CURRICULUM

Master of Philosophy Biochemistry

(M. Phil)

(Two Years Program)

Rawalpindi Medical University, Rawalpindi

2024

Program Introduction

Biochemistry is the study of the 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 in born errors of metabolism, study of oncogenes in cancer cells, the relationship of biochemistry with Genetics, Physiology, Immunology, Pharmacology, Toxicology etc.

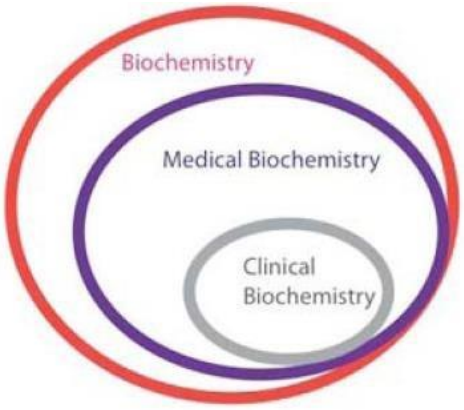

Figure 1. Biochemistry, medical biochemistry and clinical biochemistry.

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.

Phases of training in M. Phil Biochemistry Program:

<table>
<tr><td rowspan="4">Year 1</td><td colspan="3">Semester 1
(18 weeks)</td><td colspan="2">Semester 2
(18weeks)</td><td rowspan="4">End Semester Internal assessment (01 week)</td></tr>
<tr><td rowspan="2">Teaching/ Learning sessions (16 weeks)</td><td colspan="2">Semester Evaluation
(02 weeks)</td><td rowspan="3">Teaching/ Learning sessions (16 weeks)</td><td rowspan="2">Mid semester internal assessment (01 week)</td></tr>
<tr><td>Mid semester internal assessment (01 week)</td><td>End semester internal assessment (01 week)</td></tr>
<tr><td colspan="3">Assignment/Presentations</td><td colspan="2" rowspan="2">Synopsis writing and submission</td></tr>
<tr><td colspan="3">Workshops</td></tr>
<tr><td rowspan="5">Year 2</td><td colspan="6">Research & Dissertation (Lab. Work)
Research stations/centers visits</td></tr>
<tr><td colspan="6">Research project & Thesis Writing</td></tr>
<tr><td colspan="6">Thesis Submission 12 weeks before Final Examination</td></tr>
<tr><td colspan="6">Thesis evaluation (within 6-8 weeks before final exam)</td></tr>
<tr><td colspan="6">Final Examination (at the end of training)</td></tr>
</table>

List of Courses

1st semester courses (12 credit hours):

1st Half

- Course code (BCH701): Cell Biochemistry **- 2 credit hours**
- Course code (BCH702): Carbohydrates Chemistry & Metabolism **- 2 credit hours**
- Course code (BCH703): Enzymology **- 2 credit hours**

2nd Half

- Course code (BCH704): Lipid Chemistry & Metabolism **- 2 credit hours**
- Course code (BCH705): Protein Chemistry & Metabolism **- 2 credit hours**
- Course code (BCH706): Endocrinology **- 2 credit hours**

2nd Semester courses (12 credit hours)

1st Half

- Course code (BE801): Biomedical Ethics **- 1 credit hours**
- Course code (CS801): Computer Skills **- 1 credit hours**
- Course code (BRM801): Medical Education & Medical Writing **- 2 credit hours**
- Course code (ME801): Biostatistics & Research Methodology **- 2 credit hours**

2nd Half

- Course code (BCH707): GIT & Nutrition **- 2 credit hours**
- Course code (BCH708): Molecular Biology **- 2 credit hours**
- Course code (BCH709): Vitamins & Minerals **- 2 credit hours**

GENERAL SCHEDULE OF THE WEEK IN EACH SEMESTER

Days	9-11am	11:30am-1:30pm	1:30 -2:30pm
Mon	Lecture	Assignment for the week will be given and discussed	Self study
Tues	Lecture	Practical/ lab work	Assignment: Library/Internet
Wed	Interactive Discussion	Assignment discussion	Assignment: Library/Internet
Thurs	Final submission of assignment	Practical Training /lab work	Self study
Fri	Journal Club (9-12)- Presentations and discussion		
Sat	Detailed feedback on assignment	Interactive Discussion	Self study

Cell Biochemistry

Course code (BCH701)

Credit Hours: 2

Contens:

Cell organelles, Cell membrane, Physio chemical aspects-I, Physio chemical aspects-II, Electron transport chain and its Inhibitors, Oxidative phosphorylation and Uncouplers, Cancer, HIV, Ionization of water, Henderson – Hasselbach equation, Body buffers and their mechanism of action, Acid base balance regulation in human body, Acids produced in the body, mechanisms of regulation of pH, role of lungs and kidney in buffering mechanism Disorders of acid base metabolism, Receptors, Cell signaling pathways, Neurotransmitters, Xenobiotics metabolism

Practical work:

Introduction to biochemistry laboratory, Use of lab. equipments & glass wares, Preparation of buffer solutions, Qualitative analysis of unknown carbohydrate & protein, Demonstrate the phenomenon of Surface tension, Demonstrate the phenomenon of Tonicity.

Teaching Methodologies:

1. Didactic classroom instruction on multimedia and white board
2. Interactive discussions
3. Practical laboratory work
4. Assignment: Library/Internet
5. Journal Club

Recommended Books:

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

2. **Biochemistrys** Ed **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.Biochemistry. Ed Donald **Voet** and Judith G. Voet.John Wiley & sons, Inc.

5.Textbook of Biochemstry with Clinical Correlations. Ed. Thomas M. **Devlin**.Wiley-Liss Publishers.

6.Principles and Techniques of **Practical Biochemistry**. Ed .**Keith Wilson** and John Walker. Cambridge University Press.

Carbohydrates Chemistry & Metabolism Course code (BCH702)

Credit Hours 2:

Contents:

Introduction & Classification of carbohydrates, Isomerism, Chemistry of Monosaccharides and Disaccharides, Chemistry of polysaccharides, Introduction to carbohydrate metabolism – Glycolysis, Fates of pyruvate and TCA cycle, Gluconeogenesis, Glycogen metabolism, Fructose and Galactose metabolism, Disaccharide metabolism, HMP shunt, Metabolism of Glycosaminoglycan and Glycoproteins.

Practical/Lab Work:

Detection of carbohydrates and reducing sugars, Detection of polysaccharides, Barfoed's / Saliwanoff's test, Hydrolysis of sucrose

Teaching Methodology:

1. Didactic classroom instruction on multimedia and whiteboard
2. Interactive discussions
3. Practical work: demonstration and hands on practice
4. Assignment: Library/Internet, Journal Club

Recommended Readings:

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

2. **Biochemistrys** Ed **LubertStryer.** 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. Biochemistry Ed. Donald **Voet** and Judith G. Voet.John Wiley & sons, Inc

5. Textbook of Biochemstry with Clinical Correlations. Ed. Thomas M. **Devlin**.Wiley-Liss Publishers

6. Principles and Techniques of **Practical Biochemistry**. Ed .**Keith Wilson** and John Walker. Cambridge University Press

Enzymology
Course code (BH703)

Credit Hours: 2

Contents:

Introduction & classification of enzymes, Properties of enzymes, Factors affecting enzyme activity, Mechanism of enzyme action, Michaelis Menten equation, Coenzymes, Cofactors and Isoenzymes, Enzyme inhibition-I, Enzyme inhibition-II Enzyme regulation, Clinical Enzymology

Practical work:

Introduction to Spectrophotometer/ Microlab, Quantitative estimation of serum ALT and AST, Quantitative estimation of serum ALP, Demonstrate presence of salivary amylase,

Teaching Methodologies:

1. Didactic classroom instructions on multimedia and whiteboard
2. Interactive discussions
3. Practical laboratory work
4. Assignment: Library/Internet

5. Journal Club

Recommended Books:

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

2. **Biochemistrys**Ed **LubertStryer.** 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. Biochemistry. Ed Donald **Voet** and Judith G. Voet.John Wiley & sons, Inc

5. Textbook of Biochemistry with Clinical Correlations. Ed. Thomas M. **Devlin**.Wiley-Liss Publishers

6. Principles and Techniques of **Practical Biochemistry**. Ed. **Keith Wilson** and John Walker.Cambridge University Press

7. **Tietz textbook of clinical** chemistry and molecular diagnostics. Editors Burtis CA, Ashwood ER, Bruns DE. 4thed. Elsevier; 2006

8. Clinical Chemistry Techniques, Principles, Correlations Sixth Edition **Michael L. Bishop**, MS, CLS, MT (ASCP)

Lipid Chemistry and Metabolism
Course code (BCH704)

