COURSE OF STUDIES

for

Master of Philosophy

in

<BIOCHEMISTRY >

UNIVERSITY OF HEALTH SCIENCES, LAHORE PAKISTAN

Program Rationale:

Mission:

To provide a comprehensive and advanced education in biochemistry that emphasizes critical thinking, research skills, and practical application. We aim to prepare students for successful careers in academia, industry, and beyond by fostering a deep understanding of biochemical principles, promoting innovative research, and encouraging interdisciplinary collaboration.

Vision:

To be a premier program in biochemistry, known for our commitment to academic excellence, cutting-edge research, and impactful contributions to science and society. We strive to empower our graduates to become leaders in their fields, capable of addressing global challenges in health, environment, and biotechnology through their expertise and innovative solutions.

Course Objectives:

The objectives of M.Phil. program in Biochemistry is to provide students with a comprehensive understanding of human metabolic processes, hormones and their related disorders, acid-base imbalances in the body, and the significance of clinical enzymology. In addition, the program targets to impart advanced knowledge of xenobiotics, drug metabolism, and nutrition. This program also includes a course on biochemical techniques, which aims to provide students a sound understanding of important laboratory techniques used in research.

Program Learning Outcomes:

By studying these topics in depth, students will be able to develop a thorough understanding of the biochemical basis of human health and disease. This knowledge will be invaluable for those who want to pursue a career in research or academia, as well as those who want to work in the biotechnology, pharmaceutical, or healthcare industries.

SCHEME OF STUDIES (2-Year)

MS/MPhil BIOCHEMISTRY

Semester #	Course code	Course title	Credit hours		
			Theory	Practical	Total
1		Biostatistics and Research Methodology	02	0	2
	BCH-701	**Metabolic& Clinical Biochemistry**	02	01	8
	BCH-702	**Hormones in Health and Diseases**	02	0	
	BCH-703	**Cell Communication and Intracellular Signaling**	01	0	
	BCH-704	**Biochemical Regulation &Disorder of Acid base balance.**	02	0	
		Elective Course	02	0	2
2	BCH-705	**Clinical Enzymology**	02	01	8
	BCH-706	**Molecular cell biology**	02	0	
	BCH-707	**Advanced Diet and Nutrition**	01		
	BCH-708	**Biochemical Techniques**	02	0	
		Elective Course	2	0	2
3	Research (thesis)		6		6
4	Professional & Teaching Skills Apprenticeship (PTSA)		0		2
(Total: 30)					

Course Title

BCH-701 Metabolic& Clinical Biochemistry

Contact Hours:	Credit Hours:
Theory =	Theory =2
Practical =	Practical = 1
Total =	Total =3

Course Objective:

Students will able to describe the concept of anabolism, catabolism and role of high energy compounds in the cell. They will acquire knowledge related to regulation of various pathways. The importance of high energy compounds, electron transport chain, synthesis of ATP under aerobic and anaerobic conditions will be understood. The role of TCA cycle in central carbon metabolism, importance of anaplerotic reactions, redox balance will be explained.

Learning Outcome:

Students will become aware of the variations in the levels of metabolism of biomolecules and their relationship with various diseases.

Course Outline:

- **Classification and biological role of Carbohydrates, Proteins, Lipids, Nucleic acids**

Bioenergetics and energy metabolism

- Concept of metabolism
- Digestion, absorption, transport, and incorporation of biomolecules Carbohydrates, Proteins, Lipids, Nucleoproteins

- Bioenergetics
  - Oxidative phosphorylation including electron transport chain
  - Photophosphorylation
  - Inhibitors and uncouplers

Metabolism and related Disorder of Macromolecules.

- **Carbohydrate metabolism**
  - Metabolic pathways of carbohydrates and their regulation
    - Glycolysis, TCA, Gluconeogenesis, HMP shunt, Glycogenesis and Glycogenolysis, Glycogenic cycle, Glycogen storage diseases
- **Proteins metabolism**
  - Metabolic pathways of proteins and their regulation
    - Nitrogen economy and their regulations
    - Anabolism and catabolism of aromatic and aliphatic amino acids
    - Anabolism and catabolism of sulfur containing amino acids
    - Anabolism and catabolism of branched chain amino acids
    - Anabolism and catabolism of hydroxyl GP containing amino acids
    - Anabolism and catabolism of acidic and basic amino acids
    - Detoxification of Ammonia in human (urea cycle)
    - Inborn errors of protein metabolism
    - Functions of plasma proteins
- **Heme and hemoglobin metabolism**
  - Biochemistry of heme and hemoglobin
  - Metabolism of heme and hemoglobin (synthesis and degradation of hemoglobin)
  - Porphyria

