.

1.2 Systems of classification: Binomial Nomenclature; Whittaker's five kingdom Classification; Carl Woese's three kingdom classification systems, Concept of Species, Taxa, and Strain;

1.3 Brief note on Bergey's Manual of Systematic Bacteriology; Difference between prokaryotic and eukaryotic microorganisms; Definition and scope of Microbiology: Applications of Microbiology.

Unit 2: Prokaryotic microorganisms and Viruses

10hrs

2.1 General characteristics of bacteria and archaea: distribution, occurrence, morphology, reproduction and economic importance.
2.2 General characteristics of Viruses with emphasis on discovery of viruses, Nature and definition of viruses, morphology, reproduction and a brief note on Cultivation of Viruses
2.3. General features of Viral Replication; Structure and multiplication of Bacteriophage T2 and HIV

Unit 3: Microalgae

8hrs

3.1 General characteristics of algae: occurrence, morphology, habitat, ecological distribution, photosynthetic pigments, food reserves, reproduction and role in aquatic ecosystems
3.2 Morphology, reproduction, ecological significance and applications of a) **Chlorella** (Chlorophyceae) and b) **Spirulina** (Cyanophyceae).
3.3 Economic Importance of Microalgae: Biofertilizers, Biofuels, Pharmaceuticals, Food supplements, Wastewater treatment, Carbon dioxide sequestration, algal polysaccharides.

Unit 4: Fungi

9hrs

4.1 Habitat, distribution, nutritional requirements, fungal cell ultra- structure, fungal wall, Outline classification of Fungi
4.2 Important Microfungi: Morphology and structure, reproduction and applications of a) Saccharomyces (Ascomycota – Yeast) and b) Aspergillus (Ascomycota)
4.3 Economic importance of fungi: in agriculture, food, industry, medicine.

Unit 5: Protozoa

8 hrs

5.1 General Characteristics of Protozoa: Morphology, Nutrition, reproduction, Habitat and ecological role
5.2 Important Protozoa: Morphology, locomotion, nutrition, reproduction, Ecological role of a)Amoeba and b) Slime Molds
5.3 Economic Importance of Protozoa (in ecosystems, waste management, soil fertility, research and Protozoa as pathogens).

IV. Reference Books:

1. Alexopoulos, C. J., Mims, C. W., & Blackwell, M. (1996). *Introductory Mycology*. John Wiley, New York.
2. Ali-Shtayeh, M. S., Jamous, R. M., & Yaghmour, R. M.-R. (1998). *Mycology manual*. An-Najah National University.
3. Becker, E. W. (2007). *Microalgae in Biotechnology*. Cambridge University Press.
4. Bessey, E. A. *Morphology and Taxonomy of Fungi*. Vikas Publishing House Pvt. Ltd., New Delhi.
5. Bold, H. C., & Wynne, M. J. (1985). *Introduction to the Algae: Structure and Reproduction* (2nd ed.). Prentice-Hall.
6. Deacon, J. W. (2006). *Fungal Biology* (4th ed.). Blackwell Publishing.
7. Funder, H. F. (1968). *Practical mycology: Manual for identification of fungi*. McGraw- Hill.
8. Garrity, G. M. (Ed.). (2011). *Bergey's Manual of Systematic Bacteriology* (2nd ed.). Springer.
9. Hausmann, K., & Bradbury, P. C. (2002). *Protistology* (2nd ed.). E. Schweizerbart'sche Verlagsbuchhandlung.
10. Jain, A., Agarwal, J., & Venkatesh, V. (2019). *Microbiology practical manual* (1st ed.). Elsevier India.
11. Kumar, H. D., & Singh, H. N. *A Textbook on Algae* (Macmillan International College Edition).
12. Lee, R. E. (2008). *Phycology* (4th ed.). Cambridge University Press.
13. Madigan, M. T., Martinko, J. M., Bender, K., Buckley, D., & Stahl, D. (2021). *Brock Biology of Microorganisms* (16th ed.). Pearson Education.
14. Maheshwari, D. K. (2002). *Practical microbiology*. S. Chand Publishing.
15. Mehrotra, R. S., & Aneja, K. R. *An Introduction to Mycology*. New Age International Press, New Delhi.
16. Pelczar, M. J., Chan, E. C. S., & Krieg, N. R. (2009). *Microbiology: Concepts and Applications* (6th ed.). McGraw-Hill Education.
17. Prescott, L. M., Harley, J. P., & Klein, D. A. (2005). *Microbiology* (6th ed.). McGraw- Hill Education.
18. Sambamurty, V. S. S. (2010). *A Textbook of Algae*. I.K. International Publishing House Pvt. Ltd.
19. Tortora, G. J., Funke, B. R., & Case, C. L. (2020). *Microbiology: An Introduction* (13th ed.). Pearson Education.
20. Webster, J., & Weber, R. (2007). *Introduction to Fungi* (3rd ed.). Cambridge University Press.

