CURRICULUM

M.Phil. Biochemistry

Two Years Program

Rawalpindi Medical University

Rawalpindi

2024


بسم الله الرحمن الرحيم
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PREFACE

The horizons of *Medical Education* are widening, and there has been a steady rise in global interest in postgraduate medical education, an increased awareness of the necessity for expertise in educational and research skills for all healthcare and biomedical professionals, and the growing need for formal recognition of postgraduate training in Biochemistry.

We are witnessing an increased uptake of postgraduate programs in biomedical sciences, more frequent publications in medical and biochemical education journals, and further development of e-journals and other online academic resources. There is therefore a need to provide active support in postgraduate medical education for a broader national community of scholars and faculty members across basic medical sciences and at all stages of their professional development. If we were to formulate a statement of intent to explain the purpose of this curriculum, we might simply say that our aim is to help teachers to teach and students to learn biochemistry in a more effective, evidence-based, and advanced manner.

This book is a state-of-the-art document representing all academic, laboratory, and research activities of the **MPhil Biochemistry Program** at Rawalpindi Medical University. The curriculum has been incorporated into this book for the convenience of supervisors and postgraduate scholars. The MPhil Biochemistry curriculum is based on six Core Competencies of ACGME ***(Accreditation Council for Graduate Medical Education)*** including ***Patient Care, Medical Knowledge, System Based Practice, Practice Based Learning, Professionalism, Interpersonal and Communication Skills***.

The mission of Rawalpindi Medical University is to improve the health of the communities it ssserves through education, biomedical research, and healthcare delivery. As an integral part of this mission, the importance of fostering a strong research culture has been emphasized, and a comprehensive research structure along with a structured research curriculum for postgraduate scholars has been formulated and presented in this book.

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Vice Chancellor
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FOREWORD

The MPhil Biochemistry curriculum is designed to equip future biochemists with advanced knowledge, analytical skills, and practical expertise required to excel in the rapidly evolving field of biomedical sciences. Biochemistry, as a foundational discipline of medical science, has witnessed significant advancements in recent years, particularly in molecular biology, enzymology, clinical biochemistry, and metabolic research. This curriculum aims to integrate contemporary scientific developments with core biochemical principles to provide a strong academic and research-oriented framework. The program is structured to deliver a comprehensive understanding of cellular and molecular biochemistry, metabolism, enzymology, molecular genetics, clinical biochemistry, and laboratory diagnostics, while emphasizing their relevance to human health and disease. Special focus has been placed on hands-on laboratory training, research methodology, and critical thinking to ensure that graduates are not only conceptually sound but also proficient in experimental design, data analysis, and scientific interpretation.

In the current era, where metabolic disorders, genetic diseases, cancer biology, and molecular diagnostics pose growing challenges to healthcare systems, the role of a biochemist is more vital than ever. This curriculum fosters an academic environment that encourages inquiry, innovation, and lifelong learning, enabling students to contribute meaningfully to biomedical research, diagnostics, and academic advancement.

The curriculum also reflects our commitment to developing well-rounded biochemists who can effectively bridge the gap between basic science research and clinical application. By incorporating elements of ethics, research governance, quality assurance, and interdisciplinary collaboration, the programme aims to produce professionals who demonstrate not only technical competence but also social responsibility and professional integrity.

I would like to express my sincere appreciation to all faculty members and experts involved in the development of this curriculum. Their dedication to advancing postgraduate education in biochemistry will play a significant role in strengthening biomedical research and healthcare delivery in Pakistan and beyond. I am confident that this program will continue to produce competent biochemists who will emerge as leaders in research laboratories, diagnostic centers, and academic institutions.

I wish all future MPhil Biochemistry students great success in their academic endeavors and encourage them to embrace the challenges and opportunities that this program offers.

Dr. Aneela Jamil
Head of Biochemistry
Department
Rawalpindi Medical University
Rawalpindi

CURRICULUM DEVELOPMENT TEAM

Dr. Aneela Jamil

MBBS, FCPS

Associate Professor of Biochemistry

H.O.D Biochemistry

Dr Faisal Sultan

Msc,, MPhil, PHD

Adjunct PhD faculty

Revised by: (2025)

Dr. Kanwal Huma

MBBS, M.Phil, CHPE

Assistant Professor Biochemistry

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SECTION I: PROGRAM OVERVIEW

INTRODUCTION TO RAWALPINDI MEDICAL UNIVERSITY

HISTORY OF RAWALPINDI MEDICAL UNIVERSITY

Rawalpindi Medical College was established in Faisalabad on 18th March 1974 and later shifted to Rawalpindi on 5th November 1974 in an incomplete building at Tipu Road. The founder principal of RMC, Prof. Abdul Latif, worked hard to establish the institution. The student hostels, staff colony and auditorium were built. Apart from his own specialty of anatomy he completed all the faculty. He also managed to acquire the Holy family hospital from missionary church and central Government Hospital from central Government that later became Rawalpindi General Hospital and now Benazir Bhutto Hospital. The District Headquarter Hospital was also affiliated to the college as 1st teaching hospital.

Prof. Mohammad Nawaz the 2nd Principal and Prof. Mohammad Iqbal as Professor of surgery and later on Principal played pivotal as pioneer team to establish all components of RMC. Prof. Iqbal, Prof. Saad Rana worked hard to establish New Teaching Block in Holy Family Hospital with help of Islamic Development Bank.

The Legacy was taken forward by respective forthcoming Principals, worth mentioning is Prof. Mubashir Hussain Malik who established department of Psychiatry and worked hard to develop its international collaborations. The Department of Medical Education and the institute of Allied health sciences established in 2007 was the vision of Prof. Muhammad Musadiq Khan, he also started the new teaching block holy family hospital Rawalpindi as well as ICU and CCU.

First Rawalian Principal, Prof. Mohammad Umar after taking over the office in 2013, started working on multi-dimensional approach to further develop the institution. He restructured the undergraduate training program by establishing purpose-built Department of Medical Education (DME), upgraded student libraries, Cafeteria, student section and hostels. Arranging historical meeting to develop consensus on national guidelines for the undergraduate training headed by chairman HEC, President PMDC, Vice chancellor UHS and all the principals of medical colleges is another credit to RMC in his tenure.

Regarding patient care projects, worth mentioning are, State of the art center for Liver and Digestive diseases (CLD), Multi Organ Failure Centre (MOF), Medical ICU, Department of Infectious diseases (DID), Department of Emergency and Critical care (DEC) and upgradation of the affiliated hospitals.

To establish recognized postgraduate training in super specialties international conferences,

Mentorship programs are other important achievements.

Since 1947 more than 7900 students have graduated and are serving nationally and internationally, it is privileged to claim top positions in university examination several times. The best graduate in UHS is also a Rawalian.

Academic programs of the college are accredited by UHS, CPSP and PMDC. The College got full recognition by General Medical Council UK, American specialty boards and internship programs with different universities abroad and WHO.

Rawalpindi Medical College has always occupied a unique position in the public sector, being one of the leading medical colleges in South Asia. It serves as an extraordinary interface between health care provision and medical education; with the three allied hospitals bearing the brunt of the city's health care needs, medical and paramedical undergraduate courses that train the sharpest minds of the country, and diverse post-graduate training programs.

Now Old Campus mainly serves administrative purposes and the first two, i.e. non-clinical years of the students of MBBS degree, are taught there and next three in New Teaching Block Holy Family hospital.

The institute has strived to be upgraded to the level of an independent University after which the annual system of MBBS degree has been changed to the internationally preferred modular system. Now after the successful launching of MD/MS program by VC RMU we are struggling hard to get the MPhil and PhD program approved.

VISION & MISSION OF RAWALPINDI MEDICAL UNIVERSITY

MISSION STATEMENT

- To impart evidence-based research oriented medical education
- To provide best possible patient care
- To inculcate the values of mutual respect and ethical practice of medicine

VISION STATMENT

Highly recognized and accredited center of excellence in Medical Education, using evidence-based training techniques for development of highly competent health professionals

INTRODUCTION TO THE DEPARTMENT OF BIOCHEMISTRY

The Department of Biochemistry at Rawalpindi Medical University is a multidisciplinary academic unit committed to excellence in teaching, research, and service. The diverse faculty of the department is actively involved in teaching Biochemistry across different phases of MBBS and BS undergraduate programs, in addition to postgraduate training and research activities. The department aims to advance fundamental understanding of biochemical mechanisms underlying health and disease and to disseminate this knowledge through high-quality teaching, research, and scientific publication.

The Department of Biochemistry, Rawalpindi Medical University, is well established and is offering an ongoing MPhil Biochemistry Program. The department is supported by well-equipped teaching and research laboratories and has access to clinical biochemistry and chemical pathology diagnostic laboratories in RMU allied hospitals, including Holy Family Hospital, Benazir Bhutto Hospital, and District Headquarters Hospital. These facilities provide valuable exposure to clinical laboratory practices, quality control systems, and diagnostic workflows, which are highly beneficial for MPhil scholars.

A postgraduate multipurpose research laboratory complex, encompassing Anatomy, Physiology, Pharmacology, Forensic Medicine, Hematology, Chemical Pathology, Microbiology, Molecular Biology, Histopathology, and Simulation laboratories, is under development. The PC-I for this facility has been approved by HEC, Islamabad, and construction work is in progress, which will further strengthen postgraduate research and interdisciplinary collaboration.

Keeping in view the increasing demand from students and the growing national need for skilled professionals in biochemical and laboratory sciences, the initiation and strengthening of the MPhil Biochemistry Program is both timely and imperative. To successfully establish and sustain this program, the primary areas of focus include:

- Faculty development
- Research laboratories
- Specialized equipment

VISION & MISSION OF DEPARTMENT OF BIOCHEMISTRY

MISSION STATEMENT

Our mission is to provide medical students with a deep and integrated understanding of the molecular and chemical basis of human health and disease to:

- Diagnose and treat diseases more effectively
- Develop new and innovative treatments
- Conduct research for advancement of knowledge of biochemistry

VISION STATMENT

To produce health care professionals capable of applying their biochemical knowledge into clinical practice, thus helping society.

INTRODUCTION TO M.PHIL BIOCHEMISTRY PROGRAM

PROGRAM INTRODUCTION

Biochemistry is the study of chemistry related to biological organisms. It forms a bridge between biology and chemistry by studying how complex chemical reactions and chemical structures give rise to life and life's processes. Biochemistry also deals with chemical transformations that take place inside of living organisms, but the truth is that the study of biochemistry should generally be considered neither fully "biology" nor fully "chemistry" in nature. Biochemistry incorporates everything in size between a molecule and a cell and all the interactions between them. The aim of this program is to make postgraduate students able to describe in molecular terms structure and function of cellular components (such as enzymes and cellular organelles) and the processes carried out both on and by organic macromolecules - especially proteins, carbohydrates, lipids, nucleic acids, and other biomolecules. Biochemists have isolated numerous biomolecules found in cells to determine their structures and to analyze how they function. Biochemical studies have illuminated many aspects of disease that have opened up new therapeutic approaches. This program has been designed keeping in consideration the study of structural elucidation and the determination of mode of action of biomolecules, identification of disease mechanisms, study of inborn errors of metabolism, study of oncogenes in cancer cells, the relationship of biochemistry with Genetics, Physiology, Immunology, Pharmacology, Toxicology etc.

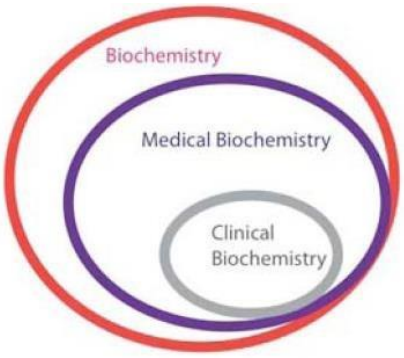


Figure 1. Biochemistry, medical biochemistry and clinical biochemistry.

SCOPE OF BIOCHEMISTRY

Many newer disciplines have been emerged from Biochemistry such as Enzymology (study of enzymes), Endocrinology (study of hormones) Clinical Biochemistry (study of diseases), and Molecular Biochemistry (Study of Biomolecules and their functions). Along with these branches certain other specialties have also come up such as Agricultural Biochemistry, Pharmacological Biochemistry etc. Medical Biochemistry seeks to advance the understanding of chemical structures and processes that constitute health and disease and underlie transformations between these two states. Clinical Biochemistry is an important applied sub-discipline of Medical Biochemistry, also known under the names of clinical Chemistry, Pathological Biochemistry or Chemical Pathology Clinical Biochemistry is concerned with methodology and interpretation of biochemical tests performed on body fluids and tissues, to support diagnosis, treatment and monitoring of disease. Clinical Biochemistry is driven by the discovery of biomarkers, and the availability of appropriate measurement methods. Therefore, its scope constantly changes. It has become an autonomous discipline. Those who acquire a sound knowledge of Biochemistry can tackle the two central concerns of the biomedical sciences.

(1) The understanding and maintenance of health

(2) The understanding and treatment of diseases.

SECTION II: PROGRAM FRAMEWORK & STRUCTURE

AIMS & OBJECTIVES

AIM

The MPhil Biochemistry program is designed to provide advanced academic and research-oriented training that develops competent biochemists, independent researchers, and ethical professionals. The program aims to strengthen analytical thinking, experimental expertise, and scientific integrity, enabling graduates to contribute effectively to biomedical research, healthcare, academia, and related industries.

OBJECTIVES

- To provide students with advanced conceptual understanding and intellectual depth required for postgraduate education and research in biochemistry.
- To enable students to critically analyze, interpret, and integrate biochemical data from scientific literature, experimental findings, and clinical laboratory investigations.
- To develop proficiency in modern biochemical, molecular, and analytical laboratory techniques, ensuring safe and accurate experimental practice.
- To strengthen problem-solving and analytical skills required to investigate complex biochemical mechanisms and disease-related molecular alterations.
- To cultivate an appreciation for continuous learning, encouraging graduates to remain updated with rapid advances in biochemistry, molecular medicine, and biotechnology.
- To promote independent and self-directed learning, preparing students to adapt to evolving scientific challenges and technological innovations.
- To build strong research competencies, including proposal development, experimental design, data analysis, interpretation of results, and scientific writing.
- To instill ethical standards and professional conduct in biochemical research and laboratory practice, emphasizing research integrity, biosafety, and responsible data management.
- To prepare graduates for academic, research, and leadership roles in universities, clinical laboratories, research centers, and biotechnology industries.

PROGRAM LEARNING OUTCOMES

Upon successful completion of the MPhil Biochemistry program, graduates will be able to:

1. **In-Depth Knowledge**

Demonstrate advanced conceptual understanding of biochemistry as a scientific discipline and its role in biomedical research, healthcare, and life sciences, using appropriate scientific terminology and reasoning.

2. **Research Independence**

Design, execute, and complete an independent research project that reflects originality, methodological rigor, and scholarly depth, contributing meaningfully to scientific knowledge.

Analytical and Practical Proficiency

Apply appropriate laboratory and analytical skills with accuracy and responsibility, ensuring reliable data generation, interpretation, and documentation in research settings.

3. **Critical Evaluation**

Critically appraise scientific literature, experimental data, and research methodologies to draw valid conclusions and support evidence-based decision-making.

4. **Problem Solving and Innovation**

Identify research problems and develop logical, creative, and feasible solutions using scientific reasoning and analytical thinking.

5. **Integration and Application**

Apply biochemical principles across interdisciplinary and applied contexts, demonstrating the ability to link fundamental science with broader biomedical and research applications.

6. **Ethical and Professional Practice**

Demonstrate ethical awareness, research integrity, and professional conduct in all academic and research activities, including responsible data handling and compliance with biosafety standards.

7. **Scientific Communication**

Communicate scientific ideas, research findings, and interpretations effectively through written reports, dissertations, oral presentations, and scholarly discussions.

8. **Teaching and Mentorship Readiness**

Exhibit foundational teaching and mentoring skills necessary for academic roles, including the ability to explain complex scientific concepts clearly and engage learners effectively.

9. **Leadership and Career Preparedness**

Demonstrate readiness for leadership roles in academic, research, and professional environments, with the capacity to contribute to institutional growth, policy development, and scientific advancement.

10. **Lifelong Learning and Professional Growth**

Exhibit self-directed learning skills and adaptability, enabling continuous professional

development in response to evolving scientific knowledge and technological progress

RESPONSIBILITIES & COMPETENCIES OF POSTGRADUATE TRAINEES

We expect our Postgraduate Trainees to be responsible regarding their:

- Behavior
- Discipline
- Punctuality
- Dress code
- Feedback
- Social media

We expect our PGTs to develop the Essential 7 core competencies of a doctor:

- Medical knowledge
- Research
- Patient care
- Interpersonal & communication skills
- Professionalism
- Practice based learning & improvement
- System based practice

EDUCATIONAL METHODOLOGY

The objectives of the training may be achieved through different modes, some of which are listed below:

- Assigning responsibilities of teaching the undergraduates of MBBS.
- Seeking information through Journal clubs, library and Internet.
- Attending workshops, Seminars, conferences, lectures, small group discussions, etc.
- Completion of assignments
- Patient/scenario-based learning
- Assisting/Supervising Research projects of undergraduates of MBBS.
- Practical laboratory work at RMU Biochemistry Lab and labs of Allied Hospitals.

TEACHING STRATEGIES

1. Interactive Lectures
2. Small group discussions
3. Presentations
4. Assignments: Library/Internet
5. Seminars/Tutorials
6. SDL, PBL
7. Practical work: demonstration and hands-on practice
8. Case based learning
9. Review of literature
10. Journal club
11. Workshops
12. Quizzes

PROGRAM DURATION & CREDIT HOURS

PROGRAM SPECIFICATION

Program Title	Mphil Biochemistry
Course Duration	2 Years
Type Of Study	Full Time
Study System	Semesters System
Total Credit Hours	30
Credit hours distribution - semester wise	**Credit hours distribution** Semester I = 12 Semester II = 12 Semester III & IV = 06 (Research work)
Time allocation per semester	Study weeks per semester: 20 weeks Prep leaves: 2 Weeks Examination: 1 week Working days: Monday to Saturday

COURSE CLASSIFICATION

- Compulsory, Core and Minor Courses

Sr No	COURSE TITLE	COURSE CODE	CREDIT HOURS
CORE COURSES			
1.	Carbohydrates Chemistry & Metabolism	BCH-702	1.5+0.5
2.	Enzymology	BCH-703	1.5+0.5
3.	Lipid Chemistry & Metabolism	BCH-704	1.5+0.5
4.	Protein Chemistry & Metabolism	BCH-705	1.5+0.5
5.	GIT & Nutrition	BCH-707	1.5+0.5
6.	Molecular Biology	BCH-708	1.5+0.5
7.	Vitamins & Minerals	BCH-709	1.5+0.5
COMPULSORY COURSES			
1.	Biostatistics & Research Methodologies	(BSR-701)	2
2.	Bioethics/Medical Ethics	(BME-701)	1
3.	Medical Education	(BWE-701)	1
4.	Mandatory Computer Skills	(CSB-701)	1
5.	Medical Writing	(MDW-702)	1
MINOR COURSE			
1.	Cell Biochemistry	(BCH-701)	1.5+0.5
2.	Endocrinology	(BCH-706)	1.5+0.5

SEMESTER-WISE DISTRIBUTION

Semester I, II (Coursework)

Semester III & IV (Research)

Total Credit Hours:

- **Course Work:** 24 Credit Hours
- **Research Work:** 6 Credit Hours

YEAR	SEMESTER	COURSES	COURSE CODES	CREDIT HOURS
1.	I.	**CORE COURSES**		
		Cell Biochemistry	BCH-701	1.5+0.5
		Carbohydrates Chemistry & Metabolism	BCH-702	1.5+0.5
		Enzymology	BCH-703	1.5+0.5
		Lipid Chemistry & Metabolism	BCH-704	1.5+0.5
		Protein Chemistry & Metabolism	BCH-705	1.5+0.5
		Endocrinology	BCH-706	1.5+0.5
	II.	**COMPULSORY COURSES**		
		Biostatistics & Research Methodologies	(BSR-701)	2
		Bioethics/Medical Ethics	(BME-701)	1
		Medical Education	(BWE-701)	1
		Mandatory Computer Skills	(CSB-701)	1

		Medical Writing	(MDW-702)	1
		CORE COURSES		
		GIT & Nutrition	BCH-707	1.5+0.5
		Molecular Biology	BCH-708	1.5+0.5
		Vitamins & Minerals	BCH-709	1.5+0.5
2.	**III. & IV.**	Literature Review		1
		Research and Thesis writing, Submission and Defense		5

DETAILED COURSE OUTLINES

COURSE OUTLINE

COURSE WORK

The MPhil/MS program shall extend over a period of at least two-years or four semesters. During the two years of MPhil, students will have to complete their 24 credit hours course work which is the minimum criteria as per HEC Policy.

- The course work will comprise of:
  - Compulsory courses are given 6 Credit hours.
  - Core courses specific for specialty are given 18 Credit hours
- Research
  - Research work =06 Credit hours
- Workshops
  - Mandatory workshops will be arranged for students in each semester.

NOTE:

Credit hour means 16 hours of lecturing/32 hours of Practical Teaching

SEMESTER I

Total Credit Hours: 12

Total Duration: 20 weeks

CORE COURSES

1. COURSE TITLE & CODE: CARBOHYDRATES CHEMISTRY & METABOLISM (BCH-702)

Couse Objectives:

Upon completion of course the students should be able to:

a. Understand the structural diversity, classification, and chemical properties of carbohydrates.
b. Explain digestion, absorption, and transport of dietary carbohydrates.
c. Describe major carbohydrate metabolic pathways and their regulation.
d. Relate carbohydrate metabolism to energy homeostasis and physiological states.
e. Understand the biochemical basis of carbohydrate-related metabolic disorders.

Course Outcomes:

After successful completion of this course, students will be able to:

a. Apply their knowledge to explain the role of carbohydrates in normal health and disease processes.
b. Analyze the coordination and regulation of carbohydrate metabolic pathways under physiological and pathological conditions.
c. Evaluate the significance of key enzymes, intermediates, and regulatory steps of each pathway in the normal functioning of the human body.

