CURRICULUM
MD MICROBIOLOGY

Rawalpindi Medical University

Program

MD MICROBIOLOGY
(2024)

Medical education is not just a program for building knowledge and skills in its recipients…..it is also an experience which creates attitudes and expectations”

Abraham Flexner

WMA DECLARATION OF GENEVA

Adopted by the 2nd General Assembly of the World Medical Association, Geneva, Switzerland, September 1948 and amended by the 22nd World Medical Assembly, Sydney, Australia, August 1968 and the 35th World Medical Assembly, Venice, Italy, October 1983 and the 46th WMA General Assembly, Stockholm, Sweden, September 1994 and editorially revised by the 170th WMA Council Session, Divonne-les- Bains, France, May 2005 and the 173rd WMA Council Session, Divonne-les-Bains, France, May 2006.

AT THE TIME OF BEING ADMITTED AS A MEMBER OF THE MEDICAL PROFESSION:

I SOLEMNLY PLEDGE to consecrate my life to the service of humanity;

I WILL GIVE to my teachers the respect and gratitude that is their due;

I WILL PRACTISE my profession with conscience and dignity;

THE HEALTH OF MY PATIENT will be my first consideration;

I WILL RESPECT the secrets that are confided in me, even after the patient has died;

I WILL MAINTAIN by all the means in my power, the honor and the noble traditions of the medical profession;

MY COLLEAGUES will be my sisters and brothers;

I WILL NOT PERMIT considerations of age, disease or disability, creed, ethnic origin, gender, nationality, political affiliation, race, sexual orientation, social standing or any other factor to intervene between my duty and my patient;

I WILL MAINTAIN the utmost respect for human life;

I WILL NOT USE my medical knowledge to violate human rights and civil liberties, even under threat;

I MAKE THESE PROMISES solemnly, freely and upon my honor.

Preface

The horizons of *Medical Education* are widening & there has been a steady rise of global interest in *Post Graduate Medical Education*, an increased awareness of the necessity for experience in education skills for all healthcare professionals and the need for some formal recognition of postgraduate training in Diagnostic Radiology.

We are seeing a rise in the uptake of places on postgraduate courses in medical education, more frequent issues of medical education journals and the further development of e-journals and other new online resources. There is therefore a need to provide active support in *Post Graduate Medical Education* for a larger, national group of colleagues in all specialties and at all stages of their personal professional development. If we were to formulate a statement of intent to explain the purpose of this curriculum we might simply say that our aim is to help clinical colleagues to teach and to help students to learn in a better and advanced way. This book is a state of the art book with representation of all activities of the MD Diagnostic Radiology program at RMU. Curriculum is incorporated in the book for convenience of supervisors and residents. MS curriculum is based on six Core Competencies of ACGME ***(Accreditation Council for Graduate Medical Education)*** including ***Patient Care, Medical Knowledge, System Based Practice, Practice Based Learning, Professionalism, Interpersonal and Communication Skills***. The mission of Rawalpindi Medical University is to improve the health of the communities and we serve through education, biomedical research and health care. As an integral part of this mission, importance of research culture and establishment of a comprehensive research structure and research curriculum for the residents has been formulated and provided in this book.

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FACULTY IN MICROBIOLOGY AND RELATED SPECIALTIES

S. No	Faculty	Name & Designation
1.	Faculty in Microbiology	**DR. NAEEM AKHTAR** MBBS, PhD (Microbiology) Professor of Pathology (Microbiology)
2.		**DR. KIRN FATIMA** MBBS, MPhil, PhD Scholar (Microbiology) Assistant Professor of Pathology
3.		**DR. AMNA NOOR** MPhil, PhD (Biochemistry/Molecular Biology) Lecturer/Demonstrator
4.	Faculty in related Pathology Specialties	**DR. MOBINA AHSAN DHODY** MBBS, FCPS (Hematology) Professor/Chairperson
5.		**DR. MUDASSIRA ZAHID** MBBS, FCPS (Histopathology) Associate Professor of Pathology
6.		**DR. FATIMA UZ ZOHRA** **MBBS, MPhil, FCPS (Chem Pathology)** Assistant Professor of Pathology

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SECTION 1

1 Introduction

The Diagnostic Microbiology curriculum provides the framework for the training of doctors to the level of independent consultant practice in diagnostic Microbiology, addressing the requirements of patients, the population and basic health services.

2 Mission Statement

The mission of MD Diagnostic Microbiology program that:

1. The student accepts Microbiology in its full sense as lifelong activity and that he/she is prepared to invest time and effort to acquire, maintain and further improve his/her own knowledge and skills.
2. A critical appreciation of techniques, procedures carried out in Microbiology; an understanding of scientific methods, reliability and validity of observations and the testing of hypothesis.
3. The ability and willingness to adopt a problem solving approach to manage clinical situations included in the definition of Microbiology.
4. The ability to plan and interpret management program with due regard to the patient's comfort and economic factors.
5. His / her awareness of the role of specialists of Microbiology in Health Care Teams.
6. The awareness that he/she has to create his/her own professional impact as a capable specialist Microbiologist, a Teacher and a researcher both nationally and internationally.
7. To pursue and develop the basic scientific pursuits and guidelines for scientific discoveries for evidence based patient management.
8. To treat our colleagues and hospital staff with kindness, respect, generosity of spirit, and patience.
9. To foster the excellence and well-being of our residency program by generously offering time, talent, and energy on its behalf.
10. To extend our talents outside the walls of our hospitals and clinics, to promote the health and well-being of communities, locally, nationally, and internationally.
11. To serve as proud ambassadors for the mission of the Rawalpindi Medical University MD Diagnostic Microbiology Residency Program for the remainder of our professional lives.

3 Rationale of curriculum

The Diagnostic Microbiology curriculum will produce a workforce fit for the needs of patients, producing doctors who are more patient-focused, more general and who have more flexibility in their career structure. The introduction of updated standards for curricula and assessment processes laid out in Excellence by Design requires curricula to be based on high-level outcomes. The high-level outcomes in this curriculum are integral parts of the syllabus to describe the professional tasks within the scope of specialty practice.

4 Training Pathway and Duration of Training:

Trainees enter Diagnostic Microbiology training via a Central Induction Process. Program has 2 phases. Phase 1 consists of 2 years training in Diagnostic Microbiology with mandatory 3 months rotations in each Hematology, Chemical Pathology, Histopathology, , ICUs followed by Mid-term Assessment. Phase 2 also consists of 2 years training in Diagnostic Microbiology having rotations in Bacteriology, Virology, Immunology, Mycology, Parasitology, Molecular Biology and Hospital Infectious Prevention and Control practices followed by Final Assessment and Defense of Thesis.

Table 1: TRAINING PATHWAY & ROTATIONS

Year of training	Training Components		Assessment Strategies
Year 1	**Theory (Months 1-11)** Course work including: • General and Systematic Bacteriology • Medical Virology • Medical Mycology • Medical Parasitology • Immunology • Molecular Biology	**Lab Techniques (Months 1-11)** Lab Bench Work including: • Specimen Collection and Transport • Microscopy, • Autoclaving, Culture Media Preparation and Storage • Biochemical Bacterial Identification • Care, maintenance and Log Book of Equipment • Safe use of Equipment • Biosafety, Biosecurity and Infection Control Practices in Lab	**Month 12:** **Exam Preparation Leave**: Two weeks **Theory Exam**: 1 week **Practical/Viva Voce Exam**: 1 week • Assignments • MCQs • SEQs • OSPE • Practical Bench work • Viva Voce
Year 2	**Theory** Three months full time rotations in each discipline of Hematology, Chemical Pathology, Histopathology Labs and Two months rotation in Molecular Biology having both theory and bench work training as per minor subject curricula	**Lab Techniques** Basic and commonly used techniques in each discipline required for any hospital Pathologist in alignment with theoretical teaching	Assessment in each discipline at the last week of each rotation as: • Assignments • MCQs • SEQs • OSPE • Practical Bench work • Viva Voce
MID-TERM ASSESSMENT (MTA)-in month-12 of year-2 This will be out of the theoretical and practical training during last two years			
Year 3	**Theory (Months 1-11)** • Clinical Microbiology including collection, transport, processing, and reporting of variety clinical samples from Respiratory Tract, GIT, Blood,	**Lab Techniques (Months 1-11)** • Lab Bench Discussions and SUPERVISED hands on training for processing and reporting of variety clinical samples from Respiratory	**Month 12:** **Exam Preparation Leave**: Two weeks **Theory Exam**: 1 week

	Urinary Tract, Body fluids, CNS and others for Bacterial, Viral, Fungal, Parasitic pathogens and immunological reactions • Journal Club Discussion • SGIS • Teaching of Year-1 MD Microbiology Students, BS-MLT students and MBBS students **Research:** Literature Review for research project	Tract, GIT, Blood, Urinary Tract, Body fluids, CNS and others for Bacterial, Viral, Fungal and Parasitic pathogens • Immunological Techniques including ELISA • Molecular Biology Techniques including PCR • Practical bench training of Year-1 MD Microbiology Students, BS-MLT students and practical rotations of MBBS students **Research:** Sample Collection, processing and data collection for research project	**Practical/Viva Voce Exam**: 1 week • Assignments • MCQs • SEQs • OSPE • Practical Bench work • Viva Voce
Year 4	**<u>Theory (Months 1-10)</u>** • Continued bench discussion as during Year-3 • Antimicrobial Resistance data planner: feedback to clinical departments **Research:** Publication, thesis writing, submission and defense	**<u>Lab Techniques (Months 1-10)</u>** • Continued bench discussion and supervised hands on training and independent reporting and feedback to clinical departments as during Year-3 **Research:** Publication, thesis writing, submission and approval	**Month 11:** Exam Preparation Leave **Month 12** (This will be out of the theoretical and practical training during FOUR YEARS) **Written, Practical, Viva Voce and Thesis Defense**
	FINAL-TERM ASSESSMENT (FTA) – Months 11-12 of year-4 **This will be out of the theoretical and practical training during FOUR YEARS** **Month-11- Exam Preparation Leave** **Month-12** **Theory Exam**: Week-1 **Practical/Viva Voce Exam**: Week-2 **Thesis Defense:** Week-4		

SECTION 2: GENERAL

1. STATUTES

1. Nomenclature:

The name of degree program shall be MD Diagnostic Microbiology. This name is well recognized and established for the last many decades worldwide.

2. Course Title:

MD Diagnostic Microbiology

3. Training Centers:

Departments of Diagnostic Microbiology at Rawalpindi Medical University (RMU) and Allied Hospitals

4. **Duration of Course:**

The duration of MD Diagnostic Microbiology course shall be four 04 years with structured training in a recognized department under the guidance of an approved supervisor.

5. **Course structure**:

The course is structured in two parts: After admission in M.D. Diagnostic Microbiology Program as per CIP Punjab:

Year 1: The resident will spend first 12 Months in the relevant Hospital Clinical Microbiology Department, during which resident will get basic theoretical knowledge and hands on training in the basic techniques in the chosen discipline and will also undertake the mandatory workshops. The research project will be designed and the synopsis be prepared during this period. Resident will undergo 1st In-training Assessment at the end of 1st year. It will comprise clinical/applied basics MCQs, SAQs, LEQs, Practical and Viva Voce. Pass marks will be 50%.

Year 2: The resident will continue formal training in the related disciplines of Pathology. This will comprise of three months full time rotations in each discipline of Hematology, Chemical Pathology, Histopathology Labs and Two months rotation in Molecular Biology having both theory and bench work training as per minor subject curricula. During this period the resident must get the research synopsis approved by ERB and AS&RB of the university.
At the end of Year-2, trainee will undergo Midterm Assessment (MTA). It will comprise of clinical/applied basics MCQs, SAQs, LEQs, Practical and Viva Voce. The course content assessed will be that taught during Year 1 and Year 2. Pass percentage in this examination is 60%.

Years 3-4: During these years of the program, there will be two components of the training:
1. Clinical Training in Diagnostic Microbiology.

2. Research and Thesis writing.

During ***Year-3***, the resident shall undergo clinical training to achieve educational objectives of MD Diagnostic Microbiology (knowledge and skills). The clinical training shall be competency based. There shall be generic and specialty specific competencies and shall be assessed by continuous Internal Assessment. Research will be completed in year-3 and thesis writing will be started.

It will comprise of clinical/applied basics MCQs, SAQs, LEQs, Practical and Viva Voce. The course content assessed will be that taught during Year 3. Pass percentage in this examination is 50%.

During ***Year 4***, preferably during first 6 months, thesis will be completed and approval by BASR will be taken. Following fulfillment of eligibility criteria, the trainee will appear in Final-Term Assessment (FTA) at the end of fourth year training which will be a comprehensive qualifying examination out of content taught during last four years. It will comprise of clinical/applied basics MCQs, SAQs, LEQs, Practical and Viva Voce. Pass percentage in this examination is 60%.

2. ADMISSION CRITERIA

Applications for admission to MD Training Programs will be invited through advertisement in print and electronic media mentioning closing date of applications and date of Entry Examination as per CIP, Punjab.

Eligibility: The applicant on the last date of submission of applications for admission must possess the:

- Basic Medical Qualification of MBBS or equivalent medical qualification recognized by Pakistan Medical Council.
- Certificate of one year's House Job experience in institutions recognized by Pakistan Medical Council is essential at the time of interview. The applicant is required to submit Hope Certificate from the concerned Medical Superintendent that the House Job shall be completed before the Interview.
- Valid certificate of permanent or provisional registration with Pakistan Medical Council.
- MD entry exam pass certificate

3. REGISTRATION AND ENROLMENT

As per policy of Pakistan Medical Council the number of PG Trainees/ Students per supervisor shall be maximum 05 per annum for all PG programs including minor programs (if any).

- The University will approve supervisors for MD courses.
- Candidates selected for the courses: after their enrollment at the relevant institutions shall be registered with RMU as per prescribed Registration Regulations.

SECTION 3: PROGRAM

DEVELOPMENTAL MILESTONES FOR MD DIAGNOSTIC MICROBIOLOGY PROGRAM AT RAWALPINDI MEDICAL UNIVERSITY

This document presents milestones designed for programs to use in semi-annual review of resident performance and reporting to the ACGME. Milestones are knowledge, skills, attitudes, and other attributes for each of the ACGME competencies organized in a developmental framework from less to more advanced. They are descriptors and targets for resident performance as a resident moves from entry into diagnostic radiology residency through graduation. In the initial years of implementation, the Review Committee will examine milestone performance data for each program's residents as one element in the Next Accreditation System (NAS) to determine whether residents overall are progressing. For each reporting period, review and reporting will involve selecting the level of milestones that best describes each resident's current performance level in relation to milestones. Milestones are arranged into numbered levels. Selection of a level implies that the resident substantially demonstrates the milestones in that level, as well as those in lower levels. A general interpretation of levels for diagnostic radiology is below:

***Level 1*:** The resident demonstrates milestones expected of one who has had some education in diagnostic Microbiology.

Level 2: The resident is advancing and demonstrating additional milestones.

***Level 3*:** The resident continues to advance and demonstrate additional milestones; the resident consistently demonstrates the majority of milestones targeted for residency.

***Level 4*:** The resident has advanced so that he or she now substantially demonstrates the milestones targeted for residency. This level is designed as the graduation target.

***Level 5*:** The resident has advanced beyond performance targets set for residency and is demonstrating "aspirational" goals which might describe the performance of someone who has been in practice for several years. It is expected that only a few exceptional residents will reach this level. These are described in **Appendix 1**

Milestones Levels

Milestones for high level outcome	Milestones Level (End of Year 1)	Milestones Level (End of Year 2)	Milestones Level (End of Year 3)	Milestones Level (End of Year 4)
Patient care and technical skills	L2	L3	L4	L5
Medical knowledge	L 2	L 3	L 4	L 5
Professionalism	L 1	L 2	L 3	L 4
Interpersonal and communication skills	L 2	L 2	L 3	L 5
System based practice	L 2	L 2	L 3	L 4
Practice based learning and improvement	L 1	L 2	L 3	L 5

SECTION 4: TEACHING & LEARNING

The curriculum is used to help design training program locally that ensure all trainees can develop the necessary skills and knowledge in a variety of settings and situations. The curriculum is designed to ensure it can be applied in a flexible manner, meeting service needs as well as supporting each trainee's own tailored learning and development plan. The requirements for curriculum delivery have not changed as a result of this new curriculum, the only difference is that this new curriculum is more structured in its delivery.

1)AIMS AND OBJECTIVES OF THE PROGRAM

AIM

The aim of four years MD program in Diagnostic Microbiology is to train residents to acquire the competency of a specialist in the field of Diagnostic Microbiology so that they can become good teachers, researchers and clinicians in their specialty after completion of their training.