VI. Co- Curricular Activities

1. Arrange guest lectures, to provide insights into the latest advancements and emerging trends in bacteriology and virology.
2. Conduct hands-on microscopy workshops using to observe eukaryotic microorganisms
3. Organize field trips to natural habitats, such as forests, ponds, or marine environments, where eukaryotic microorganisms thrive.
4. Arrange culturing workshops where students can learn how to isolate and culture eukaryotic microorganisms in the laboratory.

SEMESTER-I

COURSE 1: INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY

Practical **Credits: 1** **2 hrs/week**

I. Course objectives:

1. To learn preparation of culture media and techniques for isolation, identification, and preservation of fungi and algae.
2. To observe vegetative and reproductive structures of key fungal genera through slide preparations.
3. To study host-pathogen interaction and slime mold structures.

II. Laboratory/Field exercises:

1. Study of viruses (Bacteriophage, TMV and HIV) using micrographs
2. Preparation of Potato Dextrose Medium.
3. Isolation and identification of pathogenic and non-pathogenic fungi.
4. Study of host-pathogen interaction.
5. Study of the vegetative and reproductive structures of following genera through temporary and permanent slides: *Mucor, Saccharomyces, Penicillium, Agaricus* and *Alternaria*
6. Purification and preservation of pure cultures of common algae and fungi.
7. Observe prepared slides of slime mold structures.

SEMESTER-I

COURSE 2: PRINCIPLES OF BACTERIOLOGY & MICROBIAL TECHNIQUES

Theory **Credits: 3** **3 hrs/week**

I. Course objectives:

1. To understand the structure and function of prokaryotic cell components and their response to antibiotics.
2. To learn the key characteristics and ecological significance of Photosynthetic bacteria, Gliding bacteria, Mycoplasma, Fermentative bacteria, and Extremophiles.
3. To equip students with an understanding of microscopy principles, techniques, and staining methods used in microbiology.
4. To gain the knowledge of sterilization, disinfection, and various physical and chemical methods for microbial control.
5. To impart practical knowledge of pure culture techniques, maintenance, preservation methods in microbiology.

II. Course Outcomes: On completion of this course students will be able to:

1. Describe bacterial cell structure and explain effects of antibiotics on the cell wall.
2. Identify and describe the important features of Photosynthetic bacteria, Myxobacteria, Mycoplasma, Fermentative bacteria, Methanogens, and Halobacteria.
3. Gain insights into various microscopy techniques and apply simple and differential staining in bacterial observation.
4. Comprehend the principles, methods, and applications of sterilization and disinfection.
5. Comprehend methods for isolating and preserving pure cultures, and techniques for cultivating anaerobic and viable non-culturable bacteria.

III. Syllabus of Theory:

Unit 1 Cell organization **9 hrs**

1.1 Cell size, shape and arrangement, glycocalyx, capsule, flagella, fimbriae and pili. Cell wall: Composition and detailed structure of Gram-positive and Gram-negative cell walls.

1.2 Cell Membrane: Structure, function and chemical composition of bacterial cell membranes; Differences between eubacteria and archaebacteria;

1.3 Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome and plasmids, Endospore; Effect of antibiotics and enzymes on the cell wall: sphaeroplasts, protoplasts, and L-forms.

