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

AC-Item 25
BOS Chairperson
Andhra Kesari
University, Ongole

SEMESTER - III

COURSE 5: ANALYTICAL TECHNIQUES

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

Course objectives:

1. To understand the basic concepts of analytical techniques.
2. To gain knowledge about the latest advances in analytical techniques.
3. To apply these techniques in research.

UNIT-I

Methods of tissue homogenization. Salt and organic solvent extraction and fractionation, ultra filtration, lyophilization. Chromatography: principle, procedure and application of partition chromatography, adsorption chromatography, ion exchange chromatography, gel chromatography, affinity chromatography **UNIT-II**

Electrophoresis: Principle, procedure and application of free flow, zone electrophoresis (Paper electrophoresis, Gel electrophoresis, PAGE, SDS-PAGE) Isoelectric focusing, Immunoelectrophoretic.

UNIT-III

Centrifugation: Principle of sedimentation technique. Different types of centrifuge and rotors. Principle, procedure and application of differential centrifugation, density gradient centrifugation, ultra centrifugation, rate zonal centrifugation, isopycnic centrifugation.

UNIT-IV

Colorimetry and spectrophotometry: Laws of light absorption -Beer - Lambert's law. UV and visible absorption spectra, molar extinction co-efficient. Principle and instrumentation of colorimetry and spectrophotometry. Spectroflurimetry

UNIT-V

Important stable radioisotopes used in biochemical research. P 32, I 125, I131, Co 60. C 14 etc. Radiation hazards and precautions taken while handling radioisotopes. Units of Radioactivity, Principle and application of RIA. Measurement of radioactivity by GM counter and Scintillation counter.

SEMESTER - III

COURSE 5: ANALYTICAL TECHNIQUES

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

Practical syllabus:

1. Estimation of ascorbic acid
2. Separation and estimation of total carotenoids and β-carotene
3. Extraction and estimation of vitamin A, vitamin E, niacin and free amino
4. Estimation of phosphorus by Fiske and Subbarow method. Characterization of fats – estimation of saponification number, iodine number, acid number and R. M. Number
5. Extraction of Phytoconstituents by Soxhlet and quantification

Course Outcomes:

After completing this course, the student will

1. Understand the basic concepts and principles of biochemical techniques namely Spectrophotometry, Fluorimetry, Chromatography and Centrifugation.
2. Analyse biochemical compounds such as Carotenoids, Vitamins, Alkaloids and Flavonoids.
3. Identify the compounds by various biochemical techniques and interpret the results
4. Apply the laboratory skills and concepts in carrying out experiments using sophisticated instruments.

Recommended Books

1. Physical Biochemistry- Application to Biochemistry and Molecular Biology: Friefelder D. WH Freeman and Company
2. Principles and Techniques of Biochemistry and Molecular Biology: - Ed. K. Wilson and J. Walker, Cambridge Univerity Press.
3. The Tools of Biochemistry: Cooper T.G., John Wiley and Sons Publication.
4. Biophysical chemistry. Principles and Techniques: Upadhayay A, Upadhayay K and Nath N., Himalaya publishing house.
5. Experimental Biochemistry. Cark Jr J. M. and Switzer R.L, W.H. Freeman and Company.
6. Research Methodology for Biological Sciences: Gurumani.N. M.J.P. Publishers., Chennai, India.
7. Instrumental Methods of Chemical Analysis: Chatwal. G and Anand.S., Himalaya Publishing House, Mumbai, India.
8. A Biologist's Guide to Principles and Techniques of Practical Biochemistry: Williams.B.L. and Wilson. K. (ed.) Edward Arnold Ltd. London
9. Jayaraman, J. (2011). Laboratory Manual in Biochemistry, New Age International (P) Ltd.
10. Sadasivam, S. and Manickam, A. (2005). Biochemical Methods, Second edition, New Age International (P) Ltd.

SEMESTER - III

COURSE 6: BASIC MICROBIOLOGY

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

Course Objectives:

1. The objective of the course is learning and understanding the fundamentals of Microbiology like important characteristics and biology of bacteria, fungi, mycoplasma, viruses etc.
2. Designed to learn nutritional requirements in microorganisms and virus classification, morphology and methods of culturing of viruses, Isolation, purification and characterization.
3. The objectives of the course are to learn and understand the genetic material, chromosome and gene and understand the gene arrangement in prokaryotes.
4. To know the various microbial diseases and their prevention and treatment.