GENERAL OBJECTIVES

1. To provide a broad experience in Diagnostic Microbiology, including its inter relationship with other disciplines.
2. To enhance medical knowledge, Lab skills, and competence in diagnostic procedures.
3. To cultivate the correct professional attitude and enhance communication skill towards patients, their families and other healthcare professionals.
4. To enhance sensitivity and responsiveness to community needs and the economics of health care delivery.
5. To enhance critical thinking, self-learning, and interest in research and development of patient service.
6. To cultivate the practice of evidence-based medicine and critical appraisal skills.
7. To inculcate a commitment to continuous medical education and professional development.
8. To provide a broad training and in-depth experience at a level for trainees to acquire competence and professionalism of a specialist in Diagnostic Microbiology especially in the diagnosis, investigation and treatment of medical problems towards the delivery of holistic patient care.
9. To acquire competence in managing acute microbiolgical emergencies referred by other doctors, and in selecting patients for timely referral to appropriate tertiary care or the expertise of another specialty.
10. To encourage the development of skills in communication and collaboration with the community towards healthcare delivery.
11. To foster the development of skills in the critical appraisal of new methods of investigation and/or treatment.
12. To reinforce self-learning and commitment to continued updating in all aspects of Diagnostic Microbiology.
13. To encourage contributions aiming at advancement of knowledge and innovation in Microbiology through basic and/or clinical research and teaching of junior trainees and other health related professionals.
14. To acquire professional competence in training future trainees in Diagnostic Microbiology at Rawalpindi Medical University.

SPECIFIC OBJECTIVES

6 CORE COMPETENCIES OF CURRICULUM

Curriculum of MD Diagnostic Microbiology at Rawalpindi Medical University is an important document that defines the educational goals of Residency Training Program and is intended to clarify the learning objectives for all inpatient and outpatient rotations. Program requirements are based on the **ACGME (Accreditation Council for Graduate Medical Education)** standards for categorical training in Diagnostic Microbiology. Curriculum is based on 6 core competencies. Detail of these competencies is as follows

COMPETENCY NO. 1: PATIENT CARE

Provide patient care that is compassionate, appropriate and effective.

Skills

- Gather essential and accurate information about patients
- Develop a diagnostic plan based upon the clinical question/s and relevant clinical, microbiologic and pathologic information
- Oversee diagnostic techniques to ensure adequacy of studies performed
- Counsel patients concerning preparation for diagnostic testing
- Demonstrate a basic understanding of electronic patient information systems
- Demonstrate the ability to use the Internet as an educational instrument to expand medical knowledge
- Perform microbiologic examinations appropriately and safely, assuring that the correct examination is ordered and performed

Education (with graduated faculty supervision and feedback)

- Practical experience in developing a differential diagnosis and management plan based upon clinical data, microbiologic findings and other medical test results
- Active participation in journal reviews to determine the effectiveness of
- Graduated responsibility in performing microbiologic procedures
- Didactic instruction in microbiological safety practices
- Preparation and presentation of microbiologic cases to other members of the healthcare team

Assessment

- Global ratings by faculty
- 360 degree examination
- Procedure log
- Objective structured clinical examination

COMPETENCY NO.2: MEDICAL KNOWLEDGE

Residents must demonstrate knowledge about established and evolving biomedical and clinical sciences and the application of this knowledge to patient care.

Skills

- Demonstrate sufficient knowledge of microbiology and medicine to apply this knowledge to microbiological studies in a clinical context to generate meaningful differential diagnoses
- Demonstrate progressive acquisition of microbiological knowledge
- Demonstrate knowledge of the principles of research design and implementation
- Generate a clinically appropriate diagnostic treatment plan
- Demonstrate the ability to use all relevant information resources to acquire evidence-based data
- Understand how microbiologic equipment can be used to generate appropriate and diagnostic inferences

Education

- Didactic lectures and self-directed learning on the science and practice of microbiology
- Participation in departmental and inter-departmental case conferences
- Participation in the clinical activities of the microbiology department
- Departmental or institutional training programs on research design and implementation

Assessment

- Global ratings by faculty
- Program-developed written examinations
- ACR in-training examination
- Written examination
- Oral examination

COMPETENCYNO.3: INTERPERSONAL AND COMMUNICATION SKILLS

Residents must demonstrate interpersonal and communication skills that result in effective information exchange with patients, patient family members, medical students, other residents, supervising faculty, referring physicians, technologists, nurses and other members of the health care team.

Skills

- Provide a clear and informative written microbiologic report including a precise diagnosis whenever possible, a differential diagnosis when appropriate, and recommended follow-up or additional studies when appropriate
- Provide direct communication to the referring physician or appropriate clinical personnel when interpretation reveals an urgent or unexpected finding and document this communication in the microbiologic report
- Demonstrate effective skills of face-to-face listening and speaking with
- physicians, patients, patient's families and support personnel
- Demonstrate appropriate telephone communication skills
- Demonstrate skills in obtaining informed consent, including effective
- communication to patients of the procedure, alternatives and possible complications

Education (with graduated faculty supervision and feedback)

- Participation as an active member of the microbiology team by communicating face to face with clinicians, answering the telephone, providing consults, problem solving and decision-making
- Act as the contact person for technologists and nurses in managing patient and microbiologic issues
- Active participation in preparing and moderating multi-disciplinary conferences
- Practical experience in dictating microbiological reports

Assessment

- Global ratings by faculty
- 360 degree evaluations
- Record review (systematic evaluation of resident dictations)

COMPETENCYNO.4: PROFESSIONALISM

Demonstrate a commitment to carrying out professional responsibilities, adherence to ethical principles, and sensitivity to a diverse patient population.

Skills

- Demonstrate altruism (putting the interests of patients and others above self-interest)
- Demonstrate compassion: be understanding and respectful of the patients, patient families, and staff and physicians caring for patients
- Demonstrate excellence: perform responsibilities at the highest level and continue active learning throughout one's career
- Be honest with patients and all members of the health care team
- Demonstrate honor and integrity: avoid conflicts of interest when accepting gifts from patients or vendors
- Interact with others without discriminating on the basis of religious, ethnic, sexual or educational differences and without employing sexual or other types of harassment
- Demonstrate knowledge of issues of impairment (i.e. physical, mental and alcohol and substance abuse), obligations for impaired physician reporting, and resources and options for care of self-impairment or impaired colleagues
- Demonstrate positive work habits, including punctuality and professional Appearance Demonstrate an understanding of broad principles of biomedical ethics
- Demonstrate principles of confidentiality with all information transmitted during a patient encounter
- Demonstrate knowledge of regulatory issues pertaining to the use of human subjects in research

Education

- Discussion of conflicts of interest and the ethics of conducting research during departmental or institutional conferences and daily clinical work
- Training programs (i.e. videotapes) on the issues of harassment and discrimination.
- Didactic presentations on the recognition and management of the "impaired physician"
- Participation in hospital-sponsored core curriculum educational activities (i.e. lectures, web-based programs)
- Didactic lecture/training program on the broad principles of medical ethics
- Institutional web-based self-directed learning and assessment programs on human subjects research guidelines

Assessment

- Global ratings by faculty
- 360 degree evaluations
- Conference attendance logs
- Resident self-assessment
- Written ABR examination

COMPETENCYNO.5: PRACTICE BASED LEARNING AND IMPROVEMENT

Residents must be able to investigate and evaluate their patient care practices, and appraise and assimilate scientific evidence in order to improve their radiologic practices.

Skills

- Analyze practice experience and perform practice-based improvement in cognitive knowledge, observational skills, formulating a synthesis and impression, and procedural skills
- Demonstrate critical assessment of the scientific literature
- Demonstrate knowledge of and apply the principles of evidence-based medicine in practice
- Use multiple sources, including information technology to optimize life-long learning and support patient care decisions
- Facilitate the learning of students, peers and other health care professionals

Education

- Participate in critical assessment of the scientific literature through journal clubs, clinical conferences and independent learning
- Didactic lectures on the assessment of scientific literature, study designs and statistical methods
- Teaching students, peers and other health care professionals, with graduated supervision and feedback from supervising faculty
- Active participation in departmental or institutional quality assurance
- (QA)/quality improvement (QI) activities with faculty supervision

Assessment

- Global ratings by faculty
- ACR in-service examination
- Written ABR examination
- QA/QI conference attendance logs
- Global ratings by students
- Procedure log

COMPETENCY NO.6: SYSTEMS BASED PRACTICE

Demonstrate an awareness and responsiveness to the larger context and system of health care and the ability to effectively call on system resources to provide optimal care.

Skills

- Demonstrate the ability to design cost-effective care plans based on knowledge of best practices
- Demonstrate knowledge of the sources of financing for U.S. health care including
- Medicare, Medicaid, the Veteran's Affairs and Department of Defense, public health systems, employer-based private health plans, and patient's own funds
- Demonstrate knowledge of basic health care reimbursement methods
- Demonstrate knowledge of the regulatory environment including state licensing authority, state and local public health rules and regulations, and regulatory agencies such as Centers for Medicaid and Medicare Services (CMS) and Joint Commission for the Accreditation of Healthcare Organizations (JCAHO)
- Demonstrate knowledge of basic practice management principles such as budgeting, record keeping, medical records, and the recruitment, hiring, supervision and management of staff

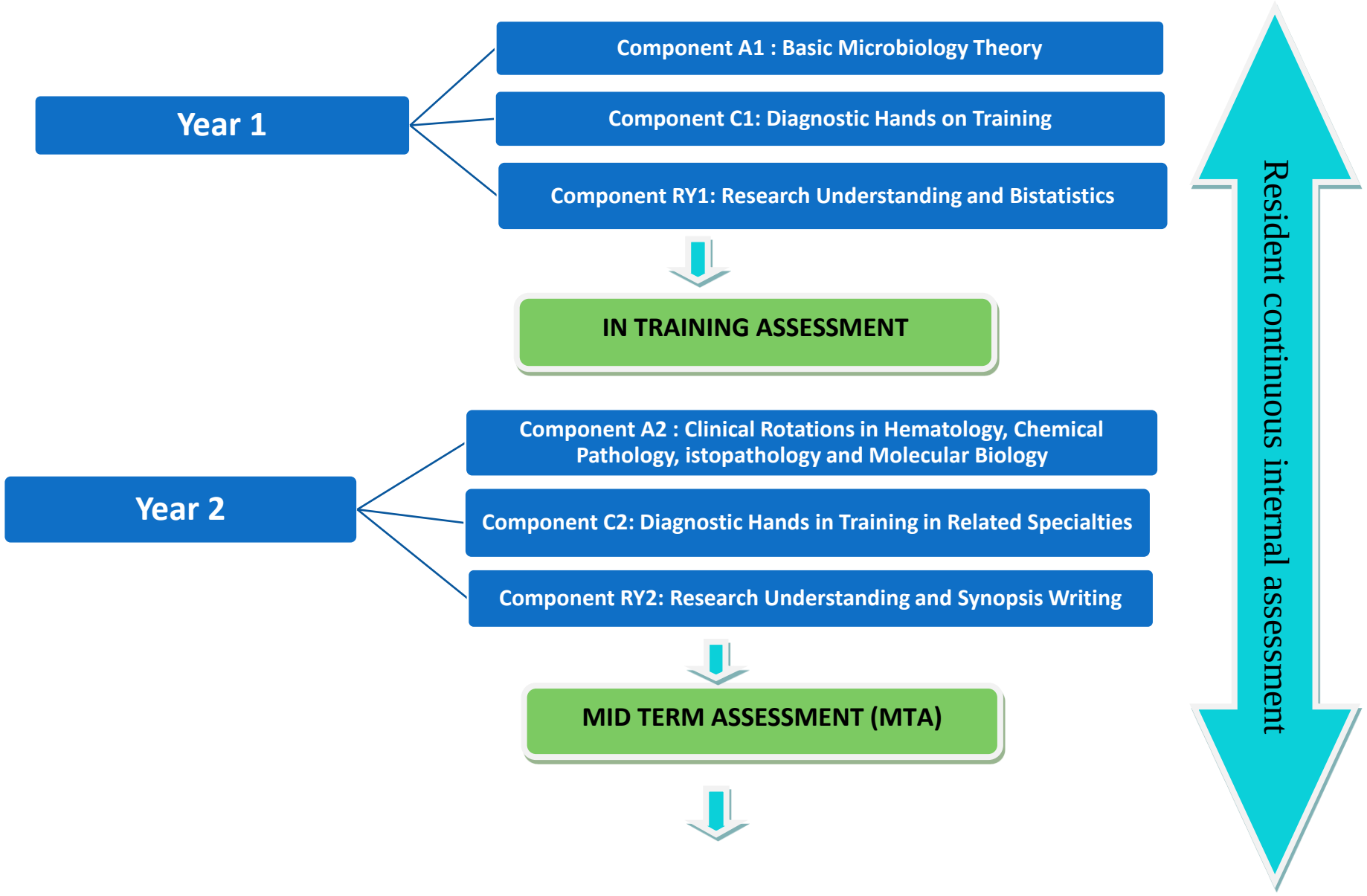
Education

- Systematic review of appropriate literature, including current American College of Radiology (ACR) Appropriateness Criteria, to develop knowledge of evidence based indications for imaging procedures
- Attendance and active participation in departmental and multi-disciplinary conferences where there is discussion of the imaging evaluation of specific diseases and most appropriate and cost-effective methods for establishing a diagnosis
- Interaction with department administrators and knowledgeable faculty to gain an understanding of the costs of diagnostic examinations and the influence of the type of payer system on reimbursement
- ACR/APDR non-interpretive skills videotapes
- Membership and active participation in local and national microbiological societies
- Departmental or institutional presentations on health care funding and regulation

Assessment

- Global ratings by faculty
- Written ABR examination
- ACR in-training examination
- Multi-disciplinary conference attendance logs
- Documented membership and participation in microbiologic societies and other health care organization

ROAD MAP OF MD TRAINING DIAGNOSTIC MICROIOLOGY



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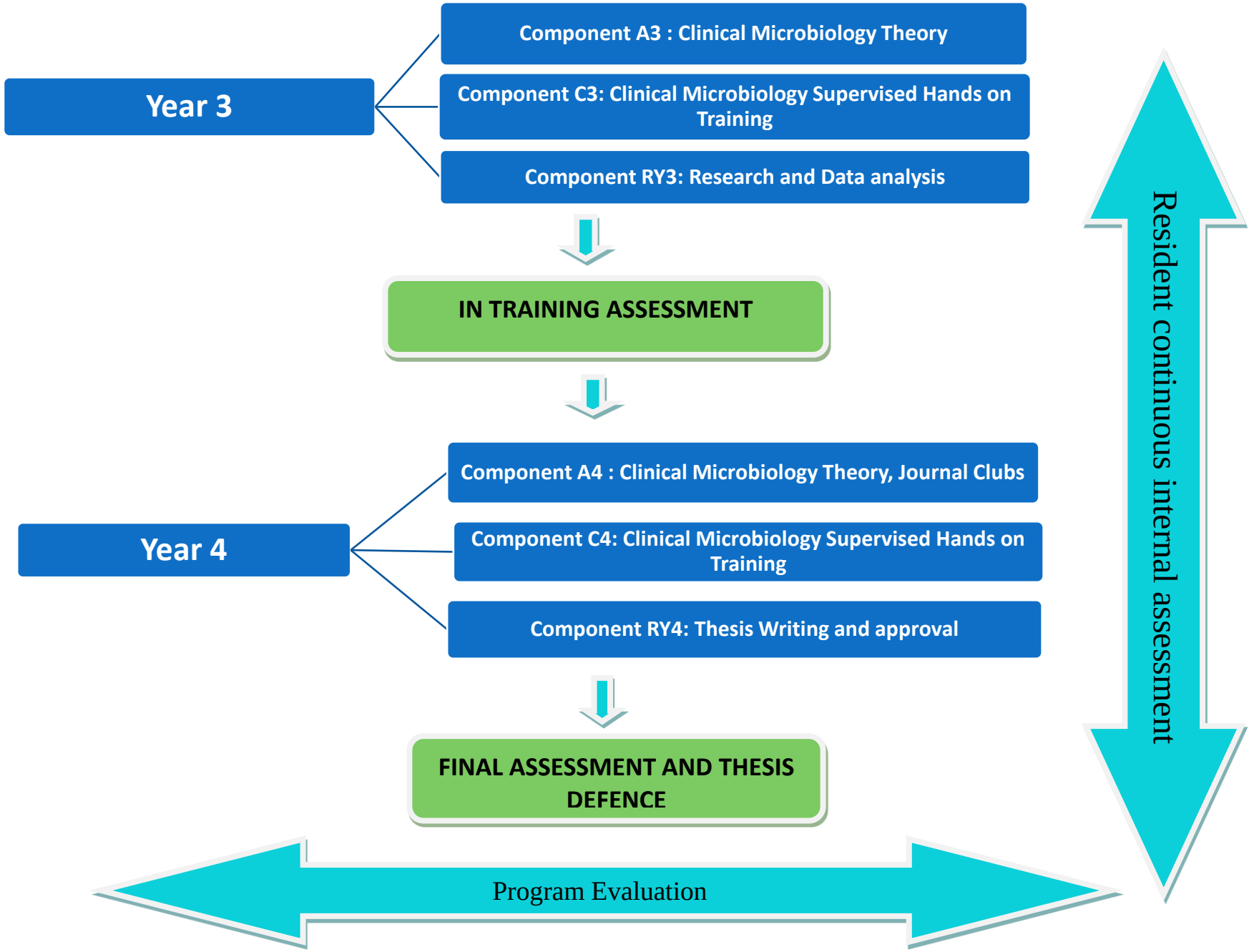
Year 3
Component A3 : Clinical Microbiology Theory
Component C3: Clinical Microbiology Supervised Hands on Training
Component RY3: Research and Data analysis
IN TRAINING ASSESSMENT
Year 4
Component A4 : Clinical Microbiology Theory, Journal Clubs
Component C4: Clinical Microbiology Supervised Hands on Training
Component RY4: Thesis Writing and approval
FINAL ASSESSMENT AND THESIS DEFENCE
Resident continuous internal assessment
Program Evaluation

LEARNING OPPORTUNITIES

1. **Reporting Sessions/ Lab Bench Discussions**

   All residents will have rotations in Autoclaving, Media Preparation, Bacteriology, Mycology, Serology, Clinical Pathology and Parasitology sections of Diagnostic Microbiology where respective reporting session will be conducted. The required knowledge and skills pertaining to respective areas shall be demonstrated. All residents will play an active role under supervision of respective fellow.