Unit 2 Type studies of Bacteria and Archaea **9 hrs**

2.1 Salient features of: a) Photosynthetic bacteria - Purple bacteria, Green bacteria and Anabaena b) Gliding bacteria - Myxobacteria

2.2 Salient features of a) Miscellaneous bacteria: Mycoplasma; b) Salient features of Fermentative bacteria

2.3 Salient features of Extremophiles- a) Methanogens and Halobacteria.

Unit 3 Basics of Microscopy

9hrs

3.1 Light Microscopy: Bright-Field Microscope- Principle, Components, Operation, resolution and Applications; Principle of Dark-field, Phase contrast and fluorescent microscopes.

3.2 Electron microscope: Principle, Components, resolution and Applications of Scanning and Transmission Electron Microscopes.

3.3 Staining Techniques – Types and properties of dyes; Simple and negative staining; Differential staining techniques- Gram staining, spore staining,

Unit 4 **Sterilization and disinfection techniques** **9hrs**

4.1 Definitions of Sterilization, Disinfection, Antiseptic, Germicide, Sanitizer, Fungicide, Virucide, Bacteriostatic and Bactericidal agent.

4.2 Physical methods of microbial control: Dry heat-Incineration, Hot air oven; Moist heat- Pressure cooker, autoclave; Filter sterilization- laminar air flow, Membrane filter; Radiation methods – UV rays, Gamma rays.

4.3 Chemical methods of microbial control: disinfectants, types and mode of action- alcohols, aldehydes, fumigants, phenols, halogens and heavy metals.

Unit 5 **Microbiological techniques** **9hrs**

5.1 Pure culture isolation: Serial dilution, enrichment culturing technique, plating methods, micromanipulator;

5.2 Maintenance and preservation/stocking of pure cultures: sub culturing, overlaying cultures with mineral oils, lyophilization, sand cultures, storage at low temperature, Culture collection Centers (MTCC, ATCC, DSMZ).

5.3 Cultivation of anaerobic bacteria; Accessing Viable non-culturable bacteria (VNBC).

IV. Reference Books:

1. Alcomo, I. E. (2001). *Fundamentals of Microbiology* (6th ed.). Jones and Bartlett Publishers.

2. Beckner, W. M., Kleinsmith, L. J., & Hardin, J. (2000). *The World of Cell* (4th ed.). Benjamin/Cummings.
3. Besty, T., & Koegh, D. C. *Microbiology Demystified*. McGraw-Hill.
4. Black, J. G. (2002). *Microbiology – Principles and Explorations*. John Wiley & Sons Inc., New York.
5. Ghatak, K. L. (2011). *Techniques and Methods in Biology*. PHI Publication.
6. Murphy, D. B. (2001). *Fundamentals of Light Microscopy & Electron Imaging* (1st ed.). Wiley-Liss.
7. Pelczar, M., Chan, E. C. S., & Krieg, N. R. *Microbiology*. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
8. Pranav Kumar. (2016). *Fundamentals and Techniques of Biophysics and Molecular Biology*.
9. Prescott, L. M., Harley, J. P., & Klein, D. A. (2002). *Microbiology* (5th ed.). WCB McGraw-Hill, New York.
10. Stainier, R. V., Ingraham, J. L., Wheelis, M. L., & Painter, P. R. *The Microbial World*. Prentice-Hall of India Pvt. Ltd., New Delhi.
11. Tortora, G. J., Funke, B. R., & Case, C. L. (2004). *Microbiology: An Introduction*. Pearson Education, Singapore.

VI. Co-Curricular Activities:

1. Conduct laboratory workshops that allow students to gain hands-on experience in bacterial culture techniques
2. Competition in performing laboratory techniques like staining
3. Artwork with bacteria or fungi in petridish
4. Quiz in identifying microscopic technique in various micrographs

SEMESTER-I

COURSE 2: PRINCIPLES OF BACTERIOLOGY & MICROBIAL TECHNIQUES

Practical **Credits: 1** **2 hrs/week**

I. Course objectives:

1. To gain practical skills in bacterial isolation, pure culture techniques, and visualization using different microscopy methods.
2. To comprehend and perform basic staining techniques, including Gram, simple, and negative staining, and observe bacterial structures such as motility and capsules.
3. To learn sterilization methods for media and glassware and apply aseptic techniques in microbiological experiments.