UNIT - I

Classification of Microorganisms – Two, Three, Four and Five Kingdom,. Domain concept and phylogenetic tree, contributions of scientists-Louis Pasteur, Robert Kotch, Antony van Leeuwenhoek, Edward Jenner. Differences between Prokaryotes and Eukaryotes.

UNIT -II

Isolation and cultivation of bacteria, bacterial growth curves. Culture media and methods, staining techniques, differences between Gram-positive and Gram-negative bacteria. Methods of sterilization and Pasteurization.

UNIT-III

General characteristics of algae, thallus organization, algae cell ultra-structure, pigments, flagella, eyespot food reserves and vegetative, asexual and sexual reproduction. Applications of Algae in agriculture, industry, environment and food.

General characteristics of fungi, fungal cell ultra- structure, thallus organization and aggregation, fungal wall structure and synthesis, asexual reproduction, sexual reproduction, heterokaryosis, heterothallism . Economic Importance of Fungi in Agriculture, environment, Industry, medicine, food, biodeterioration, mycotoxins

UNIT-IV

An account of typical eubacteria, chlamydiae & rickettsiae (obligate intracellular parasites), mycoplasma, and archaebacteria (extremophiles). Applications of bacteria in industry, environment and food. Difference between prokaryotic and eukaryotic microorganisms. General characteristics of different groups: acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance.

UNIT-V

An introduction to viruses with special reference to the structure and replication of the following: Poxvirus, Poliovirus, HIV, T4 and λ phage, lytic and lysogenic cycles. Purification of Viruses. Methods of assay- Plaque assay and Hemagglutination assay.

SEMESTER - III

COURSE 6: BASIC MICROBIOLOGY

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

Practical syllabus:

1. Microbiology Laboratory Practices and Biosafety.
2. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter)
3. Preparation of culture media – Nutrient Broth, Nutrient Agar, Mac Conkey's agar,
4. Identification of bacteria by staining techniques – simple, differential, Gram staining and acid-fast staining
5. Isolation of pure cultures of bacteria by streak plate method.

Course Outcomes:

After completing this course, the student will:

1. Understand the concept of basic microbiology – sterilization techniques.
2. Know about the isolation of microorganisms from various sources.
3. Discuss the staining techniques to study the morphology of microorganisms.

Recommended Books

1. Vasanthakumari.R, (2009) Practical Microbiology, BI Publishers Pvt Ltd, India
2. Dubey.R.C and Maheshwari D.K., (2002), Practical Microbiology, S.Chand & comp Ltd, NewDelhi.
3. Microbiology by Pelczar, Chan and Krieg 5th edn. 1995 Mc Grew- Hill.
4. General Microbiology: Boyd, R.F., Times Mirror/ Mosby College, 1984.
5. A Textbook of Microbiology, R.C.Dubey and D.K.Maheswari, S.Chand Co (2001).
6. Pharmaceutical Microbiology, By Hugo and Russell, Blackwell Scientific (1987).
7. An Introduction to Viruses by S.B.Biswas, Vikas Publishing house.
8. Microbiology 4th edition, Prescott, Harley, Klein (Mc grew Hill)
9. Fundamentals of Microbiology – M. Frebisher

SEMESTER - III

COURSE 7: IMMUNOLOGY

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

Course objectives

1. To compare and contrast the innate and the adaptive immune systems, as well as humoral and cell- mediated immune responses
2. To distinguish various cell types, antibody isotypes, and cytokines involved in immune responses and associated functions ·
3. To understand the significance of the Major Histocompatibility Complexes in immune surveillance and transplantation

UNIT I:

Overview of historical perspectives: Immunity and types of immunity: innate and adaptive, active and passive, natural and acquired immunity. Overview of immune system, cells of the immune system and their functions. Organs of the immune systems and their functions: primary and secondary lymphoid organs

UNIT II:

Antigen and Antibody: Nature and types of antigens, specificity, epitope, haptens, adjuvants. Immunogenicity and factors affecting immunogenicity. Immunoglobulins: structure, classes and functions. Antigen– antibody reactions: agglutination, precipitation, flocculation, complement fixation, neutralization.