Course Contents with Learning Objectives, Teaching Strategies and Assessment tool

Course Topics	Learning Objectives At the end of course, students will be able to:	Learning Domain	Teaching Strategy	Assessment Tool
Carbohydrate Classification	Explain the basis of classification of carbohydrates with suitable examples.	C2	Interactive lectures Presentations	MCQs SEQs LEQ VIVA
	Compare different classes of carbohydrates in terms of complexity, biological role, and digestibility.	C4		
Isomerism	Apply concepts of isomerism to identify isomers of given monosaccharides	C3	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
Chemistry of Monosaccharides & Disaccharide	Describe the chemical properties and reactions of monosaccharides and disaccharides	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Interpret the biochemical and clinical significance of monosaccharides, disaccharides, and related derivatives	C5		
Chemistry of Polysaccharides	Apply structural knowledge to explain biological roles of polysaccharides	C3	Interactive lectures Presentations	MCQs SEQs LEQ VIVA
Glycolysis & TCA	Recall key steps, enzymes, and regulation of glycolysis and TCA cycle.	C1	Interactive lectures Presentations	MCQs SEQs

	Explain the integration of glycolysis and the TCA cycle in cellular energy metabolism	C2		LEQs VIVA
	Apply glycolytic and TCA cycle pathways to determine ATP and reducing equivalent yields	C3		
Gluconeogenesis	List substrates, enzymes, and steps of gluconeogenesis.	C1	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Explain the regulation and physiological importance of gluconeogenesis.	C2		
	Apply pathway knowledge to fasting and starvation states.	C3		
	Analyze reciprocal regulation between glycolysis and gluconeogenesis.	C4		
Glycogen Metabolism	Recall enzymes involved in glycogenesis and glycogenolysis.	C1	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Explain hormonal regulation of glycogen metabolism.	C2		
	Apply concepts to interpret glycogen storage diseases.	C3		
	Analyze tissue-specific regulation of glycogen metabolism.	C4		
	Evaluate clinical consequences of glycogen storage diseases	C5		
Metabolism of Monosaccharide and Disaccharide	List alternative pathways of monosaccharide and disaccharide metabolism.	C1	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Explain metabolic entry points of fructose, galactose, and lactose.	C2		
	Analyze biochemical defects leading to metabolic disorders.	C4		
HMP shunt	Recall phases, enzymes, and products of the HMP shunt.	C1	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Integrate NADPH production with redox balance	C4		
	Evaluate disorders associated with defects in the HMP shunt.	C5		
Metabolism of Glycosaminoglycan and Glycoproteins	Explain their biosynthesis and degradation pathways.	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Analyze their role in extracellular matrix and signaling	C5		

Practical:

1. Experiments on Carbohydrates qualitative analysis – I

   Molisch Test

   Benedict's Test/ Fehling's Test
2. Experiments on Carbohydrates qualitative analysis – II

   Barfoed's Test

   Selivanoffs Test
3. Experiments on Carbohydrates qualitative analysis – III

   Iodine test
4. Experiments on Carbohydrates qualitative analysis – IV

Hydrolysis of sucrose

RECOMMENDED READINGS:

1. Principles of Biochemistry. Ed Lehninger, Nelson and Cox, CBS publishers and distributors
2. Biochemistry by Lubert Stryer W.H. Freeman and Company, New York.
3. Harper's Biochemistry. Ed. R.K. Murray, D.K. Granner, P.A. Mayes and V.W Rodwell. Appleton and Lange, Stamford, Connecticut
4. Lippincott's Illustrated Reviews: Biochemistry, 8th Ed.
5. Biochemistry Ed. Donald Voet and Judith G. Voet. John Wiley & sons, Inc
6. Textbook of Biochemistry with Clinical Correlations. Ed. Thomas M. Devlin. Wiley-Liss Publishers
7. Principles and Techniques of Practical Biochemistry. Ed. Keith Wilson and John Walker. Cambridge University Press

JOURNALS:

- *Journal of Biological Chemistry (JBC)*
- *Carbohydrate Research*
- *Glycobiology*
- *Biochimica et Biophysica Acta (BBA) – Molecular and Cell Biology of Lipids / Proteins and Proteomics*
- *Archives of Biochemistry and Biophysics*
- *Metabolism: Clinical and Experimental*
- *European Journal of Biochemistry / FEBS Journal*

2. COURSE TITLE & CODE: ENZYMOLOGY (BCH-703)

COURSE OBJECTIVES:

Upon completion of course the students should be able to:

a. Understand the chemical nature, classification, and nomenclature of enzymes.
b. Explain mechanisms of enzyme action and factors affecting enzyme activity.
c. Apply principles of enzyme kinetics and inhibition in biochemical analysis.
d. Understand regulation of enzyme activity in metabolic pathways.
e. Appreciate clinical, industrial, and research applications of enzymes.

COUSE OUTCOMES:

After successful completion of this course, students will be able to:

a. Comprehend the knowledge of properties of enzymes, their structure and mechanisms of catalytic action
b. Comprehend the knowledge of the role of enzymes and isoenzymes in disease diagnosis, prognosis, and clinical monitoring.

Course Contents with Learning Objectives, Teaching Strategies and Assessment tool

Course Topics	Learning Objectives At the end of course, students will be able to:	Learning Domain	Teaching Strategy	Assessment Tool
Introduction & Classification of Enzymes	Explain the major classes of enzymes based on reaction specificity.	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
Properties of Enzymes & Factors Affecting Activity	Explain the effects of pH, temperature and substrate concentration on enzyme activity.	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Apply enzyme properties to predict changes in reaction rates under varying conditions.	C3		
Mechanism of Enzyme Action	Explain catalytic mechanisms including acid–base, covalent, and metal ion catalysis	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIIVA
	Analyze transition state stabilization and its role in catalysis.	C4		
Enzyme kinetics	Explain Michaelis–Menten kinetics and Lineweaver–Burk analysis.	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Interpret enzyme kinetics to explain changes in reaction rate	C4		
	Evaluate the usefulness and limitations of enzyme kinetic models in living systems	C5		
Enzyme inhibition	Explain the mechanisms of different types of enzyme inhibition	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Apply inhibition concepts to interpret kinetic plots	C3		
	Analyze the effects of inhibitors on enzyme kinetics.	C4		
	Evaluate the therapeutic and toxicological relevance of enzyme inhibitors.	C5		
Physiological & Metabolic Regulation of Enzymes	Explain allosteric regulation, covalent modification, and hormonal control of enzymes	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Apply regulatory concepts to metabolic pathway control.	C3		
Clinical enzymology	Evaluate the role of enzymes as diagnostic, prognostic, and therapeutic markers	C5	Interactive lectures Presentations	MCQs SEQs LEQs VIVA

PRACTICAL:

1. Introduction to Spectrophotometer/ Microlab,

2. Quantitative estimation of serum ALT and AST
3. Quantitative estimation of serum ALP
4. Quantitative estimation of serum Amylase

RECOMMENDED READINGS:

1. Principles of Biochemistry. Ed Lehninger, Nelson and Cox, CBS publishers and distributors
2. Biochemistry by Lubert Stryer W.H. Freeman and Company, New York.
3. Harper's Biochemistry. Ed. R.K. Murray, D.K. Granner, P.A. Mayes and V.W Rodwell. Appleton and Lange, Stamford, Connecticut
4. Lippincott's Illustrated Reviews: Biochemistry, 8th Ed.
5. Biochemistry Ed. Donald Voet and Judith G. Voet. John Wiley & sons, Inc
6. Textbook of Biochemistry with Clinical Correlations. Ed. Thomas M. Devlin. Wiley-Liss Publishers
7. Principles and Techniques of Practical Biochemistry. Ed. Keith Wilson and John Walker. Cambridge University Press
8. Tietz textbook of clinical chemistry and molecular diagnostics. Editors Burtis CA, Ashwood ER, Bruns DE. 4thed. Elsevier; 2006
9. Clinical Chemistry Techniques, Principles, Correlations Sixth Edition Michael L. Bishop, MS, CLS, MT (ASCP)

JOURNALS:

- *Journal of Biological Chemistry (JBC)*
- *Biochemistry (ACS)*
- *Biochimica et Biophysica Acta (BBA) – Proteins and Proteomics*
- *Archives of Biochemistry and Biophysics*
- *Protein Science*
- *Enzyme and Microbial Technology*

3. COURSE TITLE & CODE: LIPID CEMISTRY & METABOLISM (BCH-704)

COURSE OBJECTIVES

Upon completion of course the students should be able to:

a. Understand the classification, structure, and chemical properties of lipids.
b. Explain digestion, absorption, transport, and storage of lipids.
c. Describe major lipid metabolic pathways and their regulation.
d. Relate lipid metabolism to energy balance and membrane structure.
e. Understand the biochemical basis of lipid-related metabolic disorders.

COURSE OUTCOMES:

After successful completion of this course, students will be able to:

- Comprehend the chemical structure, classification, and metabolic pathways of lipids, including their physiological and clinical significance.
- Apply knowledge of lipid metabolism to analyze regulation, integration with other metabolic pathways, and interpret lipid-related disorders.
- Evaluate the biochemical and clinical significance of lipid abnormalities and interpret laboratory data for research and diagnostic purposes.

Course Contents with Learning Objectives, Teaching Strategies and Assessment tool

Course Topics	Learning Objectives At the end of course, students will be able to:	Learning Domain	Teaching Strategy	Assessment Tool
Introduction & Classification of Lipids	Classify Lipids	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Apply lipid classification to explain structure–function relationships	C3		
Introduction, Classification & Properties of Fatty Acid	Understand types and physicochemical properties of fatty acids	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Analyze how fatty acid properties affect membrane and metabolic functions.	C4		
Simple, Compound & Derived Lipids	Recall simple, compound, and derived lipids.	C1	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Analyze metabolic and functional differences among lipid types	C4		
Triglyceride Metabolism	Apply pathway knowledge to energy storage and mobilization	C3	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
De Novo Synthesis of Fatty Acids	Explain the steps and regulation of fatty acid synthesis	C2	Interactive lectures Presentations	MCQs SEQs LEQs
	Apply pathway knowledge to anabolic states	C3		
Oxidation of Fatty Acids	Explain mitochondrial and peroxisomal fatty acid oxidation.	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Apply oxidation steps to energy metabolism	C3		
Ketone body Metabolism	Explain synthesis and utilization of ketone bodies.	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Apply knowledge to fasting and diabetic states.	C3		
	Evaluate clinical significance of ketone body metabolism	C5		
Phospholipid & Glycosphingolipid Metabolism	Explain biosynthesis and degradation of Phospholipids & Glycosphingolipid	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Apply metabolism to membrane structure and signaling	C3		
	Evaluate related lysosomal storage disorders	C5		
Eicosanoids Metabolism	Evaluate therapeutic and	C5	Interactive	MCQs

	pathological implications		lectures Presentations	SEQs LEQs VIVA
Cholesterol & Steroid Metabolism	Explain steps of cholesterol synthesis and its regulation	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Apply knowledge of cholesterol-derived steroid biosynthesis to explain hormone synthesis.	C3		
	Evaluate clinical consequences and therapeutic control of cholesterol imbalance	C5		
Lipoprotein Metabolism	Explain metabolism of chylomicrons, VLDL, LDL, and HDL	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Apply lipoprotein profiles to clinical cases.	C3		
	Analyze lipid transport defects.	C4		
	Evaluate the role of lipoproteins in cardiovascular disease	C5		
Integration of Lipid Metabolism & Regulation	Apply integrated metabolism concepts to physiological states.	C3	Interactive lectures Presentations	MCQs SEQs LEQs VIVA

PRACTICAL:

1. To prepare, observe Cholesterol crystal
2. Experiments on Fats qualitative analysis
   Liebermann Burchard Test
   Salkowski's Test
3. Quantitative Estimation of serum Cholesterol
4. Quantitative Estimation of serum Triglycerides

RECOMMENDED READINGS:

1. Principles of Biochemistry. Ed Lehninger, Nelson and Cox, CBS publishers and distributors
2. Biochemistry by Lubert Stryer W.H. Freeman and Company, New York.
3. Harper's Biochemistry. Ed. R.K. Murray, D.K. Granner, P.A. Mayes and V.W Rodwell. Appleton and Lange, Stamford, Connecticut
4. Lippincott's Illustrated Reviews: Biochemistry, 8th Ed.
5. Biochemistry. Ed Donald Voet and Judith G. Voet. John Wiley & sons, Inc.
6. Textbook of Biochemistry with Clinical Correlations. Ed. Thomas M. Devlin. Wiley-Liss Publishers.
7. Principles and Techniques of Practical Biochemistry. Ed .Keith Wilson and John Walker. Cambridge University Press.
8. Tietz Textbook of Clinical Chemistry and molecular diagnostics. Editors Burtis CA, Ashwood ER, Bruns DE. 4th ed. Elsevier; 2006.
9. Clinical Chemistry Techniques, Principles, Correlations Sixth Edition Michael L. Bishop,

MS, CLS, MT(ASCP)

JOURNALS:

- *Journal of Lipid Research*
- *Biochimica et Biophysica Acta (BBA) – Molecular and Cell Biology of Lipids*
- *Journal of Biological Chemistry (JBC)*
- *Progress in Lipid Research*
- *Metabolism: Clinical and Experimental*
- *Atherosclerosis*

4. COURSE TITLE & CODE: PROTEIN CHEMISTRY & METABOLISM (BCH-705)

COURSE OBJECTIVES

Upon completion of course the students should be able to:

- Understand the structure, classification, and chemical properties of proteins.
- Explain protein digestion, absorption, turnover, and transport of amino acids.
- Describe amino acid and protein metabolic pathways and their regulation.
- Relate protein metabolism to growth, tissue repair, and nitrogen balance.
- Understand the biochemical basis of protein and amino acid metabolic disorders.

COURSE OUTCOMES

- Comprehend the structure, classification, and physicochemical properties of proteins, including amino acids and higher levels of protein organization.
- Apply knowledge of protein metabolism to analyze digestion, absorption, synthesis, degradation, and regulation of amino acids and proteins under normal and pathological conditions.
- Evaluate the biochemical and clinical significance of disorders of protein and amino acid metabolism, using laboratory and research data.

Course Contents with Learning Objectives, Teaching Strategies and Assessment tool

Course Topics	Learning Objectives At the end of course, students will be able to:	Learning Domain	Teaching Strategy	Assessment Tool
Amino Acid Chemistry & Properties	Describe structure, classification, and properties of amino acids	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
Protein Classification & Structures	Explain levels of protein organization	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Apply levels of protein structural organization to explain protein function	C3		
Fibrous Protein: Collagen And	Recall structural features of collagen and elastin	C1	Interactive lectures	MCQs SEQs

Elastin	Explain biosynthesis and cross-linking of fibrous proteins	C2	Presentations	LEQs VIVA
	Analyze molecular defects in collagen and elastin	C4		
Globular proteins: Hemoglobin and myoglobin	Identify structural components of hemoglobin and myoglobin	C1	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Explain oxygen binding, release, and the concept of cooperative binding.	C2		
	Apply oxygen dissociation curves to interpret oxygen transport under different physiological conditions.	C3		
	Analyze the biochemical basis of hemoglobinopathies and their clinical consequences.	C4		
Protein Folding & Denaturation	Analyze causes of misfolding and denaturation	C5	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
Nitrogen Metabolism I: Ammonia Handling & Urea Cycle	Describe sources and disposal of ammonia	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Analyze defects in ammonia metabolism	C4		
	Evaluate clinical significance of hyperammonemia	C5		
Nitrogen Metabolism II: Metabolism of Individual Amino Acids	Describe pathways of essential and nonessential amino acids	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Analyze metabolic abnormalities	C4		
Fate of Carbon Skeletons of Amino Acids	Apply fate of carbon skeletons to energy metabolism	C3	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Analyze integration with carbohydrate and lipid metabolism	C4		
Synthesis of Specialized Products	Describe synthesis of biologically important nitrogenous compounds	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Evaluate importance in health and disease	C5		
Heme Metabolism & Its Disorders	Describe synthesis and degradation of heme	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Evaluate biochemical basis of porphyria and jaundice	C5		
Pasma proteins & Immunoglobulins	Explain structure and functions of plasma proteins & immunoglobulins	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Correlate disorders of plasma proteins with their clinical manifestations.	C3		
	Evaluate immunoglobulin-related disorders, including multiple myeloma, in clinical context.	C5		
Protein Separation Techniques	Apply techniques to separate and analyze proteins.	C3	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
Integration of Protein Turnover & Metabolic Regulation (Fed/fast	Describe the key pathways involved in protein turnover	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA

state, hormonal control)	Apply knowledge of hormonal control to predict changes in protein synthesis and degradation.	C3		

PRACTICAL:

1. Qualitative analysis of Protein-Color tests of proteins
2. Detection of protein by:
   Salting out method
   Heat coagulation
3. Quantitative estimation of serum Urea
4. Estimation of total proteins
   Estimation of albumin and globulin
5. Estimation of Bilirubin

RECOMMENDED READINGS:

1. Principles of Biochemistry. Ed Lehninger, Nelson and Cox, CBS publishers and distributors
2. Biochemistry by Lubert Stryer W.H. Freeman and Company, New York.
3. Harper's Biochemistry. Ed. R.K. Murray, D.K. Granner, P.A. Mayes and V.W Rodwell. Appleton and Lange, Stamford, Connecticut
4. Lippincott's Illustrated Reviews: Biochemistry, 8th Ed.
5. Biochemistry. Ed Donald Voet and Judith G. Voet. John Wiley & sons, Inc.
6. Textbook of Biochemistry with Clinical Correlations. Ed. Thomas M. Devlin. Wiley-Liss Publishers

JOURNALS:

- *Journal of Biological Chemistry (JBC)*
- *FEBS Journal*
- *Proteins: Structure, Function, and Bioinformatics*
- *Protein Science*
- *Biochimica et Biophysica Acta (BBA) – Proteins and Proteomics*

MINOR COURSES

1. COURSE TITLE & CODE: CELL BIOLOGY (BCH-701)

COURSE OBJECTIVES:

Upon completion of course the students should be able to:

- Understand the structure, organization, and functions of cellular components.

- Explain fundamental cellular processes including cell division, signaling, and communication.
- Describe the molecular mechanisms underlying organelle function and intracellular transport.
- Relate cellular functions to tissue organization, physiology, and disease.
- Develop critical thinking and practical skills in studying cells using modern experimental techniques.

COURSE OUTCOMES

After completion of course, students will be able to:

- Comprehend the knowledge of structural organization of cell and its importance in development for better understanding of the disease processes

Course Contents with Learning Objectives, Teaching Strategies and Assessment tool

Course Topics	Learning Objectives At the end of course, students will be able to:	Learning Domain	Teaching Strategy	Assessment Tool
Cell structure & organelles	Explain the structure and functions of major cell organelles	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Analyze organelle dysfunction in inherited and acquired diseases	C5		
Cell membrane & transport	Describe membrane composition and fluid mosaic model	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Apply membrane transport principles to physiological processes	C3		
	Analyze membrane defects affecting signaling and transport	C4		
Osmosis, Osmotic Pressure & Oncotic Pressure	Apply osmotic and oncotic pressure concepts to explain fluid movement across biological membranes	C3	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Analyze disturbances of osmotic and oncotic pressures in pathological states such as edema and dehydration	C4		
Phenomenon of viscosity, surface tension, emulsification and adsorption	Explain Biochemical applications and methods to measure them	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Apply these principles to physiological processes including blood flow, alveolar stability, lipid digestion, and biomolecular interactions	C3		
	Evaluate the relevance of these phenomena in biomedical research, diagnostics, and therapeutic applications.	C5		
Donnan equilibrium, and	Apply these principles to predict ion distribution across membranes and separation of biomolecules using ion-	C3	Interactive lectures Presentations	MCQs SEQs LEQs

ion exchange resins	exchange methods.			VIVA
	Analyze the effects of Donnan forces and ion-exchange behavior on cellular volume regulation and laboratory separation efficiency.	C5		
Electron transport chain and its Inhibitors	Recall the components and complexes of the electron transport chain	C1	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Explain the sequence of electron flow and ATP generation.	C2		
	Apply ETC knowledge to predict effects of specific inhibitors	C3		
Oxidative Phosphorylation and Uncouplers	Recall the chemiosmotic mechanism of ATP synthesis.	C1	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Apply the concept of uncouplers to explain their effect on ATP production and heat generation.	C3		
	Analyze the biochemical consequences of uncoupling on cellular metabolism	C4		
Cancer	Recall key biochemical alterations in cancer.	C1	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Summarize metabolic and molecular changes associated with cancer	C2		
	Critically appraise cellular alterations in malignancy	C5		
HIV	Recall key biochemical mechanisms involved in pathogenesis of HIV infection	C1	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Interpret laboratory findings related to HIV biomarkers	C3		
	Critique biochemical targets used in current therapeutic strategies.	C5		
Ionization of water	Explain ionization and ionic products of water	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Use ion product of water to calculate pH and pOH	C3		
Henderson – Hasselbach equation	Apply the equation to calculate pH and pKa	C3	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
Body buffers and their mechanism of action	Apply buffer mechanisms to physiological pH regulation	C3	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Evaluate effectiveness of different buffer systems	C5		
Acid base balance regulation in human body	Analyze compensatory responses in acid–base disturbances	C4	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
Acids produced in the body; mechanisms of	Analyze imbalance between acid load and elimination	C4	Interactive lectures Presentations	MCQs SEQs LEQs

regulation of pH	Evaluate adaptive mechanisms maintaining pH	C5		VIVA
Role of lungs and kidney in buffering mechanism	Analyze coordinated pulmonary and renal compensatory mechanisms in acid–base disorders	C4	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
Disorders of acid base metabolism	Analyze arterial blood gas data	C4	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Evaluate management strategies for acid–base disorders	C5		
Serum Electrolytes	**Explain** the physiological roles of Na, K, Cl	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Interpret electrolyte reports in clinical settings.	C3		
	Analyze electrolyte imbalances and their biochemical basis.	C4		
Receptors	**Illustrate** receptor–ligand interactions.	C3	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Analyze receptor regulation and signal amplification	C4		
Cell signaling pathways	**Outline** major cell signaling pathways.	C1	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Explain second messengers and signal transduction.	C2		
	Analyze cross-talk between signaling pathways	C4		
	Critique dysregulated signaling in pathogenesis.	C5		
Neurotransmitters	Explain the biosynthesis, storage, release, and degradation of major neurotransmitters.	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Compare excitatory and inhibitory neurotransmitters with respect to receptor activation and downstream effects.	C4		
Xenobiotic Metabolism	Explain Phase I and Phase II reactions of xenobiotic metabolism	C2	Interactive lectures Presentations	MCQs SEQs LEQs VIVA
	Interpret effects of enzyme induction and inhibition.	C3		
	Analyze genetic and environmental variations in metabolism	C4		

PRACTICAL:

1. Introduction to biochemistry laboratory

   Use of laboratory equipments & glass wares
2. Demonstrate the phenomenon of Surface tension & Tonicity
3. Estimation and clinical interpretation of Sodium & Potassium
4. pH meter

   Preparation of buffer solutions

RECOMMENDED READINGS:

1. Principles of Biochemistry. Ed Lehninger, Nelson and Cox, CBS publishers and distributors
2. Biochemistry by Lubert Stryer W.H. Freeman and Company, New York.

3. Harper's Biochemistry. Ed. R.K. Murray, D.K. Granner, P.A. Mayes and V.W Rodwell. Appleton and Lange, Stamford, Connecticut
4. Lippincott's Illustrated Reviews: Biochemistry, 8th Ed
5. Biochemistry. Ed Donald Voet and Judith G. Voet. John Wiley & sons, Inc.
6. Textbook of Biochemistry with Clinical Correlations. Ed. Thomas M. Devlin. Wiley-Liss Publishers
7. Principles and Techniques of Practical Biochemistry. Ed. Keith Wilson and John Walker

JOURNALS:

- *Journal of Cell Biology (JCB)*
- *Cell*
- *Nature Cell Biology*
- *Molecular Biology of the Cell*

2. COURSE TITLE & CODE: ENDOCRINOLOGY (BCH-706)

COURSE OBJECTIVES:

Upon completion of course the students should be able to:

- Understand the structure, function, and regulation of endocrine glands and hormones.
- Explain the mechanisms of hormone action at cellular and molecular levels.
- Describe hormonal regulation of metabolism, growth, reproduction, and homeostasis.
- Relate endocrine function to physiological states and pathological conditions.
- Appreciate diagnostic, therapeutic, and research approaches in endocrine disorders.