II. Laboratory/Field exercises:

1. Isolation of bacteria using Winogradsky column and observation
2. Study of bright field, dark field and phase contrast, Electron microscope micrographs to visualize
3. microbial cells.
4. Simple staining & Negative staining.
5. Gram's staining.
6. Observation of motility and capsule in bacteria
7. Determination of bacterial cell size by the technique Micrometry.
8. Sterilization of medium using Autoclave, Sterilization of glassware using Hot Air Oven.
9. Isolation of pure cultures of bacteria by streaking method.
10. Isolation of bacteria from natural habitat by spread and pour plate method (using serial dilution method)

SEMESTER-II

COURSE 3: FUNDAMENTALS OF BIOCHEMISTRY AND ANALYTICAL TECHNIQUES

Theory **Credits: 3** **3 hrs/week**

I. Course Objectives:

1. To comprehend the classification, structure, and properties of carbohydrates, including mono-, di-, and polysaccharides.
2. To gain knowledge about the structure, classification, and biological significance of lipids and fatty acids.
3. To understand the structure, classification, and functional roles of amino acids and proteins.
4. To understand the structure, function of nucleic acids, and to understand the role of vitamins in metabolism.
5. To understand the principles, instrumentation, and applications of key analytical techniques in biochemistry.

II. Course Outcomes: On completion of this course students will be able to:

1. Describe the structure, stereochemistry, and functional significance of different carbohydrates.
2. Understand the structure, types, and functions of lipids, fatty acids, triglycerides, phospholipids, steroids, and waxes.
3. Explain amino acid types, protein structures, and the impact of denaturation on protein function.
4. Describe DNA and RNA structures, base composition, stabilizing forces, and explain the types and metabolic significance of vitamins.
5. Apply spectroscopy, chromatography, centrifugation, and electrophoresis methods to analyze biomolecules

III. Syllabus of Theory:

UNIT-1: Carbohydrates **Hrs: 9**

1.1 General characters and outline classification of Carbohydrates.
1.2 Monosaccharides- Glucose, fructose, ribose; Stereo- isomerism of monosaccharides, epimers, mutarotation and anomers of glucose;
1.3 Disaccharides- concept of reducing and non-reducing sugars; Sucrose, Lactose, Maltose
1.4 Polysaccharides: Storage- Starch, glycogen; Structural- Cellulose, peptidoglycan and chitin

UNIT-2: Lipids and fatty acids **hrs: 9**

2.1 Definition and classification of lipids. Structure and properties of lipids. Importance of Lipids in biological systems.

2.2 Introduction to fatty acids: definition, structure, and nomenclature. Saturated and unsaturated fatty acids.

2.3 Triglycerides: structure and function

2.4 Phospholipids: structure, function, and role in cell membranes. Steroids: structure and physiological roles. Waxes: structure, functions, and applications.

UNIT-3: Amino acids and Proteins. **Hrs 9**

3.1 Aminoacids –classification, structure and function.

3.2 General characteristics of amino acids and proteins. Denaturation of proteins.

3.3 Primary, secondary, tertiary and quaternary structures of Protein

UNIT-4: Nucleic acids and Vitamins **Hrs 9**

4.1 Structure and functions of DNA and RNA. Types of DNA and RNA.

4.2 Base composition. A+T and G+C rich genomes. Basic concept of nucleic acids protein interactions. Chargaff's rule. Forces stabilizing nucleic acid structures, (hydrogen bonds and hydrophobic associations, base stacking).

4.3 Concept and types of vitamins and their role in metabolism.

Unit 5 Analytical Techniques **Hrs 9**

5.1 Spectroscopy – Principle, Beer-Lambert law, Instrumentation and applications of UV- visible spectrophotometer. Colorimetry and turbidometry.

5.2 Chromatography: Principles and applications of paper and Column chromatography

5.3 Centrifugation- Principle of centrifugation; Types of centrifuges: Low- speed, High- speed, and Ultracentrifuge – and their applications.

5.4 Electrophoretic technique: Agarose gel electrophoresis-Components, working principle and applications.

IV. Reference Books:

1. Aurora Blair. *Laboratory Techniques & Experiments in Biology*. Intelliz Press.
2. Berg, J. M., Tymoczko, J. L., & Stryer, L. (2011). *Biochemistry*. W. H. Freeman and Company.
3. Caldwell, D. R. (1995). *Microbial Physiology and Metabolism*. W. C. Brown Publications, Iowa, USA.
4. Ghatak, K. L. (2011). *Techniques and Methods in Biology*. PHI Publication.