- **Lipids and fatty acids metabolism**
  - Metabolic pathways of lipids and their regulation
    - Synthesis of fatty acids
    - Oxidation of fatty acids
    - Phospholipids
    - Cholesterol synthesis (Steroids and prostaglandins)
    - Lipid storage diseases
- **Nucleic acids metabolism**
  - Metabolic pathways of nucleic acid and their regulation
    - Biosynthesis and degradation of purines and pyrimidines
  - Disorders of nitrogen metabolism

Practical's:

To study cell organelles by separating from the cell
Preparation of plasma and serum
Understanding the lab hazards and safety guidelines
Understanding the preparation of solutions
Spectrophotometer
Estimation of Glucose
To estimate the Glucose by OGTT
Estimation of total cholesterol level
Estimation of triglycerides
Estimation of HDL cholesterol
Estimation of LDL cholesterol
Estimation of total proteins
Estimation of Albumin

The learning outcomes include: estimation of glucose, lipid and protein in blood samples. students will acquire practical training for estimation of clinically important compounds like blood glucose, cholesterol, hemoglobin and calcium, etc. This will enable the students to perform diagnostic tests for the diseases related to varying levels of these compounds/chemicals.

Recommended Books:

Clinical Chemistry, Ninth Edition, International Edition, Willam Marshall

Harper's 31 Edition, Rodwell Et.al

Lippencott, Biochemistry Eight Edition

Course Title

BCH-702: Hormones in Health and Diseases

Contact Hours:	Credit Hours:
Theory =	Theory =2
Practical =	Practical = 0
Total =	Total =2

Course Objective:

The main aim of this course inculcates the concept of hormone chemistry, synthesis, degradation, functions, hyper and hypo states of the hormones.

Learning Outcome:

Students will gain awareness about the chemical manifestation of hyper and hypo stat of hormone.

Course Outline:

Chemistry, synthesis, degradation, functions, hyper and hypo states of the following hormones:

- Insulin
- Glucagon
- Thyroid
- Adrenal cortical hormone
- Adrenal medullary hormone
- Parathyroid hormone
- Follicle stimulating hormone
- Luteinizing hormone
- Adreno cortical tropic hormone
- Thyroid stimulating hormone
- Oxytocin
- Antidiuretic

- Cell signaling
  - Composition and chemistry of membranes of the cells and organelles
  - Receptors and transport channels
  - Second messenger system
  - Ca, IP3 mechanism
  - Role of the G proteins
  - Protein kinases/Tyrosine Kinases
  - Nitric oxide synthase

Recommended Books:

Clinical Chemistry, Ninth Edition, International Edition, Willam Marshall

Harper's 31 Edition, Rodwell Et.al

Lippencott, Biochemistry Eight Edition

Course Title

BCH-703: Cell Communication and Intracellular Signaling

Contact Hours:	Credit Hours:
Theory =	Theory =1
Practical =	Practical = 0
Total =	Total =1

Course Objective:

The course aims to explains the general principles of cellular signals transduction. Moreover, it will be discussed how cells respond to physiological cues such as hormones and neuronal signals.

Learning Outcome:

After completion of the course the student will be able to discuss the different types of cell communication, including the signal molecules, and understand the importance of cell signaling for normal human body function.

- Cell signaling
  - Composition and chemistry of membranes of the cells and organelles
  - Receptors and transport channels
  - Second messenger system
  - Ca, IP3 mechanism
  - Role of the G proteins

- Protein kinases/Tyrosine Kinases
- Nitric oxide synthase

Recommended Books:

Harper's 31 Edition, Rodwell Et.al

Lippencott, Biochemistry Eight Edition

Molecular biology of THE CELL ,6th edition

Course Title

BCH-704: Biochemical Regulation and Disorder of Acid Base Balance.

Contact Hours:	Credit Hours:
Theory =	Theory =2
Practical =	Practical = 0
Total =	Total =2

Course Objective:

The lecturer will be delivered to enable the student to understand the pH, buffers and mechanism of different types of buffering and its management.

Learning Outcome:

students will be able to elaborate role of chemical and physical buffering to maintain Hydrogen ion concentration in blood.