COURSE OUTCOMES

After completion of course, students will be able to :

- Apply their knowledge of endocrine system and hormone for the understanding of disease process
- Establish link between hormonal imbalance and other cellular metabolomics
- Find the cellular factors participating in growth anomalies

Course Contents with Learning Objectives, Teaching Strategies and Assessment tool

Course Topics	Learning Objectives At the end of course, students will be able to:	Learning Domain	Teaching Strategy	Assessment Tool
Classification & MOA of hormones	Explain classification of hormones and mechanism of action	C2	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
	Compare membrane and nuclear signaling pathways	C4		
Anterior Pituitary	Describe hormones secreted by anterior pituitary and their functions	C2	Interactive lectures	MCQs SEQs

gland	Differentiate tropic hormone actions	C4	Presentations Assignments	LEQs VIVA
	Judge pituitary hormone profiles in disorders	C5		
Posterior Pituitary gland	Summarize synthesis and release of ADH and oxytocin	C2	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
	Analyze regulation of ADH secretion in fluid balance	C4		
Regulatory role of hypothalamus	Describe hypothalamic releasing and inhibiting hormones	C2	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
	Analyze hypothalamic–pituitary feedback loops	C4		
Thyroid hormones	Apply thyroid hormone actions to metabolic regulation	C3	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
	Correlate hormone levels with pathological states	C4		
Parathyroid gland	Describe parathyroid hormone synthesis and function	C2	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
	Apply PTH action to calcium and phosphate balance	C3		
	Integrate PTH with vitamin D and calcitonin action	C4		
Pancreatic hormone – insulin	Explain insulin biosynthesis and mechanism of action	C2	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
	Explore the molecular basis of insulin resistance	C4		
	Defend therapeutic approaches in diabetes	C5		
Pancreatic hormone – glucagon	Describe glucagon secretion and function	C2	Interactive lectures Presentations Assignments	MCQs SEQs LEQs
	Contrast glucagon and insulin effects	C4		
Blood glucose regulation	Apply regulatory mechanisms to fed and fasting states	C3	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
Adrenocortical hormones	Describe synthesis and actions of corticosteroids	C2	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
	Apply corticosteroid response to stress	C3		
	Assess steroid excess or deficiency and their clinical implications.	C5		
Adrenal medullary hormones	Explain catecholamine synthesis and action	C2	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
	Analyze biochemical signaling of adrenergic receptors	C4		
Sex steroid hormones	Describe synthesis and functions of sex steroids	C2	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
	Analyze regulation of gonadal hormone secretion	C4		
	Evaluate hormonal imbalance in reproductive disorders	C5		

PRACTICAL:

1. Quantitative Estimation of serum glucose
2. Glucose tolerance test
3. Use of glucometer
4. Thyroid function tests

RECOMMENDED READINGS:

1. Principles of Biochemistry. Ed Lehninger, Nelson and Cox, CBS publishers and distributors
2. Biochemistry by Lubert Stryer W.H. Freeman and Company, New York.
3. Harper's Biochemistry. Ed. R.K. Murray, D.K. Granner, P.A. Mayes and V.W Rodwell. Appleton and Lange, Stamford, Connecticut
4. Lippincott's Illustrated Reviews: Biochemistry, 8th Ed
5. Biochemistry. Ed Donald Voet and Judith G. Voet. John Wiley & sons, Inc.
6. Textbook of Biochemistry with Clinical Correlations. Ed. Thomas M. Devlin. Wiley-Liss Publishers
7. Principles and Techniques of Practical Biochemistry. Ed. Keith Wilson and John Walker

JOURNALS:

- *Endocrinology*
- *The Journal of Clinical Endocrinology & Metabolism (JCEM)*
- *Hormone and Metabolic Research*
- *Endocrine Reviews*
- *Pituitary*

SEMESTER II

Credit Hours: 12

Duration: 20 Weeks

CORE COURSES

1. COURSE TITLE & CODE: GIT & NUTRITION (BCH-707)

COURSE OBJECTIVES:

Upon completion of course the students should be able to:

- Understand the anatomy and physiology of the gastrointestinal tract.
- Explain digestion, absorption, and assimilation of nutrients.
- Understand the role of GIT hormones and enzymes in nutrition.
- Relate nutrition to gastrointestinal health and metabolic regulation.
- Understand the biochemical basis of common gastrointestinal and nutritional disorders.

COURSE OUTCOMES:

After successful completion of this course, students will be able to:

- Communicate the importance of nutrients in daily diet and explain their biochemical roles in maintaining health and contributing to disease processes.

- Analyze the role of digestive enzymes and gastrointestinal hormones in normal physiology and pathological conditions.
- Interpret clinical and laboratory data related to nutritional deficiencies, malabsorption syndromes, and gastrointestinal diseases.

Course Contents with Learning Objectives, Teaching Strategies and Assessment tool

Course Topics	Learning Objectives At the end of course, students will be able to:	Learning Domain	Teaching Strategy	Assessment Tool
Energy Metabolism	Apply the principles of energy metabolism to physiological states.	C3	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
Dietary reference intake	Recall the components of Dietary Reference Intake.	C1	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
	Apply DRI guidelines to plan nutritionally adequate diets.	C3		
Protein-energy Malnutrition	Explain the biochemical basis of marasmus and kwashiorkor.	C2	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
	Relate clinical features of PEM to underlying metabolic disturbances	C3		
	Differentiate between marasmus and kwashiorkor at the metabolic level.	C4		
Assessment of nutritional status	Recall methods used to assess nutritional status.	C1	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
	Summarize anthropometric, biochemical, and clinical assessment parameters	C2		
	Interpret nutritional assessment findings in clinical scenarios.	C3		
	Critique the effectiveness of various nutritional assessment tools	C5		
Nutritional aspects of Carbohydrate, fats, proteins	*State* the nutritional roles of carbohydrates, fats, and proteins.	C1	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
	Apply macronutrient concepts to dietary planning and disease states	C3		
	Compare the metabolic impacts of excess or deficiency of macronutrients.	C4		
GIT Digestive juices and Hormones	Describe the digestive juices and gastrointestinal hormones.	C2	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
	Apply knowledge of digestive juices and gastrointestinal hormones to explain their roles in digestion and regulation of gastrointestinal function.	C3		
Digestion and Absorption of	Describe the processes of digestion and absorption of	C2	Interactive lectures	MCQs SEQs

carbohydrates, proteins & lipids	major nutrients		Presentations Assignments	LEQs VIVA
	Illustrate mechanisms of nutrient absorption at the intestinal level.	C3		
	Analyze defects in digestion and absorption in malabsorption syndromes.	C4		

PRACTICAL:

1. Determination of constituent of saliva
2. Detection of salivary amylase
3. Determination of Bile
4. Calculation of BMI and interpretation

RECOMMENDED READINGS

1. Principles of Biochemistry. Ed Lehninger, Nelson and Cox, CBS publishers and distributors
2. Biochemistry by Lubert Stryer W.H. Freeman and Company, New York.
3. Harper's Biochemistry. Ed. R.K. Murray, D.K. Granner, P.A. Mayes and V.W Rodwell. Appleton and Lange, Stamford, Connecticut
4. Lippincott's Illustrated Reviews: Biochemistry, 8th Ed
5. Biochemistry. Ed Donald Voet and Judith G. Voet. John Wiley & sons, Inc.
6. Textbook of Biochemistry with Clinical Correlations. Ed. Thomas M. Devlin. Wiley-Liss Publishers

JOURNALS:

- *The American Journal of Clinical Nutrition*
- *Journal of Nutrition*
- *Gut*
- *Nutrition Reviews*
- *Clinical Nutrition*

2. COURSE TITLE & CODE: MOLECULAR BIOLOGY (BCH-708)

COURSE OBJECTIVES:

Upon completion of course the students should be able to:

- Understand the structure and function of nucleic acids and proteins at the molecular level.
- Explain the mechanisms of DNA replication, transcription, translation, and gene regulation.
- Describe molecular techniques used to study genes, proteins, and cellular processes.
- Relate molecular processes to cell function, development, and disease.

- Develop analytical and experimental skills in modern molecular biology research.

COURSE OUTCOMES:

After completion of course, students will be able to:

a. Describe the molecular genetics of cell that controls the cellular structure and function.
b. Gain in-sight into central dogma of life and application of molecular biology techniques
c. Apply molecular biology tools effectively to study molecular causes of diseases and find solution

Course Contents with Learning Objectives, Teaching Strategies and Assessment tool

Course Topics	Learning Objectives At the end of course, students will be able to:	Learning Domain	Teaching Strategy	Assessment Tool
Chemistry of nucleotides	Recall the structure and nomenclature of nucleotides.	C1	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
	Discuss the biomedical significance of natural and synthetic nucleotide analogues	C2		
	Differentiate between purine and pyrimidine nucleotides in structure and function	C4		
Nucleotide Metabolsim	Describe the pathways of nucleotide synthesis and degradation.	C2	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
	Analyze the biochemical basis of clinical disorders arising from defects in nucleotide metabolism	C4	Interactive lectures Presentations Assignments	
Structure of nucleic acid	Outline the structural organization of DNA and RNA.	C2	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
	Differentiate structural features of DNA and RNA.	C4		
Central dogma	Summarize the flow of genetic information in biological systems.	C2	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
DNA replication & repair	Explain the mechanisms of DNA replication in eukaryotes and prokaryotes and repair	C2	Interactive lectures Presentations Assignments Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
	Illustrate the role of enzymes involved in DNA synthesis and repair pathways.	C3		
	Differentiate between prokaryotic and eukaryotic DNA replication with respect to enzymes, origins, and regulation.	C4		
	Analyze the consequences of defective DNA repair mechanisms and correlate them with clinical disorders	C4		
Transcription	Describe mechanism of Transcription of prokaryotes & Eukaryotes	C2	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA

Genetic code and Translation	Define the characteristics of the genetic code.	C1	Interactive lectures Presentations Assignments	MCQs SEQs LEQ VIVA
	Outline the steps and components of protein synthesis.	C2		
	Differentiate the mechanisms of action of antibiotics acting at various stages of protein synthesis (translation)	C4		
Mutations	Recall the types of genetic mutations	C1	Interactive lectures Presentations Assignments	MCQs SEQs LEQ VIVA
	Interpret how point and frameshift mutations alter the genetic code and affect protein structure and function.	C3		
	Differentiate between point mutations, frameshift mutations, and trinucleotide repeat expansions based on mechanism and consequences	C4		
Regulation of gene expression	Explain levels of gene expression regulation.	C2	Interactive lectures Presentations Assignments	MCQs SEQs LEQ VIVA
	Differentiate between transcriptional, post-transcriptional, and epigenetic regulation.	C4		
Molecular Techniques	Describe the principles, procedures, and applications of the following recombinant DNA techniques: 1. PCR (Polymerase Chain Reaction) 2. RFLP (Restriction Fragment Length Polymorphism) 3. Cloning 4. Human Genome Project 5. Blotting Techniques 6. DNA sequencing	C2	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
	Apply knowledge of molecular techniques to interpret research and diagnostic data.	C3		

PRACTICALS:

1. DNA extraction

   Gel Electrophoresis
2. RNA extraction
3. PCR types and procedure

   Real-time PCR
4. Restriction Endonucleases analysis

   ELISA

RECOMMENDED READINGS:

1. Principles of Biochemistry. Ed Lehninger, Nelson and Cox, CBS publishers and distributors

2. Biochemistry by Lubert Stryer W.H. Freeman and Company, New York.
3. Harper's Biochemistry. Ed. R.K. Murray, D.K. Granner, P.A. Mayes and V.W Rodwell. Appleton and Lange, Stamford, Connecticut
4. Lippincott's Illustrated Reviews: Biochemistry, 8th Ed.
5. Biochemistry. Ed Donald Voet and Judith G. Voet. John Wiley & sons, Inc.
6. Textbook of Biochemistry with Clinical Correlations. Ed. Thomas M. Devlin. Wiley-Liss Publishers
7. Principles and Techniques of Practical Biochemistry. Ed. Keith Wilson and John Walker. Cambridge University Press.

JOURNALS:

- *Molecular Cell*
- *Journal of Molecular Biology*
- *Nature Molecular Biology*
- *Nucleic Acids Research*
- *Genes & Development*

3. COURSE TITLE & CODE: VITAMINS & MINERALS (BCH-709)

COUSE OBJECTIVES:

Upon completion of the course students should be able to:

- Understand the chemical nature, classification, and biological functions of vitamins and minerals.
- Explain the digestion, absorption, transport, and storage of vitamins and minerals.
- Describe the metabolic roles and biochemical mechanisms of micronutrients.
- Relate deficiencies and excesses of vitamins and minerals to human health and disease.
- Appreciate the clinical, dietary, and public health significance of micronutrient balance.

COURSE OUTCOMES

- Relate the biochemical structure and classification of vitamins and minerals to their physiological functions.
- Explain the role of vitamins and minerals in key metabolic pathways and enzymatic reactions.
- Comprehend the causes, biochemical mechanisms, and clinical manifestations of vitamin and mineral deficiencies and toxicities.
- Apply knowledge of vitamin and mineral metabolism to interpret clinical laboratory data.

Course Contents with Learning Objectives, Teaching Strategies and Assessment tool

Course Topics	Learning Objectives At the end of course, students will be able to:	Learning Domain	Teaching Strategy	Assessment Tool
Introduction to classification of vitamins	Describe the classification of vitamins based on their chemical nature and solubility.	C2	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
Fat Soluble vitamins	Apply knowledge of fat-soluble vitamins to explain their absorption and storage mechanisms	C3	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
	Analyze the biochemical pathways involving fat-soluble vitamins and their impact on human health and disease.	C4	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
Vitamin B complex	Describe the members and basic functions of the Vitamin B complex.	C2	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
	Compare the roles of different B vitamins in metabolic pathways.	C4	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
	Critique clinical cases involving B-complex vitamin deficiencies and treatment	C5	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
Vitamin C	Illustrate Vitamin C's role in collagen synthesis and immune function.	C3	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
Introduction and classification of minerals	Apply the classification to explain mineral functions in the body.	C3	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
Calcium and Phosphorus	Analyze the regulation of calcium and phosphorus homeostasis and their physiological significance	C4	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA
Mineral Metabolism	Analyze the regulatory mechanisms and biochemical pathways	C4	Interactive lectures Presentations Assignments	MCQs SEQs LEQs VIVA

PRACTICAL:

1. Quantitative Estimation of Serum Calcium
2. Quantitative Estimation of Ascorbic Acid

   Estimation of vitamin B12, Folic acid
3. Separation of vitamins by Thin Layer Chromatography
4. Estimation of Iron

   Biochemical Indicators of iron deficiency anemia

RECOMMENDED READINGS

1. Principles of Biochemistry. Ed Lehninger, Nelson and Cox, CBS publishers and distributors
2. Biochemistry by Lubert Stryer W.H. Freeman and Company, New York.
3. Harper's Biochemistry. Ed. R.K. Murray, D.K. Granner, P.A. Mayes and V.W Rodwell. Appleton and Lange, Stamford, Connecticut
4. Lippincott's Illustrated Reviews: Biochemistry, 8th Ed.
5. Biochemistry. Ed Donald Voet and Judith G. Voet. John Wiley & sons, Inc.
6. Textbook of Biochemistry with Clinical Correlations. Ed. Thomas M. Devlin. Wiley-Liss Publishers.
7. Principles and Techniques of Practical Biochemistry. Ed. Keith Wilson and John Walker. Cambridge University Press

JOURNALS

- *The American Journal of Clinical Nutrition*
- *Journal of Nutrition*
- *Nutrition & Metabolism*
- *Nutrients*
- *Clinical Nutrition*

COMPULSORY COURSES

1. BIOSTATISTICS & RESEARCH METHODOLOGY (BSR-701)

COURSE OBJECTIVES

Upon completion of course the students will be able to comprehend basic knowledge of epidemiology and will be able to:

- Define epidemiology and know the principles of various study designs
- Know, how to design a study and describe the validity and reliability of a study design
- Know the fundamental concepts and methods of statistics in the areas of medical and biological research
- Have good command on use of statistical computer software for data analysis
- Approaches for data analysis, Parametric, non-parametric and Semi-parametric methods, Qualitative Methodologies and Interpretation of results, validity of conclusions.
- Identify and rationalize research problems with literature review.
- Formulation of research objectives
- Learn Data collection techniques and sampling, planning for data collection, collation and analysis.

- Planning for pilot study followed by main study along with Budget making and plan for dissemination.
- Identify and define the basic concepts and procedures required for data analysis and interpretation.
- Analyze and interpret the data collected for the research project and draw conclusions related to the objectives of your study.
- Write a clear and concise research report (paper for a peer reviewed journal) and a summary of the major findings and recommendations for each of the different parties interested in the results.
- Present the major findings and the recommendations of your study to policy-makers managers and to the subjects of your research together with them finalizing the recommendations.
- Prepare a plan of action for the dissemination, communication and utilization of the findings and (if required) make recommendations for additional research.

COURSE CONTENTS:

- Descriptive epidemiology, analytic epidemiology and epidemiological inference,Classification, morbidity and mortality rates, ratios, incidence, prevalence, sampling, screening, epidemiological models
- Types of study design; their importance, uses, and limitations, field trials, controlled pidemiological surveys, sources of bias and causal models.
- Introduction to statistics, types of statistical applications, population and samples, data analysis and presentation, variables, elementary statistical methods, tabulation, chart and diagram preparations, measures of central tendency and dispersion, sampling techniques and sample size estimation, probability and proportions
- Tests of significance; normal test, t test, Chi square testetc, correlation and its applications, linear regression and multiple regression, Clinical trials and intervention studies
- Measures for developing health statistical indicators: morbidity and mortality statistics, Use of latest statistical computer software for data analysis.

RECOMMENDED READINGS:

1. Gordis, L. Epidemiology. Pennsylvania: W.B. Saunders Company. Latest Ed.
2. Rothman KJ. Modern Epidemiology. Boston: Little, Brown and Company, Latest Ed.
3. Kelsey JL, Thompson WD, Evans AS. Methods in Observational Epidemiology. New York: Oxford UniversityPress, Latest Ed.
4. Kleinbaum DG, Kupper LL, Morgenstern H. Epidemiologic Research: Principles and Quantitative Methods.Belmont, CA: Lifetime Learning Publications, Latest Ed.

5. Lilienfeld DE, Stolley PD. Foundations of Epidemiology. New York: Oxford, Latest Ed.
6. Daniel WW. Biostatistics: A Foundation for Analysis in the Health Sciences. Latest Ed. John Wiley & Sons.Inc. New York.
7. Larson R and Farber B. Elementary Statistics: Picturing the World. Latest Ed, Prentice Hall Publications.NewJersey USA.
8. Oliver, M. and Combard MS. Biostatistics for Health Professions. Latest Ed. Prentice Hall Publications, NewJersey USA.
9. Statistical Software: SPSS; EPIINFO; STATA; SAS
10. Material provided as Health Services Course

JOURNALS:

- *Cancer Epidemiology*
- *Pidemiologic Reviews*
- *Annals of Epidemiology*
- *American Journal of Epidemiology*
- *International Journal of Epidemiology*

2. RESEARCH METHODOLOGY

COURSE DESCRIPTION:

Research Methodology is a hands-on course designed to impart education in the foundational methods and techniques of academic research in social sciences and business management context. Research scholars would examine and be practically exposed to the main components of a research framework i.e., problem definition, research design, data collection, ethical issues in research, report writing, and presentation. Once equipped with this knowledge, participants would be well placed to conduct disciplined research under supervision in an area of their choosing. In addition to their application in an academic setting, many of the methodologies discussed in this course would be similar to those deployed in professional research environments.

COURSE OBJECTIVES:

The primary objective of this course is to develop research orientation among the scholars and to acquaint them with fundamentals of research methods. Specifically, the course aims to introduce them to the basic concepts used in research and to scientific social research
methods and their approach. It includes discussions on sampling techniques, research designs and techniques of analysis

At the end of the course the students should be able to

- Develop the basic framework of research process
- Develop an understanding of various research designs and techniques
- Identify various sources of information for literature review and data collection

- Elaborate ethical dimensions of conducting applied research
- Appreciate the components of scholarly writing and evaluate its quality.

COURSE CONTENT

- Introduction to research – The role of research, research process overview
- Philosophies and the language of research theory building Science and its functions, what is theory? and the meaning of methodology
- Thinking like a researcher – Understanding Concepts, Constructs, Variables, and Definitions
- Problems and Hypotheses – Defining the research problem, Formulation of the research hypotheses, The importance of problems and hypotheses
- Research design – Experimental and Non experimental research design, Field research, and Survey research Methods of data collection – Secondary data collection methods, qualitative methods of data collection, and Survey methods of data collection
- Attitude measurement and scaling – Types omeasurement scales; Questionnaire designing – Reliability and Validity
- Sampling techniques – The nature of sampling, Probability sampling design, Non-probability sampling design, Determination of sample size
- Processing and analysis of data
- Ethical issues in conducting research
- Report generation, report writing – Title page, Abstract,
- Introduction, Methodology, Results, Discussion, References, and Appendices

3. BIO ETHICS/MEDICAL ETHICS (BME-701)

COURSE DESCRIPTION

The ethics curriculum is designed to provide students with the conceptual tools that they will need to navigate the ethical issues that are commonly encountered in clinical practice. Program helps students to develop skills in critical reasoning and in using the basic concepts of medical ethics it also fosters the habits of critical reflection and discussion about the ethical issues.

Thorough exploration of ethics is critical to developing exemplary scholars and teachers. Focusing on discussion, curriculum considers central ethical and legal principles, and research ethics.

LEARNING OBJECTIVES

At the end of the course the student should be able to:

- Describe student responsibilities/ professionalism
- Enlist qualities of a physician
- Discuss codes of ethics
- Elaborate trust & fiduciary responsibility

- Describe importance of truth telling and informed consent for treatment
- Know confidentiality and the duty to warn
- Discuss ethical dangers of human subject research
- Describe importance of research and the development of new Therapies
- Elaborate the common rule: requirements for the ethical Conduct of research
- Explain justice in clinical practice
- State the right to health care
- Discuss allocation of transplant organs
- Describe concepts of autonomy
- Enlist standards for surrogate decision making
- Discuss refusal of treatment and justified paternalism
- Describe advance directives and proxies
- Explain
    - Confidentiality and legal responsibility
    - Adherence and compliance
- Geriatrics -giving bad news Analyze bioethics literature critically and comprehend the foundations of Bioethics theory
- Understand ethical issues regarding handling of research animals.
- Sacrifice research animals according to ethical principles.
- Comprehend basic knowledge of the ethical issues in biomedical research
- Comprehend ethical considerations in using animals for research experiments
- Prepare an animal model for research
- Exhibit attitude towards research on human volunteers, experimental animals and ethical aspects
- Understand 3 R rule regarding animals
- Learn the efforts to minimize the discomfort, infection, illness and pain of animal subjects.
- Interpret the results and draw inference

COURSE CONTENT

- Professional Responsibilities
    - Student Responsibilities/ Professionalism
    - Qualities of a Physician/Codes of Ethics
    - Should Patients Be Learning Tools
- Central Ethical & Legal Principles
    - Duty to Provide Care (Trust & Fiduciary Responsibility)
    - Truth Telling and Informed Consent for Treatment
    - Confidentiality and The Duty to Warn

- Research Ethics [Epidemiology]
    - Ethical Dangers of Human Subject Research
    - The Importance of Research and The Development of New Therapies
    - The Common Rule: Requirements for The Ethical Conduct of Research
- Justice and Medicine
    - Justice in Clinical Practice
    - The Right to Health Care
    - Allocation of Transplant Organs
- Nature and Value of Autonomy
    - Concepts of Autonomy
    - Concept of beneficence
    - Concept of non-maleficence
    - Standards for Surrogate Decision Making
    - Refusal of Treatment and Justified Paternalism
    - Advance Directives and Proxies
- Clinical Moral Reasoning: A Systematic Approach to Clinical Ethics Dilemma
    - Critical Care -Family Meeting
    - Emergency Medicine - Confidentiality and Legal Responsibility
    - Family Practice -Adherence and Compliance
    - Geriatrics -Giving Bad News
    - Medicine -Responding to Families
    - Neurology -Disclosing a Diagnosis
    - Ob/Gyn-Reproductive Choice
    - Pediatrics - Parental Discretion
    - Psychiatry Treatment over Objection and Confidentiality
    - Surgery Identifying Ethical Issues
- Animal Handling Research ethics
    - Reproduction and fertility;
    - Genetics and human future
    - Animal preparation and experiments of laboratory animals,
    - Maintenance of animal house
    - Animal rights in experimentation

4. EDUCATIONAL METHODOLOGY

- Interactive lectures
- Group Discussions
- Assignment

- Seminars

RECOMMENDED READINGS

1. Beauchamp, J. (2013). "Principles of Biomedical Ethics". Principles of Biomedical Ethics. 7.
2. World Medical Association. http://www.wma.net. Principal features of medical ethics [archived 4 March 2016; Retrieved 3 November 2015].

