ANDHRA KESARI UNIVERSITY ::ONGOLE

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

COURSE STRUCTURE

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
I	I	1	Biomolecules	3	3
			Biomolecules-Practical	2	1
		2	Cell Biology	3	3
			Cell Biology-Practical	2	1
	II	3	Genetics	3	3
			Genetics-Practical	2	1
		4	General Physiology	3	3
			General Physiology-Practical	2	1
II	III	5	Analytical techniques	3	3
			Analytical techniques-Practical	2	1
		6	Basic Microbiology	3	3
			Basic Microbiology-Practical	2	1
		7	Immunology	3	3
			Immunology-Practical	2	1
	IV	8	Enzymology	3	3
			Enzymology-Practical	2	1
		9	Bioenergetics and Membrane biology	3	3
			Bioenergetics and Membrane biology-Practical	2	1
		10	Endocrinology	3	3
			Endocrinology-Practical	2	1
III	V	11	Molecular Biology	3	3
			Molecular Biology-Practical	2	1
		12	Nutritional Biochemistry	3	3

N. Srinivas Rao
BOS chairperson
Andhra kesari university, ongole

SEMESTER - I

COURSE 1: BIO MOLECULES

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

Course Objectives:

1. Provides information about classification, physico-chemical properties of amino acids and structural organization of proteins.
2. To understand the structure, properties and biological importance of carbohydrates and lipids.
3. Explore the composition and structure of nucleic acids.

UNIT-I

Fundamentals of Biochemistry: History, scope and avenues of Biochemistry. Water as a biological solvent. Measurement of PH, Buffers, Biological relevance of Buffers. Outlines of surface tension, adsorption and osmosis and their biological relevance.

UNIT-II

Carbohydrates: Classification, monosaccharides, D and L designation, open chain and cyclic structures, epimers and anomers, mutarotation. Reactions of carbohydrates (due to functional groups - hydroxyl, aldehyde and ketone.) Amino sugars, Glycosides. Structure and biological importance of disaccharides (sucrose, lactose, maltose,), polysaccharides (starch, glycogen). Glycosaminoglycans.

UNIT – III

Lipids: Classification of fatty acids, structure of saturated and unsaturated fatty acids, properties of fats and oils (acid, saponification and iodine values, rancidity). Classification of lipids, general properties and structures of phospholipids. Lipoproteins- types and functions.

UNIT-IV

Amino Acids and Proteins Classification, structure, stereochemistry, chemical reactions of amino acids due to carbonyl and amino groups. Titration curve of glycine and pK values. non-protein amino acids. Peptide bond, Proteins Classification based on solubility, shape, and function. Denaturation, and renaturation of proteins. Structural organization of proteins- primary, secondary, tertiary, and quaternary structures.

UNIT-V

Nucleic acids and porphyrins, Types of RNA and DNA. Structure of purines and pyrimidines, nucleosides, nucleotides. Stability and formation of phosphodiester linkages. Effect of acids, alkali and nucleases on DNA and RNA. Structure of Nucleic acids- Watson-Crick DNA double helix structure, denaturation and renaturation of nucleic acids, Tm-values and their significance, Cot curves and their significance.

SEMESTER - I

COURSE 1: BIO MOLECULES

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

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1. Safety measures in laboratories**.**
2. Preparation of buffers (acidic, neutral, and alkaline) and determination of pH.
3. Qualitative identification of carbohydrates- glucose, fructose, ribose/xylose, maltose, sucrose, lactose, starch/glycogen.
4. Qualitative identification of amino acids- histidine, tyrosine, tryptophan, cysteine, arginine.
5. Qualitative identification of lipids- solubility, saponification, acrolein test, Salkowski test, Lieberman- Burchard test.
6. Determination of pKa of acetic acid and glycine

Course outcomes:

After successful completion of the course student should be able

1. To learn about the classification, structure, chemical properties of Carbohydrates, lipids and amino acids.
2. To acquire knowledge about the structure of Porphyrins, Nucleic acids

Recommended Books

1. Fundamentals of Biochemistry –Jain, J.L., Jain, S., Jain, N. S. Chand & Co.
2. Biochemistry – Satyanarayana. U and Chakrapani. U, Books & Allied Pvt. Lt
3. Nelson.D.L and Cox.M..M -Lehninger’s Principles of Biochemistry- Freeman & Co.-7 th Edition

SEMESTER - I

COURSE 2: CELL BIOLOGY

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

1. To study the structural and functional organization of the cell and its organelles
2. To comprehend the phases of cell cycle and cell division
3. Knowledge on Composition of plasma membrane and various transport mechanisms.

