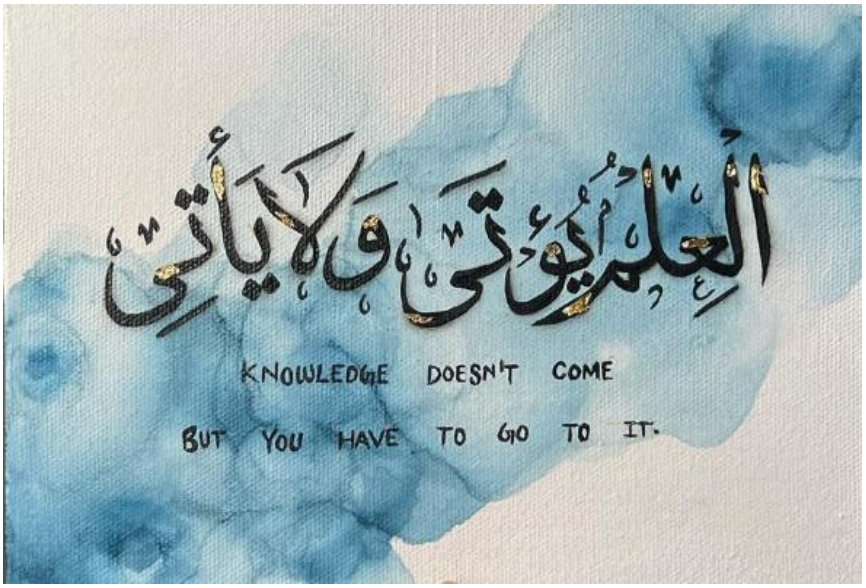
CURRICULUM

PhD Anatomy Program

(2026)

In The Name Of Allah The Most Beneficent And The Most Merciful



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SECTION-I

INTRODUCTION TO UNIVERSITY

1.1 RMU at a Glance:

Rawalpindi Medical College (RMC) was established in 1974. The founder principal of RMC, Prof. Abdul Latif (also an Anatomist), worked hard to establish the institution. Since 1974 more than 13000 students have graduated and are serving prominently at national and international stages. RMC was privileged to claim top positions in university examinations several times. Rawalians have proved themselves and their institution time and time over again.

First Rawalian Principal, Prof. Mohammad Umar after taking over the office in 2013, embarked on a multi-dimensional approach to further develop the institution. Through his untiring and dedicated efforts, Rawalpindi Medical College was upgraded to Rawalpindi Medical University in 2017. PMDC & Higher Education Commission (HEC) gave NOC to RMU for many Postgraduate programs.

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

Rawalpindi Medical University has always occupied a unique position in the public sector, being one of the leading medical University in Pakistan. In 2021 and 2022, RMU was ranked first among medical universities of Pakistan by the Impact Times Higher Education (It is an international agency which gives ranking to universities). This achievement shows that RMU has become the fastest growing university of not only of Punjab but also of Pakistan. 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.

Campus:

The University is divided in two campuses. Old teaching Block at Tipu Road campus & New Teaching Block at Holy family hospital.

Societies:

The various societies of the university include Rawalians Arts society, Rawalians sports society, Medicose Aid society, Rawalians literary society, Rawalians dramatic club, Rawalians student research society, Islamic society.

Magazine:

Shifa Magazine (Annual).

Research journals:

The university publishes several research journals including Journal of Rawalpindi medical college (JRMC), Student Journal of Rawalpindi medical college (SJRMC), Resident journal of Rawalpindi medical university (RJRMU), Journal of Nursing and Allied health (JNAH), Journal of Health and

Climate Change (JHC), Children Rights Journal of Rawalpindi medical University (crJRMU)

Office of Research, Innovation and Commercialization (**ORIC):**

In 2019 the university opened the Office of Research, Innovation and Commercialization as the focal point of all research related activities. The university's research focuses primarily on medical developments and improvements in the health sector. Students also contribute to the university's research projects by publishing their work in the Student Journal & Resident journal of Rawalpindi Medical University.

1.2 Mission Statement

- To impart evidence-based research oriented medical education .
- To cultivate a community of scholars dedicated to advancing knowledge in field of anatomy through rigorous research, interdisciplinary collaboration, and innovation.
- To inculcate the values of mutual respect and ethical practice of medicine.
- To meet the requirements of Higher Education Commission (HEC) and Pakistan Medical and Dental Council (PM&DC) up to the level of satisfaction with accuracy & transparency.

1.3 Vision and Values:

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

SECTION-II

INTRODUCTION TO PROGRAM

2.1 Starting PHD Anatomy at RMU

PhD programs in any discipline serve as powerful drivers for original research, pushing the boundaries of existing knowledge. The award of a PhD degree signifies not only the culmination of a rigorous academic journey but also a valuable contribution to the advancement of society and humanity at large. Although the doctoral journey demands intellectual rigor, unwavering dedication, and sustained effort, many eligible male and female doctors in Pakistan are inspired to undertake this challenge due to the prestige of the degree and their desire to serve the nation through research.

Currently, only a handful of institutions in Pakistan offer a PhD in Anatomy. Recognizing this gap, the esteemed Vice Chancellor, Dr. Umar, has taken the initiative to launch a robust and well-structured PhD Anatomy program at Rawalpindi Medical University (RMU). This program is envisioned to produce not only high-caliber anatomy educators for academic institutions but also to promote a culture of high-quality anatomical research in Pakistan.

In this endeavor, the Director PhD Program and the Postgraduate Department are working collaboratively, ensuring that the program is developed with academic rigor, innovation, and strategic foresight. Their joint efforts aim to cultivate a research-oriented mindset among scholars, expanding academic horizons and reinforcing RMU's commitment to excellence. The goal is to equip doctoral candidates with the scholarly competence required to contribute original research to anatomical sciences and to teach anatomy at undergraduate and postgraduate levels.

2.2 SCOPE OF ANATOMY PhD PROGRAM

Anatomy forms the basis for the practice of medicine. It leads the physician towards an understanding of a patient's disease whether by physical examination or using imaging techniques. It is also important in allied health programs in aspects of patient management that begin with an analysis of clinical signs.

Knowledge and skills in the field of macroscopic and microscopic Anatomy will enable medical graduates to practice medicine successfully and scientists to pursue a career in the discipline of Anatomy. Knowledge of the structure of the human body from what can be seen with the unaided eye (gross anatomy) down to the molecular level is fundamental to understanding bodily function and how both structure and function are modified by disease.

During the last few decades, there has been an explosion of new techniques for imaging anatomy in living patients. Examples range from endoscopy and laparoscopy to computed tomography (CT) and magnetic resonance imaging (MRI), together with newly emerging technology for three-dimensional visualization. The emergence of these sophisticated imaging techniques has been accompanied by the development of minimally invasive therapy targeted to specific organs and/or sites within them. As a result, knowledge of anatomy has become increasingly important, not only to interpret the images that are produced by these sophisticated techniques, but also to understand the pathway for targeting therapy to a specific site. Ironically, at a time when knowledge of anatomy is increasingly important, we now are facing a crisis in anatomical education. A deepening shortage of experienced faculty members willing to teach gross anatomy to medical and dental students, as well as other health professions students, has developed. Keeping in view the persistent demand from students and urgent need for experts in the field of Anatomy, it is highly imperative to initiate our own PhD program in this field.

2.3 Goals of PhD Program

1. To achieve the academic growth and development in undergraduate medical education by providing properly qualified and trained basic sciences teachers.
2. To institutionalize research by producing more PhDs, particularly in the emerging fields of basic medical sciences.
3. To educate and train health care professionals engaged as academician, researchers and field practitioners will revamp the health care delivery system and replenish the academia in the medical education set up. The community will be the ultimate beneficiary due to better health facilities.
4. To improve health standards of the community in this underdeveloped region of the world, focus of research will be on regional medical issues.
5. To train human resource to execute and streamline the operations of the Institute and will fill the vacuum in the growing medical institutions and industry.
6. To develop human resource with research and technology capabilities at RMU which will ultimately help in the development of national economy.

2.4 AIMS / OBJECTIVES

After the required period of training, the PG-trainee should be able to:

- Prove competency & clarity of concepts in Anatomy and Allied disciplines of the subject.
- Enhance postgraduate learning experience of the students by inculcating research interests and promoting high quality postgraduate activities.
- Contribute to improvement in the quality of undergraduate program.

- Identify and manage common laboratory work problems.
- Provide better research opportunities to the students for in-depth study.
- Impart contemporary teaching and communication skills to the students.
- Inculcate critical thinking in the students and make them self-directed life-long learners.
- Equip graduates with high level of scholarly competence in the field of Anatomy as well as the associated enabling Analytical, IT & AI skills to compete with the very best in the contemporary world.
- Inculcate in them an attitude of professional excellence and responsibility for ethical behaviour and civic responsibility towards humanity in general and Pakistan in particular
- Provide strong leadership in the field of Research and Medical Education.

2.5 Alignment of Program Objectives with University Mission Statement

The objectives of the program have been defined in the light of RMU Mission statement to produce competent and ethically sound healthcare professionals. This is achieved through predefined set of course content, availability of requisite facilities, feedback and evaluation of the program for continuous improvement.

2.6 Career Prospects in PhD Anatomy:

A PhD in Anatomy can open various exciting career prospects. Here are a few potential career paths:

- Teaching anatomy at universities and colleges
- Academic Researcher
- Conducting advanced research in anatomy.
- Supervising graduate and undergraduate students.
- Collaborating with healthcare professionals on research projects.
- Contributing to medical breakthroughs by conducting research in areas like genetics, or neuroscience.
- Working in research institutions
- Creating educational materials, textbooks, or scientific articles related to anatomy.
- Editing scientific journals by contributing in Editorial board of related journals.

SECTION-III

PROGRAM SPECIFICATION– PhD Anatomy

3.1 DURATION OF PROGRAM:

The PhD program at RMU will be minimum three (03) years duration and maximum Eight (08) years duration. (Annex 3.12 of HEC policy *)

3.2 Credit hours:

The student shall complete coursework of at least 48 credit hours (18 credit hours of course work + 30 credit hours of Research & Thesis) (Annex 3.6 of HEC policy *)

a) The PhD Candidate (MPhil/MS degree holders) must undertake eighteen (18) Credit hour of coursework.

b) The coursework components will consist of designated courses that are compulsory within 12 months of enrolment in the program.

c) All PhD courses will be designated a course code of "8". For international comparability purposes the term,'Doctoral or equivalent level' is used the level 8. (Annex 3.6 of HEC policy *)

- Out of 18 credit hours, six (06) credit hours are compulsory for all PhD students enrolled at RMU.

3.3 Curriculum Design

The Graduate of PhD in Anatomy will not only be a Subject Specialist but will also be a Scientific researcher, Educator, Effective communicator and Collaborator. An elaborate Curriculum needs to be designed to equip the scholars for these important roles. Therefore, besides academic Anatomy, training and development of the scholars in following should be integrated into the curriculum design:

- Research skills and methodology
- Analytical skills to conduct quality and credible research
- Educators capable of teaching medical anatomical discipline
- IT & AI skills to benefit from the tremendous resources
- Ethics & Responsibility
- Leadership
- Professionalism

3.4 PHD Anatomy –Program Specifications

Title	**Specification**
Course Duration	3-8 Years
Type of Study	Full time
Study System	Semesters system
Total Credit Hours-Coursework	20
Semester Wise distribution of Credit Hours (Course work)	Credit hours distribution Year 1 Semester 1=10 Semester 2= 10
Synopsis writing and approval	Year 1 Semester 1 = Research topic approval Semester 2 = Synopsis writing and comprehensive exam` Year 2 = Research work Year 3 =Research work & Thesis writing
Schedule Distribution	Study per semester = 16 weeks Prep leave = 2 weeks Examination = 1 week Semester break = 1 week

During study, the student can also have the option to specialize in one or more of the sub-disciplines of

anatomy by selecting the research topic related to that sub discipline of Anatomy.

- ✧ Each candidate must attend the mandatory workshops & courses as required by the university.
- ✧ For international comparability purposes, PhD courses are usually designated a course code of "8" representing the highest level of academic achievement.Level 8 includes PhD as defined and mentioned in the National Qualifications Framework. (Annex 3.6 of HEC policy 2023)*/*** . Therefore, PhD Anatomy is given a code of ANA 800.

