

ANDHRA KESARI UNIVERSITY
MICROBIOLOGY: MINOR

w.e.f 2023-24 AY

COURSE STRUCTURE

Year	Semester	Course	Title	Hr/ week	credits
I	II	1	Introduction to Microbiology	3	3
			Introduction to Microbiology	2	1
II	III	2	Biomolecules & Enzymology	3	3
			Biomolecules & Enzymology	2	1
	IV	3	Molecular Biology and Microbial Genetics	3	3
			Molecular Biology and Microbial Genetics	2	1
		4	Microbial Physiology and Metabolism	3	3
			Microbial Physiology and Metabolism	2	1

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III SEMESTER

COURSE 2: - BIOMOLECULES AND ENZYMOLOGY

credits - 3

I. Course Outcomes:

On successful completion of the course, the students will be able to

1. Understand the classification and properties of carbohydrates, including monosaccharides, disaccharides, polysaccharides, and sugar derivatives.
2. Gain knowledge of lipids and fatty acids, including their classification, structures, functions, and their role in cell signaling and metabolism.
3. Comprehend the structure and functions of amino acids and proteins, including their primary, secondary, tertiary, and quaternary structures.
4. Learn about the structure and functions of nucleic acids, including DNA and RNA, as well as the concept of base composition and nucleic acid- protein interactions. They will also be introduced to the role of vitamins in metabolism.
5. Understand the structure of enzymes, enzyme classification, and mechanisms of action. They will also learn about the factors influencing enzyme activity and various types of enzyme inhibition.

UNIT-I: Carbohydrates

No. of hours: 9

1. General characters and outline classification of Carbohydrates
2. Monosaccharides- Glucose, fructose, ribose; Stereo isomerism of monosaccharides, epimers, mutarotation and anomers of glucose
3. Disaccharides- concept of reducing and non-reducing sugars; Sucrose, Lactose
4. Polysaccharides- Storage -Starch, glycogen, Structural- Cellulose peptidoglycan and chitin
5. Sugar derivatives- glucosamine.

UNIT-II: Lipids and fatty acids

No. of

hours: 9 1. Definition and classification of lipids. Structure and properties of lipids. Importance of lipids in biological systems.

1. Introduction to fatty acids: definition, structure, and nomenclature. Saturated and unsaturated fatty acids.
2. Triglycerides: structure, function, and metabolism. Phospholipids: structure, function, and role in cell membranes. Steroids: structure, biosynthesis, and physiological roles. Waxes: structure, functions, and applications.

UNIT-III: Amino acids and Proteins.

No. of hours:9

1. Biochemical structure and notation of standard protein amino acids
2. General characteristics of amino acids and proteins.

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3. Primary, secondary, tertiary and quaternary structures of Protein
4. Non protein amino acids: Gramicidin, beta-alanine, D-alanine and D- glutamic acid.

UNIT-IV: Nucleic acids and Vitamins

No. of hours:9

1. Structure and functions of DNA and RNA.
2. Base composition. A+T and G+C rich genomes. Basic concept of nucleic acids protein interactions.
3. Concept and types of vitamins and their role in metabolism.

UNIT-V: Enzymes

No. of hours: 9

1. Structure of enzyme, Apoenzyme and cofactors, prosthetic group- TPP, coenzyme -NAD, metal cofactors; Definitions of terms – enzyme unit, specific activity and turnover number
2. Classification of enzymes, Mechanism of action of enzymes: active site, transition state complex and activation energy. Lock and key hypothesis, and Induced Fit hypothesis.
3. Effect of pH and temperature on enzyme activity.
4. Inhibition of enzyme activity- competitive, noncompetitive, uncompetitive and allosteric.