2. **Hands on Training**

   Hands on training shall be conducted for Autoclaving, Media Preparation, Bacteriology, Mycology, Serology, Clinical Pathology and Parasitology where residents shall have active participation to acquire the skills that shall play a significant role in their career ahead.

3. **Journal Club Meeting (JCM)**

   A resident will be assigned to present, in depth, a research article or topic of his/her choice of actual or potential broad interest and/or application. Two hours per month should be allocated to discussion of any current articles or topics introduced by any participant. Faculty or outside researchers will be invited to present outlines or results of current research activities. The article should be critically evaluated and its applicable results should be highlighted, which can be incorporated in clinical practice. Record of all such articles should be maintained in the relevant department

4. **Small Group Discussions/ Problem Based Learning/ Case Based Learning**

   Traditionally small groups consist of 8-12 participants. Small groups can take on a variety of different tasks, including problem solving, role play, discussion, brainstorming, debate, workshops and presentations. Generally students prefer small group learning to other instructional methods. From the study of a problem students develop principles and rules and generalize their applicability to a variety of situations PBL is said to develop problem solving skills and an integrated body of knowledge. It is a student-centered approach to learning, in which students determine what and how they learn. Case studies help learners identify problems and solutions, compare options and decide how to handle a real situation.

5. **Discussion/Debate**

   There are several types of discussion tasks which would be used as learning method for residents including: guided discussion, in which the facilitator poses a discussion question to the group and learners offer responses or questions to each other's contributions as a means of broadening the discussion's scope; inquiry-based discussion, in which learners are guided through a series of questions to discover some relationship or principle; exploratory discussion, in which learners examine their personal opinions, suppositions or assumptions and then visualize alternatives to these assumptions; and debate in which students argue opposing sides of a controversial topic. With thoughtful and well-designed discussion tasks, learners can practice critical inquiry and reflection, developing their individual thinking, considering alternatives and negotiating meaning with other discussants to arrive at a shared understanding of the issues at hand.

6. **Case Conference (CC)/ Morning Meetings**

   These sessions are held once each week; the focus of the discussion is selected by the presenting resident. For example, some cases may be presented to discuss a differential diagnosis, while others are presented to share interesting cases.

7. **Clinico-Pathological Conferences**

   The clinico pathological conference, popularly known as CPC primarily relies on case method of teaching medicine. It is a teaching tool that illustrates the logical, measured consideration of a differential diagnosis used to evaluate patients. The process involves case presentation, diagnostic data, discussion of differential diagnosis, logically narrowing the list to few selected probable diagnoses and eventually reaching a final diagnosis and its brief discussion. The idea was first practiced in Boston, back in 1900 by a Harvard internist, Dr. Richard C. Cabot who practiced this as an informal discussion session in his private office. Dr. Cabot incepted this from a resident, who in turn had received the idea from a roommate, primarily a law student.

8. **Directly Supervised Procedures (DSP*)***

   Residents learn procedures under the direct supervision of an attending or fellow during some rotations.

9. **Self-Directed Learning**

Self-directed learning residents have primary responsibility for planning, implementing, and evaluating their effort. It is an adult learning technique that assumes that the learner knows best what their educational needs are. The facilitator's role in self- directed learning is to support learners in identifying their needs and goals for the program, to contribute to clarifying the learners' directions and objectives and to provide timely feedback. Self-directed learning can be highly motivating, especially if the learner is focusing on problems of the immediate present, a potential positive outcome is anticipated and obtained and they are not threatened by taking responsibility for their own Learning.

10. **Audio Visual Laboratory**

    Audio visual material for teaching skills to the residents is used specifically in teaching ultrasound and interventional procedure details.

11. **E-learning/web-based medical education/computer-assisted instruction**

    Computer technologies, including the Internet, can support a wide range of learning activities from dissemination of lectures and materials, access to live or recorded presentations, real-time discussions, self-instruction modules and virtual patient simulations. distance-independence, flexible scheduling, the creation of reusable learning materials that are easily shared and updated, the ability to individualize instruction through adaptive instruction technologies and automated record keeping for assessment purposes.

12. **Research Based Learning**

    All residents in the categorical program are required to complete an academic outcomes-based research project during their training. This project can consist of original bench top laboratory research, clinical research or a combination of both. The research work shall be compiled in the form of a thesis which is to be submitted for evaluation by each resident before end of the training. The designated Faculty will organize and mentor the residents through the process, as well as journal clubs to teach critical appraisal of the literature.

SECTION 5: RESEARCH & THESIS WRITING

Research and Thesis have to be completed during training period. Research topic selection is must in first year. Synopsis writing and approval from IRF & BASR are must in second year of training. In third year of training Thesis should be written, while in first six months of fourth year Thesis should be completed and after appropriate defense it should be approved by BASR.

Research Experience & Workshops

The active research component program must ensure meaningful, supervised research experience with appropriate protected time for each resident while maintaining the essential clinical experience. Residents must learn the design and interpretation of research studies, responsible use of informed consent, and research methodology and interpretation of data. The program must provide instruction in the critical assessment of new therapies and of the medical literature. Residents will be advised and supervised by qualified staff members in the conduct of research
To help conduction of Research and facilitate Thesis writing following workshops are mandatory during training that will be organized by RMU:

- Communication skills
- Computer & IT skills days
- Synopsis writing
- Research Methodology & Biostatistics
- Reference Manager (Endnote)

Clinical Research

Each resident will participate in at least one clinical research study to become familiar with

1. Research design
2. Research involving human subjects including informed consent and operations of the Institutional Review Board and ethics of human experimentation
3. Data collection and data analysis
4. Research ethics and honesty
5. Peer review process

This usually is done during the consultation and outpatient clinic rotations.

Thesis

The candidates shall prepare their synopsis as per guidelines provided by Institutional Research Forum/Ethical Review Board (IRF/ERB) and Board of Advanced Studies & Research (BASR). The research topic must consist of a reasonable sample size and sufficient numbers of variables to give training to the candidate to conduct research, collect and analyze data. Synopsis of research project should be approved in 2nd year of MS program by IRF/ERB and BASR. In 3rd year Thesis work should be completed, and in 4th year it should be approved from BASR.

SECTION 6: ASSESSMENT:

1 Purpose of assessment

Assessment of learning is an essential component of any curriculum. The focus is on good practice, based on fair and robust assessment principles and processes in order to ensure a positive educational impact on learners and to support assessors in making valid and reliable judgement. The program of assessment comprises an integrated framework of examinations, assessments in the workplace and judgement made about a learner during their approved program of training. Its purpose is to robustly evidence, ensure and clearly communicate the expected levels of performance at critical progression points in, and to demonstrate satisfactory completion of, training as required by the curriculum.
Assessments can be described as helping learning or testing learning - referred to as formative and summative respectively. There is a link between the two; some assessments are purely formative others are explicitly summative with a feedback element while others provide formative feedback while contributing to summative assessment as in Continuous Internal Assessment (CIA).

The purposes of **formative assessment** are to:

- Assess trainees' actual performance in the workplace.
- Enhance learning by enabling trainees to receive immediate feedback, understand their ownperformance and identify areas for development.
- Drive learning and enhance the training process by making it clear what is required of traineesand motivating them to ensure they receive suitable training and experience.
- Enable supervisors to reflect on trainee needs in order to tailor their approach accordingly.

The purposes of **summative assessment** are to:
Provide robust, summative evidence that trainees are meeting the curriculum requirements during the training program.
Ensure that trainees possess the essential underlying knowledge required for their specialty.
Identify trainees who should be advised to consider changes of career direction.
Provide information for the quality assurance of the curriculum.

2 Assessment Methods

Workplace-Based Assessment (WBA)

Each individual WBA is designed to assess a range of important aspects of performance in different training situations. Taken together the WBAs can assess the breadth of knowledge, skills and performance described in the curriculum. Each WBA is recorded on a structured form to help assessors distinguish between levels of performance and prompt areas for their verbal developmental feedback to trainees immediately after the observation. WBAs are formative and may be used to assess and provide feedback on all clinical activity. Trainees can use any of the assessments described below to gather feedback or provide evidence of their progression in a particular area. WBAs are only mandatory for the assessment of the critical conditions and index procedures.

a) Case Based Discussion (CBD)

The CBD assesses the performance of a trainee in their management of a patient case to provide an indication of competence in areas such as clinical judgment, decision-making and application of medical knowledge in relation to patient care. The CBD process is a structured, in-depth discussion between the trainee and a consultant supervisor. The method is particularly designed to test higher order thinking and synthesis as it allows the assessor to explore deeper understanding of how trainees compile, prioritize and apply knowledge. By using clinical cases that offer a challenge to trainees, rather than routine cases, trainees are able to explain the complexities involved and the reasoning behind choices they made. It also enables the discussion of the ethical and legal framework of practice. As the actual record is the focus for the discussion, the assessor can also evaluate the quality of record keeping and the presentation of cases. The CBD is important for assessing the critical conditions) Trainees are assessed against the standard for the completion of their phase of training.

b) Clinical Evaluation Exercise (CEX) / CEX for Consent (CEX(C))

The CEX or CEX(C) assesses a clinical encounter with a patient to provide an indication of competence in skills essential for good clinical care such as communication, history taking, examination and clinical reasoning. These can be used at any time and in any setting when there is a trainee and patient interaction and an assessor is available. The CEX or CEX(C) is important for assessing the critical conditions. Trainees are assessed against the standard for the completion of their phase of training.

c) Direct Observation of Procedural Skills (DOPS)

The DOPS assesses the trainee's technical, operative and professional skills in a range of basic diagnostic and interventional procedures during routine surgical practice in wards, outpatient clinics and operating theatres. The procedures reflect the common and important procedures. Trainees are assessed against the standard for the completion of core surgical training.

d) Multi-source Feedback (MSF)

The MSF assesses professional competence within a team working environment. It comprises a self- assessment and the assessments of the trainee's performance from a range colleagues covering different grades and environments (e.g. ward, theatre, out-patients). Feedback is in the form of a peer assessment chart, enabling comparison of the self- assessment with the collated views received from the team and includes their anonymized but verbatim written comments. The supervisor should meet with the trainee to discuss the feedback on performance in the MSF. Trainees are assessed against the standard for the completion of their training level.

e) Procedure Based Assessment (PBA)

The PBA assesses advanced technical, operative and professional skills in a range of specialty procedures or parts of procedures during routine surgical practice in which trainees are usually scrubbed in theatre. The assessment covers pre-operative planning and preparation; exposure and closure; intra-operative elements specific to each procedure and post-operative management. The procedures reflect the routine or index procedures relevant to the specialty. The PBA is used particularly to assess the index procedures. Trainees are assessed against the standards.

f) Logbook

The logbook is tailored to each specialty and allows the trainee's competence as assessed by the DOPS and PBA to be placed in context. It is not a formal assessment in its own right, but trainees are required to keep a log of all operative procedures they have undertaken including the level of supervision required on each occasion using the key below. The logbook demonstrates breadth of experience which can be compared with procedural competence using the DOPS and the PBA and will be compared with the indicative numbers of index procedures defined in the curriculum.

g) **Portfolio**

A portfolio is a collection of products prepared by the resident that provides evidence of learning and achievement related to a learning plan. A portfolio typically contains written documents but can include video- or audio-recordings, photographs, and other forms of information. Reflecting upon what has been learned is an important part of constructing a portfolio. In addition to products of learning, the portfolio can include statements about what has been learned, its application, remaining learning needs, and how they can be met. In graduate medical education, a portfolio might include a log of clinical procedures performed; a summary of the research literature reviewed when selecting a treatment option; a quality improvement project plan and report of results; ethical dilemmas faced and how they were handled; a computer program that tracks patient care outcomes; or a recording or transcript of counseling provided to patients. Portfolios can be used for both formative and summative evaluation of residents. Portfolios are most useful for evaluating mastery of competencies that are difficult to evaluate in other ways such as practice-based improvement, use of scientific evidence in patient care, professional behaviors, and patient advocacy. Teaching experiences, morning report, patient rounds, individualized study or research projects are examples of learning experiences that lend themselves to using portfolios to assess residents.

h) Observation of Teaching (OoT)

The OoT assesses the trainee's ability to provide formal teaching. It can be based on any instance of formalized teaching by the trainee which has been observed by the assessor. Trainees are assessed against the standard for the completion of their phase of training.

Written/Oral Assessments

a) Objective Structured Practical Examination (OSPE)

Objective Structured Practical Examination (OSCE) will be held on the first day of the examination, for all the candidates declared eligible for clinical part of the relevant examination. Candidates will be sent information regarding the schedule of TOACS by the Examination Department. In the TOACS the candidates will be evaluated on procedures, clinical history & laboratory findings, instruments, etc. This component of examination will consist of 15 to 20 stations, 4-8 minutes per station arranged in the examination hall and the candidates will have to rotate through all of them in turn.

The TOACS stations will be of two types:

a) Observed /Interactive
b) Unobserved / Static

b) MCQ:

A written or computer-based MCQ examination is composed of multiple-choice questions (MCQ) selected to sample medical knowledge and understanding of a defined body of knowledge, not just factual or easily recalled information. Each question or test item contains an introductory statement followed by four or five options in outline format. The examinee selects one of the options as the presumed correct answer by marking the option on a coded answer sheet. Only one option is keyed as the correct response. The introductory statement often presents a patient case, clinical findings, or displays data graphically. A separate booklet can be used to display pictures, and other relevant clinical information. In computer-based examinations the test items are displayed on a computer monitor one at a time with pictures and graphical images also displayed directly on the monitor. In a computer-adaptive test fewer test questions are needed because test items are selected based upon statistical rules programmed into the computer to quickly measure the examinee's ability. Medical knowledge and understanding can be measured by MCQ examinations. Comparing the test scores on in-training examinations with national statistics can serve to identify strengths and limitations of individual residents to help them improve. Comparing test results aggregated for residents in each year of a program can be helpful to identify residency training experiences that might be improved.

c) **Short Answer Questions**

Short-answer questions are open-ended questions that require students to create an answer. They are commonly used in examinations to assess the basic knowledge and understanding of a topic before more in-depth assessment questions are asked on the topic. It is very important that the assessor is very clear on the type of answers expected when setting the questions, because SAQ is an open-ended questions, students are free to answer any way they choose, short answer questions can lead to difficulties in grading if the question is not worded carefully.

d) Practical/Lab Techniques Assessment

The candidate will be assessed for hands on training acquired during the period to be assessed as individual lab techniques or as processing of samples, isolation and identification of pathogens, serological technique etc

e) Viva Voce

Will be conducted by team of examiners/ subject specialists to assess the knowledge, competencies, interpretation of findings and training as future microbiologist and researcher.