JOURNALS

- *British Medical Journal.*
- *The Medical Journal of Australia*

5. MEDICAL EDUCATION (BWE-701)

COURSE OVERVIEW AND DESCRIPTION:

The whole course is based on principles of constructive cognitive philosophy and follows the FAIR criteria to improve learning. According to constructive philosophy the teacher is more than a transmitter of information and has responsibility for managing the student's learning. The reflective teacher has an understanding of the principles of learning. Hence, this course has four key features identified for effective learning – the FAIR criteria:

Course is designed for post graduate medical students to develop them as an effective team member and effective teacher in Integrated Curriculum development, its implementation and evaluation.

The students will understand and apply the basic core concepts in medical education while working as Task Force member, conducting an integrated session for instance, Problem based Learning Sessions' etc and assessing the students. The essential Core area in which students will be trained are 1) educational environment & students, 2) teaching and learning strategies, 3) curriculum development including educational strategies & curriculum themes, 4) Students assessment and 5) Program evaluation. The course curriculum is structurally organized in these.

LEARNING OBJECTIVES

- Introduce with the themes of HPE, trend, Issues & Challenges IN HPE & Competencies required in HPE.
- Discuss the competencies of a Medical Teacher.
- Identify the factors which constitute the educational environment and effect the students learning i.e. the factors that enhance or inhibit the learning.
- Identify various learning styles, its merits and demerits- superficial and deep learning.
- Identify the characteristics of adult learners, and the principles of adult learning.
- Link principles of adult learning with characteristics of modern curriculum.
- Identify different modes of instruction and its strength and weakness.

- Use the process of planning while designing & conducting large group teaching (Interactive lectures) session.
- Use the process of planning while designing & conducting small group discussion session.
- Discuss the principles process, role of tutors and students, student's assessment in a PBL & CBL session.
- Demonstrate effective communication skills (active participation, Proactiveness, professionalism, group dynamics, team building, conflict resolution, negotiation skills, leadership skills etc) while working in the group/team tasks.
- Define curriculum.
- Differentiate between the different components of a curriculum.
- Enlist Harden's 10 questions for curricular planning & WFME standards
- Discuss various curricular philosophies & Perspectives - curricula past, present, future.
- Identify the trends in curriculum development, educational strategies and curriculum themes.
- Discuss integrated curriculum and broad categories of integration in curriculum
- Differentiate between the aims, goals, outcomes, objectives
- Differentiate between the different levels in Bloom's taxonomy of objectives.
- Write learning objectives of 3 different domains for an integrated module and match it with the teaching and learning strategies.
- Elaborate steps of Integrated Modules planning & development
- Select core content while designing an integrated curriculum development.
- Differentiate between assessment and evaluation
- Differentiation between the formative & summative assessment,
- Criterion referenced and norm referenced.
- Discuss the characteristics of a good examination.
- Match learning objectives with the assessment tools (Miller's Pyramid).
- Construct various assessment tools e.g. M.C.Qs, SEQ, OSCE/OSPEs,
- Match the objectives with the assessment tools.
- Develop a table of specification for a module.
- Discuss the importance of evaluating a teaching session/ course/ program.
- Identify the ways of assessing the effectiveness of an educational program

COURSE CONTENTS:

A. Introduction to HPE and competencies required in HPE

- Educational environment which affects the students learning
- Factors that enhance or inhibit the learning the learning.

- Various learning styles and merits and demerits- superficial and deep learning.

B. Teaching & Learning

- The characteristics of adult learners- the principles of adult learning.
- Different instructional methodology or modes of information transfer.
- Teaching and Learning in large group: Interactive lecturing.
- Teaching and Learning in small groups teaching and learning: PBL, CBL why? How? Its principles, process – tutors and students role

C. Curriculums: structural concepts and development

- The curriculum and its components. Various curricular philosophies & Perspectives- curricula past, present, future. • Innovative trends in
- curriculum, educational strategies and curriculum themes with emphasis on integration.
- The Hardens 10 questions for curricular planning.
- Differentiation between the aims, goals, outcomes, objectives • Writing Learning objectives and Levels in Bloom's taxonomy of objectives for a course.

D. Assessments

- Definition of assessment and evaluation.
- Differentiation between the formative &summative assessment, Criterion referenced and norm referenced.
- Characteristics of a good examination and definitions of validity and reliability of exams.
- Matching learning objectives with the assessment tools.
- Design various assessment tools for knowledge, skill & attitude-
    - MCQs
    - SEQ,OSCE/OSPE
- Importance and Contents of a table of specification.

E. Program Evaluations

- Discuss the importance of evaluating a teaching session/ course/ program.
- Identify the ways of assessing the effectiveness of an educational program.

RECOMMENDED READINGS

1. Understanding medical education evidence theory and practice Twin Swanwick
2. Achieving excellence in Medical Education Richard B Gunderman Oxford book of medical education
3. Researching medical education by Jennifer Cleland and steven J Durning

JOURNALS

- *Journal of medical education and curricula development*
- *International journal of medical education*
- *Journal of postgraduate medicine education and research*

6. COMPUTER SKILLS (CSB-701)

Teaching Strategy – Hands on Workshop COURSE

COURSE OBJECTIVES:

Upon completion of course the students will be able to:

- Develop basic skills in operating computer in the mentioned software.
- Comprehend the basic principles of presenting scientific data at national and international platforms using computer and IT technology

COURSE CONTENTS:

The course contents will include:

Program Microsoft:

- Word
- Power point
- Excel

RECOMMENDED READINGS:

1. Hochreiter, Sepp; Wagner, Roland. Bioinformatics Research and Development. Series Lecture notes in Computer Science, Springer, Latest Ed.
2. Mandoiu, Ion; Narasimhan, Giri; Zhang, Yanqing. Bioinformatics Research and Applications Series: Lecture Notes in Computer Science. Springer, Latest Ed

JOURNALS:

- *Journal of Bioinformatics and Computational Biology (JBCB)*
- *BMC Bioinformatics*

SYNOPSIS WRITING AND APPROVAL FROM ERB/BASAR

By the end of 2nd semester, the students need to complete their synopsis and get it approved from Ethical Review Board (ERB) and BASAR.

SEMESTER III & IV

Literature Review

Research and Thesis writing, Submission and Defense

ELECTIVE COURSES

1. MOLECULAR PATHOLOGY & TECHNIQUES

CODE: (MPT803)

CREDITS HOUR: 3

COURSE OBJECTIVES:

The objective of the molecular pathology & techniques course is to introduce students to the molecular basis of diseases and the laboratory techniques used to detect and study these abnormalities. The course covers the principles of molecular diagnostics, including DNA and RNA analysis, gene mutations, and molecular markers in various diseases. Students will learn about essential laboratory methods such as PCR, RT-PCR, blotting techniques, DNA sequencing, and molecular imaging. The course also aims to develop students' ability to apply these techniques in clinical diagnostics, disease monitoring, and biomedical research, fostering skills for laboratory practice and academic research.

COURSE CONTENTS:

- Gene Mutation
- Reverse Transcriptase
- Regulation of Gene Expression
- DNA Damage & Repair
- Chromosomal basis of
- hereditary
- Human Karyotype and
- Chromosome behaviour
- Tumour Suppressive Genes
- Central Dogma
- Oncogenes
- DNA Structure RNA Structure
- DNA packaging in chromatin
- DNA Replication
- Recombinant DNA
- Technology
- Blotting Techniques
- Cell / Tissue Culture / Cell Lines
- Gene Annotation

COURSE OUTCOMES:

Upon completing the Molecular Pathology & Techniques course, students will have a thorough understanding of the molecular mechanisms involved in the development of genetic, infectious, and neoplastic diseases. They will be able to explain the application of various molecular diagnostic tools in identifying and monitoring diseases. Students will gain practical skills in laboratory techniques such as PCR, electrophoresis, blotting, and sequencing, and learn to analyse and interpret molecular diagnostic results. Additionally, they will be capable of integrating molecular findings with clinical data for disease management and contributing to biomedical research through the use of advanced molecular techniques and technologies.

RECOMMENDED BOOKS:

1. Keith Wilson, John walker 2000, Principles and Techniques of practical biochemistry, Cambridge university press, UK
2. John F. Robyt, BernardJ. White 1994 4rth edition Biochemical techniques: theory and Practice Waveland press Illsioness
3. Sowbney, S.K; and r. singh 2000. Introductory practical Biochemistry. Norosa Publishing house, New delhi.
4. Levinson, Wand E Jawetz. 1996. Meldical Microbiology and Immunology, 4th Ed.Appleton &Lange, Stanford, Connecticut, USA.
5. Murray, R.K; O.K. Granner, P.A. Mayes and V.W. Redwell. 2000, Harper's Biochemistry, 25th Ed. Appleton &Lange Inc. USA.

2. ANALYTICAL TECHNIQUES AND INSTRUMENTS-I

CODE: (ATI813)

CREDITS HOUR: 3

COURSE OBJECTIVES

The objective of the analytical techniques and instruments-I course is to provide students with foundational knowledge of the principles, operation, and applications of essential analytical instruments used in biomedical, pharmaceutical, and biochemical research. The course covers topics such as spectrophotometry, chromatography, electrophoresis, centrifugation, and microscopy. It aims to familiarize students with the theoretical basis and practical procedures of various analytical techniques for qualitative and quantitative analysis. By the end of the course, students will develop the ability to select appropriate analytical methods, operate laboratory instruments, and apply these techniques in clinical, research, and industrial laboratory settings.

COURSE CONTENTS

- Introduction to analytical techniques
- Chromatography & Planar Chromatography
    - Column Chromatography

- Principles of immunochemical techniques
- Optical techniques
- Automation in the clinical Laboratory
- Principles of clinical enzymology
- Electrophoresis
- Mass Spectrometry
- Chemiluminescence,
- bioluminescence and electrochemiluminescence
- Fluorometry/phosphorescence
- Arterial blood gas analysis
- Nephelometry and turbidimetry
- High performance chromatography (HPLC)
- Gas Chromatography
- Spectrophotometry / Flame emission & atomic absorption spectrophotometry
- Potentiometer/Voltammetry/Ion selective electrodes

COURSE OUTCOMES

Upon completing the analytical techniques and instruments-I course, students will be able to:

- Explain the principles and working mechanisms of commonly used analytical instruments in biomedical and biochemical laboratories.
- Develop practical skills in operating instruments such as spectrophotometers, centrifuges, chromatographs, and electrophoresis units.
- Capable of selecting suitable analytical techniques for different types of laboratory investigations and accurately analysing experimental results.
- Additionally, they will learn to maintain and troubleshoot basic laboratory equipment and interpret data for clinical diagnosis, pharmaceutical quality control, and research analysis, contributing effectively to laboratory-based research and diagnostics.

RECOMMENDED BOOKS:

1. Molecular Biology Techniques: An Intensive Laboratory Course by Walt
2. Ream (Author), Katharine G. Field (Author)
3. Molecular Biology Techniques, Third Edition: A Classroom Laboratory
4. Manual 3rd Edition by Heather Miller (Author), D. Scott Witherow (Author), Sue Carson (Author)
5. Molecular Diagnostics: Fundamentals, Methods and Clinical Applications 2nd Edition by Lela Buckingham PhD MB DLM(ASCP) (Author)

3. ANALYTICAL TECHNIQUES AND INSTRUMENTS-II

CODE: (ATI814)

CREDITS HOUR: 3

COURSE OBJECTIVES

The objective of the analytical techniques and instruments-II course is to equip students with comprehensive knowledge of sophisticated analytical tools and their applications in biomedical, pharmaceutical, and biochemical research. The course covers advanced topics such as high-performance liquid chromatography, gas chromatography, mass spectrometry nuclear magnetic resonance, flow cytometry, and advanced spectroscopy. It aims to develop students' skills in selecting, operating, and troubleshooting high-end analytical instruments. By the end of the course, students will understand the principles, techniques, and practical applications of advanced instrumentation in clinical diagnostics, quality control, pharmaceutical analysis, and cutting-edge biomedical research.

COURSE CONTENTS

- Determination of blood
- glucose, Serum TGs
- Determination of total
- Plasma proteins, albumin, globulin
- Determination of serum urea, uric acid, bilirubin
- Determination of serum/urinary calcium, phosphorus, chloride
- Osmometry- Ion selective Na+, Cl+, pH, pO2, pCo2
- Kinetic assays
- Determination of serum aspartate/alanine transaminase, lactate dehydrogenase
- Determination of creatine, phosphokinase, alkaline phosphatase
- Determination of Serum cholesterol, Lipoproteins
- Determination of serum/urinary creatinine clearance
- Determination of amylase
- Determination of IES Ca^{+2}, NH^{+4}
- Immunoradiometric assays
- ELISA/competitive Immunoassay
- Chemilummescent Immunoassays
- Protein urine
- Electrophoresis
- Immunoelectrophoresis/ immunofixation
- Immunodiffusion

COURSE OUTCOMES

Upon completing the analytical techniques and instruments-II course, students will possess an in-depth understanding of modern analytical tools used in high-level research and diagnostics. They will be able to explain the operational principles, applications, and limitations of instruments such as HPLC, GC, MS, NMR, and flow cytometry to address the test recommended for different body fluids against various diseases. Students will acquire practical skills in using these advanced instruments for qualitative and quantitative analysis in clinical, pharmaceutical, and research laboratories. They will also develop the ability to interpret complex analytical data, perform troubleshooting, and contribute to quality assurance and research innovation by integrating advanced analytical methods into biomedical investigations.

RECOMMENDED BOOKS:

1. D. L. Nelson and M. M. Cox. 2012. Lehninger Principles of Biochemistry. 6th edition. Worth Publishers, New York.
2. D. J. G. Voet and C. W. Pratt. 2014. Fundamentals of Biochemistry. 5th edition. John Wiley and Sons. Inc. NY.
3. L. Taiz and E. Zeiger. 2015. Plant Physiology. 6th edition. Sinauer Associates Inc. USA.
4. P. C. Champe., R. A. Harvey and D. R. Ferrier. 2008. Biochemistry: Lippincott's Illustrated Reviews. 4th edition. Lippincott Williams and Wilkins. U.S.A.
5. T. W. Goodwin and E. I. Mercer. 2003. Introduction to Plant Biochemistry. 2nd edition. CBS publishers and distributors. New Delhi.
6. D.A Skooge, Wert. P.M. Holler F.J and Crouch's. R. 2013. Fundamentals of Analytical Chemistry. 9th edition Brooks Publishers.
7. K. Wilson and J. Walker. 2005. Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press. UK. 6th edition.

4. MOLECULAR BIOLOGY OF MITOCHONDRIAL DISEASES

CODE: (MBM 804)

CREDITS HOUR: 2

COURSE OBJECTIVES

The objective of the molecular biology of mitochondrial diseases course is to provide students with specialized knowledge of mitochondrial structure, function, and the genetic basis of mitochondrial disorders. The course covers mitochondrial DNA replication, gene expression, and mutations affecting cellular energy metabolism. It aims to explain the molecular mechanisms involved in inherited and acquired mitochondrial diseases, their clinical presentations, and diagnostic strategies. Students will be introduced to molecular techniques used for detecting mitochondrial mutations and assessing mitochondrial function. By the end of the course, students will be equipped to apply molecular biology concepts to the study and diagnosis of mitochondrial diseases.

COURSE CONTENTS

- Introduction to Mitochondrial Biology
- Mitochondrial Genome Organization and Replication
- Mitochondrial Protein Synthesis and Import Mechanisms
- Mitochondrial Bioenergetics and Oxidative Phosphorylation (OXPHOS)
- Reactive Oxygen Species (ROS) and Mitochondrial Dysfunction
- Genetic Basis of Mitochondrial Diseases
- Pathophysiology of Mitochondrial Disorders
- Mitochondrial DNA Mutations and Clinical Syndromes
- Nuclear DNA Mutations Affecting Mitochondrial Function
- Diagnosis of Mitochondrial Diseases
- Mitochondrial Diseases and Aging
- Mitochondrial Dynamics: Fusion, Fission, and Mitophagy
- Animal and Cellular Models of Mitochondrial Disease
- Therapeutic Approaches for Mitochondrial Diseases
- Mitochondrial Diseases in Neurology and Metabolic Disorders
- Future Perspectives in Mitochondrial Medicine

COURSE OUTCOMES

Upon completing the molecular biology of mitochondrial diseases course, students will have a thorough understanding of the molecular and genetic mechanisms underlying mitochondrial disorders. They will be able to explain mitochondrial DNA structure, gene expression, mutation patterns, and their impact on cellular energy production. Students will gain practical knowledge of molecular diagnostic techniques such as PCR, sequencing, and functional assays used in the evaluation of mitochondrial diseases. Additionally, they will be capable of interpreting molecular and clinical data, correlating genetic mutations with disease phenotypes, and contributing to research and clinical diagnostics focused on mitochondrial dysfunction and related health conditions.

RECOMMENDED BOOKS:

1. Brownstein M. J and Khodursky A, Functional Genomics (Methods in Molecular Biology). Humana Press (2010).
2. Strachan T, Read A. P, Human Molecular Genetics, 4th ed, Garland Science, New York (2010).
3. Glazer A. N, MICROBIAL BIOTECHNOLOGY, Fundamentals of Applied Microbiology, Hiroshi Nikaido University of California, Berkeley (2008).
4. Updated research Published in Nature Review Cell & Molecular Biology. Articles Published in Nature Review Genetics.

5. METABOLIC DISORDERS

CODE: (BCH 816)

CREDITS HOUR: 3

COURSE OBJECTIVES

This course aims to provide an in-depth understanding of the biochemical and molecular mechanisms underlying metabolic disorders. Students will explore inborn errors of metabolism, disruptions in carbohydrate, lipid, and amino acid metabolism, and mitochondrial dysfunctions. Emphasis will be placed on diagnostic approaches, clinical manifestations, and modern therapeutic strategies including dietary, pharmacological, and gene-based interventions. The course also highlights recent research advancements and psychosocial aspects, preparing students to critically analyse, diagnose, and propose evidence-based management strategies for metabolic disorders in both clinical and research settings.

COURSE CONTENTS

- Overview of Metabolic Pathways and Common Metabolic Disorders
- Inborn Errors of Metabolism: Classification and Genetic Basis
- Carbohydrate Metabolism Disorders: Glycogen Storage Diseases
- Galactosemia and Fructose Intolerance
- Phenylketonuria (PKU) and Tyrosinemia
- Maple Syrup Urine Disease (MSUD) and Homocystinuria
- Urea Cycle Disorders
- Alkaptonuria and Other Rare Amino Acid Disorders
- Overview of Lipid Metabolism and Disorders
- Hyperlipidaemias and Atherosclerosis
- Gaucher Disease, Niemann-Pick Disease, and Tay-Sachs Disease
- Adrenoleukodystrophy and Other Peroxisomal Disorders
- Mitochondrial Dysfunction and Disorders
- Lactic Acidosis and Pyruvate Dehydrogenase Deficiency
- Fatty Acid Oxidation Disorders (e.g., MCAD Deficiency)
- Disorders of the Electron Transport Chain
- Metabolic Disorders in Neonates and Infants
- Metabolic Disorders in Pregnancy
- Metabolic Disorders in Cancer Patients
- Dietary Management of Metabolic Disorders
- Pharmacological and Enzyme Replacement Therapies
- Gene Therapy and Emerging Treatments for Metabolic Disorders
- Psychosocial Aspects of Living with Metabolic Disorders

COURSE OUTCOMES

Upon successful completion of this course, students will be able to explain the biochemical basis and genetic mechanisms of major metabolic disorders, interpret metabolic and clinical data for diagnostic purposes, and evaluate therapeutic interventions including enzyme replacement, diet modification, and gene therapy.

They will develop critical thinking skills to analyse current research in metabolic diseases, integrate biochemical knowledge into clinical applications, and demonstrate awareness of the psychosocial and ethical aspects of managing inherited metabolic disorders.

RECOMMENDED BOOKS:

1. Baynes J. W. and Dominiczak M. H., *Medical Biochemistry*, 5th Edition. Elsevier (2021).
2. Marshall W. J., Lapsley M., Day A. P., and Ayling R. M., *Clinical Biochemistry: Metabolic and Clinical Aspects*, 4th Edition. Elsevier (2014).
3. Akash M. S. H. and Rehman K., *Biochemical Aspects of Metabolic Disorders*, 1st Edition. Elsevier (2023).
4. Amponsah S. K., Ofori E. K., and Pathak Y., *Current Trends in the Diagnosis and Management of Metabolic Disorders*, CRC Press (2024).
5. Devlin T. M., *Textbook of Biochemistry with Clinical Correlations*, 8th Edition. Wiley-Blackwell (2019).

6. HEALTH BIOTECHNOLOGY

CODE: (BCH 817)

CREDITS HOUR: 3

COURSE OBJECTIVES

This course aims to provide comprehensive knowledge of biotechnological applications in healthcare, emphasizing molecular diagnostics, therapeutic development, and disease prevention. Students will explore recombinant DNA technology, vaccine production, monoclonal antibodies, stem cell research, and gene therapy. The course highlights recent advances in personalized medicine, pharmacogenomics, and biotechnology-based drug design. It also focuses on ethical, regulatory, and biosafety considerations, preparing students to apply biotechnological innovations for improved diagnosis, treatment, and management of human health and diseases.

COURSE CONTENTS

- Introduction to Health Biotechnology
- Social Acceptance of Medical Biotechnology
- The Molecular Basis of Disease
- Molecular and Genetic Markers
- Detection of Mutations
- Detection of Infectious Agents

- Active and Passive Immunization
- Vaccines (Live, Killed, Recombinant DNA Vaccines)
- Vaccines (Subunit Vaccines, DNA Vaccines, Edible Vaccines)
- Organ Transplantation
- Transplant Rejection
- Applications of Transgenic Animals (Animal Models of Diseases, Pharming)
- Applications of Transgenic Animals (Farm Animals Improvement)
- Drug Delivery Systems
- Blood Transfusion
- Grafting Techniques
- Pharmacogenetics
- Strategies of Gene Therapy
- Gene Delivery Vehicles
- Genetic Disorders and Gene Therapy
- Biopharmaceuticals from Plants
- Uses of Stem Cell Technology

COURSE OUTCOMES

Upon successful completion of this course, students will be able to explain key biotechnological principles and their applications in healthcare, including genetic engineering, vaccine and therapeutic protein production, and molecular diagnostics.

They will demonstrate the ability to analyse and interpret biotechnological data, evaluate emerging technologies such as stem cell therapy and pharmacogenomics, and assess ethical, biosafety, and regulatory aspects of health biotechnology. Students will develop critical insight into applying biotechnology for improving disease diagnosis, treatment, and public health outcomes.