III. Skill Outcomes:

On successful completion of the course, the students will be able to

1. Qualitatively Identify mono and disaccharides
2. Qualitatively Identify specific aminoacids
3. Quantitatively estimate DNA
4. Quantitatively estimate protein

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III SEMESTER

COURSE 2: - BIOMOLECULES AND ENZYMOLOGY

credits -1

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

IV. References:

1. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H. Freeman and Company Caldwell, D.R. (1995). Microbial Physiology and Metabolism, W.C. Brown Publications, Iowa, USA.
2. Lehninger, A.L., Nelson, D.L. and Cox, M.M. (1993). Principles of Biochemistry, 2 nd Edition, CBS Publishers and Distributors, New Delhi.
3. Sashidhara Rao, B. and Deshpande, V. (2007). Experimental Biochemistry: A student Companion. I.K. International Pvt. Ltd.
4. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H. Freeman
5. Voet, D. and Voet J.G (2004) Biochemistry 3rd edition, John Wiley and Sons
6. White, D. (1995). The Physiology and Biochemistry of Prokaryotes, Oxford University Press, New York.

V. Co-Curricular Activities:

1. 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. These workshops can help students understand the three-dimensional structures and interactions of biomolecules, enhancing their comprehension of molecular biology concepts.
2. Assign Biomolecule and Enzyme Case Studies case studies that require students to analyze real-world scenarios related to biomolecules and enzymes in medicine, biotechnology, or environmental science.

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IV SEMESTER
COURSE 3: - MOLECULAR BIOLOGY AND MICROBIAL GENETICS
credits - 3

I. Course Outcomes:

By the Completion of the course the learner should be able to–

1. Understand the nature of genetic material, its organization in prokaryotes and eukaryotes, and the role of DNA and RNA.
2. Explain the process of DNA replication in prokaryotes and the involvement of enzymes and factors.
3. Recognize the characteristics, types, and applications of extra chromosomal genetic elements such as plasmids and transposons.
4. Differentiate between classical and modern concepts of genes, understand gene structure, and the process of transcription.
5. Comprehend the genetic code, translation process, and regulation of gene expression in bacteria.
6. Define and classify mutations, understand their molecular basis, and gain knowledge of DNA repair mechanisms.
7. Familiarize with genetic recombination in bacteria, including conjugation, transformation, and transduction processes.

Unit - 1: DNA/RNA as genetic material, Replication of DNA
Hours:9

No. of

1.1 Experimental evidences that established DNA and RNA as genetic material. Genome organization in prokaryotes and eukaryotes.

1.2 Replication of DNA in prokaryotes.: Bidirectional and unidirectional replication, Semiconservative replication, Proof of Semiconservative replication (Messelson – Stahl Experiment). Mechanism of DNA Replication in Prokaryotes: step by step process, Enzymes and factors involved in replication- Primase, Helicase, Gyrase, DNA polymerases, DNA ligase, SSB proteins.

1.3 Extra chromosomal genetic elements: General characters, types and applications of Plasmids and transposons.

Unit - 2: Concept of gene, Transcription

No. of Hours:9

2.1 Classical Concept of gene: Muton, Recon and Cistron; One gene-one enzyme and one gene - one polypeptide and One gene – One Product hypotheses.

2.2 Modern concept of gene: Definition of gene; Open reading frame; structural, constitutive and regulatory genes; uninterrupted genes, Split genes- concept of introns and exons.

2.3 Protein synthesis in Prokaryotes: Transcription- Definition, difference from replication, promoter, RNA Polymerase, mechanism of transcription. RNA splicing in eukaryotes;

Unit - 3: Translation and regulation of gene expression**No. of Hours:9**

Protein synthesis in Prokaryotes

3.1 Genetic code: Salient features, Wobble hypothesis.

3.2 Translation- Charging of tRNA, aminoacyl tRNA synthetases, Mechanisms of initiation, elongation and termination of polypeptides. Inhibitors of protein synthesis.

3.3 Regulation of gene expression in bacteria – lac operon.

Unit - 4: Mutations and DNA repair**No. of Hours:9**

4.1 Mutations: Definition and types of Mutations (Spontaneous and induced, Somatic and germline); Physical and chemical mutagens;

4.2 Molecular basis of mutations (base pair changes, frame shifts, deletions, inversions, tandem duplications, insertions); Functional mutants (loss and gain of function mutants); Uses of mutations.