Credit Hours: 2

Contents:

Introduction & classification of lipids, Introduction, classification & properties of fatty acids, Simple, Compound and Derived lipids, Digestion & absorption of Lipids, Triglyceride metabolism, Denovo synthesis of fatty acids, Oxidation of fatty acids, Ketone body's metabolism, Phospholipids metabolism, Eicosanoids, Cholesterol & steroid metabolism, Lipoproteins metabolism

Practical work:

To prepare, observe cholesterol crystal, To detect cholesterol/ Salkowski's test & Liebermann Burchard's test, Quantitative est. of serum cholesterol, Quantitative est. of serum triglycerides

Teaching Methodologies:

1. Didactic classroom instruction on multimedia and whiteboard
2. Interactive discussions
3. Practical laboratory work
4. Assignment: Library/Internet
5. Journal Club

Recommended Books:

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

2. **Biochemistrys**Ed **LubertStryer.** 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.Biochemistry. Ed Donald **Voet** and Judith G. Voet.John Wiley & sons, Inc.

5.Textbook of Biochemstry with Clinical Correlations. Ed. Thomas M. **Devlin**.Wiley-Liss Publishers.

6.Principles and Techniques of **Practical Biochemistry**. Ed .**Keith Wilson** and John Walker.Cambridge University Press.

7. Tietz Textbook of Clinical Chemistry and molecular diagnostics. Editors Burtis CA, Ashwood ER, Bruns DE. 4th ed. Elsevier; 2006.

8.Clinical Chemistry Techniques, Principles, Correlations Sixth Edition **Michael L. Bishop**, MS, CLS, MT(ASCP)

Protein Chemistry & Metabolism
Course code (BCH705)

Credit Hours: 2

Contents:

Amino acid chemistry, Protein classification & structures, Protein folding & Denaturation, Ammonia metabolism, Individual amino acid metabolism. Fate of carbon skeletons of amino acid, Synthesis of specialized Products, Fibrous proteins, Globular proteins, Heme metabolism, Plasma proteins, Protein separation techniques.

Practical work:

Colour tests of proteins, Detection of protein by salting out method, Detection of protein by heat coagulation, Quantitative estimation of serum urea

Teaching Methodologies:

1. Didactic classroom instruction on multimedia and whiteboard
2. Interactive discussions
3. Practical laboratory work in Clinical Chemistry (Chemical Pathology) laboratory
4. Assignment: Library/Internet
5. Journal Club

Recommended Books:

1. Principles of Biochemistry. Ed **Lehninger**, Nelson and Cox. CBS publishers and distributors.
2. Biochemistrys Ed **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. Biochemistry. Ed Donald **Voet** and Judith G. Voet. John Wiley & sons, Inc.

5. Textbook of Biochemstry with Clinical Correlations. Ed. Thomas M. **Devlin**.Wiley-Liss Publishers.

6. Principles and Techniques of Practical Biochemistry. Ed. **Keith Wilson** and John Walker. Cambridge University Press.

7. Tietz Textbook of Clinical Chemistry and molecular diagnostics. Editors Burtis CA, Ashwood ER, Bruns DE. 4th ed. Elsevier; 2006.

8. Clinical Chemistry Techniques, Principles, Correlations Sixth Edition **Michael L. Bishop**, MS, CLS, MT(ASCP)

Endocrinology
Course code (BCH706)

Credit Hours: 2

Contents:

Classification & MOA of hormones, Anterior Pituitary gland, Posterior Pituitary gland Regulatory role of hypothalamus, Thyroid hormones, Parathyroid gland, Pancreatic hormone – insulin, Pancreatic hormone – glucagon, Blood glucose regulation, Adrenocortical hormones
Adrenal medullary hormones, Sex steroid hormones

Practical work:

Quantitative est. of serum glucose, Glucose tolerance test, Use of glucometer, Thyroid function tests

Teaching Methodologies:

1. Didactic classroom instruction on multimedia and whiteboard
2. Interactive discussions
3. Practical laboratory work
4. Assignment: Library/Internet
5. Journal Club

Recommended Books:

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

2. **Biochemistrys**Ed **LubertStryer.** 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.Biochemistry. Ed Donald **Voet** and Judith G. Voet.John Wiley & sons, Inc.