3 Assessment Scheme

1ST IN TRAINING ASSESSMENT (ITA) At the end of 1st Year Training (IN HOUSE)	MID-TERM ASSESSMENT (MTA) At the end of 2nd year Training (BY EXAM DEPARTMENT)	2ND IN TRAINING ASSESSMENT (ITA) At the end of 3rd year Training (IN HOUSE)	FINAL-TERM ASSESSMENT (FTA) At the end of 4th year Training (BY EXAM DEPARTMENT)
Written Paper MCQs: 50 marks SAQs: 6x5= 30 marks LEQs: 2x10= 20 marks **Practical Exam** Lab Techniques=40 marks OSPE: 6x5= 30 marks **Viva Voce** = 30 marks **Log Book (Internal Assessment)** = 100 marks	**Written Paper** (Year 1=50% and Year 2=50%) **Paper A** MCQs: 100 marks **Paper B** SAQs: 14x5= 70 marks LEQs: 3x10= 30 marks **Practical Exam** Lab Techniques=70 marks OSPE: 6x5= 30 marks **Viva Voce:** 100 marks **Log Book (Internal Assessment) =** 100 marks	**Written Paper** (In house) MCQs: 50 marks SAQs: 6x5= 30 marks LEQs: 2x10= 20 marks **Practical Exam** Lab Techniques=40 marks OSPE: 6x5= 30 marks **Viva Voce**: 30 marks **Log Book (Internal Assessment)** = 100 marks	**Comprehensive Qualifying Exam** Written, Clinical, and Thesis Written Paper **Paper A** MCQs: 100 marks **Paper B** SAQs: 14x5= 70 marks LEQs: 3x10= 30 marks **Practical Exam** Lab Techniques=100 marks OSPE: 10x5= 50 marks **Viva Voce:** 150 marks **Log Book (Internal Assessment)** 200 marks (average of four years) = 75% marks - for legibility to sit in FTA Thesis Defense = 200 marks
Total Marks= 300	**Total Marks = 500**	**Total Marks= 300**	**Total Marks= 900**
Pass Percentage = 50%	**Pass percentage = 60%**	**Pass percentage = 50%**	**Pass percentage = 60%**

4 Eligibility Criteria

1st in Training Assessment	Mid-Term Assessment	2nd in Training Assessment	Final Assessment
Certificate of Completion of: **1. 1st year training** **2. Workshops completion**: • Communication skills- 3 days • Computer & IT skills- 3 days • Synopsis writing -3 days • Research methodology & Biostatistics-3 days **Research:** • Allotment of synopsis topic by Supervisor and approval by DRB • Publication of one article in Resident Research Journal OR Statistical report of one disease • **CIA:** Minimum 75% marks certification by DME and Supervisor/s	**Certificate of completion of:** **1. 2nd year training.** **2. Passed First In Training Assessment** **3. Rotations completion** Hematology, Chemical Pathology, Histopathology and Molecular Biology **Research:** • Formulation of research synopsis with approval of ERB & BASAR by the end of 2nd year • **CIA**: Minimum 75% marks Certification by DME and Supervisor/s	**Certificate of completion of:** **3rd year training** **Passed Mid-term Assessment** **Rotations completion** **Research:** • Data collection • Data analysis & interpretation • Start writing thesis • **CIA**: Minimum 75% marks Certification by DME and Supervisor/s	**Certificate of completion of:** **4th year training** **Passed 2nd in Training Assessment** **Rotations completion** **Research/Thesis**: • Completion & submission of Thesis (6 months before completion of training) • Approval of Thesis by BASAR • Publication of one article in Resident Research Journal OR Statistical report of one disease • **CIA**: Minimum 75% marks Certification by DME and Supervisor/s • **FEE**: Evidence of submission of examination fee **No dues certificate:** submitted from all relevant departments

Final Assessment Schedule and Fee:

a. Final Assessment will be held twice a year
b. The candidates have to fulfil eligibility criteria before permission is granted to take the assessment
c. Assessment fee will be determined and varied at periodic intervals by the University
d. The Assessment fee once deposited cannot be refunded / carried over to the next assessment under any circumstances
e. The Controller of Examinations will issue an Admittance Card with a photograph of the candidate on receipt of prescribed application form, documents satisfying eligibility criteria and evidence of payment of assessment fee. This card will also show the Roll Number, date / time and venue of assessment.
f. The written part of assessment will be valid for three consecutive attempts for appearing in the Clinical and Oral Part of the Final Assessment. After that the candidates have to re-sit the written part of the Final Assessment.
g. The candidates will have two attempts to pass the final examination with normal fee. A special administration fee of Rs.10, 000 in addition to normal fee or the amount determined by the University from time to time shall be charged for further attempts

FINAL-TERM EXAMINATION (FTA)

a. Panel of four examiners will be appointed by the Vice Chancellor and of these two will be from RMU whilst the other two will be the external examiners. Internal examiner will act as a coordinator.
b. The internal examiners will not examine the candidates for whom they have acted as Supervisor and will be substituted by other internal examiner.
c. The candidates scoring 50% marks in each component of the Practical & Oral Examination will pass this part of the Final Examination.

Continuous Internal Assessments (CIA): 75%

Continuous Internal Assessments would be submitted by the supervisor considering the following:

A. Workplace Based Assessments: These assessments will include the following:
   - Generic and Specialty specific Competency Assessments
   - Multisource Feedback Evaluation
B. Assessment of Residents' Training Log Book & Portfolio

Declaration of Result:

For the declaration of result:

1. The Resident must get his/her Thesis accepted.
2. The Resident must have passed the final written examination with 50% marks and the clinical & oral examination securing 50% marks. The cumulative passing score from the written and clinical/ oral examination shall be 60%. Cumulative score of 60% marks to be calculated by adding up secured marks of each component of the Examination i.e., written and pratical & oral and then calculating its percentage.
3. The MD degree shall be awarded after acceptance of thesis and success in the final examination.
4. On completion of stipulated training period, irrespective of the result (pass or fail) the training slot of the candidate shall be declared vacant.

Submission / Evaluation of Synopsis

a. The Residents shall prepare their synopsis as per guidelines provided by the Board of Advanced Studies & Research, available on university website.
b. The research topic in clinical subject should have 30% component related to basic sciences and 70% component related to applied clinical sciences. The research topic must consist of a reasonable sample size and sufficient numbers of variables to give training to the candidate to conduct research, to collect & analyze the data.

c. Synopsis of research project shall be got approved by the end of the 2nd year of MD program. The synopsis after review by an Institutional Review Committee shall be submitted to the University for Consideration by the Board of Advanced Studies & Research, through the Principal / Dean /Head of the institution.

Submission of Thesis

1. Thesis shall be submitted by the candidate duly recommended by the Supervisor.
2. The minimum duration between approval of synopsis and submission of thesis shall be one year.
3. The research thesis must be compiled and bound in accordance with the Thesis Format Guidelines approved by the University and available on website.
4. The research thesis will be submitted along with the fee prescribed by the University.

Thesis Evaluation

a. The Resident will submit his/her thesis at least O6 months prior to completion of training.
b. The Thesis along with a certificate of approval from the supervisor will be submitted to the Registrar's office, who would record the date / time etc. and get received from the Controller of Examinations within 05 working days of receiving.
c. The Controller of Examinations will submit a panel of eight assessors within 07 days for selection of four examiners by the Vice Chancellor. The Vice Chancellor shall return the Final panel within 05 working days to the Controller of Examinations for processing and assessment. In case of any delay the Controller of Examination would bring the case personally to the Vice Chancellor.
d. The Supervisor shall not act as an examiner of the candidate and will not take part in defense of thesis.
e. The Controller of Examinations will make sure that the Thesis is submitted to examiners in appropriate fashion and a reminder is sent after every ten days.
f. The thesis will be evaluated by the examiners within a period of 06 weeks.
g. In case the examiners fail to complete the task within 06 weeks with 02 fortnightly reminders by the Controller of Examinations, the Controller of Examinations will bring it to the notice of Vice Chancellor in person.
h. In case of difficulty in find an internal examiner for thesis evaluation, the Vice Chancellor would, in consultation with the concerned Deans, appoint any relevant person as examiner in supersession of the relevant Clause of the University Regulations.
i. There will be two internal and two external examiners. In case of difficulty in finding examiners, the Vice Chancellor would, in consultation with the concerned Deans, appoint minimum of three, one internal and two external examiners.
j. The total marks of thesis evaluation will be 200 and 60% marks will be required to pass the evaluation.
k. The thesis will be considered accepted, if the cumulative score of all the examiners is 60%.

l. The clinical training will end at completion of stipulated training period but the candidate will become eligible to appear in the Final Examination at completion of clinical training and after acceptance of thesis. In case clinical training ends earlier, the slot will fall vacant after stipulated training period.

Award of MD MICROBIOLOGY Degree

After successful completion of the structured course of MD DIAGNOSTIC MICROBIOLOGY and qualifying Mid-term, Final Assessment and Thesis Defense, the degree with title MD DIAGNOSTIC MICROBIOLOGY Degree shall be awarded.

SECTION 7: CURRICULUM EVALUATION

Curriculum evaluation is an important part of curriculum development. Two basic stages of curriculum evaluation are process evaluation and product evaluation. Most important aim is to evaluate if the main goals or objective have been met in order to understand and make further improvements to the curriculum.

COURSE WORK, HANDS ON TRAINING AND RESEARCH WORK

YEAR-WISE CREDIT HOURS DISTRIBUTION

Year of Study	Courses	Credit hours
Year 1	**Theory:** Microbiology (Bacteriology, Virology, Mycology, Parasitology, Immunology) **Practical:** Basic Lab Techniques and Use of Equipment **Research:** Literature Review and Topic Selection and Approval	30(14+14+2) CrHrs
Year 2	**Rotations in Related Specialties** (Theory and Hands on Practical Training) Hematology Histopathology Chemical Pathology Molecular Biology **Research**: Synopsis Writing and Approval from ERB and BASAR	30(11+15+4) CrHrs 7 (3+4) 7 (3+4) 7 (3+4) 5 (2+3)
Year 3	**Theory:** Clinical Microbiology discussion for sample collection, transport, processing, isolation & identification of Pathogens, Reporting of results (Bacteriology, Virology, Mycology, Parasitology, Immunology) **Practical Hands on Training** Supervised Lab Bench Work for sample collection, transport, processing, isolation& identification of Pathogens, Reporting of results **Research:** Research and Data Analysis	30(8+15+7) CrHrs
Year 4	**Theory:** Recent Advances in Microbial Diagnostics (Bacteriology, Virology, Mycology, Parasitology, Immunology) **Practical Hands on Training** Lab Bench Work for sample collection, transport, processing, isolation& identification of Pathogens, Reporting of results **Research:**	30(7+16+7) CrHrs

	Publication, Thesis Writing, Approval and Defense	

Total program Credit Hours 120 Cr Hrs

- Theory 40 Cr Hrs
- Practical Hands on Training 60 Cr Hrs
- Research 20 Cr Hrs

COURSES, COURSE CODES AND CREDIT HOURS

S #	Courses	Course Codes	Credit Hours
1	General Bacteriology	BAC-701	**1**
2	Microbial Genetics	MIG-702	**1**
3	Antimicrobials and AST	AMC-703	**2**
4	Systemic Bacteriology	BAC-703	**5**
5	Immunology	IMM-704	**1**
6	Virology	VIR-705	**1**
7	Parasitology	PAR-706	**2**
8	Mycology	MYC-707	**1**
9	Molecular Biology	MB-708	**3**
10	Environmental Microbiology	ENV-709	**1**
11	Food Microbiology	FM-710	**1**
12	Clinical Microbiology	CLM-711	**2**
13	Quality Assurance in Laboratory Medicine	QLM-712	**2**
14	Recent Advances in Microbiology	RAM-713	**1**
15	Biosafety and Biosecurity	BBS-714	**1**
16	Infection Prevention and Control	IPC-715	**2**
17	Research Methodology	RSM-716	**2**
18	Computer skills	CS-717	**2**
19	Biomedical Ethics	BME-718	**1**
20	Medical Education	MED-719	**1**
21	Biostatistics and Bioinformatics	BST-720	**2**
22	Workshops		**2**
23	Journal Clubs		**2**

Course Title: General Bacteriology (2 credit hours)

LEARNING OUTCOMES

1. Understand basic concepts of bacterial structure, functions, metabolism, growth and nutrition
2. Learn about the molecular mechanisms by which bacteria cause infections.
3. Explore how bacteria interact with host cells and tissues during infection.
4. Understand the role of virulence factors in bacterial pathogenesis.

COURSE CONTENTS

- History of Microbiology
- Morphology of bacteria and other microorganisms
- Normal flora of human body
- Bacterial metabolism
- Bacterial virulence factors
- Nomenclature and classification of microorganisms
- Growth & nutrition of bacteria
- Bacterial metabolism
- Host parasite relationship
- Nosocomial infection

Course Title: Microbial Genetics (1 Credit Hour)

LEARNING OUTCOMES

The course deals with following goals

1. Organization and structure of microbial genomes
2. Concept of genome stability and plasticity
3. Methods of genetic recombination and gene transfer
4. To teach students various classical method of gene mapping in microbes

COURSE CONTENTS

- Prokaryotic microbial genomes (archaea and bacteria)
- Core genome versus pan genome
- Chromosomal islands
- Genome stability and horizontal gene transfer
- Mobile elements and genome evolution
- Plasmids and episomes: genetic structure and types
- Replication of circular plasmids
- Replication of linear plasmids
- Plasmid copy number and partitioning system
- Plasmid incompatibility
- Davis's U-tube experiment and bacterial conjugation
- Mapping bacterial genes with interrupted conjugation
- Mathematical problems for bacteria gene mapping based on
- interrupted conjugation
- Role of transfer (tra) operon in transfer of genetic material
- Molecular mechanism of conjugation in gram negative bacteria
- Molecular mechanism of conjugation in gram positive bacteria
- Transfer of genetic material from Agrobacterium tumefaciens to dicot plants
- Transposons: structure and function
- Composite and complex transposons (Tn10 and Tn3 transposable elements)
- Replicative and non-replicative transposition
- Conjugative transposons
- Regulation of transposition
- Integrons and insertion sequences
- Genetic recombination
- Molecular mechanism of genetic recombination (Holliday junction formation)

- Transformation and competence
- Transformation in gram positive bacteria (Streptococcus and Bacillus)
- Transformation in gram negative bacteria (Neisseria and Haemophilus)
- Transduction and phages
- Generalized and specialized transduction
- Gene mapping in phages
- Transduction: using phages to map bacterial genes
- Mathematical problems for bacterial gene mapping based on phage biology
- λ phage: genome and life cycle
- λ phage: genome insertion and excision
- λ phage: genetic control of lytic and lysogenic cycle
- T4 phage: genome and life cycle
- T4 phage: general pattern of gene expression
- μ phage: genome and life cycle
- μ phage: transposition as a lifestyle
- Single stranded DNA phages (M13)
- Molecular mechanisms of phase variation
- Gene transfer mechanisms in archaea
- Gene expression in archaea
- Eukaryotic microbial genomes (yeast, micro-algae and protozoa)
- Budding yeast genetics: Mendelian inheritance and tetrad analysis
- Numerical problems dealing with tetrad analysis in yeast

Course Title: Antimicrobials and AST (2 Credit Hours)

Course Title: Systematic Bacteriology (4 credit hours)

LEARNING OBJECTIVES

Learn and understand classification, morphology, diseases caused, mode of transmission, pathogenesis, symptoms and signs, laboratory diagnosis, antimicrobials, prevention and control of pathogenic bacteria belonging to various genera and species

COURSE CONTENTS

- Gram positive cocci of medical importance including
  - Staphylococci and streptococci
- Gram negative cocci and coccobacilli including:
  - Neisseria
  - Morexella
  - Haemophilus
  - Bordetella
  - Francisella
  - Brucella
  - Pasteurella
- Gram positive aerobic bacilli including:
  - Listeria
  - Bacillus
  - Corynebacterium
- Gram positive anaerobic bacilli including:
  - Clostridia
- Gram negative bacilli of medical importance including:
  - Enterobacteriaceae
  - Helicobacter

    - Camphylobacter
    - Vibrios
    - Aeromonas
    - Gardnerella
    - Pseudomonas
- Bacteriodes, anaerobic gram negative bacilli
- Mycobacteria
- Spirochaetes including Treponema, Borrelia, Leptospira
- Chyamydiae
- Mycoplasma and Ureaplasma
- Rickettsiae, Coxiella, Bartonella
- Actinomycetes & Nocardia

Course Title: Immunology (1 credit hour)

LEARNING OBJECTIVES

1. Learn and understand why immunology is crucial for maintaining human health
2. Learn about the two main types of immune responses: "innate" and "acquired" (or "adaptive")
3. Antigen-Antibody reactions in vivo and in vitro
4. Immunopathologies including hypesensitivity reactions, immunodeficencies, autoimmune disorders, organ transplantation etc

COURSE CONTENTS

- Components of immune system
- Innate and acquired immunity
- Humoral and Cell mediated immunity
- Cells & organs involved in immune response
- Antigens

- Immunoglobulins
- Antigen & antibody reactions
- Complement in health and disease
- Cytokines
- Hypersensitivity
- Immunodeficiency
- Autoimmune disorders
- MHC and Transplant Immunity
- Tumor immunity
- Vaccines and immunotherapy
- Immunological techniques

Course Title: Virology (1 credit hour)

LEARNING OBJECTIVES

5. Learn and understand classification, morphology, diseases caused, mode of transmission, pathogenesis, symptoms and signs, laboratory diagnosis, antivirals, prevention and control of pathogenic viral belonging to various genera and species
6. Explore how infection and replication of viruses are constrained by the viral genome and host immune defenses.