4.3 Outlines of DNA repair mechanisms: Direct repair, Excision repair, Mismatch Repair, Recombination Repair, SOS Repair.

Unit - 5: Genetic recombination in bacteria**No. of Hours:9**

5.1 Conjugation - discovery, F-factor, F⁺ & Hfr, mechanism of conjugation, applications of conjugation;

5.2 Transformation- Discovery, mechanism of transformation, Competence Factors affecting transformation and application of transformation.

5.3 Transduction- discovery, mechanism and types of transduction.

III. Skill Outcomes:

1. performing cell lysis and purification, quantifying DNA, and recognizing the importance of genomic DNA isolation.
2. Estimate DNA using UV Spectrophotometer include preparing DNA samples, measuring absorbance at 260 nm, calculating DNA concentration, and assessing DNA purity.
3. Solve Problems related to DNA and RNA characteristics, Transcription and Translation. 4. Analyze and solve problems related to DNA and RNA structure, understanding transcription and translation processes, and interpreting the impact of mutations on protein synthesis.
4. Prepare gels, loading DNA samples, visualizing DNA bands, analyzing fragment size, and understanding the principles of electrophoresis.
5. Understand Mutagenesis principles, perform UV exposure, assessing mutation frequency, and comprehend the effects of mutations on bacterial phenotypes.

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IV SEMESTER
COURSE 3: - MOLECULAR BIOLOGY AND MICROBIAL GENETICS
credits -1

1. Isolation of genomic DNA from E. coli
2. Estimation of DNA using UV spectrophotometer (A₂₆₀ measurement).
3. Problems related to DNA and RNA characteristics, Transcription and Translation.
4. Resolution and visualization of DNA by Agarose Gel Electrophoresis.
5. Problems related to DNA and RNA characteristics, Transcription and Translation.
6. Induction of mutations in bacteria by UV light.
7. Study of different conformations of plasmid DNA through agarose gel electrophoresis.
8. Demonstration of bacterial transformation
9. Instrumentation in molecular biology – Ultra centrifuge, Transilluminator, PCR
10. Study of different types of DNA and RNA using micrographs and model / schematic
11. representations
12. Study of semi-conservative replication of DNA through micrographs / schematic
13. Representations

IV. References

Text books:

1. James D. Watson Tania A. Baker, Stephen P. Bell Alexander Gann, Michael Levine, Richard Losick, 2013, Molecular Biology of the Gene, 5th Edition, Pearson Edu Publishers.
2. Roger Y. Stanier, Edward A. Adelberg, John L. Ingraham, 1977, General Microbiology 5th edition, London Macmillan.
3. David Freifelder 1986 Molecular Biology 3rd edition, Jones & Bartlett Publishers
4. T.A. Brown, Gene cloning and DNA analysis- An Introduction, 4th edition
5. Bernard R. Glick and Jack. J. Pasternak, Molecular Biotechnology. 3rd edition
6. David Freifelder. Essentials of molecular biology. Jones and Bartlett Publishers, 1998

V. Co-Curricular Activities:

1. Conduct poster presentations, oral presentations, and interactive sessions.
2. Visit laboratories employing molecular biology techniques

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IV SEMESTER
COURSE 4: - MICROBIAL PHYSIOLOGY AND METABOLISM
credits - 3

I. Course Outcomes:

On successful completion of the course, the students will be able to

1. Understand the nutritional requirements of microorganisms and the different methods of nutrient uptake. They will also gain knowledge of different nutritional groups and types of growth media used for microbial cultivation.
2. Comprehend microbial growth, including the definition of growth, generation time, and the different phases of growth. They will also learn about factors influencing microbial growth and methods for measuring it.
3. Gain knowledge of thermodynamics in biological systems, including concepts of free energy, enthalpy, and entropy. They will also learn about ATP structure and properties, oxidation-reduction reactions, and carbohydrate breakdown pathways.
4. Understand microbial respiration, including aerobic and anaerobic respiration, chemoautotrophy, and fermentative modes.
5. Differentiate the processes of oxygenic and anoxygenic photosynthesis.