RECOMMENDED BOOKS:

1. Silva A. C. (ed.), *Springer Handbook of Medical Biotechnology*. Springer Cham (2026).
2. Ahmad S. U. (ed.), *Modern Biotechnology in Healthcare: Advances and Applications*. Apple Academic Press (2024).
3. Ho R. J. Y. & Gibaldi M., *Biotechnology and Biopharmaceuticals: Transforming Proteins and Genes into Drugs*, 2nd Edition. Wiley-Blackwell (2013).
4. Malinowski M. J., *Handbook on Biotechnology Law, Business, and Policy: Human Health Products from the Laboratory Bench to Market Approvals*. West Academic Publishing (2016).

7. NUTRITIONAL BIOCHEMISTRY

CODE: (BCH 818)

CREDITS HOUR: 3

COURSE OBJECTIVES

This course aims to provide an in-depth understanding of the biochemical principles underlying human nutrition and metabolism. Students will study the digestion, absorption, and metabolic roles of macronutrients and micronutrients, along with their regulatory functions in health and disease. Emphasis will be placed on nutritional requirements, energy balance, and the biochemical basis of malnutrition and lifestyle-related disorders. The course also introduces nutrigenomics, functional foods, and current research trends linking nutrition, metabolism, and chronic disease prevention.

COURSE CONTENTS

- Introduction to Nutritional Biochemistry: Scope, History, and Emerging Fields
- Digestion, Absorption, and Transport of Macronutrients
- Carbohydrate Metabolism: Glycolysis, Gluconeogenesis, Glycogen Metabolism
- Lipid Metabolism: Beta-Oxidation, Ketogenesis, Lipogenesis
- Protein and Amino Acid Metabolism
- Energy Balance: ATP Production, Mitochondrial Bioenergetics
- Vitamins and Cofactors: Water-Soluble and Fat-Soluble Vitamins
- Minerals and Trace Elements in Biochemical Pathways
- Antioxidants and Oxidative Stress: Biochemical Basis
- Hormonal Regulation of Nutrient Metabolism
- Nutritional Genomics: Nutrigenomics and Nutrigenetics
- Gut Microbiome and Biochemical Interactions with Diet
- Molecular Nutrition in Chronic Diseases (Obesity, Diabetes, CVD, Cancer)
- Nutrition and Immunology: Biochemical Perspectives
- Recent Advances in Molecular Nutrition and Nutraceutical Research

COURSE OUTCOMES

Upon successful completion of this course, students will be able to explain the biochemical functions and interrelationships of nutrients in human metabolism, assess the impact of nutrient deficiencies and excesses on metabolic health, and interpret nutritional data in clinical and research contexts.

They will demonstrate understanding of energy metabolism, nutrient regulation, and nutrigenomics, and evaluate dietary strategies for disease prevention. Students will also gain analytical and critical skills to apply nutritional biochemistry in healthcare and public health improvement.

RECOMMENDED BOOKS:

1. Murray R. K., Bender D. A., Botham K. M., Kennelly P. J., Rodwell V. W., and Weil P. A., *Harper's Illustrated Biochemistry*, 33rd Edition. McGraw-Hill Education (2021).
2. Gropper S. S., Smith J. L., and Carr T. P., *Advanced Nutrition and Human Metabolism*, 8th Edition. Cengage Learning (2021).
3. Gibney M. J., Lanham-New S. A., Cassidy A., and Vorster H. H., *Introduction to Human Nutrition*, 3rd Edition. Wiley-Blackwell (2019).
4. Stipanuk M. H. and Caudill M. A., *Biochemical, Physiological, and Molecular Aspects of Human Nutrition*, 4th Edition. Elsevier (2022).
5. Berdanier C. D., Dwyer J. T., and Heber D. (eds.), *Handbook of Nutrition and Food*, 3rd Edition. CRC Press (2016).
6. Wildman R. E. C., *Advanced Human Nutrition*, 4th Edition. Jones & Bartlett Learning (2018).

SECTION III: ASSESSMENT AND EVALUATION

ASSESSMENT

ASSESSMENT POLICY

RMU MPhil Policy

01 Credit Hour Course:

- Total equated marks = 20;
- Theory/viva voce/practical marks = 15
- CIA = 05 marks
- A candidate obtaining GPA less than 2.00 (50%) is declared un-graded (fail).

02 Credit Hour Course:

- Total equated marks = 40;
- Theory/viva voce/practical marks = 30
- CIA = 10 marks
- A candidate obtaining GPA less than 2.00 (50%) is declared un-graded (fail).

03 Credit Hour Course:

- Total equated marks = 60;
- Theory/viva voce/practical marks = 45
- CIA = 15 marks
- A candidate obtaining GPA less than 2.00 (50%) is declared un-graded (fail).

FORMS OF ASSESSMENTS

- Formative assessment
- Summative assessment

FORMATIVE ASSESSMENT

Continuous Internal Assessment (CIA)

Types:

- Lecture Presentation
- Journal Club Presentation
- Preparation of MCQs/SEQs
- Practical Lab work
- SDL-Course topic assignment (Book, Journal, internet search etc.)
- Workshop, Conference report
- Any other

Marking criteria:

Assignments and Presentations will be marked by following criteria.

Grade A^+ = 90% marks

Grade A = 85% marks

Grade B^+ = 80% marks

Grade B = 75% marks

Each trainee will be assessed by:

- 2 Assignments/ Semester
- 2 Presentations /Semester

SUMMATIVE ASSESSMENT

- End-Term Semester Exam
- Thesis Defense

COMPONENTS OF ASSESSMENT

Each course will be assessed by:

A. Written (MCQs, SEQs & LEQs)
B. OSVE
C. OSPE/OSCE
D. CIA (Continuous Internal Assessment)

ASSESSMENT SCHEME

In each semester, examination marks of each course taught will be classified as following criteria.

A. Continuous Internal Assessment (CIA)– 25% of total marks
B. Final/End term assessment – 75 % of total marks

Each course has following scheme.

Sr #	No. of Credits Hours	Total Marks allocated	CIA (Marks)	Final Term Exam					
				Marks	A. Written			B. OSVE	C. OSPE/OSCE
					MCQs 1x1	SEQs 1x5	LEQs 1x10		
1	01	80	20	60	20	02	01	10	10
2	02	160	40	120	40	04	02	20	20
3	03	240	60	180	60	06	03	30	30

Minor subjects	Total marks 300
(Combine exam)	
Each subject will carry 100 marks	
MCQs	40 marks
OSPE	60 marks

STANDARD OF PASSING

1. **Cleared semester exams**.
2. **The Thesis examined or to be examined by three examiners:** If the scholar has completed his/ her dissertation then the dissertation has to be examined by minimum of three examiners preferably from technologically advanced universities.
3. **Has the Thesis been defended** If yes, then provide the details including date of defense, whether it was an open defense, notification of the defense etc.

RMU GRADING SYSTEM

Course grades shall be awarded to the students based on their performance in the semester. It will be based on GPA – 4 system

Marks (%age)	Letter Grade	Grade Points
90-100	A+	4.00
85-89	A	3.70
80-84	B+	3.30
75-79	B	3.00
70-74	B-	2.70
65-69	C+	2.30
60-64	C	2.00
55-59	C-	1.70
50-54	D	1.30
<50	F	0.00

Pass Marks

The minimum pass marks for each course shall be 50% (Grade D), whereas for award of degree, it should not be less than 2.50/4.00 CGPA

TABLE OF SPECIFICATION (TOS)

SEMESTER-I

End-Term Assessment

The End-Term Assessment of Semester I consists of 6 papers

Paper 1: Cell Biochemistry (BCH 701)

Paper 2: Carbohydrates Chemistry & Metabolism (BCH 702)

Paper 3: Enzymology (BCH 703)

Paper 4: Lipid Chemistry &Metabolism (BCH 704)

Paper 5: Protein Chemistry & Metabolism (BCH 705)

Paper 6: Endocrinology (BCH 706)

Components of Assessments

Each course will be assessed by:

A. Written (MCQs, SEQs & LEQs)
B. OSVE
C. OSPE/OSCE
D. CIA (Continuous Internal Assessment

Marks Distribution										
Paper No.	**Courses**	**Course codes**	**Credit Hours**	**A: Written Component**			**B: OSVE**	**C: OSPE/ OSCE**	**D: CIA**	**Total**
				MCQs	**SEQs**	**LEQs**				
1	**Cell Biochemistry**	BCH-701	1.5+0.5	40	20	20	20	20	40	160
2	**Carbohydrates Chemistry & Metabolism**	BCH-702	1.5+0.5	40	20	20	20	20	40	160
3	**Enzymology**	BCH-703	1.5+0.5	40	20	20	20	20	40	160
4	**Lipid Chemistry &Metabolism**	BCH-704	1.5+0.5	40	20	20	20	20	40	160

5	**Protein Chemistry & Metabolism**	BCH-705	1.5+0.5	40	20	20	20	20	40	160
6	**Endocrinology**	BCH-706	1.5+0.5	40	20	20	20	20	40	160
	Total Marks									960

Paper 1: Cell Biochemistry (BCH 701)

A. Written Paper= 80 Marks

Table of Specification				
Sr No.	Topics	MCQs	SEQs	LEQs
1.	Cell Structure & Organelles	3	1	1
2.	Cell Membrane & Transport	4		
3.	Physicochemical Principles	2		
4.	ETC & Inhibitors	4	1	
5.	Oxidative Phosphorylation & Uncouplers	3		
6.	Acid-Base Chemistry & Buffers	4	1	1
7.	Acid-Base Regulation & Disorders	4		
8.	Serum electrolytes	4		
9.	Cellular Communication (Receptors, Signaling)	4	1	
10	Neurotransmitters & Xenobiotics	4		
11	Cellular Pathology (Cancer, HIV)	4		
Number of Assessment Items		40	4	2
Total Marks		40	20	20
Time (minutes)		40	30	30

B: Objective Structured Viva Examination (OSVE)= 20 Marks

Date: _____ **Time:**_____

Roll No.	Name	Cell and Cell Membrane & Physicochemical Principles 5 Mark	Bioenergetics 5 Mark	Acid-Base Balance & Serum Electrolytes 5 Mark	Cellular communication & Cellular pathology 5 Mark	Total marks 20

C: Practical Component /OSPE/OSCE

- Total Stations= 5
- Time Allocation for each station= 3 minutes
- Marks Allocation for each station= 4 marks

Topics:

1. Introduction to biochemistry laboratory
   Use of laboratory equipments & glass wares
2. Demonstrate the phenomenon of Surface tension & Tonicity
3. Estimation and clinical interpretation of Sodium & Potassium
4. pH meter
   Preparation of buffer solutions

Paper 2: Carbohydrates Chemistry & Metabolism (BCH 702)

A. Written Paper= 80 Marks

Table of Specification

Sr No.	Topics	MCQs	SEQs	LEQs
1.	Introduction & Structural Chemistry (Classification, Isomerism)	4	1	1
2.	Carbohydrate Chemistry (Monosaccharides, Disaccharides)	4		
3.	Chemistry of Polysaccharides & Glycoconjugates	4		
4.	Core Pathways I: Glycolysis & Pyruvate Fate	5	1	
5.	Core Pathways II: TCA Cycle & Gluconeogenesis	5		
6.	Storage & Special Sugar Metabolism (Glycogen, Fructose, Galactose, Disaccharides)	4	1	
7.	HMP Shunt & Its Significance	4		1
8.	Metabolism of Complex Carbohydrates (Glycosaminoglycans, Glycoproteins)	4		

9.	Integration & Regulation of Carbohydrate Metabolism	3	1	
10	Clinical Correlations & Major Disorders (Integrative topic covering dysregulation of all paths)	3		
Number of Assessment Items		40	04	02
Marks		40	20	20
Time (minutes)		40	30	20

B: Objective Structured Viva Examination (OSVE) = 20 Mark

Date: _____ Time: _____

Roll No.	Name	Carbohydrate Chemistry 5 Mark	Glucose Transport and Metabolism 5 Mark	Metabolism of monosaccharide and disaccharide 5 Mark	HMP Shunt and complex carbohydrate metabolism 3 Mark	Integration of carbohydrate metabolism 2 Mark	Total marks 20

Remarks:

C: Practical Component /OSPE/OSCE

- Total Stations= 5
- Time Allocation for each station= 3 minutes
- Marks Allocation for each station= 4 marks

Topics:

5. Experiments on Carbohydrates qualitative analysis – I
   Molisch Test

   Benedict's Test/ Fehling's Test
6. Experiments on Carbohydrates qualitative analysis – II
   Barfoed's Test

   Selivanoffs Test

7. Experiments on Carbohydrates qualitative analysis – III
   Iodine test
8. Experiments on Carbohydrates qualitative analysis – IV
   Hydrolysis of sucrose

Paper 3: Enzymology (BCH 703)

A. Written Paper= 80 Marks

Table of Specification				
Sr No.	Topics	MCQs	SEQs	LEQs
1.	Introduction to Enzymes (Classification, Basic Properties)	3	1	1
2.	Enzyme Properties & Factors Affecting Activity (Temperature, pH, Concentration)	4		
3.	Mechanism of Enzyme Action (Active site, Binding models, Catalytic strategies)	5		
4.	Enzyme Kinetics I: Michaelis-Menten Equation	4	1	
5.	Enzyme Kinetics II: Enzyme Inhibition (Types I & II, mechanisms, graphs)	5		
6.	Cofactors, Coenzymes & Isoenzymes	4	1	
7.	Physiological & Metabolic Regulation of Enzymes (Allosteric, covalent, compartmentalization)	4		1
8.	Clinical Enzymology I: Principles & Diagnostic Enzymes	5	1	
9.	Clinical Enzymology II: Patterns in Disease (Myocardial, Hepatic, Pancreatic, Muscular)	4		
10.	Integration & Application of Enzymology (Case-based, combining kinetics, regulation, clinical)	2		
Number of Assessment Items		40	4	2
Marks		40	20	20
Time (minutes)		40	30	20

B: Objective Structured Viva Examination (OSVE)= 20 Marks

Date: _____ **Time:** _____

Roll No.	Name	Enzyme classification, properties and factors 5 Mark	Enzyme kinetics, regulation and inhibition 10 Mark	Clinical enzymology 5 Mark	Total marks 20

Remarks:

C: Practical Component /OSPE/ OSCE

- Total Stations= 5
- Time Allocation for each station= 3 minutes
- Marks Allocation for each station= 4 marks

Topics:

1. Introduction to Spectrophotometer/ Microlab,
2. Quantitative estimation of serum ALT and AST
3. Quantitative estimation of serum ALP
4. Quantitative estimation of serum Amylase

Paper 4: Lipid Chemistry &Metabolism (BCH 704)

A. Written Paper= 80 Marks

Table of Specification				
Sr No.	Topics	MCQs	SEQs	LEQs
1.	Introduction & Structural Chemistry of Lipids (Classification & Properties of Fatty Acids & Lipids)	6	1	1
2.	Core Metabolism I: Fatty Acid Synthesis (De novo) & TAG Metabolism	3	1	
3.	Core Metabolism II: Fatty Acid Oxidation	4		
4.	Ketone Body Metabolism & Its Metabolic Significance	3		
5.	Phospholipid, Glycosphingolipid, and Eicosanoid Metabolism	8	1	
6.	Cholesterol & Steroid Metabolism	5		1
7.	Lipoprotein Metabolism & Dynamics (Chylomicrons, VLDL, LDL, HDL)	6	1	
8.	Integration of Lipid Metabolism & Regulation (Hormonal control, fed/fast state)	2		
9.	Clinical Correlations of Lipid Metabolism (Atherosclerosis, Fatty Liver, Ketoacidosis, etc.)	3		
Number of Assessment Items		40	4	2
Marks		40	20	20
Time (minutes)		40	30	20

B: Objective Structured Viva Examination (OSVE)= 20 Marks

Date: _____ Time: _____

Roll No.	Name	Lipid Chemistry & Digestion and absorption 5 Mark	Fatty acid and Ketone body's metabolism 5 Mark	Complex lipid, cholesterol and Eicosanoid metabolism 5 Mark	Lipoprotein metabolism 5 Mark	Total marks 20

Remarks:

C: Practical Component /OSPE/OSCE

- Total Stations= 5
- Time Allocation for each station= 3 minutes
- Marks Allocation for each station= 4 marks

Topics:

5. To prepare, observe Cholesterol crystal
6. Experiments on Fats qualitative analysis
   Liebermann Burchard Test
   Salkowski's Test
3. Quantitative Estimation of serum Cholesterol
4. Quantitative Estimation of serum Triglycerides

Paper 5: Protein Chemistry & Metabolism (BCH 705)

A. Written Paper= 80 Marks

Table of Specification				
Sr No.	Topics	MCQs	SEQs	LEQs
1.	Amino Acid Chemistry & Properties	2	1	1
2.	Classification and functions of Proteins	1		
3.	Structural Organization of Protein	3		

4.	Fibrous Protein: Collagen And Elastin	3		
5.	Globular proteins: Hemoglobin and myoglobin	3		
6.	Protein Folding, Stability & Denaturation	1		
7.	Separation and study techniques of Protein	1		
8.	Pasma proteins & Immunoglobulins	4		
9.	Nitrogen Metabolism I: Ammonia Handling & Urea Cycle	4		
10.	Nitrogen Metabolism II: Metabolism of Individual Amino Acids	4	1	
11.	Fate of Carbon Skeletons & Synthesis of Specialized Products	4		
12.	Heme Metabolism & Its Disorders	6	1	1
13.	Integration of Protein Turnover & Metabolic Regulation (Fed/fast state, hormonal control)	1		
14.	Clinical Integration & Disorders (Inborn errors, misfolding diseases, nutritional disorders)	3	1	
Number of Assessment Items		40	4	2
Marks		40	20	20
Time (minutes)		40	30	20

B. Objective Structured Viva Examination (OSVE)= 20 Marks

Date: _____ Time: _____

Roll No.	Name	Protein chemistry 5 Mark	Protein metabolism 8 Mark	Heme metabolism 7 Mark	Total marks 20

Remarks:

C: Practical Component /OSPE/OSCE

- Total Stations= 5
- Time Allocation for each station= 3 minutes
- Marks Allocation for each station= 4 marks

Topics:

1. Qualitative analysis of Protein-Color tests of proteins
2. Detection of protein by:
    a. Salting out method
    b. Heat coagulation
3. Quantitative estimation of serum Urea
4. Estimation of total proteins
    a. Estimation of albumin and globulin
5. Estimation of Bilirubin

Paper 6: Endocrinology (BCH 706)

A. Written Paper= 80 Marks

Table of Specification				
Sr No.	Topics	MCQs	SEQs	LEQs
1.	Principles of Endocrinology	1	1	1
2.	Hypothalamic-Pituitary Axis	5		
3.	Thyroid Gland: Hormones & Disorders	4		
4.	Calcium Homeostasis	4		
5.	Pancreatic Hormones: Insulin & Its Role	4	1	
6.	Pancreatic Hormones: Glucagon & Blood Glucose Regulation	4		
7.	Adrenal Cortex: Steroid Hormones	5	1	1
8.	Adrenal Medulla & Stress Response	4		
9.	Reproductive Endocrinology	5	1	
10.	Integrated Endocrine Control & Major Disorders	4		
Number of Assessment Items		40	4	2
Marks		40	20	20
Time (minutes)		40	30	20

B: Objective Structured Viva Examination (OSVE)= 20 Marks

Date:_____ **Time:**_____

Roll No.	Name	Introduction, and mechanism of action of hormones 5 Mark	Thyroid hormone, calcium hemostasis & Pancreatic hormones 8 Marks	Adrenal hormones and reproduction 7 Marks	Total marks 20

Remarks:

C: Practical Component /OSPE

- Total Stations= 5
- Time Allocation for each station= 3 minutes
- Marks Allocation for each station= 4 marks

Topics:

1. Quantitative Estimation of serum glucose
2. Glucose tolerance test
3. Use of glucometer
4. Thyroid function tests

For each course, 25% (40 marks) of the Continuous Internal Assessment (CIA) will be evaluated under the following categories**.**

D: Continuous Internal Assessment (CIA)

S#	Assignment	Grade/Score	Score obtained	Signatures of Supervisor
1	Teaching undergraduate students (BS, MBBS)			
2	Lecture Presentation			
3	Journal Club Presentation			
4	Supervision of research project			
5	Preparation of MCQs/SEQs			
6	Practical Lab work			
7	SDL-Course topic assignment (Book, Journal, internet search etc.)			
8	Workshop, Conference report			
9	Any other (Attendance, Log Book)			

MPhil Biochemistry-Semester II
End-Term Assessment

The End-Term Assessment of Semester 2 consists of 3 papers

Paper 1: Gastrointestinal Tract (BCH 707)

Paper 2: Molecular Biology (BCH 708)

Paper 3: Vitamins & Minerals (BCH 709)

Components of Assessments

Each course will be assessed by:

A. Written (MCQs, SEQs & LEQs)
B. OSVE
C. OSPE/OSCE
D. CIA (Continuous Internal Assessment)

Marks Distribution										
Paper No.	**Courses**	**Course codes**	**Credit Hours**	**A: Written Component**			**B: OSVE**	**C: OSPE/ OSCE**	**D: CIA**	**Total**
				MCQs	SEQs	LEQs				
1	**Gastrointestinal Tract**	BCH-707	1.5+0.5	40	20	20	20	20	40	160
2	**Molecular Biology**	BCH-708	1.5+0.5	40	20	20	20	20	40	160
3	**Vitamins & Minerals**	BCH-709	1.5+0.5	40	20	20	20	20	40	160
	Total									480

Paper 1: Gastrointestinal Tract (BCH 707)

A. Written Paper= 80 Marks

Table of Specification				
Sr No.	**Topics**	**MCQs**	**SEQs**	**LEQs**
1.	Gastrointestinal Secretions I (Saliva, Gastric Juice)	3	1	1
2.	Gastrointestinal Secretions II (Pancreatic Juice, Bile)	4		
3.	Integration: Intestinal Juice & Nutrient Absorption	5		
4.	Gastrointestinal Hormones	4		

5.	Digestion & Absorption of Carbohydrates	5	1	1
6.	Digestion & Absorption of Proteins	5		
7.	Digestion & Absorption of Lipids	5		
8.	Nitrogen Balance & Nutritional Assessment (BMI, BMR)	4	1	
9.	Clinical Disorders of Malabsorption	3	1	
10.	Clinical Disorders of Nutrition	2		
Number of Assessment Items		40	4	2
Marks		40	20	20
Time (minutes)		40	30	20

B: Objective Structured Viva Examination (OSVE)= 20 Marks

Date:_____ **Time: _____**

Roll No.	Name	Gastrointestinal Secretions & Hormones 5 Mark	Digestion and absorption of carbohydrates, proteins & Lipids 10 Marks	Nitrogen Balance & Nutritional Assessment (BMI, BMR) 5 Mark	Total marks 20

Remarks:

C: Practical Component /OSPE/OSCE

- Total Stations= 5
- Time Allocation for each station= 3 minutes
- Marks Allocation for each station= 4 marks

Topics:

1. Determination of constituent of saliva
2. Detection of salivary amylase

3. Determination of Bile
4. Calculation of BMI and interpretation

Paper 2: Molecular Biology (BCH 708)

A. Written Paper= 80 Marks

B:

Table of Specification				
Sr No.	**Topics**	**MCQs**	**SEQs**	**LEQs**
1.	Chemistry of Nucleotides & Nucleic Acid Structure	4	1	1
2.	Nucleotide Metabolism I: Purine Synthesis & Degradation	4		
3.	Nucleotide Metabolism II: Pyrimidine Synthesis & Degradation	4		
4.	Clinical Disorders of Nucleotide Metabolism	4		
5.	DNA Dynamics: Replication & Repair Mechanisms	5	1	1
6.	Transcription & Its Regulation	5	1	
7.	Genetic code and Translation	5		
8.	Mutations	3		
9.	Molecular Techniques	3	1	
10.	Integration of Gene Expression & Central Dogma	3		
Number of Assessment Items		40	4	2
Marks		40	20	20
Time (minutes)		40	30	20

Objective Structured Viva Examination (OSVE)= 20 Marks

Date: _____ Time: _____

Roll No.	Name	Nucleotide Chemistry & Metabolism 4 Mark	DNA Replication & Repair 4 Mark	Transcription & Translation 4 Mark	Molecular biology techniques 4 Mark	Gene expression 4 Mark	Total marks 20

Remarks:

C: Practical Component /OSPE/OSCE

- Total Stations= 5
- Time Allocation for each station= 3 minutes
- Marks Allocation for each station= 4 marks

Topics:

1. DNA extraction
   Gel Electrophoresis
2. RNA extraction
3. PCR types and procedure
   Real-time PCR
4. Restriction Endonucleases analysis
   ELISA

Paper 3: Vitamins & Minerals (BCH 709)

A. Written Paper= 80 Marks

Table of Specification				
Sr No.	**Topics**	**MCQs**	**SEQs**	**LEQs**
1.	Introduction & Principles (Classification of Vitamins & Minerals)	1	1	1
2.	Fat-Soluble Vitamins (A, D, E, K)	7		
3.	Water-Soluble Vitamins I: B-Complex (Energy Metabolism) (B1, B2, B3, B5, B7)	6	1	
4.	Water-Soluble Vitamins II: B-Complex (Blood & Neuro) (B6, B9, B12) & Vitamin C	6		
5.	Macrominerals I: Calcium & Phosphorus (Metabolism, Hormonal Control, Disorders)	5	1	1
6.	Macrominerals II: Electrolytes & Others (Na, K, Cl, Mg)	5		
7.	Microminerals (Trace Elements) I (Iron, Zinc, Copper)	4	1	
8.	Microminerals (Trace Elements) II (Iodine, Selenium, Fluoride, Manganese)	4		
9.	Integration: Nutritional Deficiencies & Toxicity Syndromes	2		
Number of Assessment Items		40	4	2
Marks		40	20	20
Time (minutes)		40	30	20

B: Objective Structured Viva Examination (OSVE)= 20 Mark

Date: _____ **Time: _____**

Roll No.	Name	Fat soluble vitamins 7 Mark	Water soluble vitamins 7 Mark	Minerals 6 Mark	Total marks 20

Remarks:

C: Practical Component /OSPE/ OSCE

- Total Stations= 5
- Time Allocation for each station= 3 minutes
- Marks Allocation for each station= 4 marks

Topics:

1. Quantitative Estimation of Serum Calcium
2. Quantitative Estimation of Ascorbic Acid

For each course, 25% (40 marks) of the Continuous Internal Assessment (CIA) will be evaluated under the following categories**.**

D: Continuous Internal Assessment (CIA)

S#	Assignment	Grade/Score	Score obtained	Signatures of Supervisor
1	Teaching undergraduate students (BS, MBBS)			
2	Lecture Presentation			
3	Journal Club Presentation			
4	Supervision of research project			
5	Preparation of MCQs/SEQs			

6	Practical Lab work			
7	SDL-Course topic assignment (Book, Journal, internet search etc.)			
8	Workshop, Conference report			
9	Any other (Attendance, Log Book)			

PGT TOOLKIT FOR FORMATIVE ASSESSMENT

MAINTENANCE OF RECORD

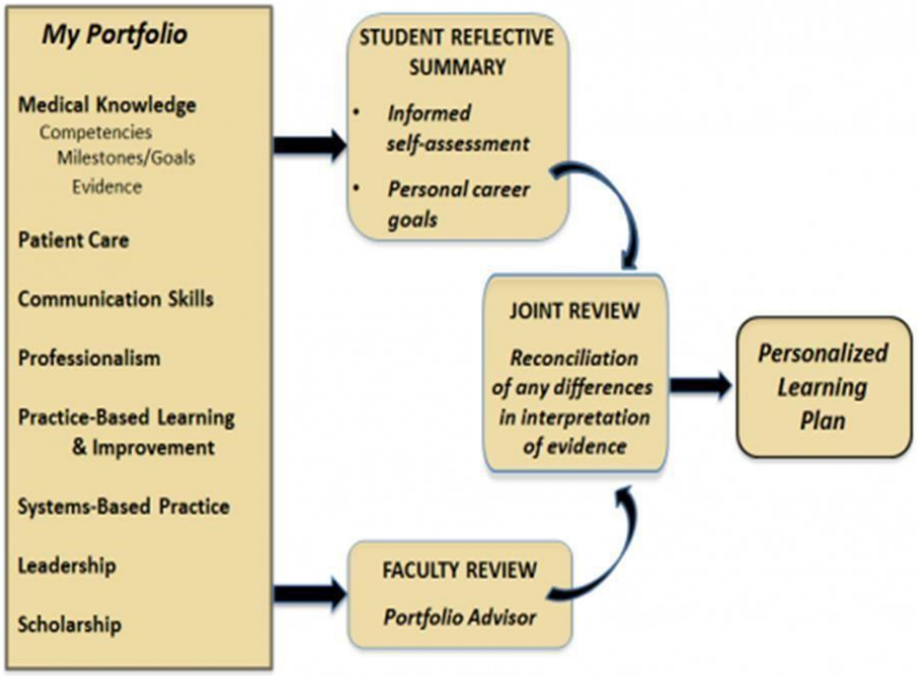
PORTFOLIO

PGTs will maintain a portfolio that takes the portfolio resume concept one step further in a multiple-page document that thoroughly covers PGTs career to date. Portfolio will contain:

- Table of contents
- Copy of standard resume
- Education: degrees, certifications, etc.
- Skills and achievements
- Career goals
- Mission statement or guiding principles
- Professional summary
- Personnel Essay
- Previous Work samples
- Evaluations or recommendations
- Publications and research
- Volunteer work
- Awards and acknowledgements
- List of references

- Cover Letter
- Critical Choices
- Senior Memory Book
- Two-Year Plan
- Academic Work samples
- Projects, examples, posters
- Student reflections (either weekly, monthly, or bi-monthly)
- Pivotal Points
- Charts, graphs created
- CPC attendance
- Assignments

PGTs will organize portfolio into sections. Use page numbers and a table of contents to make the information easy to find, as well as tabs or dividers between sections.



Example – Reflective Log

1. Describe a learning/teaching experience that was significant for PGTs.
2. Reflect on why this experience was significant for PGTs. How did PGTs feel/react? What were they thinking then?
3. Think about what this experience means. What do PGTs think made them feel/think/react in this way?
4. What do you think you learnt from this experience?

5. What would PGTs do differently in the future if PGTs found yourself in a similar situation? **Example –Learning Activity Diary**

Date:

Learning Activity:

Participants involved (students/teachers/tutors etc):

- What did you understand to be the purpose of the learning activity?
- At the start of the activity, what did you think you were required to do to successfully complete it?
- What learning resources did you use to help you? (e.g. books, equipment, internet resources the advice and help of others including fellow students
- What did you learn?
- Did you find the learning activity straightforward or difficult? Why?
- If you were asked to do the activity again, what would you do differently? **Making Plans to Achieve your Goals**
- PGTs will use this template to break down your goals, whether they're academic, career orientated or personal, into specific and achievable steps.
- Set target dates for short-, medium- and long-term goals to keep yourself motivated, but don't worry if you have to adjust these dates as you progress.
- **Goal:**
    - How will I benefit from reaching this goal? What obstacles and difficulties might I face?
    - Whom can I approach to help me reach my goal? What resources might I need?
    - What incremental steps do I need to take to achieve my goal?
    - What lessons have you learnt from this process that might be useful next time?

FORMATIVE ASSESSMENT / PROGRESS REVIEW

PGTs will use this form to reflect on progress since last meeting with their personal mentor. This is an opportunity to think about how they performed in different units over the last teaching block, not just what marks received, but how well they got to grips with the subject matter and the skills involved and what lessons drawn from the experience for work in future.

They will take the form to mentor, in advance as a basis for the discussion.

(1) How would you sum up your experiences over the last teaching block?

(2) What have been the main strengths in your performance?

(3) What are the main skills which you have acquired or developed?

(4) What have been the most important points raised in the feedback you have received?

(5) What are the main areas where you feel you can improve your performance?

(6) Are there any skills that you need to develop to do this?

(7) What is your key aim for your work over the next teaching block?

(8) Is there anything that you feel is holding you back in achieving these aims?

POSTGRADUATE TRAINEE EVALUATION

PGT EVULATION

360 Degree evaluation of PGTs:

- PGTs will be evaluated by
    - Students
    - Lab Staff
    - Mentors
    - Supervisors

EVALUATIONS:

- To make sure that residents/students are evaluated fairly, the evaluators will attend workshops on evaluation methodologies.
- There will be structured viva and written assessments
- Keys will be provided to evaluators for checking written papers/viva
- For annual confidential written evaluations of the PGT by the students, Feedback proforma will be designed in which all aspects related to teaching like Knowledge, punctuality,
- tolerance level, professionalism, communication skills and behavior with student will be covered.
- To ensure confidentiality students will be asked to fill proforma without showing their identity, different students will be asked to fill proforma at different times
- All data will be computerized and a, pass code will be generated so only concerned person will be able to access these feedback proforma
- A confidential letter will be written to PGT in which details of his/her annual Feedback will be told including all positive and negative aspects
- He /she will be called in HOD office to discuss areas where improvement is required
- He/she will be encouraged to convert weaknesses into strengths by addressing his problems

DEPARTMENT OF BIOCHEMISTRY

RAWALPINDI MEDICAL UNIVERSITY

RWP PGT EVULATION PROFORMA BY SUPERVISOR

NAME: _____SESSION: _____

PROGRAMME: _____COURSE TITLE: _____

ATTENDANCE

PRESENTATIONS

LECTURES

SGD

TUTORIALs/GUIDED SELF-STUDY

PRACTICAL

PROFESSIONALISM

CONDUCT

TEST RESULTS

WRITTEN

VIVA

TOTAL

REMARKS: _____

SUPERVISOR SIGNATURE: _____

PGT EVALUATION BY STUDENTS PROFORMA

TEACHER EVALUATION FORM

(To be filled by the student)

Course Title and Number:

Name of Instructor: _____Semester ___

Department: _____ Degree _____

Use the scale to answer the following questions below and make comments

A: Strongly Agree B: Agree C: Uncertain D: Disagree

E: Strongly Disagree

Instructor:

1. The instructor is prepared for each class. A B C D E
2. The instructor demonstrates knowledge of the subject. A B C D E
3. The instructor has completed the whole course. A B C D E
4. The instructor provides additional material apart from the textbook. A B C D E
5. The instructor gives citations regarding current situations with reference to Pakistani context. A B C D E
6. The instructor communicates the subject matter effectively: A B C D E
7. The instructor shows respect towards students and encourages class participation.

   A B C D E
8. The instructor maintains an environment that is conducive to learning. A B C D E
9. The instructor arrives on time. A B C D E
10. The instructor leaves on time. A B C D E
11. The instructor is fair in examination. A B C D E
12. The instructor returns the graded scripts etc, in a reasonable amount of time.

    A B C D E
13. The instructor was available during the specified office hours and for after class consultations. A B C D E

Course:

14. The Subject matter presented in the course has increased your knowledge of the subject.

    A B C D E

15. The syllabus clearly states course objectives requirements, procedures and grading criteria. A B C D E

16. The course integrates theoretical course concepts with real-world applications.

    A B C D E

17. The assignments and exams covered the materials presented in the course: A B C D E

18. The course material is modern and updated. A B C D E

Comments:

Instructor:

_____

_____

_____

Course:

_____

_____

_____

PROFORMA-2 FACULTY COURSE REVIEW REPORT

(To be filled by each teacher at the time of Course Completion)

Part-I

Department: _____ Faculty: _____

Course Code: _____Title: _____

Batch: _____Term: _____ Year: _

Credit / Contract: _____

Weeks: _____ No. of Lectures Conducted: _____

No. of Students enrolled: _____

Designation: _____

Assessment Methods: please give precise details (no & length of assignments, tests and presentations)

Comments:

_____

_____

_____

Overview/ Evaluation (Course Co-coordinator's Comments):

_____

_____

_____

Feedback: first summarize, and then comment on feedback received form:

_____

_____

_

1) Student (Course Evaluation) Questionnaires (filled by QEC)

2) External Examiners or Moderators (if any)

(comments of External examiner if any)

3) Curriculum: comment on the continuing appropriateness of the Course curriculum in relation to the intended learning outcomes (course objectives) and its compliance with the HEC
   Approved / Revised National Curriculum Guidelines (comments by the course teacher)

4) Assessment: comment on the continuing effectiveness of method(s) of assessment in relation to the intended learning outcomes (Course objectives)
   (comments by the course teacher)

5) Enhancement: comment on the implementation of changes proposed in earlier Faculty Course Review Reports (comments by the course teacher)

6) Outline: any changes in the future delivery or structure of the Course that this semester/term's experience may prompt (by the course teacher)

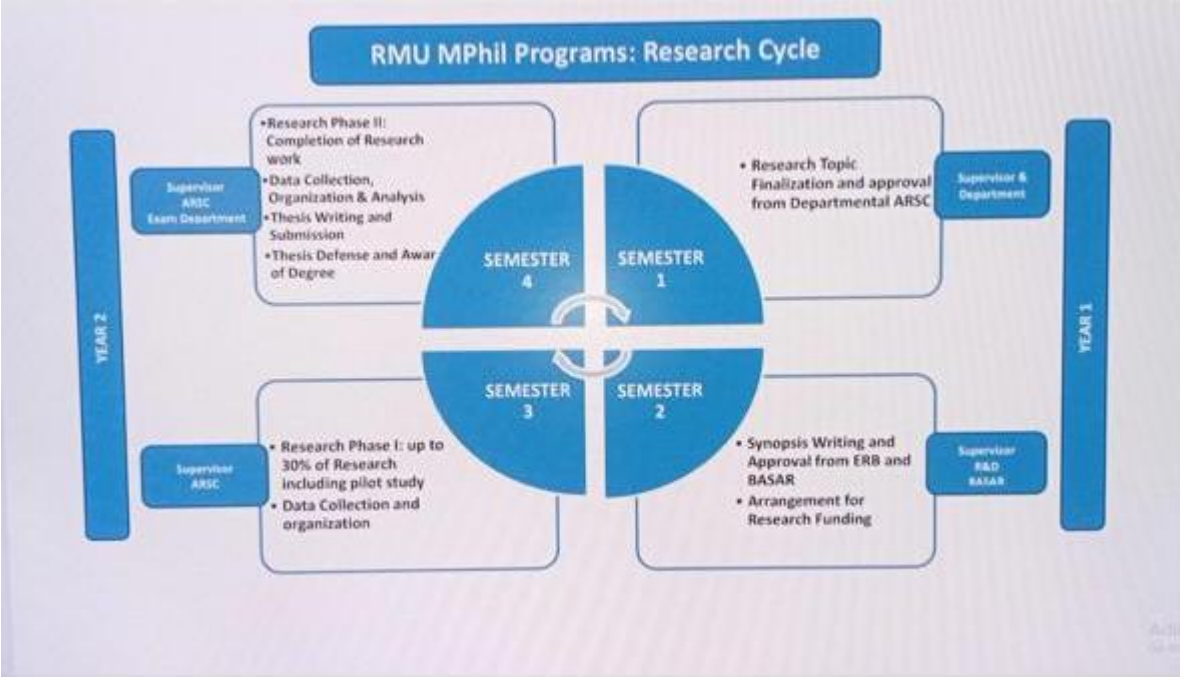
Name/ Signature _____Date_____
(Course Instructor)

Name/ Signature _____Date_____

(Head of Department)

SECTION IV: RESEARCH COMPONENT

RMU RESEARCH CYCLE



SYNOPSIS AND THESIS

GUIDELINES FOR M.PHIL. SYNOPSIS

Synopsis is the brief outline of PGTs planned research project submitted for Approval from Ethics Review Board (ERB). It gives a panoramic view of PGTS research for quick analysis by the reviewers. M. Phil research synopsis writing is an active part of the academic life of the Rawalpindi Medical University.

A synopsis should be constructed in a manner that facilitates the reviewer to understand the research project at a glance. It should be brief but precise. A synopsis must have the following Headings:

TITLE:

The title of the research project should be brief but informative. It should reflect the objectives of the study. It must be written after the whole synopsis has been written so that it is a true representative of the plan. It should neither be too short nor too long. It should not include any name of the institution or the number of cases to be studied.

INTRODUCTION:

It should provide a brief description of the selected topic. It must highlight the importance of study, its relevance and applicability of results on general population. The purpose of the study must be

evidently stated in the introduction.

HYPOTHESIS:

A hypothesis is a statement which is to be tested for possible acceptance or rejection. It is mentioned as a tentative prediction or explanation of the relationship between two or more variables. Hypothesis are of two types i.e. Null (ho) and alternative (h1).

Null Hypothesis is tested for possible rejection, whereas alternative hypothesis is tested for possible acceptance.

Hypothesis can be formulated by understanding the problem, reviewing the literature on it, and considering other factors. A hypothesis is needed in the following study designs:

All Interventional Studies

Cohort

Case Control

Comparative Cross Sectional.

AIMS AND OBJECTIVES:

An objective is indication of what the researcher wants to study. It should be stated in clear measurable terms and should be itemized. The objectives and aims should be only a few (2-3). They must pertain to the study problem. Usages of terms like "first study", "the only study", etc. should be avoided.

OPERATIONAL DEFINITION:

It may be required in some synopsis. It is the definition of exposure and outcome variables of interest in context to objective in a particular study and their means of measurement/determination.

Examples:

- Anemia
- Effectiveness
- PPHA
- Wound Healing

MATERIAL AND METHODS:

STUDY DESIGN:

Mention the name of the appropriate study design.

SETTING:

Name and place where the research work is to be conducted Duration of Study:

How long will the study take?

SAMPLE SIZE:

How many patients will be included? If there are groups how many per group?

SAMPLING TECHNIQUE:

Type of sampling technique employed.

SAMPLE SELECTION:

- Inclusion Criteria: on what basis will patients be inducted in the study?
- Exclusion Criteria: on what basis will patients be excluded from the study?

DATA COLLECTION PROCEDURE:

A detailed account of how the researcher will perform research; how she/he will measure the variable. It includes:

- Identification Of the Study Variables
- Methods For Collection of Data
- Data Collection Tools (Proforma/Questionnaire)

VARIABLES:

Variables are the factors that can change. These changes can affect the outcome of a research project. Thus, it is important to identify the variables at the planning stage. They should be quantified with a measurable unit. Knowledge of the various variables in a research project will assist in refining the objectives. Usually, objectives of a research will be to see the effect of independent variables on dependent variables.

DATA ANALYSIS PROCEDURE:

Data analysis is an important part of a research project. A good analysis leads to good results. Relevant details naming software to be used, which descriptive statistics and which test of significance if and when required, specifying variables where it will be applied. A general statement "appropriate statistical methods will be used." must be avoided.

ETHICAL CLEARANCE:

Wherever necessary, ethical committee clearance from the institute should be obtained. The certificate must be attached. Ethical clearance is required in all human and animal studies.

DATA COLLECTION INSTRUMENT:

The researcher must attach, as an annex, the proforma or questionnaire with the help of which he/she intends to collect data. The proforma/questionnaire must match the objectives and must not contain irrelevant sections like inclusion and exclusion criteria etc.

ESTIMATED COST OF THE PROJECT:

It includes the funds required for all chemicals / reagents, laboratory equipment's / materials or study animals (if any) to be utilized in the research needs.

OUTCOME & UTILIZATION:

It describes the way in which the expected results of your study can be useful in designing and delivery of health care systems.

REFERENCE:

All references quoted in review of literature and anywhere else in the synopsis should be listed here. There are two styles for writing references, Vancouver style and Harvard style. Vancouver

style is easy to follow as it depends on the numbers as quoted in text.

PROCESS OF SUBMISSION & APPROVAL

Synopsis will be approved by university institutional research forum and ethical review board. Final approval will be given by university board of advanced studies and research.

MASTER'S THESIS FORMAT

The thesis is a document that contains relevant details of the research work conducted by the post-graduate trainee relating to the problem. It emphasizes developing skills in postgraduate trainees for: collection and compilation of data, analyzing and reviewing relevant literature available on the subject& developing medical writing habits. A thesis must have the following headings:

TITLE PAGE:

It must include the title (including subtitles), author, institution, department & date of delivery.

SUPERVISOR'S CERTIFICATE:

A thesis is to be submitted for the purpose of examination. It must be obtained prior declaration by the supervisor on the standard and quality of the thesis.

ACKNOWLEDGEMENTS:

The student may acknowledge the assistance of various individuals or organizations unsuccessfully producing the thesis. This should be written in one page.

LIST OF SYMBOLS/ABBREVIATIONS:

All symbols or abbreviations found in the text should be listed on this page in alphabetical order.

TABLE OF CONTENTS:

The table of contents page must start on a new page. It should list all sections, chapters and subheadings. The titles must be written using the same words as those written in the text.

LIST OF TABLES:

This page should list all the tables found in the thesis. The page number of the table must also be included. The table numbers should be arranged according to the chapters.

LIST OF FIGURES:

Diagrams, photographs, drawings, graphs, charts and maps are included as figures. The list should be written similar as the list of tables

LIST OF APPENDICES:

All appendices should be listed on this page.

ABSTRACT:

A good abstract explains the importance of the research in one line. It then goes on to give a summary of your major results. The closing sentences explain the major inferences of your work. A good abstract is concise, readable, and quantitative. Length should be ~ 1-2 paragraphs, approx. 400 words. Information in title should not be repeated. Use numbers where appropriate. Abstract

must tell why & how you performed the study & what did you learned by the results of the study.

INTRODUCTION:

For writing a good introduction PGs must know what the body of the paper says. Preferably the introductory section(s) should be written after PGs have completed the rest of the paper, rather than before. Be sure to include a sufficiently interesting statement at the beginning of the introduction to motivate PGs reader to read the rest of the paper. This is the scientific problem that PGs paper either solves or addresses. PGTs should attract the reader and make them want to read the rest of the thesis.

The next paragraphs in the introduction should quote previous research in this field. It should cite those who had the idea or ideas first and should also cite those who have done the most recent and relevant work. PGTs should then go on to explain why more work was necessary PGs work, of course.)

PGs should also state the goal of the paper: why the study was undertaken, or why the paper was written. Do not repeat the abstract. Provide sufficient background information to allow the reader to understand the context and significance of the question PGs are trying to address. Mention proper acknowledgement of the previous work on which they building their thesis. Give sufficient references at the end. The introduction should be focused on the thesis question(s). All cited work should be directly relevant to the goals of the thesis.

AIMS AND OBJECTIVES:

An objective is indication of what the researcher wants to study. It should be stated in clear measurable terms and should be itemized. The objectives and aims should be only a few (2-3).

They must pertain to the study problem.

MATERIAL AND METHODS:

It should be same as stated in the synopsis. It includes:

STUDY DESIGN:

Mention the name of the appropriate study design.