3.5 Curriculum Breakdown

Topics	**Course code**	**Duration & Credit Hours**
Year 1		
Semester 1		**20 weeks/ 10 Credit Hours**
Gross Anatomy (Musculoskeletal) (core course)	ANA -801	(1+0)
Microscopic Anatomy & Laboratory techniques (core course)	ANA -802	(3+0)
Advances in Molecular Biology	MCB-801	(3+0)
Bio Medical Ethics	BME-801	(1+ 0)
Biostatistics & Research Methodology	BSR-801	(2+0)
Preparatory leave		2 weeks
Exams		1 week
Semester Break		1 week
Semester 2		**20 weeks/ 10 Credit Hours**
Medical writing & Medical Education	MWE-801	(2+0)
Computer skills & Bioinformatics	CSB-801	(1+0)
Developmental Anatomy (core course)	ANA -803	(3+0)
Neurosciences (core course)	ANA- 804	(3+0)
Gross Anatomy (Viscerology) (core course)	ANA-805	(1+0)
Preparatory Leave		2 weeks
End Semester Exam		1 week
Semester break		1 week
Preparatory leave for Comprehensive exam		4 weeks
COMPREHENSIVE EXAM		

3.6 Committees for Overall Supervision of the PhD Anatomy Program

1. PhD Admission Committee (AC)
2. Academic and Research Supervisory Committee (ARSC)
3. Board of Advanced Studies & Research (BASAR)
4. Ethical Review Committee (ERC)
5. PhD Synopsis Review Committee
6. Postgraduate Medical Education Committee (PGMEC) (Annex VI- 3 a of PMDC policy **)

3.7 Research Supervisory Process

To guide the supervisory process of doctoral dissertation towards the desired goals, the universities/DAIs/HEIs shall:

a) Devise a supervision manual and ensure its implementation, and

b) Constitute an Academic and Research Supervisory Committee (ARSC) for each doctoral student. Following may be the composition of the Committee:

a.	Chairperson of the Department	Member
b.	Supervisor	Convener
c.	Co-supervisor (if any)	Member
d.	One or two Expert(s) from the field of research (From University/Other Institution)	Member(s)

3.8 The Supervisor for PhD Scholar

Qualified supervision is an essential component for a successful PhD program in subject of Anatomy. The supervision will be tailored to meet the requirements of the individual PhD student and his development throughout the program. In selecting supervisors, the following elements may be considered.

Criteria of Supervisors for Launching PhD Programs:

- Holders of Level III qualification of relevant field are required to supervise Ph.D scholars (PMDC policy 2023)**
- HEC mandates a minimum of three PhD faculty members to ensure the academic integrity and credibility of the program (Annex 7.1.1 of HEC policy)*. In case of availability of only one PhD in a department, an eligible PhD faculty member from another department of the same institution and one PhD faculty member from another university from relevant speciality may contribute as adjunct member for the program (HEC notification on partial relaxation; 15-54/2019/Coord/QAD/HEC/897)**.** Three PhDs ensure the program's stability by reducing the risk of dependency on a single individual.

The Co-Supervisor for PhD Program

- It is recommended that each PhD student can have up to 02 co-supervisors in addition to the main supervisor to cover all aspects of the program.
- The co-supervisor may not be content specialist in the chosen field of research but have great knowledge about the scientific area in question and can contribute to the PhD project and help the student with the research.
- Supervisor & co-supervisor shall not be related to a student by consanguinity or by affinity to the third degree inclusive or have a dual relationship with the student.

Change of a Supervisor/Co- supervisor

In case of absence/retirement of the existing Supervisor/ CoSupervisor, the PhD scholars shall be given the choice for the change of Supervisor. If there is Co-Supervisor from the domain then he/she can be shifted as Supervisor. Otherwise, Dean Postgraduate Studies has to arrange visiting

PhD faculty (PMDC policy 2023)** If the scholar is not satisfied or has reasonable evidence of having no interest of the supervisor, or any evidence of harassment, Scholar can apply for the change of supervisor to the chairman of the department who will discuss the case at appropriate level but decide within a month. When Dean Postgraduate Studies and Director BASR are satisfied that there is sufficient reason, it may change the Supervisor/Co-Supervisor of the Candidate on the request of either Scholar or the Supervisor.

3.9 Mode of Teaching Curriculum

Semester system

3.10 Program Delivery Methodology

- Interactive Lectures
- Tutorials
- Short Group Discussions
- Guided Self-study & SDLs
- Peer Assisted learning (PAL)
- Practical & OSPE Sessions
- Skill laboratory
- Dissection
- Presentations
- Seeking information through Journal clubs, library and Internet.
- Attending workshops, seminars, conferences
- Research work

The objectives of the training may also be achieved through following modes:

- Assigning responsibilities of teaching the undergraduates & postgraduates (MBBS and M.Phil)
- Seeking information through Journal clubs, library and Internet
- Attending workshops, Seminars, conferences etc.
- Arranging regular quiz sessions for students
- Completion of assignments
- Flip classroom technique
- Assisting/Supervising Research projects of undergraduates and M. Phil students.
- Attachments with Federal, Provincial and District outlets to acquire technical know-how of laboratory work.
- Doctoral degree students will also be provided opportunities to rotate in different laboratories during the first two semesters with the intent of learning different methodologies, disciplines, and laboratory experiences before beginning more intensive research, thus encouraging interdisciplinary research and collaboration.
- Visits to different universities/DAI/HEIs where PhD scholars can explore their interest for the area of research.

3.11 Responsibilities and Competencies of Postgraduate Trainees (PGTs):

- Advance knowledge of Anatomy
- Research and Analytical skills
- Teaching and Educational competency
- Ethical and Professional conduct
- Communication and collaboration
- Leadership and management skills
- Technological Proficiency
- Critical thinking and problem solving
- Interdisciplinary Integration
- Commitment to Lifelong learner

❖ The specialty-specific competencies for training, as explained, will be identified by the respective Board of Studies and incorporated into their curriculum.

❖ A logbook will be maintained by the students for the academic/basic sciences rotation.

❖ A workbook reflecting all the practical activities and field trips undertaken by him/her will be maintained by the PhD scholar

SECTION-IV

PhD Anatomy Course Details

By the end of the course work, the PhD Anatomy scholar should be well versed in the following areas across three domains:

Cognitive Domain: Graduates will be able to:

- Evaluate and integrate current and emerging knowledge in human anatomy including gross anatomy, neuroanatomy, microscopic anatomy and developmental anatomy.
- Critically analyze complex anatomical structures and their clinical correlations using advanced tools (e.g., imaging, 3D modeling).
- Design and conduct original research in anatomical sciences with appropriate methodologies and statistical analysis.
- Interpret and synthesize scientific data to solve real-world anatomical and clinical problems.
- Contribute to scholarly literature by producing publishable-quality research papers, systematic reviews, and grant proposals.
- Apply anatomical knowledge in interdisciplinary contexts like surgery, radiology, forensic science .
- Demonstrate expert knowledge of ethical standards and regulatory policies in research involving human tissue or cadavers.

Psychomotor Domain: Graduates will be able to

- Perform advanced human cadaver dissections with precision, identifying complex structures.
- Utilize advanced histological techniques including tissue preparation, staining, and microscopy (light, fluorescence, EM if available).
- Operate and interpret data from modern imaging modalities (CT, MRI, 3D scanning).
- Develop and demonstrate skills in anatomical model creation (digital and physical).
- Teach anatomical structures effectively using dissection, models, and interactive methods & creative skills

- Maintain laboratory safety standards and ethical handling of specimens.
- Display research findings and demonstrate proficiency in scientific writing and presentation skills.
- Use of intellectual independence to think critically, evaluate existing ideas, undertake systematic investigation and reflect on theory and practice of Anatomy to generate original knowledge.

Affective Domain : Graduates will be able to

- Demonstrate professionalism, respect, and empathy in dealing with cadaveric materials and human remains.
- Adopt ethical standards in research and teaching, especially regarding consent and human dignity.
- Promote a culture of curiosity, integrity, and lifelong learning within anatomical sciences.
- Demonstrate strong work ethics & collaborate effectively in interdisciplinary research teams and educational settings.
- Mentor MBBS and Mphil students with patience, responsibility, and inclusivity.
- Advocate for the relevance and advancement of anatomical sciences in academia and healthcare.
- Maintain professional integrity by keeping personal beliefs and prejudices separate from professional responsibilities.

CORE COURSES (ANA 800)

GROSS ANATOMY ;MUSCULOSKELETAL (ANA 801)

Course Description:

The anatomy of the musculoskeletal system is of paramount importance in research due to its fundamental role in human movement, stability, and overall health. Understanding the intricate structure of bones, muscles, joints, and connective tissues is essential for various areas of research.

Learning objectives

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

1. Understand and interpret the gross structure of various parts of the body
2. Identify the bones, joints, muscles, nerves and blood vessels of the upper limb ,Lower limb, thorax, Head & neck
3. Assess the anatomy of common incisions
4. Apply the knowledge to solve clinical problems related to osteology & muscles of the body

Course content

S. No.	Topics
1.	Osteology, Joints,Musculature and Neurovascular of Upper Limb with Clinical Anatomy
2.	Osteology, Joints, Musculature and Neurovascular of Lower Limb with Clinical Anatomy
3.	Osteology, Joints, Musculature and Neurovascular of Head & Neck with Clinical Anatomy
4.	Osteology, Joints, Musculature and Neurovascular of Thoracic Wall with Clinical Anatomy
5.	Osteology, Joints, Musculature and Neurovascular of Abdominal Wall with Clinical Anatomy

MICROSCOPIC ANATOMY/HISTOLOGY & LABORATORY TECHNIQUES (ANA 802)

Course Description:

Histology is an essential tool for understanding the function of different tissues and organs in the body. It allows researchers to study the structure and organization of tissues at a microscopic level. Histology is the cornerstone of diagnostic pathology, where it is used to identify and classify diseases based on the microscopic appearance of tissues. The goal of this course is to give the scholar a basic understanding of microscopic Anatomy and to equip them to undertake research in Histopathology.

Course Objectives

Upon completion of course the students should be able to:

1. Illustrate the microscopic structure of all the tissues and organs of the human body
2. Elaborate the functional correlation of the histological structure of clinically important tissues and organs
3. Describe the uses and applications of all types of microscopes.
4. Handle microscopes commonly used in research and histology labs

Course Contents

Part-I (GENERAL HISTOLOGY)	
S No	**Topics**
1.	Introduction to different types of microscope
2.	Cell ,its organelles and cell junctions
3.	Epithelial tissue (classification & surface modifications)
4.	Connective Tissue (Cartilages; Bone, Bone marrow and blood cells)
5.	Muscular tissue
6.	Nervous tissue
7.	Lymphoid Organs
Part-II (SPECIAL HISTOLOGY)	
1.	Digestive system including associated glands
2.	Respiratory System
3.	Urinary System
4.	Reproductive System (Male & Female)
5.	Endocrine System
6.	Circulatory System
7.	Integumentary system
8.	Organs of Special Senses

Recommended Readings:

1. Junqueira, L.C.Cameiro, J. Basic histology. California, U.S.A, Lange Medical publication: Latest Ed.
2. Kelly, D.E, Wood, R.L, Enders, A.C. Bailey's Text Book of Microscopic Anatomy. Baltimore, U.S.A, Williams and Wilkins: Latest Ed.
3. Burkit,H.G, Young, B, Heaith, J.W. Wheater's Functional histology London, Churchill living stone: Latest Ed.
4. Lesson, C, R, Lesson, T. S. Histology. Philadelphia .S.A, W. B. Saunders and Company Latest Ed.
5. Faucett, D.W.A Text Book of Histology. London, Chapman and hall: Latest Ed.
6. Williams, P.L.Bannister, L.H, Berry, M.B, Collins, P., Dysons M Ferguson, M.WJ. Gray's Anatomy .London, Churchill living stone: Latest Ed.

Journals:

1. Clinical Anatomy
2. Archives of Histology and Cytology
3. International Journal of Developmental Biology
4. Anatomia, Histologia, Embryologia

Laboratory Techniques

Basic laboratory techniques are fundamental for PhD scholars in various fields. PhD scholar is expected to conduct high level Lab experiments. These techniques provide the foundation for conducting experiments, collecting data, and advancing scientific knowledge. Basic lab techniques include knowledge of safety procedures and practices. PhD scholars must understand how to handle chemicals, biological materials, and equipment safely to protect themselves and others in the lab.