COURSE CONTENTS

- General properties of viruses
- Classification of viruses
- Morphology: Virus structure
- Virus replication
- DNA viruses of medical importance including:
  - Poxviridae,
  - Herpesviridae,
  - Adenoviridiae,

- Hepadna virus
- RNA viruses of medical importance including:
  - Enteroviruses,
  - Human immunodeficiency virus,
  - Arboviruses,
  - Coronaviridae,
  - Calci viruses,
- Oncogenic viruses

Course Title: Parasitology (2 credit hours)

LEARNING OBJECTIVES

1. Learn about the different types of parasites, their classification, and their taxonomic relationships.
2. Study the parasites that commonly infect humans and cause diseases. Understand their life cycles, modes of transmission, and clinical manifestations.
3. Understand diagnostic procedures used in parasitology laboratories.
4. Explore how parasites affect human health.
5. Understand their pathogenic mechanisms, disease outcomes, and potential interventions.

COURSE CONTENTS

- General characters & classification of parasites
- Protozoan parasites of medical importance including:
  - Entamoeba histolytica free living amoebae,
  - Giardia
  - Trichomonas
  - Leishmania
  - Trypanosoma
  - Plasmodium
  - Toxoplasma

    - Cryptosporidium
    - Microsporidium
- Helminths of medical importance including those belonging to:
    - Cestodes:
        - Diphyllobothrium
        - Taeni
        - Echinococcus
        - Hymenolepis
        - Dipylidium
    - Trematodes:
        - Schistosomes
        - Fasciola
        - Fasciolopsis
        - Paragonimus
        - Clonorchis
        - Opisthorchis
    - Nematodes:
        - Trichuris
        - Trichinella
        - Strongyloides
        - Ancylostoma
        - Necator
        - Ascaris
        - Toxocara
        - Enteropbius
        - Filarial worms
        - Dracunculus

Course Title: Mycology (1 credit hour)

LEARNING OBJECTIVES

- Understanding Fungal Biology and Taxonomy:

- Learn about the structural, physiological, genetic, and growth characteristics of fungi.
- Understand the principles and schemes used to classify fungi into different groups.
- Explore fungal anatomy, life cycles, and unique characteristics of major fungal groups.

COURSE CONTENTS

- General characteristics & classification of fungi
- Morphology & reproduction of fungi
- Isolation and identification of fungi
- Tissue reactions to fungi
- Common laboratory contaminant fungi

- Yeasts and yeast like fungi of medical importance including:
  - Candida,
  - Cryptococcus,
  - Malassezia,
  - Trichosporon, Saccharomyccs

- Mycelia fungi of medical importance including:
  - Aspergillus,
  - Zygomycetes,
  - Pseudoallescheria,
  - Fusarium,
  - Piedra,
  - Other dematiaceous hyphomucetes
  - Other hyalohyphomycetes etc.

- Dimorphic fungi including:
  - Histoplasma,
  - Blastomyces,
  - Coccidioides,
  - Paracoccidiodes,
  - Sporothrix,

- Penicillium marneffei

- Dermatophytes
  - Trichphyton
  - Epidermophyton
  - Microsporum

Course Title: Molecular Biology: Theory and Techniques

Course Code: (MB-001) = 3 Cr Hrs

LEARNING OBJECTIVES

Upon completion of course work the students should be able to have strong practicalknowledge and practical hands-on training in:

1. DNA structure and function
2. Know about molecular genetics and how DNA and RNA work
3. Recognize the comparison of prokaryotic and eukaryotic genes and genomes.
4. The language of genetics and the terminology of molecular biology
5. Know about the gene regulation and gene expression.
6. Understand the processes of transcription and translation

COURSE CONTENTS

The course contents will include;

- DNA - the Genetic Code, Structure, Replication, and Manipulation of DNA
- The Chromosomal Basis of Heredity
- Gene Linkage and Genetic Mapping
- Human Karyotypes and Chromosome Behavior
- The Genetics of Bacteria and Viruses
- DNA packaging in chromatin and regulation of chromatin structure
- Structure of chromosomes
- DNA replication
- Central Dogma of Molecular Biology
- Molecular Mechanisms of Prokaryotic Gene Regulation (Gene Expression)
- Molecular Mechanisms of Eukaryotic Gene Regulation (Gene Expression)
- DNA repair including description of types of DNA damage, various DNA polymerases anddifferent types of repair
- Transposable DNA elements

- Gene Mutation & Mechanisms of Mutation
- Reverse Transcriptase
- Recombinant DNA Technology
- Tumor Suppressor Genes
- PCR & RT-PCR
- Blotting Techniques
- Cell /tissue Culture/Cell line
- Gene Annotation
- Oncogenes
- Genomics, Transcriptomics, Proteomics
- Bionanotechnology
- Biosensors
- Molecular Typing Techniques: State of the Art
- Nonamplified Probe-Based Microbial Detection and Identification

Practical Lab Work

- Extraction and purification of nucleic acids from different sources (bacteria, blood,human tissues) etc.
- Qualitative and quantitative analysis of nucleic acids
- PCR
    - PCR and Its Variations
    - Real-Time and Digital PCR for Nucleic Acid Quantification
    - Multiplex PCR for Detection and Identification of Microbial Pathogens
    - How PCR primers are designed, and how to add desirable sequences to PCR products using primer modifications.
- Blotting Techniques
    - Southern Blotting
    - Western Blotting
    - Northern Blotting
    - Gel electrophoresis
    - Phylogenetic analysis
    - *In silico* estimate of population genetic structure to the use of DNA-based phylogenies in conservation genetics

Course Title: Environmental
Course Code: EFM-002 = 1 Cr Hr

LEARNING OBJECTIVES

Upon completion of course work the students should be able to have strong theoreticalknowledge and practical hands-on training in:

COURSE CONTENTS

- Environmental Microbiology and Ecosystem
- Microorganisms Found in the Environment
- Earth Environments
- Recent advances in Microbiological waste treatment methods -
- Activated Sludge Process
- Anaerobic sludge digestion
- Root zone technology
- Microbial biosorption technology
- Mass scale production of Effective Microorganisms (EM) for waste treatment.
- Economics of waste treatment
- Hot springs, acid springs and lakes
- Microbial life in hyper saline environments – Eco physiological aspects, sea and salt lakes.
- Microbial life at low temperatures
- Microbiology to 10,500 meters under the deep sea.
- Anaerobic Microorganisms – Eco physiological aspects, principles and techniques for the isolation, enumeration and identification of Methanogens,

- Dissimilatory Sulphate reducing and Anoxygenic Phototrophic bacteria
- Geomicrobiological processes – physiological and biochemical aspects,
- Methods in Geomicrobiology. Biodiversity as a source of innovation in Biotechnology
- Microorganisms and Organic Pollutants
- Microorganisms and Metal Pollutants
- Bioremediation.
- Environmental Sample Collection and Processing
- Microscopic Techniques
- Indicator Microorganisms: Total Coliforms and Fecal Coliforms and Escherichia coli.
- Municipal Wastewater Treatment, Drinking Water Treatment

Course Title: Food Microbiology (1 Credit Hour)

LEARNING OUTCOMES

1. To know about food contamination by microorganisms
2. To learn about food spoilage by microorganisms
3. Preservation of food products & Control of microbial spoilage
4. Fermentation and fermented Food products
5. Food borne infections and intoxications

COURSE CONTENTS

- Microbiology of Primary Food Commodities
- Food Microbiology and Public Health
- Bacterial Agents of Foodborne Illness
- Non-bacterial Agents of Foodborne Illness
- Fermented and Microbial Foods
- Controlling the Microbiological Quality of Foods
- Micro-organisms and Food Materials
- Factors Affecting the Growth and Survival of Micro-organisms in Foods
- Storage and transportation of food products
- Equipment used in Food Microbiology Laboratory

- Methods for the Microbiological Examination of Foods
- Milk Microbiology
  - Methylene Blue Reduction test for Milk quality
  - Resazurin Test for Milk quality
  - Determination of coliform bacteria from milk
- Drinking Water Microbiology: Lab Testing
- Probiotics and Prebiotics

Course Title: Clinical Microbiology (2 credit hours)

LEARNING OBJECTIVES

1. Gain knowledge about the field of clinical microbiology.
2. Explore the diagnostic methods used to identify bacterial pathogens in clinical samples.
3. Learn about the importance of accurate microbiological diagnosis in patient care.
4. Study the modes of bacterial transmission (e.g., direct contact, airborne, waterborne).
5. Explore strategies for preventing the spread of bacterial infections.
6. Addresses the transmission and control of pathogens, epidemiology, determination of the significance of isolates, and safety issues in the clinical microbiology laboratory.

COURSE CONTENTS

- Sources of Infections
- Modes of Transmission of Infections
- Epidemiology of infectious diseases
- Respiratory tract infections
- Infections of ear, nose and throat
- Urinary tract infections
- Central nervous system infections
- Congenital infections
- Reproductive tract infection
- Sexually transmitted diseases

- Gastrointestinal infection
- Hepatitis
- Pyrexia of unknown origin
- Infections of eye
- Infections of cardiovascular system
- Hemorrhagic fevers
- Emerging & Reemerging infections disease
- Opportunistic infections
- Hospital acquired infections
- Investigation of an infectious outbreak

➢ Collection, Transport, processing for bacterial, fungal, viral, parasitic & immunological diagnosis and reporting of:

- Respiratory tract samples
- ENT samples
- Urine samples
- Cerebrospinal fluid samples
- Blood samples
- Reproductive tract samples in males and females
- STI samples
- Gastrointestinal tract samples
- Hepatitis
- Samples for PUO diagnosis
- Eye samples
- CVS samples
- Indwelling devices samples
- Samples for hemorrhagic fevers diagnosis
- Emerging & Reemerging infections disease
- Opportunistic infections diagnosis
- Hospital acquired infections diagnosis
- Investigation of an infectious outbreak
- Molecular diagnosis of infectious diseases

Course Title: Quality Assurance in Laboratory Medicine

Course Code: QAM-001 = 1 Cr Hr

LEARNING OBJECTIVES

Upon completion of course work the students should be able to have strong practicalknowledge and practical hands-on training in:

COURSE CONTENTS

- Quality Assurance and Quality Control
- WHO Components of Quality Control program
- Monitoring Laboratory Equipment
  - Refrigerators
  - Incubators
  - Autoclaves
  - Hot Air Ovens
  - Biosafety Cabinets
  - Automated Systems
  - Pipettes
  - Centrifuges
  - Microscopes
- Monitoring Culture Media, Reagents and Supplies

- Monitoring Continuous Staff Training
- Monitoring of Infection Control practices in Lab
- Monitoring of Lab Waste Disposal
- Internal Quality Control Program
- External Quality Control program

Course Title: Recent Advances in Microbiology (1 Credit Hours)

Course Code: AMMB-002 = 1 Cr Hr

LEARNING OUTCOMES

This advanced course aims to provide a comprehensive, well-referenced, and up-to-date description of these rapidly evolving advanced methods for the diagnosis of infectious diseases in the routine clinical as well as research microbiology laboratory.

COURSE CONTENTS

Recent Advances and Future Approaches in:

- Diagnosis of bacterial infections
- Diagnosis of viral infections
- Diagnosis of fungal infections
- Diagnosis of parasitic infections
- Immunological Techniques
- Vaccine development
- Molecular Techniques
- Raman and Fluorescent Spectroscopy in Microbiology
- Study and Characterization of probiotics
- Non-antibiotic Antimicrobials
- Flow Cytometry
- Mass Spectrometry-Based Proteomics Studies
- Metagenomic studies for Pathogen Detection and Identification
- Transcriptomic Techniques in Diagnostic Microbiology
- Artificial intelligence and machine learning

- Nanotechnology
    - Basic concepts of nanotechnology
    - Overview of history of nanotechnology
    - Basic concept of Nanotechnology driven instruments and their practical implications
    - Types and varieties of nanoparticles
    - Advancements in nanotechnology
    - Applications of nanotechnology in the field of medicine and surgery
    - Antimicrobial activity of nano-particles
    - Bioremediation through nanoparticles
    - Surface modifications of gold nanoparticles

Course Title: Biosafety and Biosecurity in Labs (1 Credit Hour)

Course Code: BBM-001 = 1 Cr Hr

LEARNING OUTCOMES

Upon completion of course work the students should be able to have strong theoreticalknowledge and practical training in:

1. Understand the importance of biosafety levels
2. Comprehend the use and significance of personal protective equipment
3. Apply biosafety to plan and conduct research
4. Analyze and assess current biosafety practices
5. Analyze the potential bio risks associated with biotechnology and molecular genetics research.
6. Comprehend basic biosecurity principles which guide bioscience research
7. Apply the basic concepts of biosecurity on real life issue.
8. To provide a coordinated approach to the prevention and management of infections.
9. To provide available current evidence built on existing international guidelines and reviews

COURSE CONTENTS: BIOSAFETY

- History of biosafety microbiology and molecular biology
- Risk assessment
- Biosafety levels
- Biosafety Cabinet: design, operation, use, and misuse

- Sharps Safety
- Containment Directional Airflow, cross contamination etc
- Fire detection and control systems
- Laboratory Security, Safety Equipment & Emergency Response
- Mental health awareness
- International biosafety
- Routes of exposure
- Laboratory facilities and safety equipment
- Safe handling of biological spills
- Report of accidents
- Biosafety measures for TB lab
- Transport of Infectious Material
- Hazardous chemicals
- Electrical Hazards
- Noise
- Ionizing radiation
- Establishment of National Biosafety Committee
- Technical advisory committee
- Safety for support staff
- Training programs
- Safety checklist
- First aid
- Immunization of staff
- WHO biosafety collaborating centers
- OSHA guidelines

COURSE CONTENTS: BIOSECURITY

- International framework on Biosafety and Biosecurity
- US biosecurity regulations
- US biosecurity guidance
- Design biosecurity plan

- Objectives of lab biosecurity
- Biosecurity and bioterrorism
- International obligations
- Pakistan biosecurity system
- Components of biosecurity
- Physical security elements
- Integration with lab biosafety
- Personnel security elements
- Accountability Elements
- Application of National Biosafety rules
- Permission and approval for Food Stuff
- Pakistan Bio-safety Measures and National legislations implementation
- Integrated pest management
- Biosafety and biosecurity in microbiology lab
- Biosafety and biosecurity in Nanotechnology
- Biosafety and biosecurity in cybernetics
- Biosecurity education for the next generation of life scientists

Course Title: Infection Prevention and Control (2 Credit Hours)

LEARNING OUTCOMES

1 To provide a coordinated approach to the prevention and management of infections.
2 To provide available current evidence built on existing international guidelines and reviews

COURSE CONTENTS

- Infection control committee and infection control team
- Healthcare objectives
- Infection control measures
- Surveillance of healthcare associated infections and hospital environment
- Infection control measures (Airborne, droplet, contact precautions)

- Universal infection control screening
- Screening of patients for routine evaluation of infection
- Personal protection of patient and healthcare workers
- Surface and equipment cleaning, decontamination and disinfection.
- Instrument sterilization
- Asepsis
- Appropriate disposal of contaminated waste including sharps.
- Occupational health and safety.
- Infection control in outbreaks
- Cleaning, disinfection and sterilization
- Prevention and control of healthcare associated infections
- Checklist for effectiveness of interventions
- Organization of training programs for healthcare workers
- Hygiene and safety products
- Waste management
- Control of nosocomial infections in hospital settings

Course Title: Research Methodology and Medical Writing
Course Code: RMW-802
Credit Hours = 02

RESEARCH METHODOLOGY (1.5 Credit Hours)

LEARNING OUTCOMES

- Demonstrate the ability to choose methods appropriate to research aims and objectives.
- Understand the limitations of particular research methods.
- Develop skills in qualitative and quantitative data analysis and presentation. Develop advanced critical thinking skills.

