

### Interdepartment Elective Offered to Other Departments

Course Code	Course Title	Hours/Week		C	Marks		
		L	P		CIA	ESE	Total
19BIOX215.1	Basic Biochemistry	3	-	3	25	75	100
19BIOX215.2	Basic Biotechnology	3	-	3	25	75	100
19BIOX315.1	Biochemical Techniques	3	-	3	25	75	100
19BIOX315.2	Immunology	3	-	3	25	75	100

#### 19BIOX 215.1 Basic Biochemistry

**Credits: 3**

**Hours: 3**

**Learning Objective (LO): To understand the structure, functions and metabolism of major biomolecules.**

Unit-1 Carbohydrates

Classification of carbohydrates. Functions of biologically important monosaccharides, disaccharides, homopolysaccharides, and heteropolysaccharides. Carbohydrate metabolism: glycolysis, citric acid cycle, gluconeogenesis, glycogen metabolism (overview only, structures not required). Diabetes mellitus (elementary details).

Unit-2 Amino Acids and Proteins

Amino acids: classification and acid-base properties. Biologically important peptides. Proteins - classification, functions, denaturation and renaturation. Orders of protein structure: Primary, secondary ( $\alpha$ -helix,  $\beta$ -pleated sheet), supersecondary, tertiary, and quaternary structures. Urea cycle, (overview only, structures not required).

Unit-3 Lipids

Classification of lipids. Structure and functions of cholesterol. Lipid metabolism:  $\beta$ -oxidation of fatty acids, biosynthesis of fatty acids (overview only, structures not required). Coronary heart disease (elementary details).

Unit-4 Enzymes

Enzymes: Classification and nomenclature. Specificity, factors affecting enzyme activity - substrate, pH and temperature. Michaelis-Menten equation and L-B plot. Coenzymes and Isoenzymes (brief account only). Allosteric enzymes. Applications of enzymes in clinical diagnosis, therapeutics and industry.

Unit-6 Nucleic acids

DNA structure - Watson and Crick model. A, B, and Z forms of DNA. DNA denaturation. Differences between DNA and RNA. Major classes of RNA- structure and biological functions.

#### **Text books**

1. Nelson and Cox. Lehninger Principles of Biochemistry. Freeman. 7<sup>th</sup> ed. 2017.
2. Rodwell et al. Harper's Illustrated Biochemistry. McGraw Hill. 31<sup>th</sup> ed. 2018.
3. Satyanarayana U. Biochemistry. Books and Allied Publ. 5<sup>th</sup> ed. 2017.

#### **Supplementary Reading**

Voet and Voet. Fundamentals of Biochemistry. Wiley. 5<sup>th</sup> ed. 2018.

#### 19BIOX 215.2 Basic Biotechnology

**Credits: 3**

**Hours: 3**

**Learning Objective (LO): To master the basic principles and applications of biotechnology.**

Unit-1 Bioprocess Engineering and Downstream Processing

Bioprocess engineering: Isolation and screening of industrially important microbes. Bioreactors - fermentation media. Downstream processing: solid-liquid separation, release of intracellular compartments, concentration of biological products, purification, preservation and stabilization. Industrial production of ethanol.

Unit-2 Environmental and Energy Biotechnology

Wastewater treatment - physical, chemical and biological treatment processes. Effluent treatment. Bioremediation, oil spill cleanup. Biodegradable plastics. Bioleaching- use of microorganisms in mining. Renewable sources of energy, biogas production.

Unit-3 Enzyme and Food Technology

Immobilization of enzymes: methods, and applications. Biosensors. Use of enzymes in detergents, textiles, leather and food industry. Production of glucose syrup. Methods of food preservation. Elementary idea of canning and packing. Basic principles of food fermentation. Production of beer.

Unit-4 Recombinant DNA Technology

Basic steps in cloning. Restriction endonucleases, cloning vectors e.g. pBR322. Introduction of rDNA into host cells by calcium phosphate coprecipitation, electroporation, lipofection, microinjection. Screening of recombinants by marker inactivation. Applications of rDNA technology.