5.Textbook of Biochemstry with Clinical Correlations. Ed. Thomas M. **Devlin**.Wiley-Liss Publishers.

6.Principles and Techniques of **Practical Biochemistry**. Ed .**Keith Wilson** and John Walker.Cambridge University

Press.

Gastrointestinal Tract
Course code (BCH707)

Credit Hours: 2

Contents:

Saliva, Gastric juice, Pancreatic juice, Bile, Intestinal juice, gastrointestinal juice, Digestion & absorption of lipid, Digestion & absorption of carbohydrates, Digestion & absorption of proteins, Nitrogen balance, Clinical disorders related to nutrition, BMI & BMR.

Practical work:

Determination of constituent of saliva, Detection of salivary amylase, Determination of bile, Estimation of bilirubin,

Teaching Methodologies:

1. Didactic classroom instruction on multimedia and whiteboard
2. Interactive discussions
3. Practical laboratory work

4. Assignment: Library/Internet

5. Journal Club

Recommended Books:

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

2. **Biochemistrys**Ed **LubertStryer.** 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.Biochemistry. Ed Donald **Voet** and Judith G. Voet.John Wiley & sons, Inc.

5.Textbook of Biochemstry with Clinical Correlations. Ed. Thomas M. **Devlin**.Wiley-Liss Publishers.

6.Principles and Techniques of **Practical Biochemistry**. Ed .**Keith Wilson** and John Walker.Cambridge University

Press.

Molecular Biology
Course code (708)

Credit Hours: 2

Chemistry of nucleotides, Purine synthesis, Purine degradation, Pyrimidine synthesis, Pyrimidine degradation, Clinical disorders related to purine and pyrimidine metabolism, Structure of nucleic acid, DNA replication & repair, Transcription in eukaryotes, Transcription in prokaryotes, Regulation of gene expression, Translation in eukaryotes, Translation in prokaryotes, PCR

Practical work:

Laboratory safety, DNA extraction precautions, DNA extraction, RNA extraction, Extraction method selection, basic extraction steps, and nucleic acid analysis, PCR procedures, PCR product analysis, and real-time PCR characteristics

Teaching Methodologies:

1. Didactic classroom instruction on multimedia and whiteboard
2. Interactive discussions
3. Assignment: Library/Internet
4. Journal Club
5. Presentations by students

Recommended Books:

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

2. **Biochemistrys**Ed **LubertStryer.** 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.Biochemistry. Ed Donald **Voet** and Judith G. Voet.John Wiley & sons, Inc.

5.Textbook of Biochemstry with Clinical Correlations. Ed. Thomas M. **Devlin**.Wiley-Liss Publishers.

6.Principles and Techniques of **Practical Biochemistry**. Ed .**Keith Wilson** and John Walker.Cambridge University Press.

Vitamins & Minerals
Course code (BCH709)

Credit Hours: 2

Contents:

Introduction to classification of vitamins, Vitamin A, Vitamin B complex, Vitamin C, Vitamin D, Vitamin E, Vitamin E, Introduction and classification of minerals, Calcium and related clinical disorders, Phosphorus and related clinical disorders, Microminerals-I, Microminerals-II.

Practical work:

Quantitative est. of serum glucose, Glucose tolerance test, Use of glucometer, Thyroid function tests

Teaching Methodologies:

1. Didactic classroom instruction on multimedia and whiteboard
2. Interactive discussions
3. Practical laboratory work
4. Assignment: Library/Internet
5. Journal Club

Recommended Books:

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

2. **Biochemistrys**Ed **LubertStryer.** 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.Biochemistry. Ed Donald **Voet** and Judith G. Voet.John Wiley & sons, Inc.

5.Textbook of Biochemstry with Clinical Correlations. Ed. Thomas M. **Devlin**.Wiley-Liss Publishers.

6.Principles and Techniques of **Practical Biochemistry**. Ed .**Keith Wilson** and John Walker.Cambridge University

Press.

Mandatory Courses

BRM-801: BIOSTATISTICS AND RESEARCH METHODOLOGY

LEARNING OBJECTIVES

To provide the students with the necessary concepts of statistics to enable them to realize a research project.

Selection of appropriate statistical techniques to address questions of medical relevance; select and apply appropriate statistical techniques for managing common types of medical data; use various software packages for statistical analysis and data management; interpret the results of statistical analyses and critically evaluate the use of statistics in the medical literature; communicate effectively with statisticians and the wider medical community, in writing and orally through presentation of results of statistical analyses; explore current and anticipated developments in medical statistics.