COURSE CONTENTS

Module Components and Duration

Sr.#	Components	Duration in hours
1	Introduction to research, its process and types	2
2	Selection and formulation of research problem / question	2
3	Quantitative research	2
4	Qualitative research	2
5	Mixed method research	2
6	Data collection Procedure	2
7	Analyzing quantitative and qualitative research data	3
8	Sample size calculation	2
9	Standard guidelines for each study design	2
10	How to make a research proposal	3
11	Guide / Key to selecting and justifying the test of significance	2

Detailed Learning Outcomes

Sr.#	Content	Learning Outcomes

1	Introduction to research, its process and types	By the end of lecture, students should be able to: • Define research • Illustrate the need for research nowadays • Enlist and discuss the types of research • Discuss the scope and steps of Health System Research (HSR) • Describe the research process
2	Selection and formulation of research problem / question & Objectives	• Do literature search • Identify the key health problems of the community • Critically appraise research manuscripts • Formulate a research problem or question • Justify their research question • Formulate research objectives
3	Quantitative & Mixed method research	• Describe the characteristics of quantitative research • Differentiate between qualitative and quantitative research
4	Qualitative research	• Discuss the requisites for qualitative research • Enlist the variables for qualitative research • Plan for qualitative research from real life example
5	Mixed method research	• Elaborate the attributes of mixed method research • To plan and execute a mixed method research
6	Data collection procedure	• Elaborate data collection methods used for qualitative and quantitative research • Describe various data collection tools used in research • Discuss advantages and disadvantages of different types of questionnaires • Present the data collection procedure for their own research
7	Analyzing quantitative and qualitative research data	• Elaborate differences between qualitative and quantitative data analysis • Discuss the use of descriptive and inferential statistics • Analyze dummy data in classroom and present it
8	Sample size calculation	• Comprehend the key principles for sample size calculation • Discuss the use of WHO sample size calculator or OpenEpi software for justifiable sample size calculation

		• Calculate sample size for their own research and justify it
9	Standard guidelines for each study design	• Discuss CONSORT checklist for clinical trials • Describe STROBE checklist for cross-sectional, case control and cohort studies • Illustrate PRISMA checklist for systematic reviews and meta-analysis • Explain STARD checklist for diagnostic researches
10	How to make a research proposal	• Enlist and describe the components of a research proposal • Discuss the types and importance of research proposal • Describe common errors in a research proposal • Evaluate a research proposal • Draft their own research proposal
11	Guide / Key to selecting and justifying the test of significance	• Discuss the selection of an appropriate test of significance depending on the type of data • Able to apply test in SPSS and interpret the P-value for their own research data • Review the articles in Journal club session and justify the selection of test of significance

MEDICAL WRITING MODULE (0.5 Credit Hour)

LEARNING OUTCOMES

By the end of this course, PhD candidates will be able to:

1. Understand the importance of medical journalism in disseminating research findings.
2. Navigate medical literature effectively, including searching for, evaluating, and critically appraising research articles.
3. Demonstrate proficiency in scientific writing, adhering to international guidelines and best practices.
4. Recognize and address ethical considerations in medical journalism, including authorship and contributorship guidelines.
5. Understand the editorial process and strategies for successful publication in medical journalism.
6. Utilize relevant software tools for medical writing, including reference software, grammar checkers, and AI-assisted writing tools.
7. Apply acquired knowledge and skills to format a study according to editorial guidelines and publish it through an online journal system.

COURSE CONTENTS

Session 1: Introduction to Medical Journalism *Duration: 1 Hour*

Description: This session provides an overview of the significance of medical journalism in the dissemination of research, focusing on its role in the context of Pakistan. It also covers the historical evolution of medical journalism in the country.

Learning Objectives:

- Explain the importance of medical journalism in disseminating research findings.
- Describe the historical context and evolution of medical journalism in Pakistan.

Session 2: Navigating Medical Literature *Duration: 1 Hour*

Description: This session focuses on equipping participants with the skills to search for, evaluate, and understand different types of medical literature. Additionally, it introduces critical appraisal techniques for research articles.

Learning Objectives:

- Demonstrate effective strategies for searching and evaluating medical literature.
- Differentiate between various types of studies.
- Apply critical appraisal techniques to assess research articles.

Session 3: Basics of Scientific Writing *Duration: 1 Hour*

Description: This session delves into the recommendations and guidelines for scientific writing, including the IMRAD format. Participants will learn about common pitfalls to avoid and best practices to follow in scientific writing.

Learning Objectives:

- Discuss the recommendations for scientific writing as outlined by the International Committee of Medical Journal Editors.
- Outline the IMRAD format and its significance in scientific writing.
- Identify common pitfalls and employ best practices in scientific writing.

Session 4: Policies and Ethical Considerations in Medical Journalism *Duration: 1 Hour*

Description: This session addresses ethical issues in medical journalism, particularly focusing on authorship and contributorship guidelines. Participants will explore various ethical considerations that arise in the field.

Learning Objectives:

- Analyze ethical issues pertinent to medical journalism.
- Understand authorship and contributorship guidelines.

Session 5: Publishing *Duration: 1 Hour*

Description: This session provides insights into the editorial process and offers tips for successful publication in medical journalism. Participants will gain

an understanding of what editors look for and how to enhance their chances of publication.

Learning Objectives:

- Understand the editorial process in medical journalism.
- Apply strategies for successful publication.

Session 6: Software for Medical Writing *Duration: 1 Hour*

Description: This session introduces participants to various software tools relevant to medical writing, including reference management software, grammar checkers, and AI-assisted writing tools.

Learning Objectives:

- Utilize reference software such as Zotero for managing citations.
- Utilize grammar check software such as Grammarly to improve writing quality.
- Explore AI tools like ChatGPT for assistance in medical writing tasks.

Capstone Assignment: *Duration: 2 Hours*

Description: Participants will format a study according to editorial guidelines discussed throughout the course and upload it onto the Online Open Journal System, demonstrating their ability to apply learned concepts and skills to real-world scenarios.

Learning Objectives:

- Format a study according to editorial guidelines.
- Upload a study onto the Online Open Journal System.

Course Title: Computer Skills

Course Code: CS-001 = 1 Cr Hr

LEARNING OUTCOMES

Upon completion of course work the students should be able to have strong practical knowledge and practical hands-on training in the analytical tools required during the PhDCourse and to develop computational skills.

COURSE CONTENTS

- Basic Concepts of Computer
- History of Computer
- Concept of Computer hardware
- Concept of Computer languages
- Microsoft Word
- Concept of Computer Software e.g. SPSS
- Computer applications in Biology Spreadsheet tools
- Introduction to spreadsheet applications, features, using formulas and functions
- Data storing
- Features for Statistical data analysis
- Generating charts / graph and other features
- Microsoft Excel
- Presentation tools: Introduction, features and functions,
- Presentation of Power Point Presentation, customizing presentation, Showing presentation, Tools – Microsoft Power Point or Similar
- Web Search: Introduction to Internet, Use of Internet and WWW
- Use of search engines
- Biological data basis

Course Title: Biomedical Ethics (01 Credit Hour)

LEARNING OUTCOMES

By the completion of the course the candidate should be able to:

i. Describe the basic principles of biomedical ethics to include: Beneficence, Non-maleficence, truth telling, justice, autonomy, confidentiality and patients' centeredness.
ii. Know the historical aspects of medical ethics and their importance, such as Hippocratic- oath and Abu Ali Sina's contributions in medical ethics.
iii. Learn how breaches in ethics in recent past, e.g. Tuskegee studies, Willow-brook Experiment, etc. lead to modern day ethics, i.e. Helsinki Code of Medical Ethics, Nuremberg Code and Belmont's report, etc.
iv. Correlate principles of biomedical ethics with relevant teachings of Islam, narrated in the Holy Quran and the 'Hadith' of Prophet Mohammad (Peace and blessings be upon him).
v. Understand the individual patient and his/her family rights, respect and dignity.
vi. Apply ethical principles in the allocation of health care resources and in the formulation of health care policy.
vii. Explain the ethical values relevant to communicable diseases and public health.
viii. Learn specific ethical issues of children, adolescents, elderly persons and mentally ill patients.
ix. Appreciate the ethical concerns of end of life care, euthanasia and teachings of Islam therein.
x. Elaborate the ethical dilemmas of reproductive ethics relevant to family medicine, contraception, abortion and application of Artificial Reproductive Technologies (ARTs) and know the Islamic guidelines concerning these issues.
xi. Understand and apply the ethics of organ donation and transplant and teachings of Islam therein.
xii. Follow the standards outlined in the recommendations of Pakistan Medical & Dental Council (PMDC), World Health Organization (WHO) and World Forum of Medical Ethics (WFME) for the practice of medicine and its expression in the clinical encounter between a patient and a physician.

Course outcomes

It is expected that teaching of biomedical ethics to PhD Clinical Sciences scholars would lead to:

i. Improvement in dealing with patients in terms of morals & ethics, i.e. in Patient-Doctor relationship.
ii. Enhancement in the capabilities of physicians in patient care and decision making.
iii. Equity in the distribution of health care resources.
iv. Upgrading the knowledge of doctors to deal with children, adolescents, elderly, and mentally ill patients.
v. Appropriate dealing with terminally ill patients (Including Euthanasia).
vi. Appreciation and adaptation of ethical principles relevant to communicable diseases and public health.

vii. Development of ethics culture in Reproductive Health, and Organ donation and Transplant.
viii. Increase in the knowledge and application of Islamic teachings in various ethical issues.

COURSE CONTENTS

The course contents have been formulated to complete in 2 credit hours (or 32 teaching hours) and include the description of basic principles of biomedical ethics and various other important ethical issues encountered by the physicians.

For the convenience of implementation, various topics have been divided into 8 sessions (0.25 credit hour each), which can be placed as four sessions (One credit hour) in 1st and 2nd semester. The distribution of topics in various sessions, teaching hours and learning objectives are given in Table 1.

Session (credit hours)	Topics & contact hours	Teaching hours	Learning Objectives
Session-1 (0.25)	**Lectures/LGIS (One hour each)** 1. Introduction, Hippocratic oath & historical aspects. 2. Basic Principles of Medical Ethics (Beneficence, Non-maleficence, Justice, Respect for Patient's Autonomy, Truth & Confidentiality, and their Islamic perspectives.	2 hours	**PhD scholars should be able to:** 1. - Explain meaning, definition, of biomedical ethics. - Describe historical landmarks of medical ethics, such as Hippocratic oath & Abu Ali Sina's contributions. - How breaches in ethics in recent past, e.g. Tuskegee studies, Willow-brook Experiment, etc. lead to modern day ethics, i.e. Helsinki Code of Medical Ethics, Nuremberg Code and Belmont's report, etc. 2. - Describe definitions and important features of basic principles of biomedical ethics. - Narrate relevant teachings in Quran Karim and 'Hadith' of Prophet Mohammad (Peace & blessings be upon him).
	Workshop/Case presentations (2 hours each) 1. Patient autonomy and informed consent. 2. Scientific rationale and ethical concerns for using animals in teaching and research.	2 hours	1. - Know importance of patient's autonomy and informed consent. - Learn various types of informed consent. - Explain procedures adopted to maintain patient autonomy. - Analyze ethical dilemmas involving breach in principle of autonomy. - Identify situations in which a doctor have to take decisions in the best interests of patient. 2. - Understand the importance of maintaining animal rights and dignity while performing animal experimentation. - Learn Islamic teachings about animal rights.
Session 2	**Lectures/LGIS (One hour each)** 1. Professionalism and its Islamic perspectives.	2 hours	1. - Explain meaning, definition and value of professionalism -Learn the Islamic perspectives of professionalism.

(0.25)	2. Role of Pakistan Medical & Dental Council (PMDC), World Health Organization (WHO) and World Forum of Medical Ethics (WFME) in the implementation of ethical concerns in medical profession.		2. - Follow the standards outlined in the PMDC, WHO and WFME guidelines for the practice of medicine and its expression in the clinical encounter between a patient and a physician. -Importance & role of medical code of conduct by PMDC -Authority of PM&DC as regulatory body to take disciplinary actions, required for criminal or serious professional misconduct of a doctor -Legal framework/jurisdiction of PMDC
	Workshop/Case presentations (2 hours each) 1. General duties of a physician. 2. Code of conduct: Collaboration, teamwork, maintaining dress, religious obligations, focus on physicians' character and duties.	2 hours	1. - Describe duties of a medical professional (as a physician, researcher and teacher) and relevant Islamic teachings. - Know the Islamic perspectives of the physician' s responsibilities. 2. -Demonstrate ethics of team work, including respect and gratitude towards colleagues. - Understand importance and methods of reporting negligence/ misconduct of a colleague.
Session 3 (0.25)	**Lectures/LGIS topics (One hour each)** 1. Patient centeredness. 2. Doctor-patient relationship.	2 hours	1. - Explain meaning, definition and value of patient centeredness. - Understand the rights of patients, and respect and dignity of patient's family - Narrate virtues and manners of visiting patient mentioned in 'Hadith' of Prophet Mohammad (Peace & blessings be upon him). 2. - Discuss the ethical principles applicable within the doctor-patient relationship. - Recognize importance of telling patient the truth about his/ her medical condition. - Justify when it is important to withhold information from a patient/ relatives. - Understand elements and process of informed consent, and beware of how to make decision when patient lacks capacity to give consent. - Appreciate ethics of discontinuation of doctor-patient relationship.
	Workshop/Case presentations (2 hours each) 1. Ethics of learning from patient 2. Continuity of patient care.	2 hours	1. -Appreciate the ethical concerns and apprehensions of patients, and needs of trainees while people are involved for teachings. 2. - Realize the importance of the continuity of patient care. - Know the responsibilities of a doctor to arrange continuity of patient care.
Session-4 (0.25)	**Lectures/LGIS topics (One hour each)** 1. Ethics of Communicable diseases, including HIV/STDs. 2. Public Health ethics.	2 hours	1. - Rationalize changes needed in basic concepts of medical ethics relevant to communicable diseases, with particular reference to HIV and other sexually transmitted diseases. 2. - Appreciate the responsibilities of physicians and public health authorities in the prevention and control of communicable diseases as well as general health promotion.

	Workshop/Case presentations (2 hours each) 1. Mental health ethics legal issues. 2. Ethics of children, adolescents and elderly.	2 hours	1. - Discuss the ethical and legal challenges of mentally ill persons, with emphasis on their vulnerability and risks involved. - Discuss how ethics of mentally ill differs from physically ill persons, e.g. in consent, capacity, confidentially, sharing of information and working with families, etc. 2. - Establish and maintain trust in children and adolescents, and guide them for their health and nutrition needs at this age. - Appreciate the ethics of elderly patients and their needs in maintaining good health. - Learn the teachings of Islam regarding dealing with children, elderly and mentally ill persons.
Session-5 (0.25)	**Lectures/LGIS topics (One hour each)** 1. Ethics in research and publication 2. Role of Ethical Review Board (ERB) in regulation of research ethics.	2 hours	1. - Identify and apply ethical principles involved in research, including informed consent and confidentiality. - Identify issues related to authorship for scientific publications - Describe authorship criteria given in ICMJE guidelines. - Identify sources of unethical conduct in research publications, such as plagiarism, fabrication of data and gift authorship. 2. - Know importance and functions of ERB. - Join ERB meetings to learn review process.
	Workshop/Case presentations (2 hours each) 1. Ethics of social media and advertising 2. Equity, social justice and ethics of resource allocation	2 hours	1. - Delineate principles of ethics involved in social media and advertising iconcerning: a. Publishing or broadcasting information b. Certificates, reports and other documents c. Teaching Photography and Consent 2. - Delineate the concept of rationing and equity in allocation of scarce resources. - Elaborate the principle of justice and appropriate rationing.
Session-6	**Lectures/LGIS topics (One hour each)** 1. Conflict of interest. 2. Ethics of Physicians' dealing with Pharmaceutical Industry	2 hours	1. - Learn meaning, definition, situations and consequences of conflict of interest 2. - Explain how Pharmaceutical industry can influence ethics of patient care and research, such as by offering gifts, drug samples, educational and research grants and funding for CME events, etc. - Describe PMDC guidelines for physicians in dealing with Pharmaceutical industry.