Learning Objectives:

By the end of the course, the PhD scholar should be able to

- Learn and apply basic laboratory safety rules and procedures to ensure personal and environmental safety.
- Become familiar with common laboratory equipment, such as microscopes, balances, pipettes, and microtomes, and understand their functions and proper usage.
- Develop basic laboratory skills, including pipetting, measuring volumes and masses, dilution techniques, and basic calculations.
- Learn proper techniques for handling and preparing various types of samples /sections.
- Understand the phenomenon of fixation, dehydration, clearing, embedding.
- Comprehend the knowledge of sectioning .
- Comprehend the knowledge of indications, procedures and correction of abnormal deviations of various staining methods.

Course Contents:

The course contents will include:

S. NO	Topics
1.	Composition, advantages and disadvantages of common fixative
2.	Fixation of tissue
3.	Clearing agents

4.	Paraffin Embedding process
5.	Sectioning Process ,freezing sections of fresh tissues
6.	Microtomes and knives, their types and uses
7.	Staining Procedure: uses and interpretation of Routine Haematoxylin and Eosin, Cresyl Violet for Nissl substance, Sudan Black B for Lipids, Mallory's connective tissue stain, Gomor's Aldehyde Fuchsin Stain for pancreas, Feulgen method for DNA, Periodic Acid Schiff (PAS) for glycogen, Modified Halmi's method for Pituitary gland, Some latest techniques.
8.	Mounting; Vital and supravital dyes and study of cell
9.	Microscopes; Components, phenomenon and uses of Simple and compound optical microscopes, Florescent microscope, Polarizing microscope, Dark field microscope, Electron microscope; Micrometry; Microphotography; Maintenance of microscopes.

Recommended Readings

1. Biological micro technique by Sanderson
2. Handbook of basic micro technique
3. Animal micrology
4. Micro technique by Bancroft

Journals

Botanical micro technique

DEVELOPMENTAL ANATOMY/ EMBRYOLOGY (ANA 803)

Course Description:

Research in embryology is crucial for understanding the processes that govern development, including cell differentiation, tissue formation, and organogenesis. Embryology plays a key role in stem cell research, which explores the potential of stem cells to develop into different cell types. By understanding the factors that control stem cell fate during embryonic development, researchers can better harness the therapeutic potential of stem cells. The goal of this course to give the scholar a basic understanding of human development & to equip them to undertake research in embryology.

Course Objectives:

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

1.Describe and interpret general aspects of normal human development

2.Identify critical periods of growth

3.Discuss the development of all systems of body

4.Discuss the mechanism, pathogenesis and clinical aspects of common congenital anomalies

5.Discuss the mechanism through which various environmental agents can affect these developmental processes

6. Discuss Various diagnostic procedures that can be used to assess fetal well being

7.Elaborate methods of In Vitro Fertilization and Cloning

Course Contents

The course contents will include:

S No.	Topics
	Part I (GENERAL EMBRYOLOGY)
1.	Various terms of life span, Cell cycle, cell division & chromosomal abnormalities
2.	Gametogenesis (Oogenesis & spermatogenesis)
3.	Fertilization, Implantation, ectopic Pregnancies, contraception, IVF & Cloning including religious and legal aspects
4.	Reproductive cycles
5.	Embryonic period (Organogenesis)
6.	Fetal period, Fetal membranes & Placenta
7.	Parturition & Multiple pregnancies
8.	Birth defects & prenatal diagnosis
	Part II (SPECIAL EMBRYOLOGY)
1.	Development of Musculoskeletal system
2.	Body Cavities, Mesenteries and Diaphragm
3.	Development of Cardiovascular System
4.	Development of Respiratory System
5.	Development of Digestive System
6.	Development of Urogenital System
7.	Development of Head& Neck and pharyngeal apparatus
8.	Development of Nervous System
9.	Development of Eye & Ear

Recommended Readings

1. Moore and Persuad. The Developing Human. Philadelphia, U.S.A, W.B. Saunders and company, Latest Ed.
2. Saddler T.W. Langman's Medical Embryology. Philadelphia, U.S.A, Lippincott Williams & Wilkins, Latest Ed.
3. Williams, P.L. Bannister, L.H, Berry, M.B, Collins, P, Dyson M, Ferguson, M.W.J. Gray's Anatomy. London, Churchill Living stone: Latest Ed.

Journals

1. Congenital Anomalies
2. Anatomy and Embryology
3. Mechanisms of Development
4. Anatomia, Histologia, Embryologia
5. Development, Growth and Differentiation
6. International Journal of Developmental Biology

7. Birth Defects Research Part A: Clinical and Molecular Teratology
8. Birth Defects Research Part A: Developmental and Reproductive
9. Toxicology

NEUROSCIENCES (ANA 804)

Course Description:

Neuroanatomy is a fascinating field that involves the study of the structure and function of the nervous system. Research in neuroanatomy covers a wide range of topics, from basic anatomical studies of the nervous system to more complex investigations into neurological disorders and brain function. Researchers in this field use various techniques, such as neuroimaging, histology, and molecular biology, to explore the structure and function of the nervous system at different levels of organization.

Course Objectives

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

1. Describe the gross and internal structure of various components of the nervous system including tracts and connections
2. Co-relate the anatomical knowledge of the nervous system with functions
3. Discuss the cross-sectional anatomy of various parts of the central nervous system.
4. Describe basic knowledge of common lesions and diseases related to the nervous system
5. Explain formation, circulation and importance of CSF
6. Discuss anatomical and functional aspects of autonomic nervous system
7. Discuss blood supply of different parts of brain and spinal cord
8. Describe applied anatomy of CNS
9. Explain signalling within neurons & Ion channels and membrane potentials
10. Describe neurotransmitter release, synaptic transmission & synaptic plasticity
11. Appreciate neuronal connections of different parts of CNS
12. Understand the fundamental principles of modern neuroscience techniques, including fMRI, optogenetics, and chemogenetics and their applications in studying brain function,to explore neural circuits, behavior, and neurological disorders.

Course Contents:

The course contents will include:

	TOPICS
1.	Meninges, Cisterns, Dural venous sinuses
2.	Spinal cord (Ascending & Descending tracts)
3.	Base of brain, Circles of willis, Blood supply of brain and venous drainage
4.	Medulla oblongata, Pons & Cerebellum
5.	Mid Brain Diencephalon (Thalamus, hypothalamus), Basal Ganglia
6.	Lateral ventricle ,4^{th} ventricle, 3^{rd} ventricle & Circulation of C.S.F
7.	Cerebral hemisphere(sulci, gyri, cortical areas)& White matter of cerebrum
8.	Cranial nerve nuclei & nerves
9.	Reticular formation & Limbic system

10.	Applied Anatomy
11.	Fundamental principles of modern neuroscience techniques, including fMRI,optogenetics,and chemogenetics and their applications in studying brain function

Recommended Readings

1. Carpenter. M.B. Text book of Neuroanatomy. Baltimore, U.S.A, Williams and Wilkins: Latest Ed.
2. Snell. R.S. Clinical Neuroanatomy for Medical Students. Philadelphia, U.S.A. Lippincott Williams and Wilkins: Latest Ed.
3. Williams, P.L. Bannister, LH, Berry, M.B, Collins, P. Dyson M, Ferguson, M.WJ.
4. Grays Anatomy. London, Churchill Living Stone: Latest Ed.

Journals:

1. Muscle and Nerve
2. Mechanisms of Development
3. Anatomia, Histologia, Embryologia
4. Development Growth and Differentiation
5. International Journal of Developmental Biology
6. Relevant latest articles

Viscerology/Splanchnology (ANA 805)

Course Description:

The anatomy of Splanchnology/Viscerology is critical in research due to its focus on the internal organs, their structure, function, and interactions. This field plays a crucial role in understanding various diseases, developing treatments, and advancing surgical techniques. Overall, the anatomy of Splanchnology/Viscerology is essential for research in various fields. It provides a foundation for understanding the structure and function of internal organs, which is crucial for advancing our knowledge of health and disease.

Course Objectives

Upon completion of course the students should be able to:

1. Understand and interpret the gross structure of various parts of the body
2. Identify the viscera grossly & in cross sections of the body
3. Assess the anatomy of common incisions
4. Apply the knowledge to solve clinical problems related to Anatomy

Course Contents:

The course contents will include:

S No.	Topics
1.	Viscera of special senses including Eye, Ear, Nose and Tongue

2.	Viscera of the head and neck including Eyeball, Orbit wall and its content, Eye lid and lacrimal apparatus, Extra ocular muscles, Maxillofacial contents, thyroid and parathyroid glands, larynx, trachea, pharynx, and upper esophagus
3.	Gastrointestinal system with associated viscera e.g. lower part of oesophagus, stomach, Pancreas, liver, Gall bladder and extra biliary apparatus, Spleen, Small intestine, duodenum, ileum, jejunum, large intestine, appendix, Rectum and Anal canal
4.	Renal System with associated viscera e.g. Kidney and supra renal, ureters & Urinary bladder
5.	Cardiovascular system and the heart
6.	Male reproductive system with external genitalia, urethra , Prostate, Seminal vesicles, Vas deferens, ejaculatory duct
7.	Female reproductive system with external genitalia,Uterus, Uterine supports, Ovary, vagina, Ischio rectal fossa
8.	Applied Anatomy, Radiograph & Surface marking

Recommended Readings

1. Snell. R.S. Clinical Anatomy for Medical Students. Philadelphia USA Lippincot Williams and Wilkins: Latest Ed.
2. Sinnatamby C.S.Lasts Anatomy Regional and Applied London, Churchill Living Stone Latest Ed.
3. Williams, P.L. Bannister, L.H. Berry, M.B, Collins, P., Dyson M. Ferguson, M.WJ. Gray's Anatomy London. Churchill living stone: Latest Ed.
4. Moore K.L. Clinically Oriented Anatomy. Baltimore, U.S.A. Williams and Wilkins

Journals:

1. Journal of Anatomy
2. Anatomia, Histologia, Embryologia

ADVANCES IN MOLECULAR CELL BIOLOGY (MCB 801)

Course Description:

A course in molecular biology typically covers the study of biological processes at the molecular level, focusing on the structure and function of biomolecules such as DNA, RNA, proteins, and lipids. The course usually includes topics such as:

Course contents:

1. Introduction to Molecular Biology and Central Dogma, DNA Replication,Chromatin Structure and Organization
2. DNA Damage and Repair Mechanisms
3. Transcription in Prokaryotes
4. Transcription in Eukaryotes

5. Regulation of Gene Expression in Prokaryotes
6.Regulation of Gene Expression in Eukaryotes
7.RNA Processing and Translation
8.Reverse Transcriptase
9. Epigenetics and Non-Coding RNAs
10.Gene Editing Tools (CRISPR, TALENs, etc.)
11.PCR, Cloning, and Recombinant DNA Technology
12.Molecular Basis of Diseases
13. Molecular Evolution and Phylogenetics
14. Molecular Biology of Stem Cells and Development
15. Synthetic Biology and Genetic Engineering
16. High-Throughput Data Analysis and Bioinformatics
17. Ethical Considerations in Molecular Biology Research
18. Advanced Genome Editing Techniques
19. Molecular Diagnostics and Biomarkers
20. Cancer Molecular Biology
21. Molecular Immunology
22. Molecular Pharmacology

Course Objectives

Upon completion of course the students will be able to:

1.Describe in details the cell structure and organization
2.Demonstrate the methods of DNA replication, transcription, protein synthesis and enzymology
3.Discuss the molecular genetics of like DNA recombination, gene structure, function and regulation as well as cell signaling pathways and cancer
4.Understand molecular cloning and molecular tools for studying genes and gene activity

Laboratory techniques

The course may also include laboratory work to provide hands-on experience with molecular biology techniques and experiments. It provides a basis for understanding the molecular basis of life and the applications of molecular biology in various scientific disciplines.