UNIT III:

Humoral and cell mediated immunity: Functions of TH, TC, TS and B lymphocytes. Primary and secondary immune responses and the role of memory cells. Polyclonal and monoclonal antibody generation and their applications.

UNIT IV:

Immunodiagnostics: Radial immunodiffusion. Single immunodiffusion: one dimension and radial, double immunodiffusion: one dimension and Immunoelectrophoresis, immunofluorescence, rocket electrophoresis, haem agglutination assay, CFT, ELISA, RIA.

UNIT V:

Hypersensitivity reactions: Types of hypersensitive reactions: type I, II, III and IV. Fundamentals of autoimmune disorders, immunodeficiency diseases, brief account on immune suppression. Transplantation immunology: graft acceptance and rejection (in brief).

SEMESTER - III

COURSE 7: IMMUNOLOGY

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

Practical syllabus

1. Immunodiffusion – SRID
2. ABO and Rh blood grouping
3. Latex agglutination assay
4. Quantitative immune precipitation assay
5. Isolation of casein by isoelectric precipitation

Course outcomes:

After successfully completing this course, the students will be able to:

1. To get an overview of the immune system and learn about the various cells, organs and tissues of the immune system.
2. Learn the basic defines mechanisms of the human body, learn how our body differentiate self from non self and thus successfully eliminate any danger from outside.
3. Understand the cellular and molecular pathways of humoral and cell-mediated immune responses and appreciate the importance of immune system
4. Learn how immunodeficiency makes us vulnerable and how vaccine is essential to protect us from infectious diseases.

Recommended Books

1. Immunology, T .J. Kindt, R. A. Goldsby, and B.A. Osborne. (2007) W.H.Freeman and Co, New York.
2. Biochemistry, Voet, D. and Voet, J.G. (2004). 3rd Edition, John Wiley C Sons, Inc. USA.
3. Immunology – Kuby
4. Immunology - J. Kannan, MJP Publishers, Chennai-5 Immunology - Roitt Ivan, Jonathan Brastoff, David Male, 1993.
5. Immunology - Janis Kuby, 4th edition, 2000.
6. Immunology - An introduction, Tizarrd, R. 1995.
7. Fundamentals of Immunology – Lippincot Praven publications, 4th edition
8. Essential and clinical Immunology - Halen chapel, Mansal Haney, Siraj Misbah and Nial Snowdan.

SEMESTER - IV

COURSE 8: ENZYMOLOGY

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

Course objectives:

1. To enlighten the students about enzyme kinetics.
2. To help the students to understand the mechanism of action of enzymes.
3. To help the students to learn the applications of enzymes

UNIT-I

Introduction to enzymes: Holoenzyme, apoenzyme, prosthetic group. Interaction between enzyme and substrate- lock and key model, induced fit model, Enzyme specificity and types. IUB system of classification and nomenclature of enzymes (Class and subclass with one example) Ribozymes, Abzymes.

UNIT-II

Enzyme kinetics: Importance, order of reaction, study of the factors affecting the velocity of enzyme catalyzed reaction- enzyme concentration, temperature, pH, substrate concentration, inhibitors and Derivation of Michaelis -Menten equation and Km value determination and its significance. Definition of Vmax value of enzyme and its significance. Lineweaver- Burk plot (Only for single substrate enzyme catalyzed reaction).

UNIT-III

Methods of measurements and expression of enzyme activity. Unit of enzyme activity - definition and importance. Enzyme inhibition: Reversible and irreversible – examples. Reversible-competitive, noncompetitive and uncompetitive inhibition- explanation of double reciprocal plot with examples.

UNIT-IV

Enzyme regulation – covalently modulated enzymes with examples of adenylation and phosphorylation and allosteric regulation- example Aspartate trans carbamoylase. Isoenzymes- Lactate dehydrogenase and creatine phosphokinase. Zymogens

UNIT-V

Immobilization of enzymes, methods of immobilization. Industrial uses of enzymes: Detergent enzymes, thermo stable alpha amylase, papain, chymotrypsin

SEMESTER - IV

COURSE 8: ENZYMOLOGY

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

Practical syllabus:

1. Assay of α- amylase activity in saliva
2. Determination of optimum pH of a plant/animal or microbial enzyme.
3. Studying the effect of different temperatures during enzyme activity measurements.
4. Studying the effect of different pH during enzyme activity measurements.
5. Substrate saturation and determination of Km value from Michaelis Menten curve.