Contents:

Data Analysis

- Descriptive Statistics
- Statistical Inference
- Comparing Two Means: The T-Test
- Comparing More Than Two Means: Analysis of Variance
- Multiple Comparison Tests
- Nonparametric Tests for Group Comparisons
- Correlation
- Regression

Measures Of Association for Categorical Variables: Chi-Square

- Statistical Measures of Reliability
- Statistical Measures of Validity
- Epidemiology: Measuring Risk
- Multivariate Analysis
- Data Management

Concept of Clinical Research
The Role of Theory in Clinical Research
Ethical Issues in Clinical Research

Part Ii- Concepts Of Measurement
Principles Of Measurement
Validity Of Measurements

CS-801: COMPUTER SKILLS

Learning Objectives

Upon completion of the course the students should be able to:

Comprehend the basic concepts of the computational skills.

Learn the use of computer in sampling techniques and the data collection and analysis.

Understand the application of computerized instruments for the practical work.

Course Contents

Basic Concepts of Computer

History of Computer

Concept of Computer hardware

Concept of Computer languages

Concept of Computer Software e.g. SPSS, Microsoft Excel or similar.

Computer applications in Biology Spreadsheet tools: Introduction to spreadsheet applications; Data storing, Statistical analysis of data, Generating charts/ graph and other features.

Presentation tools: Introduction, features and functions, Presentation of Power Point Presentation, customizing presentation, Showing presentation, Tools – Microsoft Power Point or Similar

Web Search: Introduction to Internet, Use of Internet and WWW, Use of search engines, Biological data basis.

BE-801: BIOMEDICAL ETHICS

Course Objectives

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.

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

The 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 o
Family Practice -Adherence and Compliance

- Geriatrics -Giving Bad News
- Medicine -Responding to Families o

Neurology -Disclosing a Diagnosis o
Ob/Gyn-Reproductive Choice

- Pediatrics -Parental Discretion
- Psychiatry -Treatment over Objection and Confidentiality
- Surgery -Identifying Ethical Issues

MEMR-801: Medical Education & Medical Writing
Rationale:

Due to the advancement & development of innovative educational strategies with implementation of E. Learning environment, technology zenith and advance scientific research in medical & allied health, the health professionals (Basic sciences & clinical teachers) require to be acquaint with all these innovations and demonstrate essential skills & competencies as a physician, teacher, scholar, researcher and leader. This means that training of health professionals requires high standards of education at par with the realities of the practical world. Along with the expansion of health professionals as a need, a reform in health professions education is taking place world over e.g. Curriculum integration, implementation of PBL/CBL, use of simulator in teaching, virtual patients, OSCE/OSPE as an assessment tools etc. Therefore, this course is designed keeping in mind the basic requirements for a medical teacher (Basic sciences) in Health Profession Education to demonstrate the competencies of an effective medical teacher.

Course Goal:

The course is endeavors to train post graduate students (basic medical sciences) in basics of health profession education to produce competent health profession teacher.

Outcomes of Course:

By the end of the course the students will be able to:

Adept in basic knowledge and its application in the core areas of medical education i.e. educational environment & students, teaching and learning, curriculum development including educational strategies & curriculum themes, Students assessment and Program evaluation.

Acquire knowledge, skills and attitude requires for a competent health profession educator by understanding & applying the theoretical and empirical literature in medical education

Critically examine the preparation requires for their role as educators of their profession through enhancing students understanding and implementation of principles of adult learning and teaching in relation to their target group.

Apply the educational theories and cognitive psychology in support of their role as an educator in practice.

Use knowledge and skills require for Designing & developing an integrated curriculum/Module at an undergraduate level.

Understand and apply the fundamentals of educational methodologies (Learning and Teaching)
while "Teaching to learn and learning to teach".

Understand and apply the fundamental principles in 'Assessment' while designing an assessment plan and assessment tools.

Design a plan with tools for evaluating a teaching program.

Demonstrate effective communication skills (active participation, Pro-activeness, professionalism, group dynamics, team building, conflict resolution, negotiation skills, leadership skills etc) while working in the group/team tasks.