- PCR
- Gel electrophoresis
- Restriction fragment length polymorphism (RFLP)
- Blotting Techniques (Sothern, Western and Northern Blotting)

Recommended Readings

1. Karp, Gerald. Cell and Molecular Biology: Concepts and Experiments with Student Study Guide John

Wiley & Sons, Latest Ed.
2. David S. Latchman. Basic Molecular and Cell Biology Wiley Blackwell, Latest Ed.
3. Stephen L. Wolfe. Introduction to Cell and Molecular Biology. Wiley Blackwell, Latest Ed.
4. Lizabeth A. Allison. Fundamental Molecular Biology. Wiley Blackwell, Latest Ed.
5. Harvey Lodish et. al., Molecular Cell Biology. W.H. Freeman & Co, Latest Ed.
6. Robert Weaver, Molecular Biology, McGraw Hill, Latest Ed.

Journals:

1. Biology of the Cell
2. Nature Cell Biology
3. Cell & Tissue Research
4. Journal of Cellular Physiology
5. Journal of Cellular Biochemistry
6. Journal of Molecular Cell Biology
7. Molecular and Cellular Endocrinology
8. Cellular Physiology and Biochemistry
9. Nature Reviews Molecular Cell Biology
10. International Journal of Biochemistry and Cell Biology

COMMON COMPULSORY COURSES

1.BIOMEDICAL ETHICS (BME-801)

Course Description of Medical Ethics

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 professionalism, codes of ethics & importance of truth telling
- Discuss ethical dangers of human subject research
- Describe concepts of autonomy
- Explain justice in clinical practice, Confidentiality, legal responsibility, Adherence and compliance
- Understand ethical issues regarding handling of research animals
- Exhibit attitude towards research on human volunteers, experimental animals and ethical aspects

Course Content

S no	Topic
1.	**Introduction & history of Biomedical Ethics.** ➢ Define biomedical ethics ➢ List key historical milestones in biomedical ethics (e.g., Nuremberg Code, Tuskegee Syphilis Study, Belmont Report). ➢ Describe the ethical code of practice in research ➢ Discuss the code of Medical Ethics in Pakistan ➢ Identify the four principles of biomedical ethics (autonomy, beneficence, non-maleficence, justice). ➢ Describe the role of institutions in global bioethics governance. ➢ Give real life examples of research misconduct
2.	**Basic Pillars of Biomedical Ethics and their Islamic Perspective** ➢ Identify and explain the principle of respect for autonomy in healthcare ethics. ➢ Define the principle of non-maleficence in healthcare ethics. ➢ Define the principle of beneficence in healthcare ethics. ➢ Define the principle of justice in healthcare ethics. ➢ Appraise the historical perspective of Hippocratic Oath (5th Century BCE) ➢ Understanding the beginnings of Contemporary Bioethics to address ethical dilemmas raised by rapid advances in medical science and biotechnology.
3.	**Doctor Patient relationship, Conflict of interest & Dealing with Pharmaceutical Industry.** ➢ Define the doctor-patient relationship and its core components (trust, communication). ➢ List common types of conflicts of interest in healthcare (e.g., financial incentives, gifts from pharmaceutical companies, dual roles). ➢ Analyze a case study (e.g., physician prescribing drugs from a company they consult for) using ethical principles. ➢ Analyze a case study (e.g., a physician prescribing a costly drug after attending a pharma-sponsored conference) ➢ Assess the risks vs. benefits of participating in pharma-sponsored research (e.g., bias in trial design, access to new therapies).

4.	**Patient centeredness & rights, respect of family, Building trust in children & adolescents, Care of elderly, Euthanasia & Islamic teachings.** ➢ List the fundamental rights of patients (e.g., informed consent, confidentiality, refusal of treatment) ➢ Analyze case studies where patient autonomy conflicts with medical advice (e.g., Jehovah's Witness refusing blood transfusions). ➢ Explain the ethical tension between patient confidentiality and family involvement (e.g., disclosing a terminal diagnosis to family first). ➢ Identify common ethical challenges in geriatrics (e.g., capacity assessment, polypharmacy, elder abuse). ➢ Distinguish euthanasia, assisted suicide, and palliative sedation from an Islamic bioethics' lens. ➢ Quote Quranic verses/Hadith on sanctity of life and suffering (e.g., Prophetic prayers for healing).
5.	**Ethics of teaching on patients. Medical Error, Negligence & Pharmacovigilance, Research & publication ethics.** ➢ Define medical error**,** negligence**,** and malpractice and distinguish between them with examples. ➢ Analyze a case study (e.g., wrong-site surgery, medication overdose) to determine if negligence occurred. ➢ Evaluate institutional policies for error reporting ➢ Evaluate the role of pharmacovigilance in preventing harm (e.g., reporting adverse drug reactions to national systems). ➢ Discuss the questionable publishing practices (e.g., ghost authorship, data manipulation). ➢ Identify key stakeholders in research ethics (Institutional Review Boards, journals, funding agencies) and their roles. ➢ Apply ICMJE (International Committee of Medical Journal Editors) criteria for authorship to real-world scenarios.
6.	**Ethic of social media and advertisement, Ethics of communicable diseases & Public Health, Ethics of mentally ill patients** ➢ Define professional boundaries in healthcare social media use (e.g., patient privacy, dual relationships) ➢ Analyze the cases (e.g., HIV disclosure laws) for justice and stigma considerations ➢ Discuss the approaches for diverse belief systems about illness ➢ List ethical principles specific to psychiatry (e.g., least restrictive alternative, beneficence vs. autonomy)

7	**Ethical & legal aspects of Organs Donation & Transplant, & their Islamic perspectives.** ➢ Define Organ donation and its importance ➢ Define key terms **(** Brain death vs. cardiac death, Living vs. cadaveric donation) ➢ Discuss the ethical issues involved in living organ donation ➢ Describe Xenotransplantation and organ printing ➢ Compare global legal models **(**Opt-in (USA) vs. opt-out (Spain) systems, Sharia-compliant legislation (e.g., Saudi Arabia's 1982 transplant law)
8	**Ethics of Reproduction: Contraception, Abortion, Assisted Reproductive Techniques (ARTs) & their Islamic perspectives.** ➢ Define key terms (Contraception, Abortion, IVF, surrogacy, sperm/egg donation) ➢ Interpret Islamic rulings on**:** • Contraception: Permissibility of temporary methods (e.g., IUDs) vs. permanent sterilization • Abortion: Conditions for allowance (e.g., risk to mother's life, fetal anomalies) • IVF: Requirements for halal practice (e.g., marital union, no donor mixing)

Recommended Readings

- Beauchamp, J. (2013). "Principles of Biomedical Ethics".
- Principles of Biomedical Ethics.
- 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

2. BIO STATISTICS & RESEARCH METHODOLOGY (BSR-801)

Course Objectives of Biostatistics

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

1. efine epidemiology and know the principles of various study designs
2. Know how to design a study and describe the validity and reliability of a study design
3. Know the fundamental concepts and methods of statistics in the areas of medical and biological research
4. Have good command on use of statistical computer software for data analysis
5. Approaches for data analysis, Parametric, non-parametric and Semi-parametric methods, Qualitative Methodologies and Interpretation of results, validity of conclusions.

6. Identify and prioritize research problems with literature review.
7. Formulation of research objectives
8. Learn Data collection techniques and sampling, planning for data collection, collation and analysis.
9. Planning for pilot study followed by main study along with Budget making and plan for dissemination.
10. Identify and define the basic concepts and procedures required for data analysis and interpretation.
11. Analyze and interpret the data collected for the research project and draw conclusions related to the objectives of your study.
12. 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.
13. Present the major findings and the recommendations of your study to policy-makers managers and to the subjects of your research together with them to finalize the recommendations.
14. Prepare a plan of action for the dissemination, communication and utilization of the findings and (if required) make recommendations for additional research.

Course Contents:

S No.	Topics
1.	Descriptive epidemiology, analytic epidemiology and epidemiological inference
2.	Classification, morbidity and mortality rates, ratios, incidence, prevalence, sampling, screening, epidemiological models
3.	Types of study design; their importance, uses, and limitations, field trials, controlled epidemiological surveys, sources of bias and causal model
4.	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
5.	Tests of significance; normal test, t test, Chi square test etc, correlation and its applications, linear regression and multiple regression, Clinical trials and intervention studies
6.	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

Journals:

1. Cancer Epidemiology
2. Epidemiologic Reviews
3. Annals of Epidemiology
4. American Journal of Epidemiology
5. International Journal of Epidemiology

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, students would be well placed to conduct disciplined research under supervision in an area of their choosing.

Course Objectives:

The primary objective of this course is to develop a research orientation among the scholars and to acquaint them with fundamentals of research methods. Specifically, the course aims at introducing 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

1. To develop the basic framework of research process
2. To develop an understanding of various research designs and techniques
3. Identify various sources of information for literature review and data collection
4. Elaborate ethical dimensions of conducting applied research

Course Content

S No	TOPIC
1.	Introduction to research – The role of research, research process overview
2.	Problems and Hypotheses – Defining the research problem, Formulation of the research hypotheses, The importance of problems and hypotheses
3.	Research design – Experimental and Non experimental research design, Field research, and Survey research
4.	Methods of data collection – Secondary data collection methods, qualitative methods of data collection, and Survey methods of data collection
5.	Attitude measurement and scaling – Types of measurement scales; Questionnaire designing – Reliability and Validity
6.	Sampling techniques – The nature of sampling, Probability sampling design, Non-probability sampling design, Determination of sample size
7.	Processing and analysis of data & knowing Ethical issues in conducting research
8.	Report generation, report writing – Title page, Abstract, Introduction, Methodology, Results, Discussion, References, and Appendices

MEDICAL WRITING & MEDICAL EDUCATION (MWE-801)

Course Objectives of Medical Writing

Upon completion of course the students should be able to:

1. Present and communicate research articles/research data in conferences and symposia
2. Critically analyze data, design a project and write up research proposals
3. Design experiments in the field of biological sciences

Course Contents:

The course contents include: strategies and methods of communication of scientific work, barriers of communication and how to improve communication skills. Literature survey, data collection, types of biomedical research, manuscripts and poster writing, research proposal, synopsis and thesis writing.

Recommended Readings:

1. Arifullah, Shahnaz and Bhatti K.M Research process simplified, Peshawar. Latest Ed.
2. W.H.O. Training manual on health research methodology Latest Ed.
3. The Psychology of Interpersonal Behaviour (Penguin Psychology) by Michael Argyle
4. Skilled Interpersonal Communication: Research, Theory & Practice, 5th Ed. by Owen Hargie
5. The Interpersonal Communication Book by Joseph A. DeVito
6. The Complete Guide to Medical Writing by Mark Stuart and Mark Stuart
7. A-Z of Medical Writing by Tim Albert
8. Medical Writing: A Guide for Clinicians, Educators and Researchers by Robert B. Taylor

Medical Education

Course Goal:

The course is endeavours 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 :

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:

F	**F**eedback to the learner as to progress
A	**A**ctive rather than passive learning
I	**I**nterest or motivation of the learner
R	**R**elevance 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.

Course Content

The essential Core area 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

5) Program evaluation

Learning Resources:

- A practical Guide for Medical Teacher by John A. Dent & Ronald M. Harden. (4th 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.

4. COMPUTER SKILLS & BIOINFORMATICS (CSB-801)

Computer Skills

Course objectives:

Upon completion of course the students will be able to:

1. Develop basic skills in operating computer in the mentioned softwares.
2. 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:

- Programme 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:

1. Journal of Bioinformatics and Computational Biology (JBCB)
2. BMC Bioinformatics

Bioinformatics

Course Description

- This course introduces fundamental concepts and methods for bioinformatics and the advanced applications. Topics covered include
- Bioinformatics database
- Sequence and Structure alignments
- Protein folding and Protein structure prediction

Learning Objectives

- Learn about bioinformatics and gain understanding of lab and research techniques using molecular biology methods.
- Understand the error, limitations, and costs/sample for each technology.
- Understand methods for producing and using SNP arrays , Compare and contrast exome sequencing to whole genome and SNP sequencing, including their limitations
- Gain familiarity with computational methods in order to address problems in molecular biology.
- Become knowledgeable about the storage, retrieval, sharing and use of biological data, information, and tools

Course Contents:

- Gene ontology and gene annotations
- Databases of human genes
- Gene Expression Patterns
- Profiling of micro RNA mRNA Proteins and disease genes by various Browsers
- Statistical correlations between Entities in a Database,
- Utilization and exploitation of NCBI, UCSC, ENSEMBL and BioGPS genomic browsers in Genomics and Proteomics research.