Course Outcomes:

After completing this course, the student will:

1. Acquire the knowledge of structure and organization of protein
2. Identify the different classes of enzymes, the methods used for purification of enzymes and describe enzyme kinetics for bisubstrate and multisubstrate reactions.
3. Do research in a contemporary action of enzyme and enzyme inhibition.
4. Explain the enzyme regulation and multienzyme complex.
5. Explore the applications of enzymes in clinical and various industrial sectors

Recommended Books

1. Enzymes: M. Dixon and E. C. Webb. Longman Publication
2. Enzymology: Nicholas and Price
3. Biochemistry: D.Voet and J. G. Voet, John Wiley C sons Inc. New York Chischester Brisbane, Toronto, Singapore ISBN 0-471-58651-X
4. Biochemistry: L. Stryer. and Hall, J.E., Library of congress cataloguing-in publication Data, Bery, Jeremy mark ISBN -0-7167-4684-0.
5. Enzymes: Trevor Palmer Affiliated East- West Press Pvt. Ltd, New Delhi ISBN 81 7671-04

SEMESTER - IV

COURSE 9: BIOENERGETICS AND MEMBRANE BIOLOGY

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

Course objectives:

1. To learn basic concepts of Bioenergetics, the importance of high energy compounds,
2. To learn the basic concepts of electron transport chain, synthesis of ATP, mechanisms of oxidative phosphorylation
3. To learn the concepts of photophosphorylation.
4. To learn the structure and composition of membrane.
5. To learn the transport mechanism in membranes

UNIT-I

Laws of thermodynamics, state functions, entropy enthalpy, equilibrium constant, coupled reactions, energy charge, ATP cycle, phosphorylation potential, phosphoryl group transfers. Chemical basis of high standard energy of hydrolysis of ATP, other phosphorylated compounds and thioesters. Redox reactions,

UNIT-II

Oxidative phosphorylation Mitochondria. Electron transport chain - its organization and function. Electron transport and its carriers-Complex I, II, III, IV; Inhibitors of ETC and uncouplers. Peter Mitchell's chemiosmotic hypothesis. Proton motive force. Fo - F1 ATP synthase, structure and mechanism of ATP synthesis.

Metabolite transporters in mitochondria. Regulation of oxidative phosphorylation. Oxidation and reduction enzymes, utilization of oxygen aby oxygenase's, superoxide dismutase and catalase. Respiratory control. Respiratory chain inhibitors and uncouplers of oxidative phosphorylation

UNIT – III

Photophosphorylation: General features of photophosphorylation, Hills reaction, photosynthetic pigments, Photophosphorylation in plants - structure of chloroplast, molecular architecture of Photosystem I and Photosystem II, Z-scheme of photosynthetic electron flow, oxygen evolving complex and action of herbicides. Cyclic photophosphorylation and its significance..

UNIT – IV

Composition of biomembranes - prokaryotic, eukaryotic, neuronal and subcellular membranes. Study of membrane proteins. Fluid mosaic model with experimental proof. Monolayer, planer bilayer and liposomes as model membrane systems. Polymorphic structures of amphiphilic molecules in aqueous solutions - micelles and bilayers. CMC, Membrane asymmetry.

UNIT – V

Membrane transport : Thermodynamics of transport. Simple diffusion and facilitated diffusion. Passive transport - glucose transporter, anion transporter and porins. Primary active transporters - P type ATPases,

V type ATPases, F type ATPases. Secondary active transporters - lactose permease, Na+-glucose symporter. ABC family of transporters - MDR, CFTR.

SEMESTER - IV

COURSE 9: BIOENERGETICS AND MEMBRANE BIOLOGY

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

Practical syllabus:

1. Effect of lipid composition on the permeability of a lipid monolayer
2. Determination of CMC of detergents.
2 RBC ghost cell preparation and to study the effect of detergents on membranes.
4. Separation of photosynthetic pigments by TLC.
5. Isolation of mitochondria from liver and assay of marker enzyme SDH.
6. Isolation of chloroplast from spinach leaves, estimation of chlorophyll and photosynthetic activity

Course Outcomes:

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

1. Gain knowledge on high energy compounds
2. Describe the importance of Electron transport and ATP production mechanism.
3. Describe about Photophosphorylation
4. Gain in knowledge in membrane structure and membrane transport.