SETTING:

Name and place where the research work is to be conducted

DURATION OF STUDY:

How long will the study take?

SAMPLE SIZE:

How many patients will be included? If there are groups how many per group?

SAMPLING TECHNIQUE:

Type of sampling technique employed.

SAMPLE SELECTION:

- Inclusion criteria: on what basis will patients be inducted in the study?
- Exclusion criteria: on what basis will patients be excluded from the study?

DATA COLLECTION PROCEDURE:

A detailed account of how the researcher will perform research; how she/he will measure the variable. It includes:

- Identification of the study variables
- Methods for collecting data
- Data collection tools (proforma/questionnaire)

• DATA ANALYSIS PROCEDURE:

Data analysis is an important part of a research project. A good analysis leads to good results. Relevant details naming software to be used, which descriptive statistics and which test of significance if and when required, specifying variables where it will be applied. A general statement "appropriate statistical methods will be used." must be avoided.

RESULTS:

The results are actual statements of observations, including statistics, tables and graphs. Results indicate information on range of variations. Mention negative results as well as positive. Do not interpret results - save that for discussion. Use S.I. units (m, s, kg, w, etc.) Throughout the thesis. Break up their results into logical segments by using subheadings. Key results should be stated in clear sentences at the beginning of paragraphs. It is far better to say "x had significant positive relationship with y than to start with a less informative like "there is a significant relationship between x and y". Describe the nature of the findings; do not just tell the reader whether or not they are significant.

TABLES & FIGURES:

All tables must be numbered. A caption should be positioned at the top of the table. If the caption is written in a single line, it should be centered. If the caption is written more than one line, it should be aligned to the left. Tables must be numbered with respect to the chapter. Illustrations such as maps, charts, graphs, drawings, diagrams, and photographs are referred as figures. All figures must be clear and of high quality. Figures must be numbered. A caption should be located at the bottom of the figure. If the caption is written in a single line, it should be centered.

If the caption is written in more than one line, it should be aligned to the left. Figures are numbered with respect to the chapter.

DISCUSSION:

Discussion should be started with a few sentences that summarize the most important results. The discussion section should be a brief essay in itself. It should emphasize on the major patterns in observations, the relationships, trends and generalizations among the results. The exceptions to these patterns or generalizations should also be mentioned. Describe the likely causes (mechanisms) underlying these patterns resulting predictions. Explain the agreement or disagreement with previous work. Interpret results in terms of background laid out in the

introduction. Mention the implications of the present results. Include the evidence or line of reasoning supporting each interpretation. This section should be rich in references to similar work and background needed to interpret results. However, interpretation/discussion section(s) are often too long and verbose. Break up the sections into logical segments by using subheads.

CONCLUSION:

Conclusions include the strongest and most important statement that PGs can make from his/her observations. Refer back to problem posed and describe the conclusions that PGs reached from carrying out this investigation, summarize new observations, new interpretations, and new insights that have resulted from the present work. Include the broader implications of your results. Do not repeat word for word the abstract, introduction or discussion. The conclusions should be linked with the objectives of the study.

APPENDICES:

Appendices are supplementary materials to the text. These include tables, charts, computer program listings, and others.

REFERENCE:

References are detailed description of items from which information was obtained in preparing the thesis. All references must be listed at the end of the text.

SECTION V: DEGREE AWARD REQUIREMENTS

MINIMUM CGPA REQUIREMENT

A candidate obtaining GPA less than 2.00 (50%) is declared ungraded (fail).

POLICY FOR MPHIL THESIS WRITING AND SUBMISSION

- Students will select topic and get it approved in first semester.
- Students will write synopsis and get it approved in 2nd semester.
- Students will do research work In the 3rd semester
- Students will complete research work and write down the thesis in the 4th semester

The thesis submitted by MPhil candidate shall comply with the following conditions:

a) It shall form a distinct contribution to knowledge and afford evidence of originality, shown by the discovery of new facts, by the exercise of independent critical judgment, and/or by the invention of new methods of investigation.

b) It should not include research work for which a degree has already been conferred in this or any other university.

c) It shall be written in English, and the presentation must be satisfactory for publication.

d) Any part of the thesis which has been published before submission of the thesis may be appended at the end of the thesis.

PLAGIARISM UNDERTAKING

I solemnly declare that research work presented in the thesis titled

"…….

…….”

Is solely my research work with no significant contribution from any other person. Small contribution/help wherever taken has been duly acknowledged and that complete thesis has been written by me.

I understand the zero-tolerance policy of the HEC and University

…… (name of university) ……

Towards plagiarism. Therefore, I as an author of the above titled thesis declare that no portion of my thesis has been plagiarized, and any material used as reference is properly referred/cited.

I undertake that if i am found guilty of any formal plagiarism in the above titled thesis even after award of MPhil degree, the university reserves the rights to withdraw/revoke m degree and that HEC and the university has the right to publish my name on the HEC/university website on which names of students are placed who submitted plagiarized thesis.

Student /author signature: _____ Name: _____

MPHIL THESIS DEFENSE AND AWARD OF DEGREE

1. There shall be a standing list of external examiners for respective departments consisting of persons of eminence in the field of research. The list shall be suggested from time to time by the board of studies of faculty concerned and approved by the research board. The external examiners will be requested to critically examine the thesis for its suitability for the award of MPhil degree.
2. There shall also be a standing list of local examiners for departments consisting of eminent persons engaged in research. The list shall be suggested from time to time by the board of studies of the department/board of faculty concerned and approved by the research board. The local examiners will be requested to conduct the final viva-voce examinations of thesis.
3. The candidate shall in the first instance submit six unbound copies of his/her completed thesis along with an application on prescribed form for the evaluation of his/her thesis, duly forwarded by his/her supervisor and the chairman of the department: - Three for external
    - One for examination section
    - One for department office
    - One for the supervisor
4. After corrections have been incorporated in accordance with the comments of external examiners; two copies of thesis in loose binding, to be sent to vivavoce examiners.
5. After the viva-voce examination; four copies of the final hard-bound thesis be submitted:
    - One for examination section
    - One for central library
    - One for departmental office
    - One for supervisor
6. The supervisor shall suggest a panel of at least six external examiners from the approved list. The vice-chancellor shall appoint three external examiners from the suggested panel to evaluate the thesis.
7. The reports of the examiners shall be placed before the research board for consideration.
8. If the thesis is adjudged as adequate by two of the three examiners, the research board shall

allow the candidate to appear in the viva-voce (thesis defense) examination.

9. If two of the three examiners find that the thesis is wholly inadequate it may be rejected by the research board.
10. If any of the examiners suggests modification/revision of the thesis, the candidate shall be required to resubmit a revised version of the thesis, duly certified by the supervisor, within one year.
11. The revised version of the thesis shall be approved by the same examiner who suggested modification/revision of the thesis.
12. If any of the examiners finds the thesis adequate but suggests minor modifications/revision, this may be incorporated without referring again to the examiner as required in clause (k).
13. The viva-voce examination shall be conducted by the two external examiners appointed by the vice-chancellor from the panel approved by the research board, the supervisor and the chairman of the department concerned.
14. The viva-voce examination shall be open to the public but the evaluation will be done only by the panel of examiners.
15. If the candidate fails to satisfy the examiners in the viva-voce examination he/she may be given a chance to defend the thesis for the second and final time within a period of six months.
16. A candidate who successfully completes all the requirements shall be awarded, with the approval of the research board and the syndicate, the degree of MPhil under the seal of the university.
17. The vice-chancellor may approve the recommendations of the research board on behalf of the syndicate regarding the award of MPhil degree to the candidate.

SECTION VI: FACILITIES AND RESOURCES

FACULTY REQUIREMENTS AND AREAS OF EXPERTISE

Department of Biochemistry is enriched with full-time dedicated, qualified and experienced faculty for teaching of undergraduate and post-graduate courses.

S No	Name	Designation PMDC NO.
1.	Dr. Aneela Jamil	Associate Professor Biochemistry Head of Department 55092-P
2.	Dr. Tayaba Saleha Hashmi	Assistant Professor 58980-P
3.	Dr. Kanwal Huma	Assistant Professor 87193-P
4.	Dr. Ray Khalid Yaqub	Demonstrator 54869-P
5.	Muhammad Abdul Rab Faisal Sultan	Adjunct PhD faculty

Location: Biochemistry department is in the old campus of Rawalpindi Medical University, Tipu Road, Rawalpindi.

The department caters to teaching and training of over 1000 undergraduate and postgraduate students in the following disciplines.

MBBS

- 1st Year (376 students)
- 2nd Year (374 students)

B.Sc. and Allied Health Sciences

- **1st Year (124 students)**
- Optometry
    - Orthotics
    - Doctor of Physiotherapy (DPT)
    - Medical Imaging Technology (MIT)

- Medical Laboratory Technology (MLT)

2nd Year (80 Students)

- Doctor of Physiotherapy (DPT)
- Optometry

B.Sc. Nursing

- 1st Year (250 students)

LABORATORY FACILITIES AND MAJOR EQUIPMENT

The department of Biochemistry, RMU, Holy Family Hospital, Benazir Bhutto Hospital and District Head Quarters Hospital have well equipped laboratories, catering to the educational needs of the postgraduate and undergraduate students as well as providing quality diagnostic services to the community. We have well equipped diagnostic laboratories in all of our RMU Allied Hospitals which are already recognized for training in MPhil (Microbiology), FCPS (Hematology), FCPS (Histopathology), MCPS (Clinical Pathology) and DCP (Pathology) with a number of postgraduate trainees present in different specialties.

The Laboratory facilities present in Biochemistry Department at RMU Campus include:

1. Postgraduate Research Laboratory for Chemical & Molecular Pathology/Biochemistry, New Teaching Block, RMU
2. Chemical & Molecular Pathology/Biochemistry Labs HFH, BBH, DHQ Hospitals
3. Chemical Pathology Labs HFH, BBH, DHQ Hospitals
4. Hematology Labs HFH, BBH, DHQ Hospitals
5. Histopathology Labs HFH, BBH Hospitals

The Biochemistry laboratories in the attached teaching hospitals have basic as well as advanced facilities for the research work as well as patient care. Some of the advanced facilities available in teaching hospitals' biochemistry laboratories include:

1. BSL-II laboratory with BSL-III Safety Cabinet, Holy Family Hospital
2. BSL-III laboratory, Benazir Bhutto Hospital
3. Gene-Xpert & MGIT-960 systems in Mycobacteriology Labs

Each Biochemistry Lab has a collection point, well equipped bacteriology section, sterilization room, urine R/E section, serology section, PCR lab, TB section, reporting room and classroom along with multimedia and microscope projection on LCD, and internet connection.

Our underdeveloped Postgraduate Research Laboratories Complex (approved as PC1 by HEC, Islamabad) includes laboratories for Anatomy, Physiology, Pharmacology & animal house, Forensic Medicine, Hematology, Chemical Pathology, Microbiology, Molecular Biology, Histopathology, Biochemistry.

AVAILABLE FACILITIES

List of equipment and facilities offer in our laboratories is attached herewith

LIST OF EQUIPMENTS IN BIOCHEMISTRY LAB

Sr No.	Name of Items	Quantity	Serial No	Issue date
1.	Clinical pH meters	02	09180937 09180942	17-06-2009
2.	Incubator	01	201320058541-5	08-05-2023
3.	Electronic Balance	02	AA-200DS SF-400C	10-02-2024 08-10-2024
4.	Glucometers	12		29-07-2019 23-08-2025
5.	Centrifuge	02	60080686 60080691	30-04-2009
6.	Micro labs	02	42070GB 41706GB	04-07-2020
7.	Microscopes	10	1. 20061706 2. 20061713 3. 20061716 4. 20061717 5. 20061722 6. 300724 7. 300779 8. 300778 9. 615748 10. 615172	1. 28-08-2020 2. 28-08-2020 3. 28-08-2020 4. 28-08-2020 5. 28-08-2020 6. 02—09-2006 7. 02—09-2006 8. 02-09-2006 9. 02-09-2006

				10. 02-09-2006
8.	Refrigerators	02	074018 36848	30-04-2009
9.	Water distillation plant	01 (Non-Functional)	WSC-008. MH 3.4	17-06-2009
10.	One electric water bath	01	MC02810202XMTD	25-06-2009
11.	Stopwatches	10		29-07-2019
12.	Hot box oven	01	30004288	12-02-2007

LIST OF EQUIPMENTS IN POSTGRADUATE CHEMICAL & MOLECULAR PATHOLOGY/ BIOCHEMISTRY LAB

Laboratory Title	**Postgraduate Chemical & Molecular Pathology/Biochemistry Lab**
Location and area	**NTB, RMU**
Objectives	Laboratory is used for research work for graduate and postgraduate research students
Software available (if any)	Internet facility available
Major apparatus	Beakers, cylinders, test tube, glass slides, pipettes
Major Equipment	• Automated ELISA machines • UV Laminar Flow Hood Chamber • Hot Air Ovens • Centrifuge • Incubators • Digital Balance • Autoclave
Adequacy for instruction	Laboratory manuals, logbooks and standard operating procedures are available in respective laboratory
Safety regulations	Fire extinguishers and safe exits are available

Laboratory Title	**Chemical & Molecular Pathology/Biochemistry Labs**

Location and area	**Holy Family Hospital**
Objectives	Laboratories are used for diagnostics and research work for graduate and postgraduate research students
Software available (if any)	Computers are linked with hospital management system
Major apparatus	Beakers, cylinders, test tube, glass slides, pipettes, autoclave jars
Major Equipment	• Automated ELISA machines • Incubator large 37C (Memmert) • Gene-Xpert for Mycobacteria • Hot Air Ovens • Centrifuge • Digital Balance • Hot Air Ovens (Memmert) • Refrigerators (2-8C) cultured • Freezer (-20C) • Freezer (-80C) • Microscope • LEC Microscope • Water bath • pH Meter • Autoclave • Class-II type A2 Biosafety Cabinet • Class-III type Biosafety Cabinet • Vortex mixer • Hotplate • CO2 incubator • Computers and printer
Adequacy for instruction	Laboratory manuals, logbooks and standard operating procedures are available in their respective laboratory and with supervisors
Safety regulations	Fire extinguishers and safe exits are available

Laboratory Title	**Chemical & Molecular Pathology/Biochemistry Biology Labs**
Location and area	**Benazir Bhutto Hospital**
Objectives	Laboratories are used for diagnostics and research work for graduate and postgraduate research students
Software available (if any)	Computers are linked with hospital management system
Major apparatus	Beakers, cylinders, test tube, glass slides, pipettes

Major Equipment	• BSL-III Lab PCR Machine (Rotor Gene) • Biosafety Cabinet Class-II • Incubator large (Memmert) • Gene-Xpert for Mycobacteria • Media Making Machine (APS 320) • Hot Air Oven • Centrifuge • Incubators • Digital Balance • Autoclave • Hot Air Oven (Memmert) • Refrigerators • Deep Freezers • EIISA Plate Reader • Autoclave Manual • Microscope • LEC Microscope • Weighing Balance • VersaTrek automated Blood Culture system • Bectec automated Blood Culture system
Adequacy for instruction	Laboratory manuals, logbooks and standard operating procedures are available in their respective laboratory and with supervisors
Safety regulations	Fire extinguishers and safe exits are available

Laboratory Title	**Chemical & Molecular Pathology/Biochemistry Biology Labs**
Location and area	**District Headquarters Hospital**
Objectives	Laboratories are used for diagnostics and research work for graduate and postgraduate research students
Software available (if any)	Computers are linked with hospital management system
Major apparatus	Beakers, cylinders, test tube, glass slides, pipettes
Major Equipment	• PCR Machine (Rotor Gene) • Safety Cabinet Class-II • Incubator large (Memmert) • Gene-Xpert for Mycobacteria • Hot Air Oven • Centrifuge • Incubator • Digital Balance • Autoclave • Refrigerators • Deep Freezers

Adequacy for instruction	Laboratory manuals, logbooks and standard operating procedures are available in their respective laboratory and with supervisors
Safety regulations	Fire extinguishers and safe exits are available

LIST OF EQUIPMENTS IN CLINICAL CHEMISTRY LABS

Laboratory Title	**Clinical Chemistry Labs**
Location and area	**Holy Family Hospital**
Objectives	Laboratories are used for diagnostics and research work for graduate and postgraduate research students
Software available (if any)	Computers are linked with hospital management system
Major apparatus	Beakers, cylinders, test tube, glass slides, pipettes, autoclave jars
Major Equipment	• AU-680 Backmen • AU-480 Backmen • C-501 Roche • P-500 Diatron • Centrifuge • Blood Gas Analyzer (Medical) • RO water purification system • Refrigerator (2-8C) cultured • Freezer (-20C) • Immunochemistry Analyzer • Hot Air Oven JOUAN • Hot Air Oven JOUN • ABGs MEDITEC • AC PEL • HBA1C
Adequacy for instruction	Laboratory manuals, logbooks and standard operating procedures are available in their respective laboratory and with supervisors
Safety regulations	Fire extinguishers and safe exits are available

Laboratory Title	**Clinical Chemistry Labs**
Location and area	**Benazir Bhutto Hospital**

Objectives	Laboratories are used for diagnostics and research work for graduate and postgraduate research students
Software available (if any)	Labs have computers linked with hospital management system
Major Equipment	• Chemistry Analyzer Beckman Coulter (Fully Automated) • Blood Gas Analyzer (Medical) • Hormone Analyzer • ELISA Reader/ Washer Machine (Diamed) • Centrifuge • Electrolyte Analyzer • Weighing Balance • GP getein Bio tech HbA1C • P-500 Diatron • Hot Air Oven (Jouan) • Cornley AF 500 • Lab Way HbA1C • FIA8600 HbA1C • DMO 412 Centrifuge • Immulite • Vitros ECI
Adequacy for instruction	Lab manuals and standard operating procedures are available
Safety regulations	Fire extinguishers and first aid boxes are available

Laboratory Title	**Clinical Chemistry Labs**
Location and area	**District Headquarters Hospital**
Objectives	Laboratories are used for diagnostics and research work for graduate and postgraduate research students
Software available (if any)	Labs have computers linked with hospital management system
Major Equipment	• Chemistry Analyzer Beckman Coulter (Fully Automated) • Blood Gas Analyzer (Medical) • Hormone Analyzer • ELISA Reader/ Washer Machine (Diamed) • Centrifuge • Electrolyte Analyzer • Weighing Balance • GP getein Bio tech HbA1C • P-500 Diatron • Hot Air Oven (Jouan) • Cornley AF 500 • Lab Way HbA1C • FIA8600 HbA1C • DMO 412 Centrifuge • Immulite

Adequacy for instruction	Lab manuals and standard operating procedures are available
Safety regulations	Fire extinguishers and first aid boxes are available

LIST OF EQUIPMENTS IN HAEMATOLOGY LABS

Laboratory Title	**Haematology Labs**
Location and area	**Holy Family Hospital**
Objectives	Laboratories are used for diagnostics and conducting practical experiment related to the training of postgraduates
Software available (if any)	Labs have computers linked with hospital management system
Major apparatus	Labs have computers linked with hospital management system
Major Equipment	• Haematology Analyzer Sysmex KX-21 • Haematology Analyzer Mindray -3000+ • Haematology Analyzer Abacus • Coagulation Analyzer • Centrifuge D-Lab microscope • Water Bath (Memmert) • Incubator (Memmert) • Blood CP Analyzer (3 part) vitanix • Sysmex KX-21 (3 part) • Blood CP Analyzer (5 part) Mindray 6200 • Mindray C3510 (Coagulation Analyzer) • Hb Electrophoresis (Manual) • Binocular Microscope • Sample Mixer • Centrifuge • Pipettes
Adequacy for instruction	Lab manuals and standard operating procedures are available Besides this faculty members also keep their personal books to prepare lessons
Safety regulations	Fire extinguishers, safe exits and first aid boxes are available in laboratories

Laboratory Title	**Haematology Labs**
Location and area	**Benazir Bhutto Hospital**

Objectives	Laboratories are used for diagnostics and conducting practical experiment related to the training of postgraduates
Major Equipment	• Haematology Analyzer Sysmex KX-21 • Haematology Analyzer Mindray -3000+ • Haematology Analyzer Abacus • Hb Electrophoresis • Coagulation Analyzer • Centrifuge D-Lab • Microscope • Water Bath (Memmert) • Incubator (Memmert) • Hot Air Oven • Centrifuge Machine • Water Bath • ESR Analyzer
Adequacy for instruction	Lab manuals and standard operating procedures are available Besides this, faculty members also keep their personal books to prepare lessons
Safety regulations	Fire extinguishers, safe exits and first aid boxes are available in laboratories

Laboratory Title	**Haematology Labs**
Location and area	**District Headquarters Hospital**
Objectives	Laboratories are used for diagnostics and conducting practical experiment related to the training of postgraduates
Major Equipment	• Haematology Analyzer Mindray -3000+ • Haematology Analyzer Abacus • Hb Electrophoresis • C-4 Coagulation Analyzer • Centrifuge D-Lab • Microscope • Water Bath (Memmert) • Incubator (Memmert) • Abacus (Haematology analyser)
Adequacy for instruction	Lab manuals and standard operating procedures are available Besides this, faculty members also keep their personal books to prepare lessons
Safety regulations	Fire extinguishers, safe exits and first aid boxes are available in laboratories

LIST OF EQUIPMENTS IN HISTOPATHOLOGY LABS

Laboratory Title	**Histopathology Labs**
Location and area	**Holy Family Hospital**
Objectives	Laboratories are used for diagnostics and conducting practical experiment related to the training of postgraduates
Major Equipment	• Automated Tissue Processor • Semi-automated Tissue Processor • Cryostat • Microtome • Cytospin • Centrifuge • Blade Sharpener • Automatic Slide Stainers • Hot Air Oven • Embedding Station • Hot Plate • Water Bath • Electronic Balance • Microscope (Bi-Head) • Microscope (Binoclar) • Computer Systems (CPU, LCD, Key Board & Mouse) • Air Conditioner • Heaters (Gas) • Printer • Refrigerator • UPS
Adequacy for instruction	Lab manuals and standard operating procedures are available Besides this, faculty members also keep their personal books to prepare lessons
Safety regulations	Fire extinguishers, safe exits and first aid boxes are available in laboratories

Laboratory Title	**Histopathology Labs**
Location and area	**Benazir Bhutto Hospital**
Objectives	Laboratories are used for diagnostics and conducting practical experiment related to the training of postgraduates
Major Equipment	• Rotary Microtome • Electric Water Bath • Refrigerator • Hot Air Oven • Digital Tissue Floating Bath • Cyto tech • Hot Plate Stirrer

	• Staining Jar
Adequacy for instruction	Lab manuals and standard operating procedures are available Besides this, faculty members also keep their personal books to prepare lessons
Safety regulations	Fire extinguishers, safe exits and first aid boxes are available in laboratories

LIBRARY

Library Old and New Teaching Block Rawalpindi Medical University Rawalpindi

S #	Title	Author	Publisher	Year	Edition	Books' Qty.
1.	Modern Experimental Biochemistry	Boyer,Rodney	Pearson Education	2000	3rd	06
2.	Clinical Biochemistry	Gaw,Allan (et al)	Churchill Livingstone	2001	3rd	01
3.	An Introduction to Computational Biochemistry	Tsai,C.stan	john wiley & Sons	2004		01
4.	Colour Atlas of Biochemistry	Koolman,J(et al)	Thieme	2005		02
5.	Essential Biochemistry	Pratt,Charlotte w(et al)	John Wiley & Sons	2004		01
6.	Biochemistry	Lippincott,s	Lippincott Williams &Wilkins	2005	2nd	11
7.	Computational Biochemistry and Biophysics	Becker,Oren.M(et al)	Marcel Dekker	2001		01
8.	Biochemistry	Garrett,Reginald(et al)	Thomson	2005		01
9.	Biochemistry	Voet,Donald(et al)	Wiley John &Sons	2004		01
10.	Biochemistry Of the Eye	Harding,John.J	Chapman & Hall Medical	1997		01
11.	Essentials of Medical Biochemistry	Ahmad,dr.Mushtaq	National Book Foundation	1975		389