Recommended Readings:

- Evolutionary Computation in Bioinformatics Fogel, G.B. and Corne, D.W.
- Pierre Baldi and Soren Brunak, Bioinformatics: The Machine Learning Approach.
- Introduction to Bioinformatics. (A Theoretical and Practical Approach). A. Krawetz and D. Womble. 2002.
- Introduction to Bioinformatics. Lesk, A.M. 2002 Oxford University Press. A collection of relevant review and research articles will also be distributed in class as required reading

Mandatory Workshops/Courses /Rotations

1. Journal Club

Course Objectives:

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

1. ollect information from the available resources
2. Prepare a presentation on a given topic
3. To read and critique published research articles
4. Present research findings on a forum
5. Write literature review with proper internet search and references
6. Work as a Reviewer

Course Contents:

- The student will attend regular Journal Club Meetings and actively participate with presentations , lectures, discussions, and question-answer sessions;
- The student will prepare all the necessary back ground information, meaning of scientific terminology, methodology used, statistical tests applied and discussion.
- He/she will also discuss limitations of the study.
- The audience including faculty and students will ask questions

Resources:

1. Internet
2. Libraries
3. Peer Advice

2. Biosafety & Biosecurity

Course Objectives:

Upon completion of the course the students will be able to

1.Know the bio-risk associated with working in research lab
2.Apply principles of biosafety and biosecurity in facilities
3.Reduce/eliminate the risk of infection in laboratory setting
4.Understand the national and international standards of lab safety
5.Comprehend bio-security of the hazardous material used in research

6. Empower students with the skills, tools, and confidence on sustainable bio-risk management.

Course Contents:

a. Biorisk assessment ie Hazards & threat identification & analysis
b. Biosafety Levels (BSL-1,BSL-2,BSL-3,BSL-4)
c. Lab equipment calibration & validation
d. PPE
e. Biosecurity

3. Copyrights, Trademarks & Patents

Course Objectives:

Upon completion of the course the students will be able to

- Understand the fundamentals of Intellectual Property (IP), including the scope, purpose, and importance of copyrights, trademarks, and patents.
- Differentiate between copyrights, trademarks, and patents, with respect to subject matter, duration of protection, registration process, and legal rights.
- Identify protectable intellectual creations, including literary, scientific and technological works.
- Explain national and international IP frameworks, such as WIPO, TRIPS, and relevant national laws governing IP protection.
- Apply copyright, trademark, and patent laws in academic & research environments.
- Recognize IP infringement and plagiarism, and understand legal remedies and enforcement mechanisms.
- Understand the process of registration and commercialization of copyrights, trademarks and patents.
- Promote ethical use of intellectual property in teaching, research and innovation
- Develop awareness of IP management strategies for researchers and institutions.
- Encourage innovation and protection of original work through effective use of intellectual property rights.

4. Research Rotations

Rotations provide an excellent opportunity for students to experience a variety of labs and find the one that best fits their interests for pursuing thesis research. Rotations also offer a source of experiential training in different experimental models, approaches, and technologies. It is required for our PhD students to rotate in at least three laboratories throughout the course of the first year.

Objectives

Upon completion of the research rotations, the PhD scholar will be able to:

- Develop a comprehensive understanding of diverse research methodologies and laboratory techniques relevant to their field of study.
- Critically evaluate ongoing research projects and identify strengths, limitations, and potential for innovation.
- Gain hands-on experience with data collection, analysis, and interpretation across different research environments.
- Enhance interdisciplinary collaboration skills by engaging with different research teams and scientific cultures.
- Formulate scientific questions and hypotheses based on real-world research exposure.
- Improve scientific communication skills through regular presentations and reporting of rotation findings.
- Understand research ethics, safety protocols, and quality assurance practices in various research settings.

SECTION V
METHODS OF EVALUATION

5.1 Program Output Evaluation

Program output is evaluated through:

- **Formative Assessments** (through regular feedback)
- **Summative Assessment** (through Examination)

5.2 Assessment Procedure

- Assignments/tests/logbook/portfolio

  (The performance of every student shall be continuously monitored and assessed throughout the semester. During the semester a student's performance shall be evaluated by taking quizzes, assignments, mid-Term examination, laboratory reports, project presentations etc and will be maintained as "LOG BOOK")
- There will be Continuous Internal Assessments of each candidate during the training period. These Continuous Internal Assessments will include Assessments/Quiz/assigned tasks and supervisor's Review Report.
- There shall be two examinations for each course during each semester. These examinations shall be termed as mid term and end term examination. In addition to these examinations, the instructor may give home assignments, demonstrations and class presentations.

5.3 Mid-term and End-term Assessment

- Mid-term and End-term exams shall also be taken during each semester covering the entire syllabus including theory and practical. The course teacher shall be responsible for the evaluation of work/performance of the students of his class and for the award of grades to them based on such evaluation.

- Mid-term examination will primarily comprise of theory component of MCQs, SEQs and Essay Questions. Viva voce can also be a component.
- End-term examination will have a theory component comprising of MCQs, SEQs and Essay Questions and practical examination. Viva voce will also be a component.

Evaluation Components /Assessment Type for Semester Course work

a. Theory Course

i) Quizzes/Assignments/Projects/ Presentations:

There shall be an appropriate number of quizzes/ assignments/ course project/ presentations etc. as maintained on logbook dually marked by teacher/instructor.

ii) Mid term Examination

There shall be one mid Semester examination of 02 hours duration for each theory course in a semester after 8th week of teaching.

iii) End term Examination

There shall be separate End-term examination for every subject. The duration of this exam will be 03 hours covering the entire course at the end of each semester. The examination shall be held in the last 03 weeks of each regular semester.

b. Viva & practical examination

The end term viva & practical examination will also be conducted jointly by the course teacher (i.e. Internal examiner) and external/neutral Examiner as notified by the relevant Chairman.

c. Combined Theory & Lab Weightage of Evaluation Components /Assessments

The final grades shall depend on the marks obtained in each of the evaluation components listed above. The weightage given to each component is as follows:

Quizzes/Assignments/ Lab Projects/ Lab Report/Presentations etc.	25%
Mid Term Examination	25%
End Term Examination + Practical+ Viva Voce etc.	50%

Re-mid Examination

A student who fails to take his Mid Semester examination due to some unavoidable reasons shall apply in writing to the Chairman/VC for retaking mid term examination before the end term examination. In case a student is allowed to retake mid term examination, the examination will be conducted by the concerned course teacher before the end term examination on the payment of prescribed fee by the student.

5.4 Pass Marks

The minimum pass marks for each course shall be 60% and CGPA ≥ 3.0/4.0 in Semester.

- Passing Comprehensive Exam (60% pass marks)

5.5 Failure/Improvement in a Course

a) A student obtaining less than 60% in any course shall be deemed to have failed in that course and will be awarded "F" grade.

b) If a student fails to appear in the final theory examination of a course he/she shall be treated as absent and declared to have failed in that course with "F" grade.

d)The candidate can improve the course already passed with grade "C" or below.

e) A student obtaining "F" grade in core course has to re- register for the course on the advice of Chairman/VC to pass it.

5.6 Dismissal from Program

If a student obtains "F" (Failing) grade in more than one courses at the end of first year of enrolment, he will be dropped from the degree program.

5.7 Comprehensive Examination

The Comprehensive Exam assesses the student's competency in the anatomical sub-disciplines and determines if the student is prepared to begin thesis research.

a) Comprehensive Exam must be conducted at the end of one year of enrolment (Annex 3.7 of HEC policy *)

b) To be eligible to appear in comprehensive examination, student must have passed 18 credit hours course work with a CGPA of minimum 3.0 out of 4.0 with evidence.

c) Paper of the comprehensive examination will be set by the Director of post graduate program, in consultation with the course teachers. One External Faculty member expert in the field of study can also be a paper setter who can be from another department or from another university.

A certificate of satisfactory completion of the program by the Supervisor shall be mandatory for the eligibility to sit for course examinations. (Annex part 8 -2a of PMDC policy **)

d)Comprehensive examination will comprise of: Two theory papers of 100 marks each

i. Paper A: Major and Minor specific subjects (10 Essay Questions 10 marks each)

ii.Paper B: Major and minor specific subjects (10 Short Essay Questions of 05 marks each and 50 MCQs 01 mark each)

iii.The weightage of courses in the theory paper will be as per credit hours

e) Viva Voce Exam of 100 marks: Major and minor specific subjects. The viva voce exam will comprise of all the courses of major and minor specific subjects studied during the course work. Emphasis will be given to research aptitude of the scholar.

f) The viva will be conducted by the department through a panel of examiners with at least one

examiner from one of the other relevant departments of the University or another University as approved by the Vice Chancellor RMU.

g) Passing marks for PhD Comprehensive examination will be 60%.

h) PhD Candidates will only be allowed a maximum of two chances to clear the comprehensive examination within two years of enrolment in the PhD program as per HEC policy.

i)In case of not qualifying the comprehensive examination in two (02) attempts student will no longer retain the status of "PhD candidate" of the university.

j) The comprehensive examination mentioned for the scholar will be prepared and conducted by PhD Research Monitoring Committee & ARSC .

5.8 Preparation and Approval of Synopsis by BASAR

a) In consultation with the supervisor/co-supervisor, the candidate will finalize research topic during first semester of the doctoral studies and positively will get it approved from his Academic and Research Supervisory Committee (ARSC)

b) As per approved research topic, the candidate will prepare the synopsis as per format of the university, in consultation with the supervisor/co-supervisor, during second semester of the doctoral studies and positively will get it approved from his Academic and Research Supervisory Committee (ARSC), Ethical Review Board (ERB)and Board of Advanced Study and Research of the university (BASAR).

c) After the completion and passing of course work with CGPA of ≥3.0/4.0 and of scholar, and passing the Comprehensive Examination with 60% marks, the student can start the research work.

5.9 Review Article Submission: PhD Scholars of Anatomy program at RMU must write a review article on his/her topic of interest. It provides foundation of knowledge on topic. Review writing helps in Identification of areas of prior importance, gaps in research, conflicts in previous studies, open questions left from other researchers. Also,it will identify need for additional research.

5.10 Registration

To be registered as a "PhD Scholar" with the RMU, candidates must submit following documents to the Dean:

i. Completion of 18 Credit Hour Coursework
ii. Passing the Comprehensive Examination
iii. Approval of Synopsis by ERB & BASAR of the University

5.11 Suspension of Registration:

Where a PhD Scholar is unable to continue with their research program because of severe issues like health, family problems and financial reasons, BASAR may suspend their registration for a specified period of maximum up to 1 year. (PMDC policy 2023) **

5.12 Migration or transfer of postgraduate trainee:

Migration or transfer of students undergoing PhD shall not be permitted by any university or any authority without prior permission of HEC & PMDC. (PMDC**/HEC policy *2023)

5.13 Transfer of credit hours:

- PG can be facilitated for transferring the credit hours on special grounds However, PMDC guidelines are mandatory for all the DAI to follow at the time of transfer.
- No credit hour of a course will be transferred if the grade is less than C. Credit hours may only be transferred between recognized DAI nationally or internationally (PMDC policy 2023) **

SESSION VI

EVALUATION & MONITORING OF THE TRAINING PROGRAM

6.1 Progress Report

a) There will be a bi-annual review of research progress of the PhD Scholar by the Supervisor

b) At the end of every six months after confirmed registration, PhD scholar would submit a summary of the progress of the research work through the Supervisor to dean.

c) In case of more than two unsatisfactory reports forwarded to the PhD Committee, the scholar will be notified in writing and given reasonable opportunity to respond to the PhD Committee. In Case PhD Scholar fails to satisfy the committee, the committee shall recommend removal of his/her name from university register.

d) There will be a time of 15 days given to the scholar to appeal to the BASAR through the Vice Chancellor against the decision and final decision of the BASAR will be implemented.

6.2 Evaluation methodologies

- 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 behaviour 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 Supervisor's office to discuss areas where improvement is required.
- He/she will be encouraged to convert weaknesses into strengths by addressing his/her problems.