UNIT-I

Historical aspects: cell theory, protoplasm theory and organizational theory. Broad classification of cell types: prokaryotic cell and eukaryotic cells, and their characteristics. Compartments and division of labour within organelles. Ultrastructure of virus, bacterial, plant and animal cells.

UNIT -II

Cell Organelles: Structure and functions of: endoplasmic reticulum (rough endoplasmic reticulum and smooth endoplasmic reticulum), Golgi apparatus, lysosomes, centrioles, basal bodies, vacuoles, ribosomes and microbodies (peroxisomes and glyoxisomes). Mitochondria: structure, function and organization of the respiratory chain. Chloroplasts: structure, function and photophosphorylation.

UNIT III

Structure of the nucleus and the nuclear core complex. Internal organization of the nucleus, the nuclear matrix and the nucleolus. Supercoiling and organization of genomic DNA: chromosomes and higher order chromatin structure, functional domains within the nucleus. Cell cycle: cell division (mitosis and meiosis), and its regulation: checkpoints in the cell cycle.

UNIT-IV

Cell division: mitosis, meiosis, cell cycle and its regulation, different phases of cell cycle. Apoptosis, Regulation of cell cycle, Cyclins, MPF, Cyclin dependent kinases, Growth factors, Nuclear Laminins, inhibition of cell cycle progression, MPF and progression to Metaphase, Proteolysis and MPF, Regulation of MPF activity.

UNIT-V

Bio membranes: Chemical composition of Membranes, Composition of plasma and organelle membranes of animal and plant cells. Lipids, proteins, and Carbohydrates of membranes Distribution of membrane lipids. Assembly of membrane components. Molecular structure of membranes: Miscelle, and liposomes, biological membrane; Symmetry of the membrane;
Membrane fluidity; fluid mosaic model of biological membranes.

SEMESTER - I

COURSE 2: CELL BIOLOGY

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

1. Isolation of chloroplast
2. Isolation of Mitochondria from liver
3. Mitosis experiment in onion
4. Meiosis experiment in onion
5. Visualization of animal and plant cells by methylene blue.
6. Staining and visualization of mitochondria by Janus green stain

Course Outcomes

Students will be able to:

1. Learn about the cell structure, cell organelles. 2: Understand the concept of cell division.

3: Acquire knowledge about biological membranes.

Recommended Books

1. Goldman, Emanuel, and Lorrence H. Green, eds. Practical handbook of microbiology. CRC Press, 2015.
2. Dubey, R. C., and D. K. Maheshwari. Practical microbiology. S. Chand, 2002.
3. Microbiology: A laboratory manual by Cappuccino and Sherman, Pearson Education, 6th Ed.

SEMESTER - II

COURSE 3: GENETICS

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

1. The objectives of the course are to learn and understand the fundamentals of genetics like DNA as genetic material, chromosome and gene and understand the gene arrangement in prokaryotes and eukaryotes.
2. To learn and understand the concept of bacterial genetics and detailed information about Mutation.
3. To learn and understand the bacterial, transformation, transduction, and conjugation and Transposable genetic elements and their antibiotic resistance
4. To learn and understand the bacteriophage lifecycle and various plasmids and CRISPR- Gene editing

UNIT-I

Genetic material – Direct and Indirect evidences of DNA as genetic material, experimental proof. Evidences of RNA as genetic material – eg. Virus. Chromosome - Chromosome and genes, chromosomal replication, **UNIT-II**

Gene – arrangements in prokaryotes and eukaryotes. Gene structure in eukaryotic organisms, introns, exons, pseudogenes, and gene clusters, spacers, repetitive sequences. Single and multiple copy genes in eukaryotes, eg – Histones, Alu, copia, satellite. Gene regulatory mechanism, cell memory, extra nuclear inheritance. New gene evolution, Tiniest genome of proteobacteria and bacteroicidetes.

UNIT-III

Bacterial genetics – Bacterial chromosomes, plasmids, PBR322 and other synthetic plasmids - isolation and uses. Transposable genetic elements, transformation, transduction, and conjugation in bacteria. Recombination in bacteria.

UNIT-IV

Structure of Bacteriophages and their use in the study of molecular genetics – lytic cycle- replication of T- phages, Lysogeny and its regulation. Transduction – specialized, generalized and abortive. Transfection and cosmids. Fine structure analysis of T- phages, Benzers work and concept of cistrons. Bacterial defence (CRISPR- Gene turning on).