Unit-5 Plant, Animal, and Medical Biotechnology

Biofertilisers. Biopesticides (*Bacillus thuringiensis*). Transgenic plant technology: gene transfer by *Agrobacterium*-mediated method, development and uses of transgenic plants. Development and uses of transgenic animals. Gene therapy - basic principles. The human genome project (elementary details). Hazards and safety aspects of biotechnology.

#### **Text Books**

1. John E. Smith. Biotechnology. Cambridge Univ Press. 5<sup>th</sup> ed. 2009.
2. Singh B.D. Biotechnology. Expanding Horizons. Kalyani Publ. 3<sup>rd</sup> ed. 2010
3. Nicholls DTS. Genetic Engineering. Cambridge Univ Press. 3<sup>rd</sup> ed. 2008.
4. Ratledge and Kristiansen. Basic Biotechnology. Cambridge Univ. Press. 3<sup>rd</sup> ed. 2006.

#### **Supplementary Reading**

Watson et al. Recombinant DNA. Sci Am Publ. 3<sup>rd</sup> ed. 2006.

### **19BIOX 315.1 Biochemical Techniques**

**Credits: 3**

**Hours: 3**

**Learning Objective (LO): To learn the principle, operation, and applications of various techniques for analyzing biomolecules.**

Unit-1 Spectroscopic Techniques

Laws of absorption and absorption spectrum. Principle, instrumentation and applications of UV-visible spectrophotometry, spectrofluorimetry and atomic spectroscopy.

Unit-2 Radioisotope Techniques

Nature and units of radioactivity. Detection and measurement of radioactivity - Geiger-Muller counter, solid and liquid scintillation counting. Autoradiography. Applications of radioisotopes in biology. Radiation hazards.

Unit-3 Electrophoresis and Blotting Techniques

Principle, technique and applications of PAGE, SDS-PAGE, agarose gel electrophoresis and isoelectric focusing. Blotting techniques: Southern and Western.

Unit-4 Chromatography

General principles of partition and adsorption chromatography. Principle, operation and applications of thin layer, ion-exchange, molecular exclusion, and affinity chromatography. HPLC - principle, instrumentation and applications.

Unit-5 Centrifugation

Basic principles. Types of centrifugation: analytical and preparative. Subcellular fractionation. Ultracentrifugation.

**Text Books**

1. Andreas Hofmann and Samuel Clokie. Wilson and Walker. Principles and Techniques of Biochemistry and Molecular biology. Cambridge University Press. 8<sup>th</sup> ed. 2018.
2. Upadhyay, Upadhyay and Nath. Biophysical Chemistry Principles and Techniques. Himalaya Publ. 2010.

**Supplementary Reading**

Rodney. F. Boyer. Modern Experimental Biochemistry. Pearson Education. Inc. 3<sup>rd</sup> ed. 2000.

**19BIOX 315.2 Immunology**

**Credits: 3**

**Hours: 3**

**Learning Objective (LO): To acquire knowledge on immunological mechanism and immunotechniques.**

Unit-1

Types of immunity - innate and acquired. Humoral and cell mediated immunity. Central and peripheral lymphoid organs. Cells of the immune system - lymphocytes, mononuclear phagocytes-dendritic cells, granulocytes, NK cells and mast cells. Antigens - antigenicity, epitopes, haptens. Immunoglobulins - structure, classification and functions.

Unit-2

T-cell, B-cell receptors, Antigen recognition - processing and presentation to T-cells. Immunological memory. Effector mechanisms - macrophage activation. Complement activation. Organization and expression of immunoglobulin genes. Generation of antibody diversity.

Unit-3

Transplantation types. MHC antigens in transplantation. Immunodeficiency disorders - AIDS: The HIV genome and life cycle. Autoimmunity and elementary details of autoimmune disorders (systemic lupus erythematosus).