Students will be evaluated based on:

- Attendance record (more than seventy-five percent for each year of study)
- Performance of the scheduled / desired activity
- Participation in discussion (tutorial and seminar etc)
- Efficiency and effort put in the assignment (lectures, demonstration, Computer training, etc)
- Quiz
- Practical work
- Presentation and Computing skills

6.3 Standard of Passing the course work

- Cleared the semester exams
- Cleared the comprehensive exam

6.4 Criteria for Award of PhD Degree

- PhD level course work of at least 18 credit hours followed by course exam and a comprehensive examination, completion of research work along with thesis defense will be essential for the award of PhD degree
- The thesis must be examined by two foreigner examiners from technologically/academically advanced countries (see 7.5 for details)
- Date of defense of the dissertation should be notified
- At least one Published research paper in an HEC approved W category or 2 in X category journal is essential for the award of PhD degree

6.5 Evaluation & Monitoring of the Training Program

The proposed / suggested evaluation of the training program will be done by:

a. The students
b. The faculty members (Program team Members)
c. The Supervisor
d. Self Assessment with External and Internal Evaluators (SAR)

This will be carried out by filling the HEC Program Evaluation Proforma by the concerned member followed by analysis and reporting.

SESSION VII

THESIS

7.1 Thesis Supervision

a) Supervisor should be the full-time faculty members of the university and must be from the specialty that the student is enrolled in (Annex 4.4 of HEC policy *)

b) Eligibility of the Supervisor/co-supervisor will be in line with the HEC/PM&DC guidelines.

c) Dean may also appoint a co-supervisor from any other related department/Institution to provide the link if the research is of an interdisciplinary nature or if the research is being undertaken in collaboration with another organization.

7.2 Modification /Change of Research Topic

a) A candidate may modify/change the topic of his/her research with the approval of the BASAR by submitting an application, duly supported by the Supervisor,Dean and recommended by the PhD committee.

b) The students can perform research/experiments at other HEC recognized universities/ multidisciplinary laboratories, subject to approval by the student supervisor, Dean & VC RMU.

7.3 Freezing of Registration/Discontinuation of PhD Research

HEC/PM&DC rules will be followed for termination or freezing of PhD program:

a) Where a PhD Scholar is unable to continue with their research program because of severe issues like health, family problems and financial reasons, BASAR may suspend their registration for a specified period of maximum up to 1 year.

b) The Scholar must be able to satisfy the BASAR of the University that any period of freezing will not adversely affect the viability of the candidate's research after consultation with the Supervisory Committee and Dean.

c) Any period of freezing will be excluded from the calculation of the final submission date.

d) While registration is suspended, a scholar is exempted from fees, and is not entitled to any tuition or supervision, or to the use of any other research resources of the University.

7.4 Thesis Submission

a. The supervisory committee advises the student throughout the conduct and completion of the doctoral research project, including the writing and defence of a Dissertation.

b. Thesis submission should be done within three to eight years of enrolment in the program.

c) Submitted thesis must accompany the plagiarism report along with all other documents prescribed by the examination department of RMU

d) At the time of thesis submission, the supervisor would submit a list of the suitable local & foreign examiners that have relevant subject expertise through the Dean to Controller of examination for approval.

7.5 Evaluation Of Thesis

a) The thesis will be presented by the student in Thesis Review Committee (TRC) to be notified by the Dean of Faculty/Director BASAR.

b) After satisfactory report of the TRC, the scholar shall submit seven copies of his/her thesis written on a prescribed format to the Dean's office through Supervisor and Chairman of the Department.

c) External Evaluation is one of the main elements for PhD research work as per HEC policy to get confidence of research work. The PhD thesis must be evaluated by:

At least two external experts who shall be:

i. PhD faculty member from the world top 500 universities ranked by the Times Higher Education or QS World Ranking in the year corresponding to dissertation evaluation year OR

ii. Pakistan-based Distinguished PhD Professors from any national university

d) Each examiner will be provided with an electronic copy of the thesis and, acting independently, is required to provide the controller of examinations within two months of receipt of the thesis, with a written report on the quality of the thesis. If there is no response from examiner in two months after two reminders, the examiner will be replaced.

e) The examiners can suggest either of the following option:

- To award the degree, subject to satisfactory performance at the oral examination.
- To award the degree after specified "minor corrections" have been made to the thesis, to the satisfaction of the oral examiner, by a specified date, and subject to satisfactory performance at the oral examination.
- To permit the candidate to revise the thesis to incorporate the major changes suggested and resubmit it for examination.

f) In case of recommendations of minor or major corrections, the scholar would be asked to submit the correction within a specific period for further evaluation.

g) The evaluation reports of the examiners would be considered in the BASAR.

h) The scholar would be allowed to proceed to the oral examination if the evaluation reports approve

her/his thesis.

A copy of PhD Dissertation (both hard and soft) must be submitted to HEC for placing/including in PhD Country Directory and for attestation of the PhD degree by the HEC in future.

7.6 Policy for PhD Thesis Writing

The thesis submitted by a PhD 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 shall 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.

e) If a student who is re-admitted to PhD program and had previously spent the minimum period of three years as a PhD student, he/she may be allowed to submit the thesis after one year from the date of his/her readmission.

7.7 Guidelines for Thesis Format

All thesis presented in typescript for the degree of PhD should comply with the following specifications unless permission to do otherwise is obtained from the relevant authority / body.

- Size of Paper: A4 size be used, no restriction is placed on drawings and maps.
- Paper Specification: Six copies on good quality paper (minimum 80g) be submitted.
- Method of Production: The text must be typewritten in acceptable type face and the original typescript (or copy of equal quality) must normally be submitted as the first copy. The second and subsequent copies may be produced by means of other acceptable copying methods.
- Layout of Script: Typescript should appear on one side only,with lines at least one and a half spaced. Footnotes, quotations, references and photographic captions may be single spaced. Where appropriate, these should contain lists giving the locations of figures and illustrations.
- Font Size: Title Page Headings/subheadings, Text, Footnotes, Footnotes be given on the same page where reference is quoted
- Type Style: Times New Roman / Arial / Courier New
- Margins: At least 1⁄4 -1⁄2 inches (3.17-3.81cm) on the left-hand side, 3/4 - 1 inch (2 - 2.54cm) at the top and bottom of the page, and about 1⁄2 - 0.75 inches (1.27 - 1.90cm) at the outer edge.

The best position for the page number is at top-centre or top right 1⁄2 inch (1.27 cm) below the edge. Pages containing figures and illustrations should be suitably paginated.

- The thesis shall be hard bound with maroon cloth cover and golden lettering on the front and the spine.
- Spine of the thesis should show "PhD thesis" on top across the width of spine, name of the candidate in the middle along the length of spine, and the year of submission across the width at the bottom. Lettering on spine should be in 18 pt. and may be in boldface.

The Preferable layout of the Thesis

- o Title page
- o Abstract / Summary
- o Acknowledgements
- o Abbreviations
- o Contents
  - List of Tables (where applicable)
  - List of Figures (where applicable)
  - Introduction (including literature review)
  - Material and Methods
  - Results may be comprised of one chapter or several chapters depending upon the subject matter/ requirements
  - Discussion (including Conclusion(s)
  - Limitations of the study
  - Recommendation(s)
  - References / Bibliography / Literature Cited
  - Appendices (where applicable)
  - Any other information specific to the respective discipline

- **Title Page**. All thesis must contain a title page giving the title of the thesis, the author's name, the name of the degree for which it is presented, the department in which the author has worked or the faculty to which the work is being presented, and the month and year of submission.
- **Length of Thesis**. Whilst the regulations do not contain a clause relating to the maximum length of theses, the work presented for the degree of PhD should normally be between 40,000 - 120,000 words of text. Candidates wishing to greatly exceed these sizes should discuss the

matter with their supervisors.

- **Published Work**. Published/accepted for publication work from the thesis be included as appendix

7.8 Thesis Defense

a) There shall be a standing list of external examiners for the department 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 PhD degree.

b) There shall also be a standing list of local examiners for department consisting of eminent persons engaged in research in the field of Anatomy. The list shall be suggested from time to time by the board of studies of faculty concerned and approved by the research board. The local examiners will be requested to conduct the final viva-voce examinations of thesis.

c) 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:

- 03 for external
- 01 for examination section
- 01 for department office
- 01 for the supervisor

After corrections have been incorporated in accordance with the comments of external examiners; two copies of thesis in loose binding, to be sent to viva-voce examiners. After the viva-voce examination; four copies of the final hardbound thesis be submitted

d) The supervisor shall suggest a panel of at least six external examiners from the approved list.

e) The vice-chancellor shall appoint three external examiners from the suggested panel to evaluate the thesis.

f) The reports of the examiners shall be placed before the research board for consideration.

g) If the thesis is judged as adequate by two of the three examiners, the research board shall allow the candidate to appear in the viva-voce (thesis defense) examination.

h) If two of the three examiners find that the thesis is wholly inadequate it may be rejected by the research board.

i) 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.

j) The revised version of the thesis shall be approved by the same examiner who suggested modification/revision of the thesis.

k) If any of the examiners finds the thesis adequate but suggests minor modifications/revision, this may be incorporated without referring again to the examiner.

l) 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.

m)The viva-voce examination shall be open to the public, but the evaluation will be done only by the panel of examiners.

n) 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.

o) A candidate who successfully completes all the requirements shall be awarded, with the approval of the research board and the syndicate, the degree of Ph.D under the seal of the university.

p) The vice-chancellor may approve the recommendations of the research board on behalf of the syndicate regarding the award of Ph.D degree to the candidate. Reports of the examiners shall be placed before the research board for consideration.

Public Defense & Oral Examination

An open defense of Dissertation after positive evaluation of Dissertation is essential part of PhD Program.

a) The Controller of Examinations will arrange thesis examination.

b) Before the Oral examination, thesis will be presented by the scholar for public defense.

c) Public defense will be open for the entire faculty and student participation will be compulsory.

d) The examination must be attended by the candidate, the oral examiners, and the Dean or his nominee. The main supervisor or co-supervisor will also be present.

e) The examiners will be provided the evaluation report of the thesis by foreign and local examiners.

f) On completion of the oral examination, the Dean will provide a written report endorsed by the examiners. The report can include following recommendations:

a. To award the degree, subject to satisfactory performance at the oral examination.

b. To award the degree after specified “minor corrections” have been made to the thesis, to the satisfaction of the oral examiner, by a specified date, and subject to satisfactory performance at the oral examination.

c. To permit the candidate to revise the thesis to incorporate the major changes suggested and resubmit it for examination.

d. An open defense of the dissertation will be conducted after positive evaluation of the dissertation by the committee members.

e. After considering all the reports of the examiners, the Dean will make the final decision as to the award of the PhD degree.

SECTION-VIII

PhD Program Regulations

8.1 Teachers to Students Ratio:

The number of students per supervisor should 4-5 PhD students in basic sciences of any post graduate program at any given time (PMDC**/HEC policy 2023*).

8.2 RMU PhD Publication Policy:

For award of PhD degree, a PhD researcher shall be required to publish research articles meeting the following criteria: At least:

i. One research article in W category journal or two research articles in X category journals (HEC policy 2023) *
ii. The PhD researcher shall be the first author of these publications. That will be followed by supervisor, cosupervisor and any other contributor.
iii. The research article shall be relevant to the PhD research work of the PhD researcher.
iv. The article shall be published after approval of the research synopsis.
v. The article shall be published in a relevant research journal.

8.3 HEC Requirements at completion of Degree:

The following documents will be submitted to the HEC following the completion of studies:

a) A duly filled completion form will be sent to the HEC from the Office of the Controller of Examinations of the university notifying the HEC that the PhD scholar has completed all the requirements for the award of the PhD degree.

b) A Copy of PhD Dissertation for inclusion in PhD Country Directory and for attestation of the PhD degree by the HEC.

c) A duly filled Performa for the PhD Country Directory signed by the Principal Supervisor, Controller of Examination and the Vice Chancellor.

8.4 PMDC Requirements at completion of Degree:

All PG students after completing their PhD Anatomy degree shall be registered by the Council (PMDC policy 2023) **

8.5 Support and counselling of trainees:

The University in collaboration with the profession, will ensure that a system for support, counselling and career guidance of trainees. Counselling shall be provided based on monitoring the progress in training and program. (PMDC policy 2023)**

8.6 Leave Rules for scholars

Casual leave not exceeding 24 days per year shall be admissible. More than 10 days leave at one time shall not be allowed. Leave on medical grounds shall be admissible on production of medical certificate by the Medical Officer as per Punjab Medical Attendance Rules. However, if medical leave is continued and exceeds one month eg during pregnancy or lactation, the scholar is allowed to freeze that semester.

