University of PYAY

Department of Chemistry

Syllabus for BSc Degree

Biochemistry Specialization

2019–2020

First Year (Semester I)

Module No. BC 1101

CHAPTER I

1. QUANTUM NUMBERS AND ELECTRON CONFIGURATIONS

CHAPTER II

2. THE FOUNDATIONS OF CHEMISTRY

4.2.4.1 Complex Biomolecules (proteins, nucleic acids, carbohydrates, fats

4.3 Cellular Foundation

4.3.1 Cells are Structural and Functional Units of All Living Organisms

4.3.1.1 Prokaryotes and Eukaryotes

4.3.1.2 Plant Cell and Animal Cell

4.3.1.3 Introduction to Cell Organelles

(i) Cell Wall

(ii) Cytoskeleton

(iii) The Genetic Material

(iv) Ribosomes and Protein Production

(v) Role of the Endoplasmic Reticulum

(vi) Mitochondria

(vii) Chloroplasts

(viii) Golgi Apparatus

(ix) Peroxisomes

(x) Vacuoles

(xi) Lysosomes

4.3.2 Experimental Approach

4.3.2.1 Isolation of Molecules

4.3.2.2 Determination of the Structure of Biomolecules

4.3.2.3 Analysis

First Year (Semester II)

Module No. BC 1102

(I) Carbohydrates of Biochemical Importance

- Monosaccharides
- Hexoses
- Glycosides
- Deoxy sugars
- Amino sugars (Hexosamines)
- Disaccharides
- Polysaccharides
- Carbohydrates of cell membrane

(II) Water and pH

- Body water, intracellular fluid and extracellular fluids
- Water as ideal biologic solvent
- Hydrogen bonds and molecular structure
- Water as a nucleophile
- Ionization of water
- pH
- Buffer solution

Second Year (Semester I)

Module No. BC 2101

1.Introduction to Biomolecules

1.1 Biomolecules

1.1.1 Properties of Biomolecules

1.1.2 Types of Biomolecules

2. Carbohydrates

2.1 Classification

2.2 Structure and Chemistry of Monosaccharides

2.3 Stereochemistry

2.4 Cyclic and Anomeric Forms of Monosaccharides

2.5 Reactions of the Monosaccharides

2.5.1 Mutarotation

2.5.2 Glycoside formation

2.5.3 Reduction and oxidation

2.5.4 Epimerization

2.5.5 Esterification

2.6 Important Monosaccharides

2.7 Disaccharides

2.7.1 Maltose

2.7.2 Lactose

2.7.3 Sucrose

2.8 Oligosaccharides

2.9 Polysaccharides

2.9.1 Important Polysaccharides

3. Lipids

3.1 Fatty Acids

3.1.1 Characteristics

3.1.2 Function

Module No. BC 2103

1. SEPARATION TECHNIQUES

1.1 Introduction

1.1.1 Classification of Separation Techniques

1.2 General Methods of Separation

1.2.1 Zonal Methods

1.2.2 Frontal Methods

1.2.3 Displacement Methods

2. CHROMATOGRAPHY

2.1 History of Chromatography

2.1.1 Paper Chromatography

2.1.2 Thin Layer Chromatography

2.1.3 Ion Exchange Chromatography

2.1.4 Gel Permeation Chromatography

2.1.5 Affinity Chromatography

2.1.6 Gas Chromatography

2.1.7 Supercritical Fluid Chromatography

2.1.8 High Performance Liquid Chromatography

2.1.9 Capillary (Zone) Electrophoresis

3. ELECTROPHORESIS

3.1 Introduction

3.2 General Features of Electrophoresis

3.3 Native protein electrophoresis

3.4 Polyacrylamide Gel Electrophoresis in The Presence of SDS (SDS–PAGE)

3.4.1 Gradient PAGE

3.5 Isoelectric Focusing

3.6 2D Electrophoresis

3.7 Staining, Densitometry and Blotting

5.4 Mass Spectrometry

5.4.1 The Mass Spectrum Fragmentation

5.5 Infrared Spectroscopy

5.5.1 Stretching and Bending Vibrations

5.5.2 Obtaining an Infrared Spectrum

5.5.3 The Functional Group and Fingerprint Regions

6. FLUOROMETRY

6.1 Introduction to Fluorescence

6.1.1 Phenomena of Fluorescence

6.1.2 Jablonski Diagram

6.1.3 Characteristics of Fluorescence Emission

REFERENCES

Second Year (Semester II)