(0.25)	**Workshop/Case presentations (2 hours each)** 1. Medical negligence and malpractice 2. Reporting doctor's negligence and misconduct with patient.	2 hours	1. - Appreciate the difference between medical negligence and willful misconduct and their legal consequences/outcomes. 2. - Know the importance and procedures of reporting medical negligence and misconduct of a colleague.
Session 7 (0.25)	**Lectures/LGIS topics (One hour each)** 1. Ethic of organ donation and transplant 2. Medical errors	2 hours	1. - Elaborate ethical issues in organ donation such as: 'Cadaveric Donor' & 'Living Donor', 'Related' & 'Unrelated Donors', 'Infant & children donation', 'Fetal tissue donation', 'Reward' & 'Gift' for donors, etc. - Understand the benefits and risks of 'Xenotransplantation'. - Know Islamic teachings regarding organ donation and transplant. 2. - Understand Medical Errors & their types. - Elaborate why medicine is particularly susceptible to error. - Describe ethics of reporting medical errors (or disclosure). - Enlist reasons of reluctance to report.
	Workshop/Case presentations (2 hours each) 1. Legal perspectives involving organ transplant, including Human Organ and Tissue Transplantation Authority Act (HOTA) 2010 and amended HOTA 2016. 2. Pharmacovigilance	2 hours	1. - Learn the salient features of Human Organ & Tissue Transplantation Authority Act (HOTA) 2010 and amended HOTA 2016 of Pakistan. 2. - Define Pharmacovigilance & explain guidelines on management of high alert medication. - Perform pharmacovigilance in clinical setting with focus on filling following forms: a. Error reporting form b. Error analysis form - Comprehend WHO guidelines for: a. Surgical procedure safety b. Prevention of medication error c. Prevention of diagnostic error
Session 8	**Lectures/LGIS topics (One hour each)** 1. Reproductive health ethics. 2. End of life care & Euthanasia	2 hours	1. - Describe ethical and legal issues relevant to contraception and abortion. - Learn Islamic perspective of contraception and abortion. - Recognize public health burdens imposed by uncontrolled sexual behavior and pregnancy. 2. - Understand patients' rights concerning end of life decisions. - Explain the terms "best interests", "advance directives", "withdrawal or withholding of life support system", "do not resuscitate (DNR) orders" and "euthanasia" - Learn the Islamic teachings relevant to end of life decisions & euthanasia.

	Workshop/Case presentations (2 hours each) 1. Artificial Reproductive Techniques (ARTs). 2. Surrogacy.	2 hours	1. - Understand and describe ethics of ARTs linked to gametes and embryo; and donation of spermatozoa (or Third-Party Reproduction). - Know the Islamic perspectives of ARTs. 2. - Explain what is meaning of surrogacy? - Learn the Islamic perspectives of surrogacy.

4. Teaching strategies

The suggested teaching and learning activities include:

1. Lectures
2. Demonstrations
3. Small group discussions
4. Seminars, Case presentations
5. Case-Based Learning
6. Role Play

5. Assessment methods

1. Knowledge Assessment: MCQs.
2. Skill Assessment: OSCE.
3. Attendance and participation in the face to face sessions.
4. Log-book and Portfolio.

6. Context/ References

1. PMDC guidelines for teaching of Medical Ethics to post-graduate trainees in medicine and surgery.
2. GMC guidelines for doctors working in UK.
3. World Health Organization (WHO) and World Forum of Medical Ethics (WFME) guidelines for clinical practice and doctor-patient relationship

Course Title: Medical Education
Course Code: MEMW-002 = 1 Cr Hr

Medical Education

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

Course Goal:

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

LEARNING OUTCOMES

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, curriculumdevelopment 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 aneducator 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 andTeaching) while “Teaching to learn and learning to teach”.
- Understand and apply the fundamental principles in ‘Assessment’ while designing anassessment plan and assessment tools.
- Design a plan with tools for evaluating a teaching program.
- Demonstrate effective communication skills (active participation, Proactiveness, professionalism, group dynamics, team building, conflict resolution, negotiation skills, leadership skills etc) while working in the group/team tasks.

Introduction to HPE & Educational Environment

Course Content

1. Introduction to HPE and competencies required in HPE
2. Educational environment which effect the students learning- factors that enhanceor inhibit the learning the learning.
3. Various learning styles and merits and demerits- superficial and deep learning.

Learning Objectives:

1. Introduce with the themes of HPE, trend, Issues & Challenges IN HPE&Competencies required in HPE.
2. Discuss the competencies of a Medical Teacher.
3. Identify the factors which constitute the educational environment and effect thestudents learning i.e. the factors that enhance or inhibit the learning.
4. Identify various learning styles, its merits and demerits- superficial and deeplearning.

Teaching & Learning

Course Content

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

Learning Objectives:

1. Identify the characteristics of adult learners, and the principles of adult learning.
2. Link principles of adult learning with characteristics of modern curriculum.
3. Identify different modes of instruction and its strength and weakness.
4. Use the process of planning while designing & conducting large group teaching(Interactive lectures) session.
5. Use the process of planning while designing & conducting small group discussionsession.
6. Discuss the principles process, role of tutors and students, student's assessmentin a PBL& CBL session.
7. Demonstrate effective communication skills (active participation, Proactiveness, professionalism, group dynamics, team building, conflict resolution, negotiationskills, leadership skills etc) while working in the group/team tasks.

Curriculums: Structural Concepts and Development

Course Content

1. The curriculum and its components.
2. Various curricular philosophies & Perspectives- curricula past, present, future.
3. Innovative trends in curriculum, educational strategies and curriculum themeswith emphasis on integration.
4. The Hardens 10 questions for curricular planning.
5. Differentiation between the aims, goals, outcomes, objectives
6. Writing Learning objectives and Levels in Bloom's taxonomy of objectives for acourse.
7. The selection of core content while integrated curriculum development.
8. Steps of Integrated Modules planning & development.

Learning Objectives:

1. Define curriculum.
2. Differentiate between the different components of a curriculum.
3. `Enlist Harden's 10 questions for curricular planning &WFME standards
4. Discuss various curricular philosophies & Perspectives - curricula past, present,future.
5. Identify the trends in curriculum development, educational strategies andcurriculum themes.
6. Discuss integrated curriculum and broad categories of integration in curriculum
7. Differentiate between the aims, goals, outcomes, objectives
8. Differentiate between the different levels in Bloom's taxonomy of objectives.
9. Write learning objectives of 3 different domains for an integrated module andmatch it with the teaching and learning strategies.
10. Steps of Integrated Modules planning & development
11. Select core content while designing an integrated curriculum development.

BIOSTATISTICS AND BIOINFORMATICS

Course Code: BSE-801

Credit Hours = 02

1.1.1 BIOSTATISTICS (01 Credit Hour)

Module Components and Duration

Sr.#	Components	Duration in hours
1.	Introduction to Biostatistics, Data and its presentation	2
2.	Descriptive statistics (Measures of Central Tendency & Dispersion)	1
3.	Normal distribution curve and skewness	1
4.	Probability	1
5.	Hypothesis testing and errors	1
6.	Inferential statistics – Confidence Interval	1
7.	Test of significance (Parametric & Non-Parametric tests)	2
8.	Sampling Techniques and errors	2
9.	Correlation	1
10.	Regression – multiple, linear, logistic	2
11.	Using SPSS for data analysis	2

Detailed Learning Objectives

Sr.#	Content	Learning Objectives
1.	Introduction to Biostatistics, Data and its presentation	By the end of lecture, students should be able to: 1. Define biostatistics 2. Illustrate importance of statistics in medicine 3. Classify data with appropriate examples 4. Elaborate scales for data measurement 5. Discuss different data presentation methods
2.	Descriptive statistics (Measures of Central Tendency & Dispersion)	1. Explain measures of central tendency 2. Differentiate between grouped and ungrouped data 3. Calculate measures of central tendency for grouped & un-grouped data 4. Discuss measures of dispersion 5. Illustrate their advantages and disadvantages 6. Calculate Measures of Dispersion 7. Elaborate measures of central tendency for skewed data
3.	Normal distribution curve and skewness	1. Describe characteristics of Normal Distribution curve 2. Discuss types of data distribution 3. Describe skewness and its types with appropriate examples
4.	Probability	1. Discuss the concept of probability 2. Discuss Baye's theorem 3. Illustrate types of probability 4. Take decisions about acceptance or rejection of hypothesis in the light of P-value
5.	Hypothesis testing and errors	1. Describe the types of hypotheses 2. Elaborate the steps of hypothesis testing 3. Differentiate between chance and bias 4. Enlist the common types of bias 5. Discuss the errors in hypothesis testing
6.	Inferential statistics – Confidence Interval	1. Define and discuss the basic concept inferential statistics 2. Enlist components of inferential statistics 3. Define Confidence Interval (CI) 4. Elaborate all categories of Confidence Interval based on Normal Distribution Curve 5. Comprehend the concept of standard error

		6. Explain relationship of CI with sample size 7. Calculate Confidence Interval 8. Interpret the results
7.	Test of significance (Parametric & Non-Parametric tests)	1. Elaborate parametric & non-parametric test of significance 2. Describe steps for application of chi-square test 3. Interpret results of chi-square test 4. Elaborate conditions for application and t-test & z-test 5. Explain steps of hypothesis testing in application of t & z-tests 6. Discuss the types of t and z test 7. Discuss the conditions for application of ANOVA 8. Interpret the results
8.	Sampling Techniques and errors	1. Define sampling 2. Classify sampling techniques 3. Differentiate between probability and non-probability sampling techniques with suitable examples 4. Elaborate sampling and non-sampling errors 5. Enlist advantages and disadvantages of sampling techniques
9.	Correlation	1. Discuss correlation and correlation coefficient 2. Interpret correlation between 2 variables from correlation coefficient 3. Perceive correlation between 2 variables from scatter diagram 4. Discuss the use of Spearman rank correlation and Pearson correlation 5. Describe coefficient of determination
10.	Regression – multiple, linear, logistic	1. Define regression 2. Differentiate between correlation and regression 3. Discuss Regression equation (Equation of straight line) 4. Elaborate multiple, logistic and linear regression
11.	Using SPSS software for data analysis	1. Enter and code the variables in SPSS 2. Do data entry and analysis 3. Able to apply descriptive statistics in SPSS 4. Do cross tabulation 5. Apply test of significance in SPSS on entered data and interpret the P-value.

EPIDEMIOLOGY MODULE (01 Credit Hour)

Module Components and Duration

Sr.#	Components	Duration in hours
1	Scope of epidemiology and health / disease burden	2
2	Causation and prevention of epidemiology	2
3	Observational study designs (Cross-sectional & Correlational)	2
4	Observational study designs (Case control & Cohort)	2
5	Experimental / Clinical epidemiology	2
6	Environmental and occupational epidemiology	2
7	Communicable disease epidemiology and healthcare planning	2
8	Journal Club	2

Detailed Learning Outcomes

Sr.#	Content	Learning Outcomes
1	Scope of epidemiology and health / disease burden	By the end of lecture, students should be able to: • Define epidemiology and discuss its scope • Discuss measures of mortality and morbidity • Differentiate between incidence and prevalence from real life examples • Elaborate ice berg phenomenon and web of causation • Discuss emerging infections that are labelled by WHO as PHEIC nowadays
2	Causation and prevention of epidemiology	• Discuss natural history of disease and levels of prevention • Illustrate association and causation of disease • Enlist the types and needs for screening • Discuss the criteria for instituting a screening program • Elaborate sensitivity, specificity and predictive values of screening tests from real life examples • Interpret the results pertaining to various terminologies of screening • Describe diagnostic accuracy of screening test

3	Observational study designs (Cross-sectional & Correlational)	• Classify study designs • Differentiate between descriptive and analytical studies • Discuss the types of cross-sectional studies • Elaborate the key features of correlational studies • Plan an observational study from real life examples
4	Observational study designs (Case control & Cohort)	• Differentiate between case control and cohort studies • Discuss the pros and cons of both studies • Calculate relevant measure of association for both studies and interpret the results
5	Experimental / Clinical epidemiology	• Differentiate observational from experimental studies • Enlist the types of experimental studies • Elaborate the protocol / eligibility for conducting experimental studies • Discuss the relevant measure of association • Describe efficacy, efficiency and effectiveness of treatment
6	Environmental and occupational epidemiology	• Discuss occupational epidemiology • Describe dose-effect and dose-response relationships • Illustrate risk assessment and risk management
7	Communicable disease epidemiology and healthcare planning	• Discuss the commonly used infectious disease epidemiology terms • Describe the chain of infection and mode of transmission of disease • Elaborate the steps to investigate an epidemic
8	Journal Club	• Review and critically appraise the research articles published in different indexed journals • Justify the study design used in various studies • Discuss the technicalities and limitations of published studies

BIOINFORMATICS

Course Code: HIC 803

Credit Hours: 02

Module Components and Duration

Course Code	HIC 803
Course Title	**Health Informatics and Computational Tools**
Credit Hours	**2 (2,0)**
Prerequisites by Course(s) and Topics	**Background in Clinical Sciences**
Assessments (homework, quizzes, midterms, final, programming assignments, lab work, etc.)	**Semester Project: 10%** **Quizzes: 5%** **Home-works: 10%** **Midterm: 25%** **Final: 50%**
Current Description	**Course Description:** This course provides an introduction to health informatics, the field devoted to the optimal use of data, information, and knowledge to advance individual health, health care, public health, and health-related research. Students will **learn** the application of informatics skills and knowledge to health-related problems. **Application** activities will include simple data analysis and visualization of clinical data, answering clinical questions using information retrieval methods, and doing simple association analysis of gene variants and disease. The course is focused toward upper-level graduate students in health-related majors, although students from all majors may be admitted.
Textbook **(or Laboratory Manual for Laboratory Courses)**	1. Hoyt, RE and Yoshihashi, A, Eds. (2014). Health Informatics: Practical Guide for Healthcare and Information Technology Professionals, Sixth Edition. Pensacola, FL, Lulu.com. 2. Sharon E. Straus, W. Scott Richardson, Paul Glasziou, and R. Brian Haynes, Evidence-Based Medicine: How to Practice and Teach EBM (Third Edition), Churchill-Livingstone, 2005 3. Kwon, Y. Min, Ricke and Steven C. 2011. High-Throughput Next Generation Sequencing. Springer, Germany 4. Rodríguez E., Naiara, Hackenberg, Michael, Aransay and M. Ana. 2012. Bioinformatics for High Throughput Sequencing. Springer, Germany

	5. David R., J. Westhead and Howard P. 2003. Instant Notes in Bioinformatics Bios Scientific Publishers Limited, UK

Topics Covered in the Course, with Number of Lectures on Each Topic

Week#	Topic	Assessments
1	**Introduction** **Objective:** Introduce the research and practice of the field in the context of the problems that motivate its work. **Motivational Questions:** What are some of the problems that informatics tries to address in healthcare? Why do we need informatics? **Reading Assignment:** Hoy and Yoshihashi, Chapter 1	Quiz - Answer knowledge-based questions, grading based on percent correct
2	**Health Data, Information, and Knowledge** **Objective:** Describe the data, information, and knowledge environment of health informatics, from cells and genes to people to health systems **Motivational questions:** How does informatics improve healthcare? How does a discovery go from a research finding to become actionable in the healthcare system? **Reading Assignment:** Hoy and Yoshihashi, Chapter 2	Quiz - Answer knowledge-based questions, grading based on percent correct
3	**Electronic Health Records Objective:** Describe and demonstrate the electronic health record (EHR) and its derivatives, and the functions for which it is used, including clinical decision support and re-use of clinical data **Motivational questions:** How does information get into EHRs? How can we use this information? How does this inform us when we reuse EHR data? **Reading Assignment:** Hoy and Yoshihashi, Chapter 4	Quiz - Answer knowledge-based questions, grading based on percent correct
4	**Personal Health Records and Decision Aids** **Objective:** Describe and demonstrate the personal health record (PHR) and decision aids, and the functions for which they are used to inform personal health decision-making **Motivational questions:** How does information get into PHRs? How can we use this information for personal health-related decision aids? **Reading Assignment:** Hoy and Yoshihashi, Chapter 10	Quiz - Answer knowledge-based questions, grading based on percent correct
5	**Information Retrieval (Search) Objective:** Discuss the discovery and dissemination of health-related knowledge and demonstrate the ability to retrieve and appraise it **Reading Assignment:** Hoy and Yoshihashi, Chapters 12-13	Demonstrate ability to ask, search for information, and answer a health-related

			question; grading based on rubric for completion of task
	6	**Bioinformatics** Objective: Find and apply informatics in genomics and other aspects of molecular biology Motivational Questions: How do genes contribute to disease and how can we use this information to improve treatment of these diseases? How can informatics help? Reading Assignment: Hoy and Yoshihashi, Chapter 20	Demonstrate ability to ask, search for information, and answer a health-related question; grading based on rubric for completion of task
	7	**Informatics Applications in Public Health** **Objective:** Describe the applications of informatics to public health **Motivational Questions:** How can data and information improve public health? Reading Assignment: Hoy and Yoshihashi, Chapter 21	Quiz - Answer knowledge-based questions, grading based on percent correct
	8	**Data Science, Analytics, and Visualization** Objective: Apply analytical and visualization skills to data sets Motivational Questions: How does visualization help us understand clinical data? What are the pitfalls of clinical data? How can analytics improve health care? Reading Assignment: Hoy and Yoshihashi, Chapter 3	Perform visualization and simple analysis of a data set to assess difficulty of predicting cardiovascular risk in a synthetic patient dataset, grading based on rubric for completion of task
	9	**Ethical Issues in Health Informatics Objective:** Discuss the ethical challenges for the use of data and information in health-related areas. **Motivational Questions:** How can we maximize the benefit while minimizing the risk of Health Informatics applications? How can we minimize discrimination that might occur from data, algorithms, and the digital divide? **Reading Assignment:** Hoy and Yoshihashi, Chapter 9	
	10	Careers in Health Informatics Objective: Describe the career and training options for work in health informatics Motivational Questions: What skills do I need to succeed within Health Informatics? What are the upcoming challenges? Reading Assignment: TBD	Interview an informatics professional and describe their work in relation to course material in a short paper, grading based on completion of rubric for task
	12	Personalized Genomic Medicine (PGM)	Case studies in research papers and Media