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 understands the principles of learning. Hence, this course has four key features identified for effective learning – the FAIR criteria:

Feedback to the learner as to progress
Active rather than passive learning
Interest or motivation of the learner
Relevance to the perceived and real needs of the learner

This course is designed for the post gradates medical students to develop them as an effective team member and effective teacher in an 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 and themes in medical education 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 **five Themes.**

Instruction strategies:

Interactive lectures by the teacher followed by the group discussions/activity weekly 1 hrs.

Self-study and literature search- for assignment.

Assignments (Students are expected to submit 02 evidence-based written assignment-01 major & 01 minor)

Assessment strategy:

Formative assessment- there will be continuous assessment on the ongoing small group activities and attitude of each student and that will be recorded through an evaluation performas (checklists, rating scales) used during the sessions. Constructive Feedback will be provided on it by the teachers. Students, who will score satisfactory and achieve the minimum required standard, will be allowed to sit in end of course/semester assessment.

Summative assessment:

Assessment modalities:

For Knowledge:

Students are expected to submit 02 evidence-based written assignments (01 major & 01 minor related to major themes).

Final end of Semester Exam: At the end of the course there will be a Theory Exam comprises of MEQ (Modified Essay Questions).

For Skill and attitude:

It will be assessed through ongoing continuous assessment in small group activities, presentations and mini projects assigned during the classes and that will be recorded through an evaluation performas (checklists, rating scales).

Learning Resources:

A practical Guide for Medical Teacher by John A. Dent & Ronald M. Harden. (4^{th} edition, A Book)

Journal Articles will be provided from the latest medical education journals.

Other reading materials from the renowned author's books and research work, some good websites.

Logistics / Training Resources for the course:

Photostat facility for handouts and readings.

Room for classes with multimedia.

Course Sequencing, Time Planning and TOS

Total 18 hours of teaching: Each session will be of 01 hour

Sr. #	Theme #1	Theme #2	Theme #3	Theme #4	Theme #5	Total
Topic	Introduction to HPE& Educational Environment	Teaching And Learning	Curriculum: structural concepts and development	Assessment	Program Evaluation	
Duration	4hrs	4hrs	4hrs	4hrs	2hrs	18hrs
Marks	20	25	25	20	10	100

Course Content and Learning Objectives (Course Evaluation Procedure)

THEME # 1:

Introduction to HPE& Educational

Environment Number of Lectures: 04

Content:

Introduction to HPE and competencies required in HPE

Educational environment which effect the students learning- factors that enhance or inhibit the learning the learning.

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

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.

THEME # 2:

Teaching & Learning

Number of Lectures: 04

Content:

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.

Learning Objectives:

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.

THEME # 3:

Curriculums: structural concepts and development

Number of Lectures: 04

Content:

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.

The selection of core content while integrated curriculum development.

Steps of Integrated Modules planning & development.

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.

Steps of Integrated Modules planning & development

Select core content while designing an integrated curriculum development.

THEME # 4:

Assessments

Number of Lectures: 04

Content:

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 of learning objectives with the assessment tools

Design various assessment tools for knowledge, skill & attitude- MCQs, SEQs, & OSCE/OSPE

Importance and Contents of a table of specification.

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/OSE

Match the objectives with the assessment tools.

Develop a table of specification for a module.

THEME # 5: Program Evaluations Number of Lectures: 02 Learning Objectives:

Discuss the importance of evaluating a teaching session/ course/ program.

Identify the ways of assessing the effectiveness of an educational program.

Assessment Procedure

1. Assignments/tests/log book/portfolio 10 percent marks

2. Semester Exam:

If subject has practical:

Viva/practical OSPE 45 percent

Written Examination 45 percent

If subject has no practical then:

Written Examination 90 percent

Calculate GPA as per university rules.

Marks Distribution

- ☐ Total marks per semester 500 marks

First Semester:

- ☐ MCQs 45 marks (each subject)
- ☐ SEQs 45 marks (each subject)

- ☐ Viva (Advance Biostatistics) 100 marks
- ☐ Viva (Advance Research Methodology) 100 marks
- ☐ Mandatory Workshops 100 marks

2nd Semester:

- ☐ MCQs 45 marks (each subject)
- ☐ SEQs 45 marks (each subject)
- ☐ Viva+ Practical 100 marks (each subject)
- ☐ Mandatory Workshops 100 marks