Course Outline:

- pH
    - Acidosis
    - Alkalosis
    - Henderson-Hasselbalch equation
    - Dissociation of water and concept of Buffers
- Mechanism of pH Regulation
    - Chemical Buffers
    - Plasma protein buffer
    - Hemoglobin Buffers
    - $HHbO_2$ & HbO_2 buffer
    - HHB & Hb buffer
    - Phosphates
    - H_2CO_3 & HCO_3 buffer
- Physiological Buffeters
- Respiratory and Metabolic Mechanism:
- Causes, Mode of action, compensation, biomedical importance and management of:
    - Respiratory acidosis and alkalosis
    - Metabolic acidosis and alkalosis

Recommended Books:

Textbook of Biochemistry with clinical correlation.

Harper's 31 Edition, Rodwell Et.al

Lippencott, Biochemistry Eight Edition

Clinical Chemistry, Ninth Edition, International Edition, Willam Marshall

Course Title

BCH-705: CLINICAL ENZYMOLOGY Credit Hours. 2+1

Contact Hours:	Credit Hours:
Theory =	Theory =2
Practical =	Practical = 1
Total =	Total =3

Course Objective:

This course will provide fundamental knowledge of enzymes and their mode of action and discus how enzyme imbalance responsible for different disease.

Learning Outcome:

After completion of this course students will be able to understand about the normal function of liver, kidney and heart enzymes in blood and their significance in maintaining good health and also get acquainted with the role of enzymes in diagnosis of various disease

Course Outline:

- Enzymology
  - Nomenclature, Units, Coenzymes, Cofactors
  - Classification

- Factors affecting enzyme activity
- Regulatory enzymes
  - Allosteric activity
  - Covalent modification
  - Isoenzymes
  - Inhibition of enzymes
  - Others
- RNA as an enzyme
- Clinical importance of enzymes
- Kinetics of enzymes
  - Michaelis Menton equation
  - Lineweaver Burk equation

Enzymology and function of specialized tissues.

- Liver function tests
  - Biochemical functions of liver
  - Pathophysiology and clinical presentation of liver diseases
  - Lab diagnosis and interpretation of liver function tests
- Cardiac markers
  - Basic biochemistry and tissue distribution
  - Clinical utility of cardiac markers
  - Lab diagnosis of Myocardial Infarction
- Tumor markers
  - Introduction to tumor markers
    - Clinical applications of tumor markers
    - Specific tumor markers
- Renal Function Tests
  - Diagnosis and screening of renal diseases
  - Types of renal failure, the uremic syndrome, and nephrotic syndrome
  - Renal function tests
  - Disorders of acid-base balance; acidosis, alkalosis their types and compensation
  - Tubular transport Machinarium, role in acid base balance
- Lunges. Role in acid base balance, surfactant system

Practicals:

Biomarkers
Tumor markers
Introduction to Liver Function Tests
Estimation of bilirubin

Estimation of Aspartate aminotransferase (AST)
Estimation of Alanine transaminase (ALT)
Estimation of Alkaline Phosphatase (ALP)
Introduction to Renal Function Tests
Estimation of Urea
Estimation of Uric Acid
Estimation of Creatinine
Estimation of Creatinine Clearance

They will be in a position to interpret enzyme level with clinical conditions of the individuals.

Recommended Books:

Harper's 31 Edition, Rodwell

Clinical Chemistry, Ninth Edition, International Edition, Willam Marshall

Lippencott, Biochemistry Eight Edition

Course Title

BCH-706 Molecular cell Biology

Contact Hours:	Credit Hours:
Theory =	Theory =02
Practical =	Practical =
Total =	Total =02

Course Objective:

This course aim to deliver the metabolism of xenobiotics. How genetic information flow in direction from DNA to RNA to make functional protein and how mutation cause diseases.

Learning Outcome:

The students will be able to demonstrate central dogma and how xenobiotic metabolize in body.