	13	Student Presentations (From latest research papers in the field)	
Laboratory Projects/Experiments done in the course	Though it's a non-laboratory course we still do some hands-on exercises in the class, depending upon the importance of topics and availability of resources and time. All students will perform a semester projects selecting any topic of one's interest and submit a written report of typically 5 to 10 pages followed by an oral presentation (5 to 15 minutes).		
Class Time Spent on	**Theory (50%)**		
Class Time Spent on (in credit hours)	**Hands on 20%**	**Latest trends (20%)**	**Administrative (10%)**

LAB BENCH WORK

YEAR 1

General Bacteriology, Systemic Bacteriology and Applied Microbiology

1. Introduction to microbiology laboratory work set up, equipment and consumables.
2. Handling of laboratory equipment.
3. Maintenance of record of all consumables and equipment being used in microbiology laboratory.
4. Purchase of laboratory equipment and consumables.
5. Critical values in microbiology laboratory and their timely information to attending physician.
6. Collection / transport of specimens for microbiological investigations.
7. Preparation, examination & interpretation of direct smears from clinical specimens.
8. Plating clinical specimens on media for isolation, purification, identification and quantification purposes.
9. Preparation of stains viz., Gram, Albert's, capsules, spores, Ziehl Neelsen (ZN) Silver impregnation stain and special stains, etc.
10. Preparation and pouring of media.
11. Preparation of reagents
12. Quality control of media, reagents, etc.
13. Operation of autoclave, hot air oven, distillation plant, filters like sietz and membrane filters.
14. Infection prevention and control in clinical laboratories and hospitals.
15. Standard and expanded precautions in clinical laboratories and hospital settings.
16. Physical and biological containment
17. Hospital waste management
18. Disposal of Infectious waste in clinical laboratory.
19. Disinfection of contaminated materials like cultures.
20. CLSI guidelines; interpretation and implementation.
21. Quality control and quality assurance.
22. Microscopy techniques used in clinical and microbiology laboratory
23. Care and operation of microscopes.
24. Washing and sterilization of glassware (plugging and packing).
25. Care and maintenance of common laboratory equipment like water bath, centrifuge, refrigerators, incubators, etc.
26. Aseptic practices in laboratory and safety precautions.
27. Sterilization and disinfection of consumables and equipment and surfaces in laboratory.

28. Biosafety and biosecurity in microbiology laboratory.
29. Biosafety levels for clinical laboratories.
30. Use of various types of Biosafety cabinets and their maintenance.
31. Aseptic practices in laboratory and safety precautions.
32. Sterility tests.
33. Sample collection and handling.
34. Sample processing.
35. Plating clinical specimens on media for isolation, purification, identification, and quantification purposes.
36. Sample collection from different sites of the human body.
37. Sample transportation within hospital and outside the hospital.
38. Sample labelling, sample receiving criteria, timeline for sample reporting.
39. Sample inoculation on different culture media, biochemical reaction testing.
40. Antimicrobial sensitivity testing techniques.
41. Reporting of culture and sensitivity tests.
42. Interpretation of microbiological laboratory reports.
43. Test for Beta-lactamase production.
44. Introduction of semiautomated and automated methods used in microbiological laboratory.
45. Long term and short-term preservation of microbiological cultures. Maintenance & preservation of bacterial cultures.
46. Preparation, examination & interpretation of direct smears from clinical specimens.
47. Identification of bacteria of medical importance up to species level (except anaerobes which could be up to generic level).
48. Introduction to the techniques of anaerobiosis.
49. Tests for Motility: hanging drop, Cragie's tube, dark ground microscopy for spirochaetes.
50. In-vitro toxigenicity tests – Elek test, Naegler's reaction.
51. Special tests – Bile solubility, chick cell agglutination, sheep cell hemolysis, niacin and
52. catalase tests for Mycobacterium, Satellitism, CAMP test, catalase, slide & tube Coagulase test.
53. Test for Beta-lactamase production.
54. Testing of disinfectants – Phenol coefficient and "in use" tests.
55. Quantitative analysis of urine by pour plate method and semiquantitative analysis by standard loop tests for finding significant bacteriuria.
56. Disposal of contaminated materials like cultures.
57. Disposal of infectious waste.
58. Bacteriological tests for water, food and air.
59. Maintenance & preservation of bacterial cultures.
60. Intradermal test like Mantoux.

Immunology

1. Collection of blood by venipuncture, separation of serum and preservation of serum for short and long periods. Preparation of antigens and their standardization.
2. Performance of serological tests.
3. ELISA.
4. Latex and staphylococcal co-agglutination test separation of lymphocyte.
5. Separation of Lymphocyte and T cell rosette.
6. Immunoelectrophoretic techniques.

Virology

1. Preparation of glassware for tissue cultures (washing, sterilization).
2. Preparation of media used for viruses.
3. Preparation of clinical specimens for isolation of viruses.
4. Serological tests – Elisa for HIV, HBsAg, Hemagglutination inhibition and Hemadsorption for influenza virus.
5. Introduction to molecular techniques.
6. Sample collection for PCR.
7. Sampe processing steps of Polymerase chain reaction techniques.
8. Pipetting techniques.

Mycology

1. Collection of Specimen.
2. Direct Examination of Specimen.
3. Examination of Histopathology slides.
4. Isolation and identification of fungi & slide culture.
5. Special techniques.

Parasitology

1. Collection of Specimen.
2. Examination of faeces for parasitic ova and cyst by direct and concentration method.
3. Egg counting techniques for helminths.
4. Examination of blood smears for protozoa.
5. Histopathology sections – Examination and identification of parasites.
6. Leishman and Giemsa staining.

7. Identification of common arthropods and vectors.
8. Preservation of parasites – mounting fixing & staining Maintenance of stock cultures.

YEAR 2

Rotations in Related Specialties

1. Histopathology: 3 months
2. Hematology: 3 months
3. Chemical Pathology: 3 months
4. Molecular Biology: 2 months

YEAR 3

Bacteriology

1. Multidrug resistant organism detection and reporting.
2. Isolation precautions for specific infections.
3. MRSA isolation and AST reporting
4. Preparation of antibiotic discs; performance of antimicrobial susceptibility testing e.g., Kirby-Bauer, Stoke's method, Estimation of Minimal Inhibitory / Bactericidal concentrations by tube /plate dilution methods.
5. Performance and interpretation of bacteriological tests for water, air and milk.
6. Performance of anaerobic Culture.
7. Performance and reporting of Antimicrobial Susceptibility Testing. M.I.C., M.B.C.
8. Reporting and interpretation of Automated blood culture techniques and their interpretation.
9. Reporting and Identification of various microorganisms using API techniques on different samples.

Clinical Microbiology and Infectious Disease

1. Diagnostic techniques for various infectious diseases.
2. Respiratory sample collection, processing, and reporting.

3. Genitourinary sample collection, processing, and reporting.
4. Gastrointestinal sample collection, processing, and reporting.
5. Cerebrospinal fluid sample collection, processing, and reporting.
6. Multiple fluid sample collection, processing, and reporting.
7. Visit in Multiple wards and ICU of hospital.
8. Follow up of various infectious disease reports.
9. Infection control protocol applications in hospital.

Virology

1. Preparation of clinical specimens for isolation of viruses.
2. Preparation of monkey kidney cells (Primary) and maintenance of continuous cell lines by subcultures. Preservation in -70°C and liquid nitrogen.
3. Preparation of monkey kidney cells (Primary) and maintenance of continuous cell lines by subcultures. Preservation in -70°C and liquid nitrogen.
4. Recognition of CPE producing viruses.
5. Performance of hemadsorption for Parainfluenza Hemagglutination for influenzas, Immunofluorescence, neutralization for Enteroviruses and Respiratory viruses' identification tests on tissue cultures and supernatants etc.
6. Performance of Serological tests – Elisa for HIV, HBsAg, Hemagglutination inhibition and Hemadsorption for influenza virus of CPE producing viruses.

Mycology

1. Collection of Specimen for Mycology and their direct Examination of Specimen with their examination of Histopathology slides.
2. Isolation and identification of fungi & slide culture
3. AST for fungal species.
4. Special techniques used in mycology.
5. Maintenance of fungal stock cultures.
6. Mycobacteriology (Tuberculosis) sampling, processing and identification of Mycobacteria and their antibiotic resistance testing using various culture methods and molecular techniques like LJ medium, MGIT, and Gene expert.
7. Anaerobic culture methods.

Serology and Immunology

1. Collection of blood for serological tests by venipuncture, separation of serum and preservation of serum for short and long periods.
2. Preparation and use of antigens and antisera in laboratory.
3. Performance of serological tests like Brucella agglutination, Weil Felix, cold agglutination, VDRL, Paul Bunnel, Rose Waaler, IFA, ELISA.

4. Latex and staphylococcal co-agglutination test separation of lymphocytes.
5. Immunoelectrophoretic techniques.
6. Performance and independent reporting of ELISA technique performance for Hepatitis viruses.
7. Performance of serological techniques for common pathogens independently.

Molecular Biology

1. Performance of PCR method.
2. Extraction of Nucleic acid from samples.
3. Interpretation of results of real time PCR.
4. Trouble shooting in PCR.

RESEARCH CURRICULUM
MD MICROBIOLOGY
2024

Rawalpindi Medical University

Research Planner of 4 Years University Residency Program

RESEARCH & THESIS WRITING

Research and Thesis have to be completed during training period. Research topic selection is must in first year. Synopsis writing and approval from DRB, IRF & BASR are must in second year of training. In third year of training Thesis should be written, while in first six months of fourth year Thesis should be completed and after appropriate defense it should be approved by BASR.

RESEARCH EXPERIENCE & WORKSHOPS

The active research component program must ensure meaningful, supervised research experience with appropriate protected time for each resident while maintaining the essential clinical experience. Residents must learn the design and interpretation of research studies, responsible use of informed consent, and research methodology and interpretation of data. The program must provide instruction in the critical assessment of new therapies and of the medical literature. Residents will be advised and supervised by qualified staff members in the conduct of research

To help conduction of Research and facilitate Thesis writing following workshops are mandatory during training that will be organized by RMU:

a) Communication skills
b) Computer & IT skills days
c) Synopsis writing
d) Research Methodology & Biostatistics
e) Reference Manager (Endnote)
f) Clinical Research

Each resident will participate in at least one clinical research study to become familiar with

1. Research design
2. Research involving human subjects including informed consent and operations of the Institutional Review Board and ethics of human experimentation
3. Data collection and data analysis
4. Research ethics and honesty
5. Peer review process

This usually is done during the consultation and outpatient clinic rotations.

Research Article or Statistical Report of one Disease

Components of article writing for Resident Research Journal or Statistical Report of one disease are mandatory in First while optional in Third year.

Thesis

The candidates shall prepare their synopsis as per guidelines provided by Institutional Research Forum/Ethical Review Board (IRF/ERB) and Board of Advanced Studies & Research (BASR). The research topic must consist of a reasonable sample size and sufficient numbers of variables to give training to the candidate to conduct research, collect and analyze data. Synopsis of research project should be approved in 2nd year of MS program by IRF/ERB and BASR. In 3rd year Thesis work should be completed, and in 4th year it should be approved from BASR.

Submission / Evaluation of Synopsis

The Residents shall prepare their synopsis as per guidelines provided by the Board of Advanced Studies & Research, available on university website.

The research topic in clinical subject should have 30% component related to basic sciences and 70% component related to applied clinical sciences.

The research topic must consist of a reasonable sample size and sufficient numbers of variables to give training to the candidate to conduct research, to collect & analyze the data.

Synopsis of research project shall be got approved by the end of the 2nd year of MS program. The synopsis after review by an Institutional Review Committee shall be submitted to the University for Consideration by the Board of Advanced Studies & Research, through the Principal / Dean /Head of the institution.

Submission of Thesis

Thesis shall be submitted by the candidate duly recommended by the Supervisor.

The minimum duration between approval of synopsis and submission of thesis shall be one year.

The research thesis must be compiled and bound in accordance with the Thesis Format Guidelines approved by the University and available on website.

The research thesis will be submitted along with the fee prescribed by the University.

Thesis Evaluation

The Resident will submit his/her thesis at least O6 months prior to completion of training.

The Thesis along with a certificate of approval from the supervisor will be submitted to the Registrar's office, who would record the date / time etc. and get received from the Controller of Examinations within 05 working days of receiving.

The Controller of Examinations will submit a panel of eight assessors within 07 days for selection of four examiners by the Vice Chancellor. The Vice Chancellor shall return the Final panel within 05 working days to the Controller of Examinations for processing and assessment. In case of any delay the Controller of Examination would bring the case personally to the Vice Chancellor.

The Supervisor shall not act as an examiner of the candidate and will not take part in defense of thesis.

The Controller of Examinations will make sure that the Thesis is submitted to examiners in appropriate fashion and a reminder is sent after every ten days.

The thesis will be evaluated by the examiners within a period of 06 weeks.

In case the examiners fail to complete the task within 06 weeks with 02 fortnightly reminders by the Controller of Examinations, the Controller of Examinations will bring it to the notice of Vice Chancellor in person.

In case of difficulty in find an internal examiner for thesis evaluation, the Vice Chancellor would, in consultation with the concerned Deans, appoint any relevant person as examiner in supersession of the relevant Clause of the University Regulations.

There will be two internal and two external examiners. In case of difficulty in finding examiners, the Vice Chancellor would, in consultation with the concerned Deans, appoint minimum of three, one internal and two external examiners.

The total marks of thesis evaluation will be 100 and 60% marks will be required to pass the evaluation.

The thesis will be considered accepted, if the cumulative score of all the examiners is 60%.

The clinical training will end at completion of stipulated training period but the candidate will become eligible to appear in the Final Examination at completion of clinical training and after acceptance of thesis. In case clinical training ends earlier, the slot will fall vacant after stipulated training period.

ASSESSMENT SCHEME

4 YEARS PROGRAMME MD MICROBIOLOGY		
In Training Assessment	**(ITA-1)**	At the end of 1st year training
Mid Training Assessment	**(MTA)**	At the end of 2nd year training
In Training Assessment	**(ITA-2)**	At the end of 3rd year training
Final Training Assessment	**(FTA)**	At the end of 4th year training

RESEARCH REQUISITES OF UNIVERSITY RESIDENT

Training year	4 years Training Program
1st year	ONE disease statistical report to be submitted by the end of 1st year training to be eligible to appear in ITA-1 Submit research topic in Research and Development department
2nd year	Research synopsis approval from Ethical Review Board (ERB) and Board of Advance Studies and Research (BASR) is mandatory appearing in MTA
3rd year	Data collection
4th year	Thesis submission 6 months before date of completion of 4 years training to be eligible to appear in FTA

AWARD OF MD MICROBIOLOGY DEGREE

After successful completion of the structured course of **MD Microbiology**, and qualifying In-Term, Mid-term, Final Term Assessment (Written, Clinical: OSCE & ORAL and Thesis), the degree with title **MD Microbiology**, shall be awarded by Rawalpindi Medical University.