Unit-4

Immunization practices - active and passive immunization. Vaccines - killed, and attenuated. Recombinant vaccines - DNA vaccines, synthetic peptide vaccines. Production of applications of polyclonal and monoclonal antibodies.

Unit-5

Agglutination and precipitation techniques. Immunoelectrophoresis, RIA, Immunoblotting, Avidin-biotin mediated immunoassay. Immunohistochemistry, immunofluorescence. ELISA - principle and applications.

**Text Books**

1. Jenni Punt, Sharon Stranford et al. Kuby Immunology. WH Freeman & Co. 8<sup>th</sup> ed. 2018.
2. Abbas et al. Cellular and Molecular Immunology. Elsevier. 9<sup>th</sup> ed. 2018.
3. Janeway, C. (Ed), Paul Travers. Immunobiology. Garland Publ. 9<sup>th</sup> ed. 2016.
4. Coico and Sunshine. Immunology: A short course. Wiley. 7<sup>th</sup> ed. 2015.

**Supplementary Reading**

Roitt et al. Essential Immunology. Willey-Blackwell Sci. 13<sup>th</sup> ed. 2017.

**M.Sc – Integrated(5 Years)  
Ancillary Offered to Other Departments  
19IBTA15: Biochemistry- Paper I**

**Credits: 4**

**Hours: 4**

**Learning Objective (LO): To learn about laws of thermodynamics, basics of enzymology, structure and functions of amino acids, proteins, carbohydrates and lipids.**

Unit-1 Bioenergetics

Laws of thermodynamics. Basic concepts of free energy, entropy and enthalpy. Standard free energy change. Exergonic and endergonic reactions. Bioenergetics: high energy phosphate compounds, the ATP/ADP cycle. Electron transport chain: components. Oxidative phosphorylation - Chemiosmotic theory. Introduction to metabolism-anabolism and catabolism.

Unit-2 Enzymes

Nomenclature and classification. Enzyme units. Factors affecting enzyme activity - substrate, pH, and temperature. Michaelis-Menten equation and Lineweaver Burk plot. Enzyme inhibition- competitive, non-competitive and uncompetitive (derivation of rate equation not required), allosteric enzymes, feedback inhibition. Coenzymes and isoenzymes. Applications of enzymes in clinical diagnosis and therapy.

Unit-3 Carbohydrates

Classification and general properties of carbohydrates. Biologically important monosaccharides and disaccharides. Homopolysaccharides: structure and biological functions of starch, glycogen, and cellulose. Heteropolysaccharides: biological role of glycosaminoglycans. Carbohydrate metabolism- glycolysis, citric acid cycle, gluconeogenesis, glycogen metabolism.

Unit-4 Amino acids and Proteins

Classification. Biologically important peptides. Proteins - classification, functions, and denaturation. Orders of protein structure: Primary, secondary ( $\alpha$ -helix,  $\beta$ -pleated sheet), supersecondary, tertiary, and quaternary structures. Urea cycle, catabolism of carbon skeletons (overview only). Conversion of amino acids to specialized products.

Unit-5 Lipids and Biomembrane

Classification of lipids. Structure and functions of cholesterol. Brief account of lipoproteins. Lipid metabolism:  $\beta$ -oxidation of fatty acids, biosynthesis of fatty acids. Biosynthesis of ketone bodies, utilization and clinical significance. Membrane structure - lipid bilayer, integral and peripheral proteins, the fluid mosaic model.

Text Books

1. Nelson and Cox. Lehninger Principles of Biochemistry. Freeman, 7<sup>th</sup> ed. 2017.
2. Rodwell et al. Harper's Illustrated Biochemistry. McGraw Hill. 31<sup>th</sup> ed. 2018.
3. Satyanarayana U. Biochemistry. Books and Allied Publishers, 5<sup>th</sup> ed. 2017.

Supplementary Reading

Voet and Voet. Fundamentals of Biochemistry. Wiley. 5<sup>th</sup> ed. 2018.