Semester	Course Title	MCQ Marks	SCQ Marks	VIVA/Practical Marks	Internal Assessment
First	Medical Writing & Health Education	45	45	N/A	10
	Advanced Biostatistics	45	45	90	20
	Advance Research Methodologies	45	45	90	20
PhD Biochemistry					
	BIOCHEMISTRY I	45	45	90	20
	BIOCHEMISTRY II	45	45	N/A	10

Second	Differential Diagnosis in Rehabilitation Sciences	45	45	90	10

STANDARD OF PASSING

Cleared the semester exams

Cleared the comprehensive exam If yes, then the evidence of clearing the comprehensive exam

The dissertation examined or to be examined by at least two foreign examiners and one national examiner. If the scholar has completed his/ her dissertation then the dissertation has to be examined by minimum of two foreigner examiners preferably from technologically advanced countries and one national examiner.

Has the dissertation been defended If yes, then provide the details including date of defense, whether it was an open defense, notification of the defense etc.

Submitted paper for publication in HEC approved journals. The scholar has to publish at least 2 research papers in HEC approved journal for the purpose to attain Ph.D. Degree. For this purpose, if the paper is published then the evidence of publication is to be submitted; if the paper is accepted for publication, then the documentary proof of acceptance from the journal will be submitted.

RECOMMENDED READINGS
COMPULSORY COURSES FOR ALL SPECIALTIES

BOOKS

BIOETHICS AND MEDICAL ETHICS

John Arras and Bonnie Steinbock. Ethical Issues in Modern Medicine, Mayfield, Latest Ed.

Françoise Baylis, Jocelyn Downie, Benjamin Freedman, Barry Hoffmaster, and Susan Sherwin. Health Care Ethics in Canada. Harcourt Brace, Latest Ed.

Tom L. Beauchamp and James F. Childress. Principles of Biomedical Ethics. Latest Ed. Oxford University Press.

Jonathan Glover, Causing Death and Saving Lives. Penguin Books, Latest Ed.

Glenn C. Graber and David C. Thomasma. Theory and Practice in Medical Ethics. Continuum, Latest Ed.

Thomas A. Mappes and David Degrazia. Biomedical Ethics, 4th ed. McGraw-Hill, Latest Ed.

Gregory E. Pence. Classic Cases in Medical Ethics.2nd ed., McGraw-Hill, 1990.

BIOSTATISTICS AND RESEARCH METHODOLOGY

Gordis, L. Epidemiology. Pennsylvania: W.B. Saunders Company. Latest Ed.

Rothman KJ. Modern Epidemiology. Boston: Little, Brown and Company, Latest Ed.

Kelsey JL, Thompson WD, Evans AS. Methods in Observational Epidemiology. New York: Oxford University Press, Latest Ed.

Kleinbaum DG, Kupper LL, Morgenstern H. Epidemiologic Research: Principles and Quantitative Methods. Belmont, CA: Lifetime Learning Publications, Latest Ed.

Lilienfeld DE, Stolley PD. Foundations of Epidemiology. New York: Oxford, Latest Ed.

Daniel WW. Biostatistics: A Foundation for Analysis in the Health Sciences. Latest Ed. John Wiley & Sons. Inc. New York.

Larson R and Farber B. Elementary Statistics: Picturing the World. Latest Ed, Prentice Hall Publications. New Jersey USA.

Essentials of clinical research By Stephan P. Glasser.

Rehabilitation Research (Principles and Applications) 3rd Edition By Elizabeth Domholdt.

Dowrick C. Medicine in society: behavioral sciences for medical students. CRC Press; 2001
Billingham KA, Feldman HS & Lopez MA. Developmental psychology for health care prefession. Michigan: westviewpress ;1982.
Purtilo RB & Doherty RF. Ethical dimensions: in the health professions. 6th ed. St. Louis: Elsevier; 2016
Veatch RM. Medical ethics. 2nd ed. USA: Jones & Bartlett. 1997

COMPUTER SKILLS

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

JOURNALS:

COMPUTER SKILLS

Journal of Bioinformatics and Computational Biology (JBCB)
BMC Bioinformatics

BIOETHICS

Cambridge Quarterly of Healthcare Ethics
Hastings Center Report
Journal of Clinical Ethics
Journal of Medical Ethics
Journal of Medicine and Philosophy
Kennedy Institute of Ethics Journal
Nursing Ethics

BIOSTATISTICS

Cancer Epidemiology
Epidemiologic Reviews
Annals of Epidemiology
American Journal of Epidemiology
International Journal of Epidemiology