Recommended Books

1. Principles of Biochemistry, White. A, Handler, P and Smith.
2. Biochemistry, Lehninger A.L.
3. Biochemistry, David E. Metzler.
4. Biochemistry, LubertStryer.
5. Text Book of Biochemistry, West and Todd.

SEMESTER - IV

COURSE 10: ENDOCRINOLOGY

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

Course Objectives:

1. To impart knowledge about various hormones and their mechanism of action
2. To understand the functions and abnormalities of thyroid and parathyroid gland
3. To inculcate knowledge on adrenal gland. To understand the role of pancreatic and gastrointestinal tract hormones.
4. To study the disorders associated with reproductive glands.

UNIT-I

Hormones, hormone secreted by various glands, tropic hormones of hypothalamus and Pituitary (functions only), Classification of hormones (Steroid, Amino acid derivatives, Peptide / Protein hormones), Hormone receptor interaction (Overview), Mechanism of action of hormones (membrane receptor, c-AMP, IP3- DAG, nuclear chromatin).

UNIT-II

Thyroid gland, functions of thyroid hormones, hypothyroidism – Goiter, Myxedema, hyperthyroidism- Exophthalmos, Natural goitrogens. Parathyroid gland, functions of parathyroid hormones, Rickets, Osteomalacia, Osteoporosis.

UNIT-III

Adrenal gland, functions of adrenal cortex hormones - cortisol, aldosterone, hypoadrenalism – Addison's disease, hyper adrenalism – Cushing's disease, functions of adrenal medullary hormones – epinephrine, Nor-epinephrine.

UNIT-IV

Pancreas, functions of pancreatic hormones- Insulin, Glucagon, Somatostatin, Diabetes mellitus (Type I & II), Insulinoma. Functions of Gastrointestinal hormones – Gastrin, Cholecystokinin, Secretin, Ghrelin, Leptin, Motilin, P- substance.

UNIT-V

Gonadal glands (Ovary, Testis), functions of gonadal hormones –Testosterone, Estrogen, Progesterone, Functions of Relaxin, Hypogonadism in males, PolyCystic Ovarian Syndrome (PCOS).

Course Outcomes:

1. Student can apply the knowledge in integration of body system by endocrines
2. Student can analyse the integration of thyroid hormones with metabolism and parathyroid hormones with calcium metabolism
3. Student can link the relationship between adrenal hormones with, neurotransmission, mineral and energy metabolism
4. Student can discuss the link between pancreatic and gastrointestinal hormones with diseases
5. Student can create awareness on gonadal systems and measures to prevent the reproductive disorders

SEMESTER - IV

COURSE 10: ENDOCRINOLOGY

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

Practical syllabus:

1. Microscopic observation of endocrine glands
2. Estimation of Protein by Lowry method.
3. Estimation of Protein by Biuret method.
4. Study of scavenging activity (Indirect method)
5. Estimation of plasma insulin by RIA- demonstration
6. Estimation of TSH by ELISA- demonstration

Course outcomes:

1. Students can estimate protein by Lowry and Biuret method.
2. Students can understand the estimation of Plasma insulin by RIA.
3. Students can understand estimation of Thyroid stimulating hormones by ELISA.

Recommended Books

1. Textbook of Medical physiology-Guyton & Hall, 11th Edition, Churchill Livingstone, 2004
2. Text book of Biochemistry with clinical correlations - Thomas M.Devlin, 6th Edition, John Wiley & Sons Inc. Publications, 2004.
3. Textbook of Medical Biochemistry–MN Chatterje & Rana Shinde, 8th Ed, Jaypee Pubs, 2013.
4. Human Anatomy & Physiology – Elaine N.Marieb, RN, 3rd Edition, The Benjamin/ Cummings Publishing Company, 1991.
5. Clinical Chemistry Concepts & Applications – Shauna C.Anderson, Susan Cockayne, 1993, W.B.Saunders Publishers, Tokya,
6. William's Textbook of Endocrinology- Larsen, Kronenberg, Melmed& Polonsky, 10th Edition, Saunders Publishers, 2003.
7. Mark's Basic Medical Biochemistry- A Clinical Approach, Colleen Smith, Allan D.Marks, Michael Lieberman, 2nd Edition, Lippincott Williams &Willkins, 2005.