5. Lehninger, A. L., Nelson, D. L., & Cox, M. M. (1993). *Principles of Biochemistry* (2nd ed.). CBS Publishers and Distributors, New Delhi.
6. Plummer, D. T. (1987). *An Introduction to Practical Biochemistry*. McGraw Hill Publication.
7. Pranav Kumar. (2016). *Fundamentals and Techniques of Biophysics and Molecular Biology*.
8. Rao, B. S., & Deshpande, V. (2007). *Experimental Biochemistry: A Student Companion*. I.K. International Pvt. Ltd.
9. Tymoczko, J. L., Berg, J. M., & Stryer, L. (2012). *Biochemistry: A Short Course* (2nd ed.). W. H. Freeman.
10. Voet, D., & Voet, J. G. (2004). *Biochemistry* (3rd ed.). John Wiley and Sons.
11. White, D. (1995). *The Physiology and Biochemistry of Prokaryotes*. Oxford University Press, New York.
12. Wilson, K., & Walker, J. (2000). *Principles and Techniques in Practical Biochemistry* (5th ed.). Cambridge University Press.

VI. Co-Curricular Activities:

1. Test various food samples for the presence of mono-, di-, and polysaccharides using simple chemical tests. Results can be presented as a poster or infographic explaining the type and significance of carbohydrates in different foods.
2. Organize Biomolecule Modeling Workshops where students can learn to build physical models or use computer simulations to visualize biomolecules such as proteins, nucleic acids, carbohydrates, and lipids.
3. Test knowledge of principles, applications, and troubleshooting of analytical methods by conducting a quiz.

SEMESTER-II

COURSE 3: FUNDAMENTALS OF BIOCHEMISTRY AND ANALYTICAL TECHNIQUES

Practical **Credits: 1** **2 hrs/week**

I. Course Objectives:

1. To gain practical skills in qualitative and quantitative analysis of sugars, amino acids, proteins, and DNA.
2. To understand and apply chromatographic techniques for the separation of biomolecules.
3. To learn centrifugation and electrophoresis methods for isolating and analyzing cellular and molecular components.

II. Laboratory/Field exercises:

1. Qualitative tests for sugars
2. Qualitative Analysis of Aminoacids.
3. Colorimetric estimation DNA by diphenylamine method.
4. Colorimetric estimation of proteins by Biuret/Lowry method
5. Separation of monosaccharides/amino acids by paper chromatography.
6. Separation of bacterial cells (cell pellet) from broth culture by using a laboratory scale centrifuge.
7. Separation of DNA fragments by Agarose gel electrophoresis.

SEMESTER-II

COURSE 4: MICROBIAL PHYSIOLOGY

Theory **Credits: 3** **3 hrs/week**

I. Course Objectives:

1. To understand the nutritional requirements, transport mechanisms, and growth media used for microbial cultivation.
2. To develop critical understanding of the concept of growth phase, and factors affecting microbial growth, and methods to measure it.
3. To understand the structure, classification, properties, and mechanisms of enzyme action, factors affecting activity and inhibition.
4. To understand the biochemical pathways of microbial respiration and fermentation, energy generation under aerobic and anaerobic conditions.
5. To comprehend the pigments and pathways involved in oxygenic and anoxygenic photosynthesis in bacteria.

II. Course Outcomes: On completion of this course students will be able to:

1. Describe microbial nutritional groups, nutrient uptake mechanisms, and select appropriate growth media for different microorganisms.
2. Explain microbial growth patterns and apply techniques to measure growth.
3. Explain enzyme structure and function, interpret the Michaelis-Menten equation, and differentiate between types of enzyme inhibition.
4. Students will be able to describe glycolysis, TCA cycle, electron transport, and fermentation pathways.
5. Describe bacterial photosynthetic pigments, the photosynthetic machinery, and the differences between oxygenic and anoxygenic photosynthesis.