Module No. BC 2104

(I) Nutrition

- Nutrient requirements in human
- Energy requirements in human
- Macronutrient
- Minerals
- Dietary recommendation
- Nutrition and chronic diseases
- Protein–calorie malnutrition

Module No. BC 2105

(I) Biochemistry of Digestion and Absorption

- Digestion of carbohydrates
- Protein digestion
- Gastric juice composition
- Proteolytic enzymes
- Pepsin, Trypsin, Chymotrypsin

- Digestion of lipids
- Absorption from the gastrointestinal tract
- Enzyme deficiency

Module No. BC 2106

(I) Proteins

- Myoglobin and Haemoglobin
- Function of myoglobin and haemoglobin
- The oxygen dissociation curve
- Mutant human haemoglobins

Third Year/ First Year Honours (Semester I)

Module No. BC 3101/ 3201

(I) Basic Concepts of Metabolism

- Metabolic map
- Catabolic and Anabolic pathway
- Regulation of metabolism
- Transduction by intracellular receptors
- Transduction by cell–surface receptors
- Intracellular messenger systems

(II) Bioenergetics and Oxidative Phosphorylation

- Free energy
- ATP as an energy carrier
- Electron transport chain
- Oxidative phosphorylation

Module No. BC 3102/ 3202

(I) Glycolysis

- Transport of glucose into cells
- Reactions of glycolysis
- Alternate takes of pyruvate
- Energy yield of glycolysis

- Clinical notes
- Hormonal regulation of glycolysis

Module No. BC 3103/ 3203

(I) Citric Acid Cycle

- Reaction of the citric acid cycle
- Stoichiometry of the citric acid cycle
- Regulation of the citric acid cycle

(II) Hexose Monophosphate Pathway and Uronic Acid Pathway

- Oxidative reactions
- Non–oxidative reactions
- Uses of NADPH
- Glucose–6–phosphate dehydrogenase deficiency
- Uronic acid pathway

Module No. BC 3104/ 3204

(I) Glycogen Metabolism

- Structure and function of glycogen
- Synthesis of glycogen
- Degradation of glycogen
- Regulation of glycogen synthesis and degradation
- Glycogen storage diseases

(II) Gluconeogenesis

- Reaction unit to gluconeogenesis
- Substrates for gluconeogenesis
- Regulation of gluconeogenesis

Third Year / First Year Honours (Semester II)

Module No. BC 3105/ 3205

(I) Metabolism of Monosaccharides and Disaccharides

- Fructose Metabolism
- Galactose Metabolism
- Lactose Metabolism

(II) Glycosaminoglycans

- Structure of glycosaminoglycans
- Structure of proteoglycans
- Synthesis of glycosaminoglycans
- Degradation of glycosaminoglycans
- Micopolysaccharidoses

(III) Glycoproteins

- Structure of glycoproteins
- Synthesis of glycoproteins
- Lysosomal degradation of proteins

Module No. BC 3106/ 3206

(I) Fatty Acid and Triacylglycerol Metabolism

- Structure of fatty acid
- De Novo synthesis of fatty acid
- Mobilization of stored fats and oxidation of fatty acids
- Specialized fatty acids
- Ketone bodies

Module No. BC 3107/ 3207

(I) Phospholipid Metabolism

- Structure of phospholipids
- Synthesis of phospholipids
- Degradation of phospholipids

Module No. BC 3108/ 3208

(I) Cholesterol and Steroid Metabolism

- Structure of cholesterol
- Synthesis of cholesterol
- Degradation of cholesterol
- Bile acids and bile salts
- Plasma lipoproteins
- Steroid hormones

Fourth Year/ Second Year Honours (Semester I)

Module No. BC 4101/ 4201

(I) Amino Acid Metabolism

- Removal of nitrogen from amino acids
- Metabolism of ammonia
- Urea cycle
- Biosynthesis of non–essential amino acids

(II) Nitrogen Metabolism

- Overall nitrogen metabolism
- Digestion of dietary proteins
- Transport of amino acid into cell
- Catabolism of the carbon skeletons of amino acids
- Role of folic acid in amino acid metabolism
- Metabolic defects in amino acid metabolism

Module No. BC 4102/ 4202

(I) Glycolipid Metabolism

- Structure of glycosphingolipids
- Synthesis of glycosphingolipids
- Degradation of glycosphingolipids
- Sphingolipiddoses