12.	Harper's Review Of Biochemistry	Martin, David W. et al	Lange Medical	1983	20th	01
13.	Microanalysis In Medical Biochemistry	Wootton, I.D.P. (et al)	Churchiil Livingstone	1974	5th	02
14.	Biochemistry	Cantarow, Abraham (et al)	W.B. Saunders	1967	4th	01
15.	Biochemistry	Stryer, Lubert	Freeman And Company	1975	3rd	04
16.	Biochemistry	Datta, S.P. (et al)	Bailliere Tindall	1976	3rd	03
17.	Davidson's The Biochemistry Of The Nucleic Acids	Adams, R.L.P. (et al)	Chapman And Hall	1976	8th	02
18.	An Introduction To Practical Biochemistry	Plummer, David T,	McGraw-Hill Book Company	1978	2nd	01
19.	Harper's Review Of Biochemistry	Martin, David W. (et al)	Lange Medical Publications	1985	20th	01
20.	Textbook Of Biochemistry	West, Edward Staunton, et al	Macmillan	1966	4th	06
21.	Textybook of Physiology and Biochemistry	Davidson,Bell	The English Society Book	1977	8th	20
22.	Textbook of Physiology and Biochemistry	Bell, George H. (et al)	The English Society Book	1977	8th	02
23.	Textbook of Biochemistry	Mazur,Abraham	W.B.Saunders	1979		05
24.	Biochemistry For Medical Students	Thorpe, William Veale	J. & A. Churchill Ltd	1970	9th	21
25.	Elementry Medical Biochemistry	Brown, J. M. M. (et al)	Butterworths	1977		02
26.	Principles Of Biochemistry	White, Abraham (et al)	McGraw-Hill International	1978		01
27.	Textbook of Physiology and Biochemistry	Bell,George	National book Foundation	1979	9th	21
28.	Textbook Of Biochemistry	West, Edward Staunton (et al)	Maclillan Company	1966	4th	04
29.	Harper's Review Of Biochemistry	Martin, David W	Lange		19th	07

30.	Essentials of Medical Biochemistry	Ahmad,dr.Mushtaq	Islami Kitab Khana	1982	4th	07
31.	Principles Of Biochemistry	Lehninger, Albert L.	Worth Publishers	1982		01
32.	Biochemistry For Medical Sciences	Danishefsky, Isidore	Little Brown And Company	1980		02
33.	Biochemistry Of parasitic Helminths	Barrett, John	University Park Press	1981		02
34.	Essentials Of Medical Biochemistry	Ahmad, Mushtaq	Ilmi Kitab Khana	1982		29
35.	Essentials Of Medical Biochemistry	Mushtaq Ahmad	Merit Publisher	1982	4th	01
36.	Harper's Biochemistry	Murray, R.K. (et al)	Lange	1988	21st	04
37.	Biochemistry	Friedman, Paul Jay	Little Brown	1987	3rd	02
38.	Biochemistry	Bohinski,Robert.C	Allyn Bacon	1987	5th	02
39.	Principles Of Biochemistry	Smith, Emil L. (et al)	McGraw-Hill International	1983	7th	01
40.	MCQ in Biochemistry	Malhotra,V.K	Jaypee Brothers	1985		05
41.	Biochemistry	Montgomery, Rex (et al)	C.V. Mosby	1990	5th	01
42.	Biochemistry	Halkerston, Ian D. K.	Williams And Wilkins	1988	2nd	05
43.	Lecture Notes on Clinical Biochemistry	Whitby,L.G(et al)	Blackwell scientific	1980	5th	06
44.	Harper's Biochemistry	Murray, Robert K. (et al)	Prentice-Hall International	1993	23rd	08
45.	Biochemistry	Glick, David M.	Prentice-Hall International	1991	10th	01
46.	Outlines Of Biochemistry	Conn, Eric E. (et al)	John Wiley & Sons	1987		01
47.	Textbook Of Biochemistry And Human Biology	Talwar, G.P. (et al)	Prentice-Hall Of India	1989	2nd	01

48.	Clinical Biochemistry Of Steroid Hormones	Grant, J.K. (et al)	Croom Helm	1983		01
49.	Biochemistry For The Medical Sciences:	Higgins, S J. (et al)	Longman Scientific & Technical	1994		01
50.	Principles Of Biochemistry	Horton, H. Robbert et al	Prentice Hall International	1993		01
51.	Clinical Biochemistry	Cantarow, Abraham (et al)	W.B. Sundres	1962	6th	01
52.	Clinical Biochemistry	Goldberg,Stephen	Mcgraw Hill	1993		01
53.	Text Book Of Biochemistry	Devlin, Thomas M.	Wiley-Liss	1993	3rd	02
54.	Practical Manual Of Biochemistry	Singh, S.P.	CBS Publishers & Distributors	1994	3rd	01
55.	Lippincott's Illustrated Reviews Biochemistry	Champe, Pamela C. (et al)	Lippincott's	1994	2nd	01
56.	Harper's Biochemistry	Murray, Robert K. (et al)	Prentice-Hall International	1996	24th	02
57.	Biochemistry Illustrated	Campbell,Peter.N(et al)	Churchill Livingstone	1993	3rd	01
58.	Biochemistry A Concise Text for Medical Students	Apps, D. K. [et al]	Bailliere Tindall	1992	5th	10
59.	Biochemistry	Voet,Donald(et al)	John wiley and sons	1995	2nd	01
60.	Biochemistry	Lehinger, Albert L.	Worth	1975	2nd	
61.	Biochemistry	Lehninger, Albert L.	Worth	1975	2nd	02
62.	Fundamentals Of Biochemistry	Jain, J.L.	S.Chabd & Company	1997		02
63.	Notes In Biochemistry	Hames, B.D. (et al)	Viva Books Private Limited	1998		02
64.	Principles of Biochemistry	Zubay ,Geoffrey.L(et al)	W.M.C.Brown.	1995		01
65.	High Yield Biochemistry	Wilcox,R.Bruce	Lippincott Williams & Wilkins	1999		02

66.	Lehninger Principles Of Biochemistry	Nelson, David L. [et al]	Worth Publishers	2000	3rd	02
67.	TextBook Of Biochemistry	Devlin, Thomas M. (Editor)	Wiley-Liss	2002	5th	02
68.	Harper,s illustrated Biochemistry	Murray,Robert.K(et al)	Mcgraw Hill	2003		10
69.	Lehninger principles of Biochemistry	Nelson,David(et al)	W.H.Freeman and company	2005	3rd	02
70.	Biochemistry	Champe,Pamela.C(et al)	Lippincott Wolliams Wilkins	2003	2nd	16
71.	Biochemistry Illustrated	Campbell,Peter.N(et al)	Churchill Livingstone	2000	4th	02
72.	Harper,s illustrated Biochemistry	Murray,Robert.K(et al)	Mcgraw Hill	2003		15
73.	Biochemistry	Berg,Jeremy.M(et al)	W.H.Freeman Company	2001	15th	03
74.	Illustrated Medical Biochemistry	Raju,Sm(et al)	Jaypee Brothers Medical	2005		02
75.	Biochemistry	Champe,Pamela.C(et al)	Lippincott Wolliams Wilkins	2005	3rd	19
76.	Lehninger principles of Biochemistry	Nelson,David(et al)	W.H.Freeman and company	2005	4th	02
77.	Biochemistry	Voet,Donald(et al)	Wiley John &Sons	2004		02
78.	Fundamentals of Biochemistry	Voet,donald(et al)	John Wiley & Sons	2006	2nd	02
79.	General, Organic, And Biochemistry	Denniston, Katherine J.	MC Graw Hill	2007	5th	02
80.	Color Atlas of Biochemistry	Koolman,Jan(et al)	Thieme	2005	2nd	05
81.	Lehinger Principles of Biochemistry	Nelson, David L (et al)	W. H. Freeman and Company	2006	4th	04
82.	Modern Experimental Biochemistry	Boyer, Rodney	Pearson Education	2000	3rd	01
83.	Textbook of Biochemistry	Devlin,Thomas.M	A John Wiley.Liss	2006	6th	03

84.	Elsevier,s Integrated Biochemistry	Pelley,John.W	Mosby Elsevier	2007		02
85.	Biochemistry	Champe,Pamela.C(et al)	Lippincott Wolliams Wilkins	2008	4th	10
86.	Biochemistry	Berg, Jeremy M. (et al)	W.H. Freeman And Company	2007	6th	04
87.	Biochemistry	Champ	Lippincott		4th	20
88.	Harper's Illustrated Biochemistry	Murry, Robert K.	Mc Graw Hill	2006	27th	19
89.	Dictioary Of Biochemistry	Whitemore	IVY Publisher			02
90.	Lehninger Principals Of Biochemistry	Nelson	Freeman & Company		4th	03
91.	Medical Biochemistry Human metabolism In Health Diseases	Rosenthel	John Wiley			02
92.	Modern Experimental Biochemistry	Boyer	Pearson		3rd	03
93.	MCQS In Biochemistry	Mahapatra	New Central Books			04
94.	Pretest Biochemistry & Genetics	Wilson	MCGraw Hill		3rd	04
95.	Principals & Teachniques Of Biochemistry & Molecular Biology	Wilson	Cambridge Uni		6th	04
96.	Schaun's Outline Biochemistry	Kuchel	MCGraw Hill		2nd	03
97.	Harper's Illustrated Biochemistry	Murray, Robert	McGraw Hill		28th	02
98.	Lippincott Illustrated Reviewq Of Biochemistry	Champe, Pamela C.	W H Freeman		4th	02
99.	Mark's Essentials Of Medical Biochemistry	Lieberman,Michael	Williams Wilkin			02

100.	ANQA Biochemistry Secret Of OSPE	Qaiser, Affan	Nishter Books			04
101.	Fundamental Of Biochemistry	Jain, J. L	S. Chand			02
102.	Review Happeek Illus Trated Biochemistry	Murrey Robert	MC Graw Hill		28th	03
103.	Introductory Practical Biochemistry	Narosa Sawhney	Narosap			03
104.	Lippincptt Illustrated Biochemistry		Lippincott		4th	02
105.	Pretest Biochemistry And Genetics	Wilson, Golder	McGraw Hill			03
106.	TextBook Of Biochemistry With Clinical Correlation	Devlin, Thomas.m	John Willinstone			02
107.	Biochemistry	Satyanarayana, U.	Elsevier	2017	5th	15
108.	Harpers Illustrated Biochemistry	Rodwell, Victor W.	MCGraw Hill	2015	30th	45
109.	Lippincott Illustrated reviews Biochemistry	Ferrier, Denise R.	Wolters Kluwer	2017	7th	30
110.	MCQS In Biochemistry	Sagar, G Vidya.	New Age International Publisher	2008		03

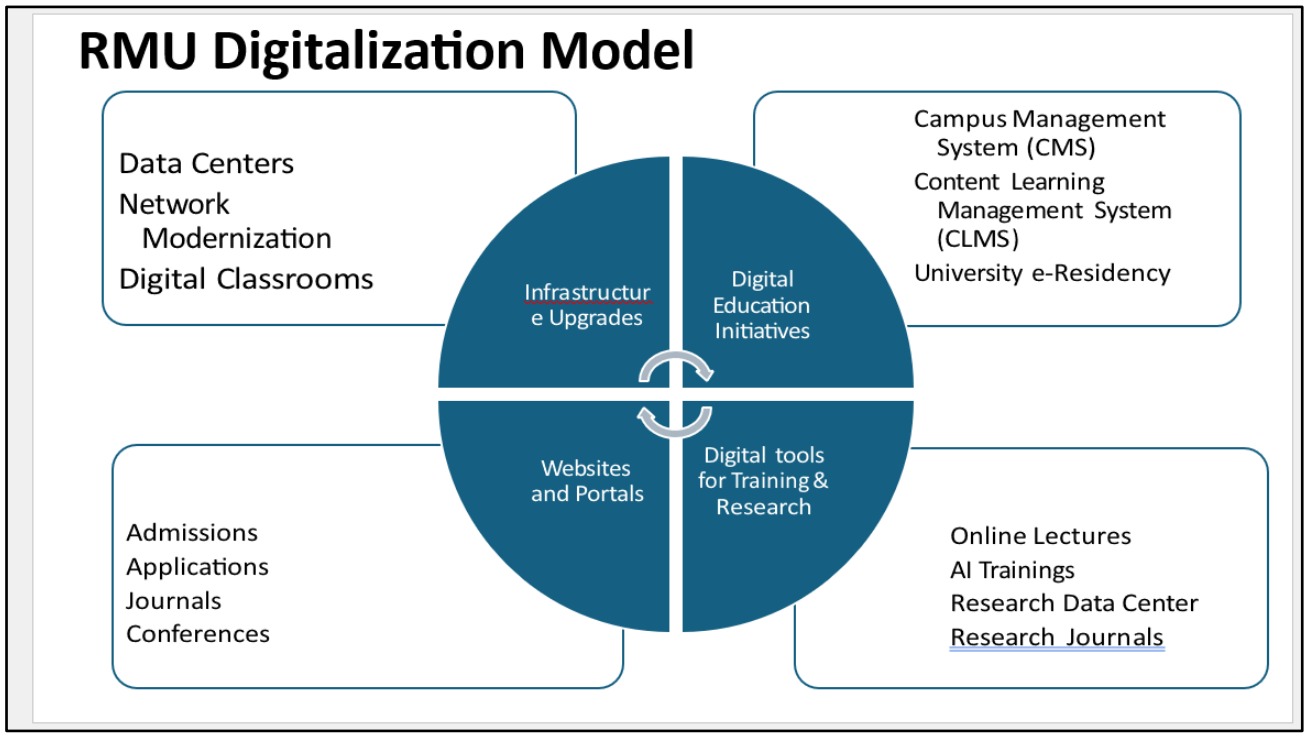
JOURNALS

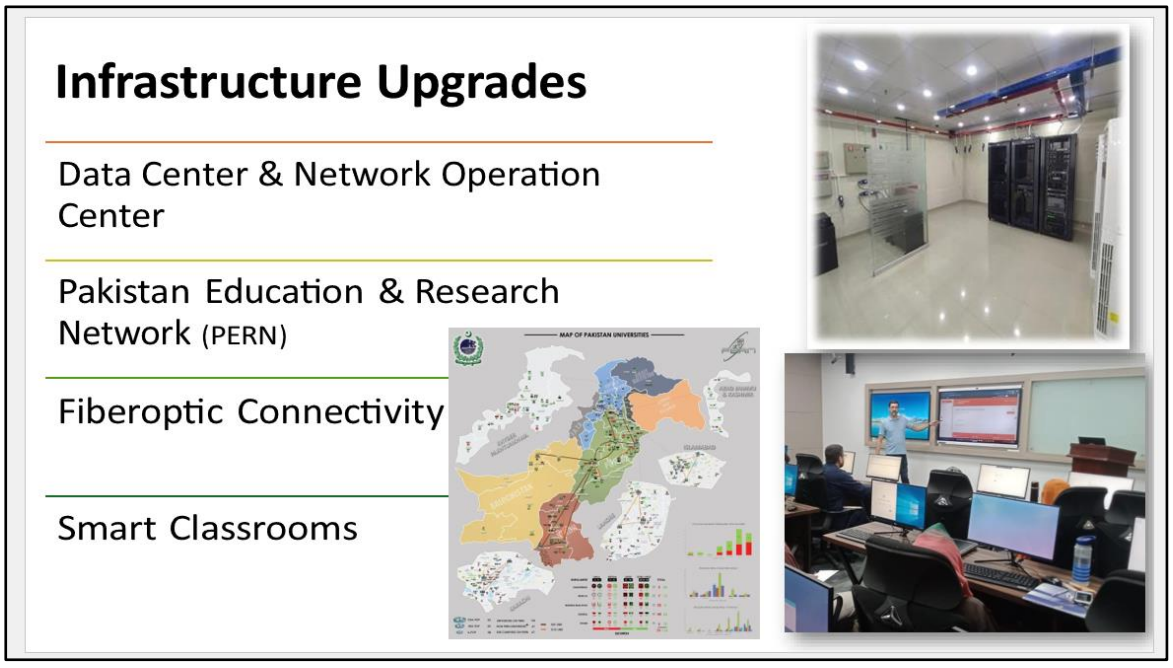
Links and Publishers of Biochemistry Journals

Sr No.	Journal Name	Publisher	Link
1.	**Journal of Biological Chemistry (JBC)**	Elsevier (ASBMB)	https://www.jbc.org/
2.	**Carbohydrate Research**	Elsevier	https://www.sciencedirect.com/journal/carbohydrate-research
3.	**Glycobiology**	Oxford University Press	https://academic.oup.com/glycob
4.	**BBA – Molecular & Cell Biology of Lipids/Proteomics**	Elsevier	https://www.sciencedirect.com/journal/biochimica-et-biophysica-acta-bba-molecular-and-cell-biology-of-lipids
5.	**Archives of Biochemistry and Biophysics**	Elsevier	https://www.sciencedirect.com/journal/archives-of-biochemistry-and-biophysics
6.	**Metabolism: Clinical and Experimental**	Elsevier	https://www.metabolismjournal.com/
7.	**FEBS Journal (formerly Eur J Biochem)**	Wiley	https://febs.onlinelibrary.wiley.com/journal/17424658
8.	**Biochemistry (ACS)**	American Chemical Society	https://pubs.acs.org/journal/bichaw
9.	**Protein Science**	Wiley	https://onlinelibrary.wiley.com/journal/1469896x
10.	**Enzyme and Microbial Technology**	Elsevier	https://www.sciencedirect.com/journal/enzyme-and-microbial-technology
11.	**Journal of Lipid Research**	ASBMB	https://www.jlr.org
12.	**Progress in Lipid Research**	Elsevier	https://www.sciencedirect.com/journal/progress-in-lipid-research
13.	**Atherosclerosis Journal**	Elsevier	https://www.atherosclerosis-journal.com

14.	**Proteins: Structure, Function & Bioinformatics**	Wiley	https://onlinelibrary.wiley.com/journal/10970134
15.	**Journal of Cell Biology**	Rockefeller Univ Press	https://rupress.org/jcb
16.	**Nature Cell Biology**	Nature Portfolio	https://www.nature.com/ncb/
17.	**Molecular Biology of the Cell**	ASCB	https://www.molbiolcell.org/
18.	**Journal of Clinical Endocrinology & Metabolism**	Oxford University Press	https://academic.oup.com/jcem
19.	**American Journal of Clinical Nutrition**	American Society for Nutrition	https://ajcn.nutrition.org/
20.	**Journal of Nutrition**	American Society for Nutrition	https://jn.nutrition.org/
21.	**Nutrition & Metabolism**	BMC (Springer Nature)	https://link.springer.com/journal/12986
22.	**Clinical Nutrition**	Elsevier	https://www.sciencedirect.com/journal/clinical-nutrition
23.	**Journal of Molecular Biology**	Elsevier	https://www.sciencedirect.com/journal/journal-of-molecular-biology
24.	**Nucleic Acids Research**	Oxford University Press	https://academic.oup.com/nar
25.	**Genes & Development**	Cold Spring Harbor Lab Press	https://genesdev.cshlp.org/

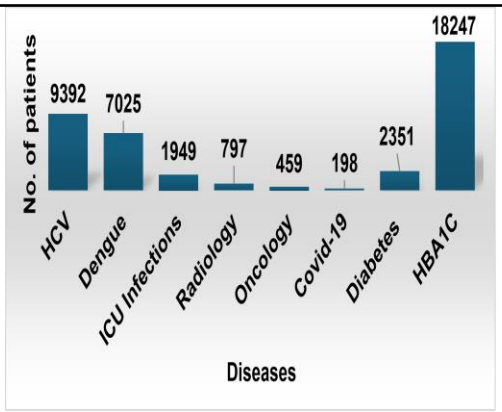
DIGITAL LEARNING RESOURCES





Research Services

RMU Research Data Center



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UpToDate

RMU Libraries

April 16, 2025

PubMed | Ad H-Index | HEC Library | Uptodate | JRMC | SJRMC | RJRMU

SECTION VII: ADMISSION CRITERIA

CRIETERIA FOR ADMISSION

ELIGIBILITY CRITERIA:

- Sixteen years of schooling or 4 years (minimum 124 credit hours) education after HSSC/A' Level in relevant discipline with minimum 55% marks • MBBS from an institute recognized by PM&DC and one year house job
- Candidates who have teaching experience in Biochemistry will be preferred.
- The GAT-General (www.nts.org.pk/gat/gat.asp) conducted by the National Testing Service with a minimum 50% cumulative score will be required at the time of admission to MPhil/M.S. The GAT-General test is valid for a period of two years.
- The entry tests & interviews for admission to MPhil will be conducted through Departmental Admission Committee (DAC).
- Senior faculty of the University will be responsible to sort and verify documents, and suitability of the applicants
- Government employees should produce NOC from their respective departments.
- For award of MPhil/M. S/Equivalent degree, candidates will need to complete 30 credit hours with 24 credit hours of course work and 6 credit hours for research work.

RAWALPINDI MEDICAL UNIVERSITY

FLOW CHART FOR MPHIL PROGRAM

APPLICATIONS ENTRANCE EXAMINATION ADMISSION
(Registration as MPhil Candidate)

↓

Minimum 24 Credit Hours Course work in 03 semesters
Submission and Approval of Synopsis by ERB/BASAR

↓

Semester Examinations with cGPA ≥2.5/4.0

↓

(Registration as MPhil Research Scholar)
Research Work

↓

Acceptance of 01 research Article in any HEC/PM&DC Recognized Journal category

↓

MPhil Thesis Evaluation by External Examiner(s)
Public Defense of Thesis and Viva Voce Exam

↓

Recommendation for Award of MPhil Degree by the Examiner(s)

↓

Award of MPhil Degree

HEC INSPECTION ANNEXURE

CLO–PLO Mapping: M.Phil Biochemistry

Program Learning Outcomes (PLOs):

- PLO-1: Advanced Biochemical Knowledge
- PLO-2: Research Design & Methodology
- PLO-3: Analytical & Critical Thinking
- PLO-4: Practical & Laboratory Skills
- PLO-5: Ethical & Professional Practice
- PLO-6: Scientific Communication
- PLO-7: Lifelong Learning & Leadership

CLO–PLO Mapping Table

Course	CLOs (Summary)	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7
Cell Biochemistry	Cell structure, signaling, acid–base balance	✓		✓	✓			
Endocrinology	Hormone regulation & metabolic integration	✓		✓				
Carbohydrates Metabolism	Carbohydrate pathways & disorders	✓		✓				
Enzymology	Enzyme kinetics & clinical application	✓		✓	✓			
Lipid Metabolism	Lipid pathways & dyslipidemia	✓		✓				
Protein Metabolism	Amino acid & protein disorders	✓		✓				

Molecular Biology	Gene expression & molecular disease basis	✓	✓	✓	✓		✓	
Vitamins & Minerals	Micronutrient metabolism & deficiencies	✓		✓				
Biostatistics & Research	Study design, data analysis		✓	✓			✓	
Bioethics	Ethical conduct in research & medicine					✓		