III. Syllabus of Theory**:**

UNIT I: Microbial Nutrition No. of hrs: 9

1.1. Nutritional requirements of Microorganisms

1.2. Methods of uptake of nutrients by microbial cells- Primary and secondary active transport, concept of uniport, symport and antiport Group translocation; Iron uptake

1.3. Nutritional groups of microorganisms-based on C, energy and electron sources: autotrophs, heterotrophs, lithotrophs, organotrophs, Phototrophs, Chemotrophs;

1.4. Growth media - synthetic, nonsynthetic, selective, enrichment and differential media.

UNIT II: Microbial Growth **Hrs: 9**

2.1. Microbial Growth- Definitions of growth, generation time and specific growth rate; different phases of growth in batch cultures;
2.2. Synchronous, continuous, biphasic growth.
2.3. Factors influencing microbial growth: Temperature, oxygen concentration, pH, Salt
2.4. Methods for measuring microbial growth - Direct microscopy, viable count estimates, turbidometry and biomass.

Unit III Enzymes **Hrs: 9**

3.1 Structure of enzyme, Apoenzyme and cofactors, prosthetic group- TPP, coenzyme -NAD, metal cofactors; Definitions of terms: enzyme unit, specific activity and turnover number. Properties of enzymes.
3.2 Outline Classification and nomenclature of enzymes, Mechanism of action of enzymes: Lock and key hypothesis, and Induced Fit hypothesis. Michaelis-Menten equation,
Factors
affecting enzyme activity
3.4 Inhibition of enzyme activity- competitive, noncompetitive, uncompetitive and allosteric inhibition.

UNIT IV: Microbial Respiration and Fermentation **Hrs: 9**

4.1 Glycolytic Pathways: Glycolysis/EMP pathway and ED; TCA cycle.
4.2. Aerobic respiration - ETS and oxidative phosphorylation
4.3. Anaerobic respiration, chemoautotrophy - oxidation of inorganic compounds - N and S.
4.4. Fermentative modes in microorganisms with special reference to alcoholic, Lactic acid fermentations

UNIT V: Bacterial Photosynthesis **Hrs: 9**

5.1. Photosynthetic pigments, Photosynthetic apparatus in prokaryotes
5.2. Outlines of oxygenic photosynthesis in bacteria
5.3. Outlines of anoxygenic photosynthesis in bacteria

IV. Reference Books:

1. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company
2. Caldwell, D.R. (1995). Microbial Physiology and Metabolism, W.C. Brown Publications,Iowa, USA.
3. Lehninger, A.L., Nelson, D.L. and Cox, M.M. (1993). Principles of Biochemistry, 2 nd Edition, CBS Publishers and Distributors, New Delhi.
4. Sashidhara Rao, B. and Deshpande, V. (2007). Experimental Biochemistry: A student Companion. I.K. International Pvt. Ltd.

5. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman
6. Voet,D. and Voet J.G (2004) Biochemistry 3rd edition, John Wiley and Sons
7. White, D. (1995). The Physiology and Biochemistry of Prokaryotes, Oxford University Press, New York.

VI. Co-Curricular Activities:

1. Assignments in nutrient utilization, energy production, metabolic pathways,
2. Students can study microbial growth curves, metabolic pathways, or physiological responses to environmental factors.
3. Organize seminars where students can deliver presentations on specific topics in microbial physiology and metabolism.
4. Create visual representations of microbial metabolic pathways.
5. Extract and analyse bacterial photosynthetic pigments using paper chromatography to visualize pigment composition and understand functional roles.

SEMESTER-II

COURSE 4: MICROBIAL PHYSIOLOGY

Practical **Credits: 1** **2 hrs/week**

I. Course Objectives:

1. To cultivate phototrophic bacteria by enrichment and observe their morphology and pigmentation.
2. To study *E. coli* growth under different temperature, pH, and salt conditions, and plot its growth curve.
3. To identify cyanobacteria from permanent slides and understand their ecological role.

II. Laboratory/Field exercises:

1. Cultivation of phototrophic bacteria by enrichment method.
2. Effect of Temperature on *E. Coli* growth
3. Effect of pH on bacterial *E. Coli* growth
4. Effect of salt on growth of *E. coli* growth
5. Study and plot the growth curve of E. coli by turbidometric and standard plate count methods
6. Observation and identification of permanent slides of cyanobacteria