Course Outline:

- Xenobiotics metabolism
- Phases and reactions of detoxification
- Medical genetics and biotechnology
- Genes, chromosomes, central dogma
- Cell cycle
- Mendelian laws of inheritance (pedigree) analysis
- Autosomal inheritance
- Mitochondrial inheritance
- X-linked diseases
- Y-linked diseases
- Monogenic and multifactorial inheritance pattern
- Identifying human gene diseases
- Replication and proof reading

- Transcription - post transcriptional modifications
- Translation – post translational modifications
- Human genome project and mutation
- Genetic engineering
    - Plasmid, vector, translocation
    - Cloning
    - Recombinant DNA technology
    - Nucleic acid sequencing

Recommended Books:

Molecular biology of THE CELL ,6th edition

Harper's 31 Edition, Rodwell Et.al

Lippencott, Biochemistry Eight Edition

Course Title

BCH-707 Advanced Diet and Nutrition

Contact Hours:	Credit Hours:
Theory =	Theory =01
Practical =	Practical =
Total =	Total =01

Course Objective:

Nutrition and Dietetics is an emerging field of healthcare. This course will provides an integrated study of specialized food in different disease and lifestyle interventions in the management of lifestyle disorders

Learning Outcome:

The student will able to make specialized dietary plan in Diabetes, pregnancy, obesity, cardiac and renal disease. They will be well understanding the role of vitamin and mineral as cofactor in different pathway and their role in normal healthy growth and disease

Course Outline:

- Advance Nutrition
    - Food in health
    - Balanced diet and its composition
    - Diet for
        - Newborn (0-6 month)
        - Infants (7-1 year)
        - Children (1.1 – 12 years)
        - Teenagers (13 – 19 years)
        - Adults (20- 45 years)
        - Old age (46 – 70 years)

- Diet for pregnant and lactating women
- Diet for ailments (hypertensive, cardiac and renal patients)
- Diet for obese and patients with malnutrition (Marasmus, Kwashiorkor)
- Diet for diabetic patients
- Diet for diarrhea patients
- BMR, PM, Caloric value
- Composition and caloric value in commercially available commodities

- Vitamins
    - Basic concept and classification of vitamins
    - Sources, absorption, and excretion of vitamins
    - Biochemical functions and deficiencies of water-soluble vitamins
    - Biochemical functions and deficiencies of fat-soluble vitamins
- Minerals and trace elements
    - Biochemistry and functions of essential trace elements
    - Clinical application of deficiency and toxicity of trace elements

Recommended Books:

Harper's 31 Edition, Rodwell Et.al

Lippencott, Biochemistry Eight Edition

Course Title

BCH-708 BIOCHEMICAL TECHNIQUES

Contact Hours:	Credit Hours:
Theory =	Theory =2
Practical =	Practical = 0
Total =	Total =2

Course Objective:

The aim of this course is to reinforce and extend knowledge of fundamental principles behind several basic and more advanced techniques commonly used in biochemical research.

Learning Outcome:

The students will get equipped with the latest techniques used in analysis of biomolecules and this will help them in undertaking further research in the area of biochemistry in any research/industrial institution.

Course Outline:

- **Cell fraction Technique**
  - Centrifugation
  - Introduction & principal
    - Differential Centrifugation
    - Density gradient centrifugation
    - Ultracentrifugation
  - Chromatography
  - Introduction &classification
    - Classification of chromatography
    - Paper chromatography
    - Thin layer chromatography

- Column chromatography
    - Adsorption chromatography
    - Gel filtration chromatography
    - Ion exchange chromatography
    - Gass chromatography
    - High performance liquid chromatography
    -
- Electrophoresis
- Introduction, principal &classification
    - Paper electrophoresis
    - Starch gel electrophoresis
    - Polyacrylamide gel electrophoresis
    - Agarose gel electrophoresis
- Spectroscopy
- Introduction
- Spectroscopy techniques in biochemical investigation
    - Gama (ϒ) and *X*-ray spectroscopy
    - Ultraviolet and visible spectroscopy
    - Infrared spectroscopy
    - ORD (optical rotation dispersion) spectroscopy
    - CD (circular dichroism,) spectroscopy
    - Electron spin resonance (ESR) spectroscopy
    - Nuclear Magnetic resonance (NMR) spectroscopy
    - Mass spectroscopy
    - Atomic absorption spectroscopy (AAS)
        - Flame photometry
- Immunochemical Techniques
    - Rradioimmunoassay (RIA)
    - Eenzyme-linked immunosorbent assay (ELISA)
    - Fluorescence-activated cell sorting (FACS)
- Molecular Biology Techniques
    - Western blotting
    - Southern blotting
    - Eastern blotting
    - Northern blotting
    - Polymerase chain reaction PCR

Recommended Books:

Molecular biology of THE CELL ,6th edition

Harper's 31 Edition, Rodwell Et.al

Lippencott, Biochemistry Eight Edition

DEPARTMENT OF MEDICAL EDUCATION
UHS
اقرا