UNIT-V

Mutation – Types of mutations, mutagens, mechanism of mutation, Mutagenesis, induction and isolation of mutants. Haploid genetic tools. Radiation effects on human heredity. Phylogenetic inheritance. Heritability and its measurements and mapping, gene duplication and self-incompatibility.

SEMESTER - II

COURSE 3: GENETICS

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

1. Isolation of phages from sewage and quantification by plaque assay.
2. Restriction digestion of the vector and the insert
3. Ligation of restricted DNA fragments
4. Preparation of competent *E. coli* cells, transformation and expression of cloned gene
5. PCR and restriction diagnosis-based identification of positive clones

Course Outcomes:

After the completion of this course, the student will be able to

1. The students will learn about the DNA, RNA as genetic material.
2. Learn about bacterial transformation, transduction and inputs to genetic engineering
3. Gain knowledge on mutations and isolation of mutants and types of mutagens

Recommended Books:

1. Molecular Genetics by D Friefelder
2. Cell molecular biology, Albert Bruce
3. Molecular cloning by Maniatis and Co Vol I, II, III
4. Genetics by Gardner
5. Molecular Biology of the gene by Watson.
6. Genetics by G Zubay
7. Cell molecular Biology by Baltimore.
8. Molecular Biology by D Friefelder.
9. Genes VII Benjamin Lewin (2000). Oxford Univ. Press. London.
10. Cell and Molecular Biology 2ndEdit. (2002) By P. K. Gupta, Rastogi Publ.

SEMESTER - II

COURSE 4: GENERAL PHYSIOLOGY

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

Course objectives:

1. To impart knowledge about blood composition and function and blood clotting mechanism.
2. To study about the muscular and nervous system.
3. To appreciate about the components of Urinary system and mechanism of Urine formation
4. To understand the structure and function and different components of Digestive system.
5. To introduce the organization of endocrine system and classification of hormones

UNIT-I

Blood- composition & function. Types of blood cells, morphology & function - RBC, WBC, platelets. erythropoiesis. Blood groups- A B O & Rhesus system;, function of plasma proteins. Blood clotting mechanism, anticoagulants

UNIT-II

Muscular system- types of muscle & functions. Brief outline of nervous system, Structure of Neuron. Synapses- chemical and electrical synapse, nerve impulse, action potential and neurotransmitters.

UNIT-III

Urinary system – components of the urinary system, Kidney structure and organization. Structure, function of nephrons. Mechanism of urine formation- functions of glomerular filtration rate

UNIT-IV

Digestive system -Components of digestive system Mechanism of Digestion- Digestion of carbohydrates, lipids, and proteins. Secretion of HCL, Role of hormones and enzymes in digestive process.

UNIT-V

General organization of endocrine system- classification of hormones. Biological functions - Thyroid, Para Thyroid, Insulin, Glucagon, hormones of the adrenal glands and gonadal hormones

SEMESTER - II

COURSE 4: GENERAL PHYSIOLOGY

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

Practical syllabus:

1. RBC count & WBC count
2. Differential leucocyte count by Leishman' s staining
3. Estimation of Hemoglobin by Sahli's acid haematin method
4. Determination of Erythrocyte sedimentation rate
5. Determination of blood group
6. Measurement of blood Pressure
7. Histology of connective tissue, liver /kidney permanent slides

Course Outcomes:

1. Recognize and analyse blood cells and blood groups Blood clotting mechanism
2. Outline the muscular and nervous system, Mechanism of muscle contraction and structure of brain and spinal cord
3. Utilize the knowledge about the structure kidney and nephron, to understand the mechanism of Urine formation and learn the concept of Dialysis,
4. Acquire knowledge about the components of Digestive system, HCl formation and Digestion process
5. Compile the classification of Hormones and its biological role

Recommended Books

1. Textbook of Medical Physiology – Guyton & Hall, 11th edition, 2006
2. Davidson's Principles and Practice of Medicine (XX Edition)- John.A.A.Hunter
3. Human Anatomy & Physiology – Elaine N.Marieb, 3rd edition, 1995
4. Essentials of Medical Physiology –Sembulingam, 1999 5. Medical Physiology – Ganong
5. Text book of Medical Biochemistry Physiology – MN.Chatterjee and, Rana Shinde, 7th ed.
6. Animal physiology – Mariakuttikan and Arumugam