**19IBTA26: Biochemistry-Paper II**

**Credits: 4**

**Hours: 4**

**Learning Objective (LO): To acquire a comprehensive knowledge on biomolecules and their functions and biochemical basis of diseases.**

Unit -1 Vitamins and minerals.

Sources, requirements, biological actions and clinical significance of fat-soluble (A, D, E, and K) and water-soluble (thiamine, riboflavin, niacin, pyridoxine, pantothenic acid, biotin, folic acid and vitamin B<sub>12</sub>) vitamins. Biological functions and clinical significance of calcium, phosphate, and iron.

Unit-2 Nucleic Acids

DNA structure - Watson and Crick model. A, B, and Z forms of DNA. DNA denaturation. Differences between DNA and RNA. Major classes of RNA - structure and biological functions. Minor classes of RNA.

Unit-3 DNA and RNA biosynthesis

The central dogma of molecular biology. DNA replication- enzymes, basic mechanism and inhibitors. DNA damage. DNA repair - photoreactivation, excision repair. Transcription - RNA polymerase, overview of steps, inhibitors. Brief account of post-transcriptional modifications. Reverse transcription (concept only).

#### Unit- 4 Translation and Recombinant DNA Technology

Genetic code-general features. Translation-steps. Inhibitors. Post-translational modifications. The lac operon model.

Recombinant DNA technology: Basic steps in cloning. Restriction endonucleases, cloning vectors (e.g. pBR322). Gene transfer methods (electroporation, lipofection, microinjection). Screening of recombinants by marker inactivation. Applications of rDNA technology.

#### Unit-5 Nutritional and biochemical disorders

BMR. Essential amino acids and fatty acids. Protein quality. Protein energy malnutrition: marasmus and kwashiorkor. Obesity: causes and consequences. Inborn errors of metabolism (PKU only). Diabetes mellitus: classification, diagnosis, management. Atherosclerosis: risk factors, and management. Jaundice: classification, diagnosis and management.

#### Text Books

1. Nelson and Cox. Lehninger Principles of Biochemistry. Freeman, 7<sup>th</sup> ed. 2017.
2. Rodwell et al. Harper's Illustrated Biochemistry. McGraw Hill. 31<sup>th</sup> ed. 2018.
3. Nicholls DTS. An Introduction to Genetic Engineering. Cambridge Univ Press. 3<sup>rd</sup> ed. 2008.
4. Satyanarayana U. Biochemistry. Books and Allied Publishers. 5<sup>th</sup> ed. 2017.

#### Supplementary Reading

1. J. L. Jain Fundamentals of Biochemistry. 7<sup>th</sup> ed.
2. Voet and Voet. Fundamentals of Biochemistry. Wiley. 5<sup>th</sup> ed. 2018.

### **19IBTP27: Biochemistry Practical (Ancillary)**

**Credits: 4**

**Hours: 4**

**Learning Objective (LO): To learn the preparation of solutions and analyze biomolecules.**

1. Preparation of buffers.
2. Qualitative analysis of carbohydrates
3. Qualitative analysis of amino acids.
4. Estimation of protein by Biuret/Lowry et al method
5. Determination of acid number/iodine number/saponification value of a fat.
6. Separation of lipids by TLC (demonstration)
7. Estimation of ascorbic acid in lemon.
8. Isolation of DNA from rat liver and estimation of DNA by diphenylamine method.
9. Estimation of RNA by orcinol method.
10. Estimation of glucose.
11. Estimation of cholesterol.

#### Supplementary Reading

1. David Plummer. An Introduction to Practical Biochemistry. Paperback. 2017.
2. Alan H. Gowenlock. Varley's Practical Clinical Biochemistry. CBS. 6<sup>th</sup> ed. 2006
3. Todd & Stanford. Clinical Diagnosis and Management by Laboratory Methods. 16<sup>th</sup> ed. 2016.