UNIT I: Microbial Nutrition

No. of hours: 9

1. Nutritional requirements of Microorganisms
2. Methods of uptake of nutrients by cells- Primary and secondary active transport, concept of uniport, symport and antiport Group translocation; Iron uptake
3. Nutritional groups of microorganisms-based on C, energy and electron. sources
4. Growth media - synthetic, nonsynthetic, selective, enrichment and differential media.

UNIT II:

Microbial Growth

-No. of hours:9

1. Microbial Growth- Definitions of growth, generation time and specific growth rate; different phases of growth in batch cultures;
2. Synchronous, continuous, biphasic growth.
3. Factors influencing microbial growth
4. Methods for measuring microbial growth - Direct microscopy, viable count estimates, turbidometry and biomass.

UNIT IV: Thermodynamics; Breakdown of Carbohydrates

No.of hours: 9

1. Thermodynamics in biological systems - Concept of free energy, Enthalpy, Standard Free Energy change of reaction, Entropy. First and Second law of Thermodynamics. Open and Closed system.
2. Structure and properties of ATP, Standard Free energy change of hydrolysis of ATP and other high energy compounds. Biological oxidation-reduction reactions. Structure and Function of NAD and FAD.

3. Breakdown of carbohydrates· Glycolytic pathways- EMP, HMP shunt/pentose phosphate pathway and ED; TCA cycle.

UNIT V: Microbial Respiration and Fermentation **No. of hours: 9**

1. Aerobic respiration - ETS and oxidative phosphorylation
2. Anaerobic respiration, chemoautotrophy - oxidation of inorganic compounds - N, S, Fe and H.
3. Fermentative modes in microorganisms with special reference to alcoholic, Lactic acid fermentations

UNIT V: Bacterial Photosynthesis **No. of hours:9**

1. Photosynthetic pigments, Photosynthetic apparatus in prokaryotes
2. Outline of oxygenic photosynthesis in bacteria
3. Outline of anoxygenic photosynthesis in bacteria

II. Skill Outcomes:

On successful completion of the course, the students will be able to

1. Understand the impact of temperature and pH on bacterial growth and metabolism.
2. Gain proficiency in colony counting techniques for microbial enumeration.
3. Analyze and interpret growth curve data to understand bacterial growth dynamics.
4. Develop skills in observing and identifying cyanobacteria under the microscope.
5. Apply knowledge of microbial growth factors and techniques to interpret and analyze experimental results.

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IV SEMESTER
COURSE 4: - MICROBIAL PHYSIOLOGY AND METABOLISM
credits -1

1. Effect of Temperature on bacterial growth 2.Effect of pH on bacterial growth
2. Colony count in Plates
3. Study and plot the growth curve of E. coli by turbidometric and standard plate count methods
4. Observation and identification of permanent slides of cyanobacteria

IV References:

1. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company Caldwell, D.R. (1995). Microbial Physiology and Metabolism, W.C. Brown Publications,Iowa, USA.
2. Lehninger, A.L., Nelson, D.L. and Cox, M.M. (1993). Principles of Biochemistry, 2nd Edition, CBS Publishers and Distributors, New Delhi.
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5. Voet,D. and Voet J.G (2004) Biochemistry 3rd edition, John Wiley and Sons
6. White, D. (1995). The Physiology and Biochemistry of Prokaryotes, Oxford University Press, New York.

V 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.

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ANDHRA KESARI UNIVERSITY-ONGOLE, PRAKASAM DISTRICT
Minor Programme from the Year 2023-24 Onwards
Programme-B.Sc. Honours Microbiology - Question Paper model,
Second Year-Semester-III & IV

Time: 3 Hours

Total Marks: 75

PART –A

Answer any five of the following

Draw labeled Diagrams wherever necessary, Examiners must give two questions from each unit

5X5=25 Marks

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10

PART –B

Answer any five of the following

Draw labelled Diagrams wherever necessary, Examiners must give two questions from each unit

5x10=50 Marks

- 11.
- 12.
- 13.
- 14.
- 15.
- 16.
- 17.
- 18.
- 19.
- 20.

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