Module No. BC 4103/ 4203

(I) Enzyme Catalysis

5 Role of cofactors in enzyme catalysis: NAD/NADP+, FMN/FAD, conenzyme A, biotin, TPP, pyridoxal phosphate, cobalamin, tetrahydrofolate

(II) Enzyme Kinetics

Module No. BC 4104/ 4204

(I) Porphyrin Metabolism

(II) Nucleotide Metabolism

Module No. BC 4105/4205

(I) Research Methodology

- Basic Concept of Research Methodology
- Literature Survey
- Research Design
- Data Collection and Analysis
- Report Writing and Presentation

Module No. BC 4106/4206

(I) Clinical Biochemistry I

Fourth Year/ Second Year Honours (Semester II)

Module No. BC 4107/ 4207

(I) Vitamins

- Vitamin supplements
- Water–soluble vitamins
- Fat–soluble vitamins
- Deficiency diseases

Module No. BC 4108/ 4208

(I) Metabolism of Xenobiotics

Module No. BC 4109/ 4209

(I) Molecular Biology I

- Basic concepts of genetic information
- Structural levels of nucleic acids

Module No. BC 4110/ 4210

(I) Medical Biochemistry

- Mechanism of action at molecular level of selected antibiotics, anti metabolites, analgesics, hallucinogens and other drugs, mechanism of resistance to antibiotics and other drugs
- Lysosomes and their physiological role
- Cerebrospinal fluid, composition in health and disease

- Blood coagulation, clotting factors, mechanism of coagulation

Module No. BC 4111/4211

(I) Nutritional Biochemistry I

- Overview
- Tables of Inorganic Nutrients
- Sodium, Potassium, Chloride, and Water
- Iodine
- Iron
- Calcium and Phosphate
- Magnesium
- Manganese
- Zinc and Copper
- Molybdenum, Sulfite and Sulfate
- Selenium and Glutathione
- Other Inorganic Nutrients

Module No. BC 4112/4212

(I) Clinical Biochemistry II

Third Year Honours/ MSc (Qualifying) (Semester I)

Module No. BC 5201

(I) Environmental Biochemistry I

Air pollution

- Particular matter
- Compounds of carbon, sulphur, nitrogen and their interactions
- Methods for their estimation
- Their effects on atmosphere

Module No. BC 5202

(I) Hormones I

- Introduction
- Classification of hormones
- Mechanism of hormones action
- Hormone that regulate fuel metabolism
- Hormone that regulate salt and water balance

Module No. BC 5203

(I) Introduction to Secondary Metabolism I

Module No. BC 5204

(I) Molecular Biology II

- DNA replication
- Transcription
- Translation and regulations of gene expression
- Mutation and repair
- Recombinant DNA technology

Module No. BC 5205

(I) Separation Methods of Enzymes, Amino Acids, Proteins and Nucleic Acids

Module No. BC 5206

(I) Biochemical Techniques I

Basic Principles of Biochemical Technology

- Protein purification
- Protein analysis
- DNA analysis
- Fragmentation
- Gel–electrophoresis
- Sanger Dideoxy method
- The polymerase chain reaction

Third Year Honours/ MSc (Qualifying) (Semester II)

Module No. BC 5207

(I) Environmental Biochemistry II

Water pollution

- Types of water bodies and their general characteristics
- Major pollutants in domestic, agricultural and industrial wastes
- Methods of their estimation
- Effects of pollutants on plants and animals
- Treatment of domestic and industrial wastes, solid–wastes and their treatments

Module No. BC 5208

(I) Hormones II

- Hormones that regulate calcium and phosphate metabolism
- Hormones that regulate body size and metabolism
- Hormones that regulate the male reproductive splim
- Hormones that regulate the female reproductive splim

Module No. BC 5209

(I) Introduction to Secondary Metabolism II

Module No. BC 5210

(I) Bioenergetics and Radioisotopic Techniques

Module No. BC 5211

(I) Biochemical Techniques II

6 Chromatography

Module No. BC 5212

(I) Nutritional Biochemistry II

- Overview
- Cancer of the Large Bowel
- Genetic Changes that Result in Cancer
- RAS and the MAP Kinase Signaling Pathway
- Mutations in the RAS Gene and Cancer
- Cadherin Protein
- Epidemiology of Diet and Colon Cancer
- Summary