SECTION-IX
PROGRAM RESOURCES

9.1 Anatomy Department

Department of anatomy participates in the following degree programs and caters to over 900 students.

- MBBS
- MPhil in Anatomy
- B.Sc and Allied Health Sciences
- Optometry
- Orthotics
- Doctor of physiotherapy(DPT)
- Medical Imaging Technology(MIT)
- Medical Laboratory Technology(MLT)
- Diploma in Cardiology

9.2 Teaching Activities

The department conducts lectures, tutorials, problem-based learning sessions and small group discussions. In addition, Histology practical sessions and cadaver dissection sessions are also conducted

9.3 Faculty:

Department of Anatomy is enriched with full-time dedicated, qualified and experienced faculty for teaching

RAWALPINDI MEDICAL UNIVERSITY

ANATOMY DEPARTMENT

Name of faculty member	Qualification	Designation
Dr. Saima Naz	MBBS, PhD (Anatomy) ,CHPE	Professor (PhD Supervisor)
Dr. Ayesha Yousaf	MBBS, M-Phil (Anatomy), CHPE	Professor (HOD)
Dr. Ifra Saeed	MBBS, M-Phil (Anatomy), CHPE	Professor (DME)
Dr. Mothashim Hina	MBBS, M-Phil (Anatomy), CHPE	Associate Professor
Arsalan Manzoor Mughal	MBBS , M-Phil (Anatomy),MHPE	Associate Professor
Dr. Maria Tasleem	MBBS , M-Phil (Anatomy) ,CHPE	Assistant Professor
Dr. Sumyyia Bashir	MBBS , FCPS (Anatomy) ,CHPE	Assistant Professor
Dr. Sadia Aman	MBBS, M-Phil (Anatomy), CHPE	Assistant Professor
Dr. Sara Bano	MBBS, M-Phil (Anatomy), CHPE	Assistant Professor
Dr. Tayyaba Qureshi	MBBS, M-Phil (Anatomy) ,CHPE	Assistant Professor
Dr. Minahil Haq	MBBS, M-Phil (Anatomy) ,CHPE	Demonstrator
Dr. Sadia Baqir	MBBS	APWMO
Dr. Tariq Furqan	MBBS	Senior Demonstrator
Dr. Sajjad Hussain	MBBS	Senior Demonstrator
Dr. Zeneara Saqib	MBBS	Senior Demonstrator
Dr. Ali Raza	MBBS	Demonstrator
Dr. Kashif Ashraf	MBBS	Demonstrator

9.4 Infrastructure:

The facilities present in Anatomy Department at RMU Campus include

- Chairperson's Room (HOD)01
- Professor's Room 02
- Associate Professor 's Room 02
- Assistant Professor's Room 02
- Female Staff Room 01
- Male Staff Room 01
- Conference Room 01
- Seminar Room 01
- Support Staff Room 01
- Departmental library
- Air-Conditioned Lecture halls with Audio Visual facilities.
- One cadaver dissection hall and body preservation area.
- Histology Laboratory - fully equipped with over 50 microscopes with modern teaching facilities e.g. multimedia and microscope projection on LCD.
- Museum/Model Room – comprising a collection of anatomy models and carefully selected x-ray, CT and MRI films, 3 D projections on LCD which are available for student learning activities.
- Embalming services are also available in the department.
- Right now, Pathology laboratories (multi-disciplinary) in the attached teaching hospitals have basic as well as advanced facilities for the research work for PGs of RMU. Some of the advanced facilities available in our teaching hospital laboratories include:
- PCR Laboratory: Our under constructed postgraduate multipurpose University Post-graduate Research Complex includes laboratories for Anatomy, Physiology, Pharmacology, Forensic Medicine, Hematology, Chemical Pathology, Microbiology, Molecular Biology, Histopathology and skill laboratories. It's PC1 has been submitted to Higher Education Commission of Pakistan.

9.5 Equipment Available In Department

S No.	Item	Quantity
1.	Mortuary cooler	05
2.	Microphone	02
3.	Microphone neck	07
4.	Magazine round	01
5.	Microtome rotary	01
6.	Multimedia	03
7.	Overhead trolley	01
8.	Centrifuge	01
9.	Dissection Kocher	02

10.	Drum tab	01
11.	Split AC	01
12.	Water filter	01
13.	Animal weighing machine	01
14.	Projector lamp	10
15.	C.C.T.V camera	01
16.	Presenter	02
17.	Disposable knife holder	01
18.	BP apparatus	02
19.	Air conditioner split dissection Hall	06
20.	Weighing machine	02
21.	X-ray eliminator	04
22.	Trolley with stricture	01
23.	Shacking machine	01
24.	Stethoscope	02
25.	Projection screen	02
26.	Photostat machine	01
27.	Screen wall mounted	02
28.	Desert cooler	06
29.	Hot plate	01
30.	Tissue floating bath	01
31.	Examination coach	01
32.	Tissue processor	01
33.	Telephone set	04
34.	Tank specimen	05
35.	Slide projector	05

36.	UPS 1000 w	04
37.	Amplifier	03
38.	Speaker	12
39.	Knife microtome	02
40.	Incubator	01
41.	Slides 35mm	100
42.	Balance (electric)	01

Dissection Hall Instruments

S. No.	Instruments	Quantity
1.	Bone cutting forceps	06
2.	Chasel postpartum	04
3.	Forceps 5 inch plane	37
4.	Forceps 3 inch brunt	40
5.	Brain box	21
6.	Hammer s.s	06
7.	Knife	06
8.	B.P handle	06
9.	Scissors s.s pointed	15
10.	Tray s.s 12x10x12	04
11.	Tray s.s 10x18x12	29
12.	Surgical scissors	29
13.	Specimen jars	200
14.	Saw postpartum	13
15.	Pointed forceps	24
16.	Frame	56

Histology Laboratory Equipment

S.no	Item	Quantity
1.	Teaching microscope	01
2.	Multi head microscope bx40	01
3.	Photographic microscope	01
4.	Binocular microscope two head	04
5.	Stereo microscope	01
6.	Binocular microscope Nikon	45
7.	Student microscope	10
8.	Binocular microscope 1007 China	06
9.	Wooden cabinet	01
10.	Slide box	30
11.	Meter exposure	01
12.	Condenser	06
13.	Eye piece	10
14.	Instrument cabinet	06
15.	Stage micrometre	01

Equipment Essential For PhD Anatomy Program

S. No.	Equipment	Min Required	Deficiency	Remarks
1.	ELISA/RIA Apparatus	1	Nil	Working
2.	Fluorescent Microscope	1	Nil	Working
3.	PCR	1	Nil	Working
4.	Safety Hood	1	Nil	Working
5.	Gel Electrophoresis Apparatus	1	Nil	Working
6.	Gel Documentation System	1	----	----

7.	Centrifuge 4C0	1	Nil	Working

9.6 Facilities

Animal House: At RMU ;In process.

MOU signed with NIH

Library

- Available space including seating capacity: Eighty students
- Total No. of Books = More than 21 thousand
- Total Journals: 133 (Pakistani: 41 & Foreign: 92)

March 2023 onwards Digital library is accessible to all students & faculty (24 hours service via digital Library).

Books Available in the Library for Specialty

S No.	Name	Authors
1.	Last Anatomy Regional and applied	RMH McMinn (Churchill Living stone)
2.	Clinically Oriented Anatomy	Keith L. Moore (Lippincott, William and Wilkins)
3.	Gray's anatomy	William Et Al (Churchill Living stone)
4.	The developing Human	Keith L. Moore (saunders0
5.	Medical Embryology	Jan Langman (William and Wilkins)
6.	Baily's text book	Wilfred M. (coopenhaver, Kelly wood)
7.	Functional histology	Bringer (Little brown and Co)
8.	Histology: A text and an atlas	B. Young & H. Heath (Churchill Living stone)
9.	Genetics in medicine	J.S Thompson & W.B Sauders (M.W. Thompson)
10.	Human Neuroanatomy	J. Stuin& M.B Carpenter (William and Wilkins)
11.	Clinical Neuroanatomy	Richard S. Snell (William and Wilkins)
12.	Histochemistry theoretical and applied	Anthony Guy Everson. Pearse (Churchill Living stone)
13.	Histopathologistictecnic and Prac. Histochemistry	Ralph Dougall, Lillie

14.	Biological Micro technique	Sanderson J
15.	Junqueira's Basic Histology: Text & Atlas	Anthony L. Mescher
16.	Di Fiore's atlas of histology	Eroschenko
17.	Developing Human: Clinically Oriented Embryology	Keith L. Moore
18.	Ross, M.H. and Pawlina, W. Histology: A Text and Atlas, 6th ed	Lippincott, Williams
19.	Netter Atlas of human Anatomy	Netter
20.	Principles of anatomy and physiology	Jortora, Gerard (et al)
21.	Anatomy and Physiology in health	Waugh, Anne (et .al)
22.	Anatomy & Physiology in health & illness	Kathleen, J,W. Wilson.
23.	Concepts of human Anatomy & Physiology	Graaf, Kent. M Van De (et al)

LIST OF JOURNALS

1.	British Journal of Anatomy
2.	American Journal of anatomy
3.	ActaAnatomica
4.	Journal of Medical Genetics
5.	The journal of bone & joint surgery
6.	Journal of Anatomical science India
7.	Annals of Saudi Medicine
8.	Saudi journal of Kidney diseases & transplantation
9.	Pakistan journal of medical research
10.	Journal of the Pakistan Dental Association
11.	Pakistan journal of medical sciences
12.	Himont medical journal

13.	Journal of the Pakistan medical association (centre)
14.	Pakistan journal of pathology
15.	Pakistan Armed Forces medical journal
16.	Annals of Pakistan Institute of Medical science
17.	The Pakistan journal of Gastroenterology
18.	The journal of Baqai Medical university
19.	British journal of obstetrics & gynaecology
20.	Journal of surgery Pakistan
21.	Rawal medical journal
22.	The journal of bone & joint surgery
23.	The British journal of surgery
24.	Journal of Rawalpindi Medical college
25.	BMJ books catalogue
26.	AXIOM Innovation in intervention
27.	The Professional
28.	Anuals of KEMU
29.	Pakistan Journal of chest Medicine
30.	Sultan Qaboos University Medical Journal
31.	Pakistan journal of Medical Ethics
32.	Pakistan oral & Dental Journal
33.	Pakistan journal of Medical Education
34.	Pakistan journal of Medical Research

35.	International journal of Pathology
36.	Journal of Ayub Medical College Abbottabad
37.	Journal of Surgery Pakistan
38.	Pakistan journal of Physiology.
39.	Journal of the CPSP

Program Objective Assessment:

How Measured	When Measured
Employer Survey + Faculty Survey + Student Survey	After completion of each semester

SOURCES/ REFERENCES:

* https://www.hec.gov.pk/english/services/faculty/Plagiarism/Documents/HEC-PhD-Policy.pdf

** https://pmdc.pk/Documents/law/Approved%20PG%20regulations%202023.pdf

*** https://www.hec.gov.pk › universities › pqf › National Qualifications Framework of Pakistan

Proforma

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 hr/Week:	**Th**	**Pr**	**No. of Lectures Conducted**	**Theory**	**Practical**

Name of Course Teacher		**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)

PGT EVALUATION BY STUDENTS

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:_____
_____
_____

Faculty Course review report

Grades secured and other outcomes (to be provided by controller of Examination)

Name of Teacher:	**Course Taught**		**Term:**	
Session / Batch:	**Date of completion of term.**			

Flow Chart for PhD Scholars of RMU

Admission as per HEC/PMDC/RMU PhD Policy

↓

Admission Documentation in Respective Department

↓

Approval of Admission Dean's office/BASAR/Vice Chancellor

↓

Issuance of Registration No. in Registrar Office and Display of List of Registered Candidates

↓

Allocation of Academic Advisor/Supervisor/Co-Supervisor for each Candidate

↓

Academic and Research Supervisory Committee for each Candidate

↓

Start of Academic and Research Activities

↓

S #	Academic Activity	Research Activity*
Semester 01	• Course work (9-12 CHrs) • Mid-Semester/End-Semester Exams (GPA ≥2.5 in each course and GPA ≥3.0/4.0 in Semester mandatory)	Research Topic Finalization and approval from Departmental Academic and Research Supervisory Committee
Semester 02	Course work (9-12 CHrs) Mid-Semester/End-Semester Exams (GPA ≥2.5 in each course and GPA ≥3.0/4.0 in Semester mandatory) Passing Comprehensive Exam (60% pass marks)	Synopsis Writing and Approval from RB and BASAR Arrangement for Research Funding
Semester 03	• Workshops • Conferences • Visits/Training in other Institutions	• Start of Research including pilot study • Phase I: up to 30% of Research) • Procurement of Required materials • Sample Collection and Processing
Semester 04	• Workshops • Conferences • Visits/Training/Collaboration in other Institutions	• Phase II: up to 70% of Research) • Sample Collection and Processing • Experimental Work • Data Collection and organization
Semester 05	• Collaborative work in other Departments/Institutions • Preparation of Research Publication	• Phase III: Completion of Research • Experimental Work • Data Collection and organization • Data Analysis
Semester 06	Research Publication	• Thesis Writing and submission

*__Note:__ The given research model is as per facilitation from the Supervisor, Department and the University

Trainees/students will be informed about their assignments/duties by putting their duty rosters and teaching schedules on Campus management system of RMU

- By keeping academic log books
- By maintaining and displaying annual academic calendars
- All schedules will be readily available on college website

Grading System

It will be based on GPA – 4 system (HEC policy 2023) **

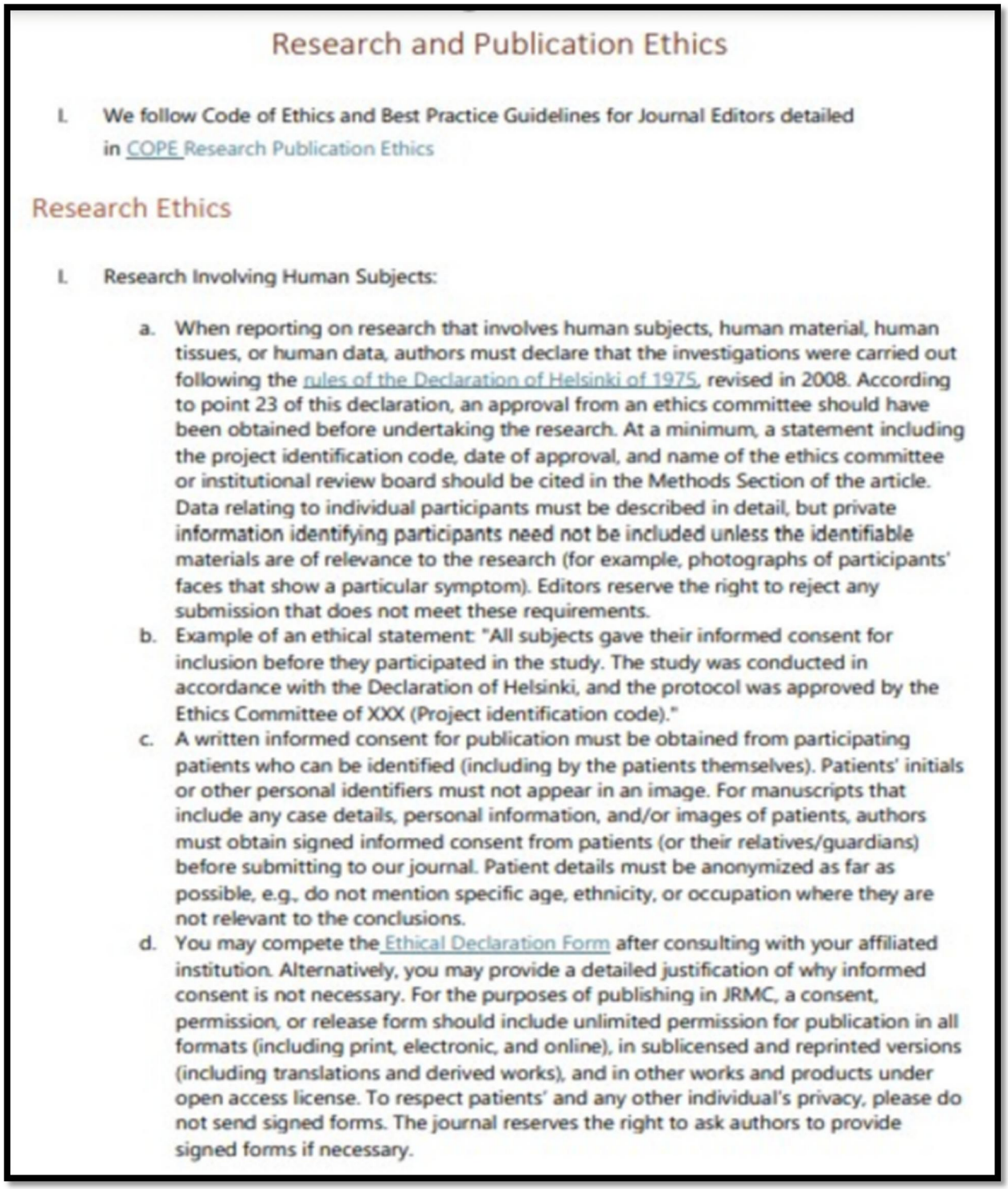
Marks obtained in Percentage range	Numerical Grade	Alphabetical Grade
85% and above	4.0	**A**
80-84 %	3.66	**A-**
75-79%	3.33	**B+**
71-74%	3.0	**B**
68-70%	2.66	**B-**
64-67%	2.33	**C+**
61-63%	2.0	**C**
58-60%	1.66	**C-**
54-57%	1.3	**D+**
50-53%	1.00	**D**
<50 Un-grade-able	0	**F**

Cumulative transcript is issued at the end of clearance of each semester.

Plagiarism Policy

1. All RMU submissions are screened for plagiarism using "Turnitin" as per Higher Education Commission of Pakistan (HEC) policy
2. Similarity Index by Turnitin must be <19%, and from a single source, it must be <5%.
3. Plagiarism, data fabrication, and image manipulation is not acceptable.
4. Plagiarism includes copying text, ideas, images, or data from another source, even from your own publications, without giving any credit to the original source.
5. Reuse of text that is copied from another source must be between quotes and the original source must be cited. If a study's design or the manuscript's structure or language has been inspired by previous works, these works must be explicitly cited.
6. If plagiarism is detected during the peer review process, the manuscript may be rejected. If plagiarism is detected after publication, we may publish a correction or retract the paper.
7. Image files must not be manipulated or adjusted in any way that could lead to misinterpretation of the information provided by the original image.
8. Irregular manipulation includes: 1) introduction, enhancement, moving, or removing features from the original image; 2) grouping of images that should obviously be presented separately (e.g., from different parts of the same image, or from different image); or 3) modifying the contrast, brightness or color balance to obscure, eliminate or enhance some information.

9. If irregular image manipulation is identified and confirmed during the peer review process, we may reject the manuscript. If irregular image manipulation is identified and confirmed after publication, we may correct or retract the paper.
10. Any allegations of publication misconduct will be investigated by JRMC Editorial Staff who may contact the authors' institutions, funders, appropriate bodies if necessary. If evidence of misconduct is found, appropriate action will be taken to correct or retract the publication.



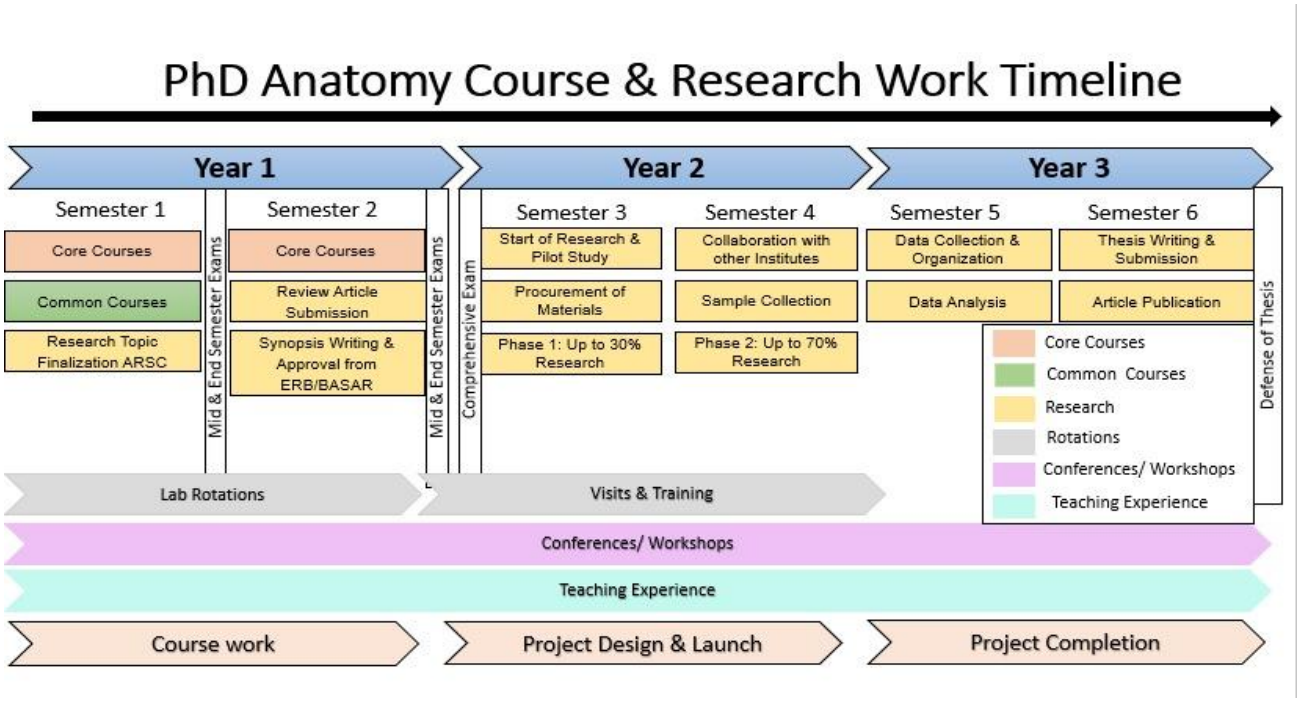
Research and Publication Ethics

I. We follow Code of Ethics and Best Practice Guidelines for Journal Editors detailed in COPE Research Publication Ethics

Research Ethics

I. Research Involving Human Subjects:

a. When reporting on research that involves human subjects, human material, human tissues, or human data, authors must declare that the investigations were carried out following the rules of the Declaration of Helsinki of 1975, revised in 2008. According to point 23 of this declaration, an approval from an ethics committee should have been obtained before undertaking the research. At a minimum, a statement including the project identification code, date of approval, and name of the ethics committee or institutional review board should be cited in the Methods Section of the article. Data relating to individual participants must be described in detail, but private information identifying participants need not be included unless the identifiable materials are of relevance to the research (for example, photographs of participants' faces that show a particular symptom). Editors reserve the right to reject any submission that does not meet these requirements.
b. Example of an ethical statement: "All subjects gave their informed consent for inclusion before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of XXX (Project identification code)."
c. A written informed consent for publication must be obtained from participating patients who can be identified (including by the patients themselves). Patients' initials or other personal identifiers must not appear in an image. For manuscripts that include any case details, personal information, and/or images of patients, authors must obtain signed informed consent from patients (or their relatives/guardians) before submitting to our journal. Patient details must be anonymized as far as possible, e.g., do not mention specific age, ethnicity, or occupation where they are not relevant to the conclusions.
d. You may compete the Ethical Declaration Form after consulting with your affiliated institution. Alternatively, you may provide a detailed justification of why informed consent is not necessary. For the purposes of publishing in JRMC, a consent, permission, or release form should include unlimited permission for publication in all formats (including print, electronic, and online), in sublicensed and reprinted versions (including translations and derived works), and in other works and products under open access license. To respect patients' and any other individual's privacy, please do not send signed forms. The journal reserves the right to ask authors to provide signed forms if necessary.



PhD Anatomy underlying Theme: