MASTER OF PATHOLOGY (MEDICAL MICROBIOLOGY)

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TRAINING CURICULUM FOR TRAINEES AND SUPERVISORS
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-2022-

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1. AIM

This document provides an overview of a four-year post-graduate training program in Pathology (Medical Microbiology).

2. BACKGROUND

The School of Medical Sciences, USM, was established in 1979 to train undergraduate medical doctors. This evolved into developing post-graduate training in Medicine, which begun in 1987. Presently there are more than fifteen specialty post graduate training programmes being conducted by the School of Medical Sciences, USM.

The Master of Pathology (Medical Microbiology) programme aims to produce specialists in clinical microbiology with in-depth theoretical and practical knowledge in laboratory diagnoses and management of infectious diseases. The specialists produced are competent in laboratory and clinical aspect of the diseases and are able to provide clinical consultations on patients' management as well as being actively involved in daily clinical decision making. Thus, they provide a critical communication link between the microbiology laboratory and the clinical team in having a more constructive contact and interaction with each other that are essential for optimum patient care.

2.1 Programme description

Master of Pathology (Medical Microbiology) is a four-year programme for training of qualified doctors to become specialists in the field of Medical Microbiology which encompasses knowledge and skills in the laboratory diagnosis of infectious diseases with active participation in clinical decision making. It also includes in-depth knowledge on the role of the laboratory in both management of infectious diseases and the elucidation of the epidemiology of infection. Training in basic and medical microbiology researches is also provided.

Modes of training include lectures, seminar/journal presentation, bench-working, clinical attachment and consultation. Apprenticeship in an accredited medical microbiology laboratory provide training in laboratory management and quality management system. The students are provided with training in infection control and outbreak management.

3. STRUCTURE OF COURSE

The course structure is shown in Appendix I.

The training is divided into 2 Stages.

Stage 1 (Year 1) : Students will undergo rotations in all medical-lab based departments such as Anatomic Pathology, Chemical Pathology, Haematology, Medical Microbiology with minor postings in Clinical Immunology and Medical Genetics

Stage 2 (year 2-4) : The first 2 years are held in teaching and/or Malaysia Ministry of Health hospitals, while the final year is in-campus. The focus is on advanced understanding and application of general and systemic medical microbiology in greater detail.

3.1 Curriculum structure of Stage I (Basic Training in Pathology)

The detail structure and syllabus for Stage I training is described in Appendix II.

3.2 Curriculum structure of Stage II (Training in Medical Microbiology)

The detail structure and syllabus is described in Appendix III.

3.3 Research Dissertation

A research dissertation is compulsory for clinical microbiology part 2 programme and the candidate have to pass the research dissertation as a prerequisite for the part 2 examination. The purpose of the dissertation is to allow assessment of the practical ability of candidates and of ability to report and assess the significance of their findings. It is a test of the ability to analyse, criticise and present raw data. The overall standard of the project should be such that it is suitable for publication in a professional scientific journal.

A proposal describing the background, the research questions, the objective of the intended study, the details of the proposed experimental work and the expected outcomes must be presented and submitted for the approval by the committee. The project and the writing of the dissertation should be carried out under the supervision of a designated lecturer. Out-campus candidate may have extra co-supervisor from their respective hospitals.

The dissertation must be written in English and should be submitted according to Guide to The Preparation & Submission of Dissertation: Applicable for Master of Medicine, Master of Surgery & Master of Pathology, School of Medical Sciences Universiti Sains Malaysia. The candidate can submit the dissertation in Traditional format or Manuscript ready format [for publication in peer-reviewed journal] as stated in the guidelines.

The dissertation will be examined by designated examiners and will be marked by assigning to it one of four scales:

Scale 1 : The candidate's dissertation is acceptable unconditionally as partial fulfilment of the requirement for the Masters Degree.

Scale 2 : The candidate's dissertation is acceptable as partial fulfilment of the requirement for the Masters Degree subject to the candidate making such changes/corrections as listed by examiner.

Scale 3 : The candidate should be permitted to resubmit the dissertation after the candidate has made changes/corrections as listed by examiner for re-examination

Scale 4 : The candidate's dissertation is not acceptable as partial fulfillment of the requirement for the Master of Medicine degree.

Candidates will be informed of the Scale awarded following approval by the Examiners' Sub-committee. A candidate awarded a Scale 4 will be barred from taking the Part 2 final examination.

4. MODE OF TEACHING AND LEARNING

Various modes will be used to achieve effective learning objectives.

- Notes, articles, books and journal references will be provided to the candidates.
- Lectures and seminar will be given in packages to cover the whole syllabus of medical microbiology.
- Candidate will be actively involved in clinical and laboratory activities including bench work, laboratory rounds, case-based discussions and on-call duties.
- Preparation of case reports.
- Actively participating in academic and research activities
- Writing up of dissertation (refer section 3.3).

5. SUPERVISION AND PROGRESS REPORTS

The medical school will appoint a qualified clinical microbiologist to be a supervisor for each candidate. The supervisor is responsible for the progress report of the candidate.

6. EXAMINATION AND ASSESSMENT

6.1 STAGE 1 ASSESSMENT

6.1.1 Continuous Assessment

For purposes of continuous assessment:

1. In Stage 1, the candidate is required to maintain a log book to record all procedures performed and level of competence achieved. The log book is to be signed by Medical laboratory technologist, scientific officer (where relevant) or a supervising pathologist.

2. final progress report shall be submitted to the Head of the Department of Pathology/Program Coordinator at the end of the last posting in Stage 1.

3. Unsatisfactory performance or non-fulfilment of requirements of Stage 1 training are grounds for barring a candidate from sitting the Stage I examination. Candidates found unsuitable for further training will be counselled to leave the Programme.

4. In some disciplines, mini-tests may be conducted regularly. The purpose of such tests is formative i.e. to detect deficiencies so that remedial action may be undertaken. The marks will not be taken into account for the Stage I examination.

6.1.2 Prerequisites for sitting the Part 1 Examination

To be eligible to sit the Part 1 Examination the candidate must have:

1. Satisfactorily completed all postings in Stage I (Year 1). The supervisor is required to certify that the progress of the candidate has been satisfactory throughout the Stage and that the candidate is eligible to sit for the Stage I Examination.

2. Satisfactorily completed all the required tasks as set out in the log book to the supervisor's satisfaction. The log book must be submitted to the Head of Department of Pathology/Program Coordinator for inspection at the end of the last rotation posting.

3. Satisfactorily completed all assignments [where applicable].

6.1.3 PART I EXAMINATION

The Part 1 examination comprises:

(a) Theory papers
(b) Practical papers

The allocation of marks in the Part 1 examination shall be as follows:

Theory	50%
Practical	50%

The Theory examination:

Anatomical Pathology (20 MCQ and 1 essay)
Chemical Pathology (20 MCQ and 1 essay)
Hematology (20 MCQ and 1 essay)
Medical Microbiology (20 MCQ and 1 essay)

The MCQ will be of the standard format (a statement followed by 5 True/False responses) with negative marking for incorrect responses. The minimum mark for a question is zero.

Format of the Practical Component (OSPE):

Anatomical Pathology (10 stations)
Chemical Pathology (10 stations)
Hematology (10 stations)
Medical Microbiology (10 stations)

The time allocated for each station is between 5 - 10 minutes. Every station carries equal marks.

Criteria for pass:
The candidate must obtain an overall score of 50% AND

a) score ≥ 50% for the theory components and obtain ≥ 50% for the practical components AND

b) obtain a score for the theory of each discipline of not less than 40% AND

c) obtain a score for the practical of each discipline of not less than 40%

Repeat examinations:
A candidate who has failed may be allowed to repeat the examination after one year.
A candidate is allowed a maximum of ONE (1) repeat examination.

6.2 STAGE 2 ASSESSMENT

6.2.1 Continuous assessment in Stage 2

Daily routine work in the laboratory is a form of continuous assessment. Students who do not perform routine work satisfactorily may be barred from progressing to the subsequent year.

The candidate is required to maintain a log book to record all procedures performed and the level of competence achieved.

The log book is to be signed by the MLT or scientific officer in charge (where relevant) or the respective lecturer/specialist.

6.2.2 Prerequisites for Part II (Final) Examination

To be eligible to sit for the Part II (Final) Examination the candidate must have:

1. satisfactorily completed all postings in Years 2, 3 and 4. The supervisor is required to certify that the progress of the candidate has been satisfactory throughout Stage 2 and that the candidate is eligible to sit for the Final Examination.

2. completed all the required tasks to the supervisor's satisfaction. Submitted a research project report accompanied by the supervisors report. The research project report should be submitted at the end of Year 3 but not later than 3 months before the Final Examination. A revision of the research project report may have to be undertaken if necessary.

3. submitted all case books, case summaries and any other assignments required by the relevant discipline. The deadline for submission of these reports shall be submitted 2 months before the Final examination

6.2.3 PART II (FINAL) EXAMINATION

The Part II Examination will be held at the end of Year 4 and comprises:

(a) theory papers
(b) practical papers
(c) *viva-voce*

The allocation of marks in the Stage II examination shall be as follows:

Theory	45%
Practical	45%
Viva-voce	10%
Total	100%

Criteria for passing:

To pass the Part 2 examination the candidate must obtain an overall score of 50% AND pass BOTH the theory and practical components.
The pass mark for each component is 50%.

Repeat examinations:

1. *Repeat examination after six months*

A candidate may be allowed to repeat the examination after six months if he has an overall score of 50% or more but has failed either the theory OR the practical component

In this repeat examination the candidate will be examined in the failed component and be given a viva-voce.

2. *Repeat examination after one year.*

A candidate may be allowed to repeat the examination after one year if he has obtained an overall score of less than 50% OR has failed BOTH the theory and practical components of the Stage II examination.

In this repeat examination the candidate will be examined in the theory and practical components and be given a viva-voce.

3. A candidate is allowed a maximum of four repeat examinations.

The maximum duration permitted for the completion of the entire course is SEVEN years.

APPENDIX I

Programme Structure

Stage	Year	Curriculum
I	1	* Basic Pathology (rotations of Medical Microbiology, Anatomic Pathology, Chemical Pathology, Hematology, Clinical Immunology, Medical Genetics * Logbook
Part I Examination		
II	2 -4	* Clinical Duties: Bacteriology, Virology, Mycology, Parasitology,M diagnostics, Infection Control * Case Presentation Conferences/Multidisciplinary Meetings * Log book * Dissertation * Elective posting * Continuous supervisor assesment
Part II (Final) Conjoint Examination		

APPENDIX II

STAGE 1 CURRICULUM

1. COURSE STRUCTURE

   The candidate shall undergo a rotation posting in the 4 major disciplines of 10 weeks duration each. An orientation course will be held at the beginning of the academic year and an intensive course during the academic year. Both these courses will be conducted in the universities.

   During the postings, the candidate shall maintain a log book and perform to the supervisor's satisfaction a list of procedures.

2. FRAMEWORK OF STAGE 1 COURSE

Orientation	1 week
Rotational postings	40 weeks (10 weeks X 4)
Intensive course	3 weeks
Self-study	2 weeks
Examinations	2 weeks
Posting breaks	4 weeks
TOTAL	52 weeks

3. **ANATOMIC PATHOLOGY MODULE**

   To acquired knowledge on

- General pathology:
  - **-** Cell injury and necrosis.
  - **-** Inflammation and repair
  - **-** Cellular adaptive mechanisms
  - **-** Haemodynamic disorders
  - **-** Neoplasia
  - **-** Nutritional disorders
  - **-** Disorders related to environment.
  - **-** Inborn errors of metabolisms.
  - **-** Genetic disorders

- Systemic pathology: Congenital, inflammatory, degenerative, vascular, metabolic and neoplastic disorders of the organ systems: cardiovascular, respiratory, genitourinary, gastrointestinal, hepatobiliary, lympho -reticular, reproductive,

musculoskeletal, nervous, dermatology, endocrine, ophthalmology and otorhinolaryngology systems

- Teaching methods: The trainees will be exposed to various teaching-learning

i. Methodologies Student centered learning e.g.; seminar, tutorials/slide sessions, journal club, CME/CPC, e- learning
ii. Apprenticeship training, lectures
iii. Preparation and reporting of stained tissue sections:
Carry out (at least once) the complete process of making slides starting with an unfixed specimen to preparation of an H&E stained slide. (Manual tissue processing and H&E staining)
iv. Examine routine H&E stained sections of surgical specimens and submit 50 histopathological reports
v. Autopsy: Observe 10 autopsies. This requirement may be achieved over the first year of training rather than limited to anatomic pathology posting.

4. **HAEMATOLOGY MODULE**

To acquire knowledge on:

Haematology

i. Haemopoiesis and normal haemostasis
ii. Red cells disorders:

a. Anaemias: Nutritional anaemias, anaemia of chronic disease and aplastic anaemia
b. Haemolyticanaemias
c. Thalassaemia and common haemoglobinopathies.

iii. White cell disorders:

a. Benign – Infections, leukaemoid reaction
b. Acute Leukaemias, chronic leukaemias, multiple myeloma, myeloproliferative neoplasms, myelodysplastic syndrome, and lymphoproliferative disorders.

iv. Bleeding disorders caused by vascular, platelet abnormalities and coagulation disorders
v. Thrombophilia
vi. Basic genetic concept in haematology
vii. Basic principles of quality assurance in haematology

Transfusion Medicine:

i. ABO, Rh and other clinically important blood group systems
ii. Compatibility testing
iii. Haemolytic disease of the foetus and newborn
iv. Preparation, storage and use of blood components
v. Complications of blood transfusion
vi. Donor management
vii. Basic principles of quality assurance in transfusion medicine

Teaching methods:

Haematology (lectures, seminars, case presentation)

Transfusion medicine (lectures, seminars, presentations and practical/slide sessions) case presentations and practical sessions)

5. **MEDICAL MICROBIOLOGY MODULE**

To acquire knowledge on:

THEORETICAL ASPECTS

i. Basic concepts on laboratory safety.
ii. Bacteriology: morphology, cultural characteristics, aetiology,

epidemiology, pathogenesis, clinical manifestation, laboratory diagnosis, principles of management, prevention and control of common bacterial infections.

iii. Virology: morphology, transmission, replication, aetiology, epidemiology, pathogenesis, clinical manifestation, laboratory

diagnosis, principles of management, prevention and control of common viral infections.

iv. Mycology: morphology, cultural characteristics, aetiology, epidemiology, pathogenesis, clinical manifestation, laboratory diagnosis, principles of management, prevention and control of common fungal infections.

v. Parasitology: morphology, lifecycle, aetiology, epidemiology, pathogenesis, clinical manifestation, laboratory diagnosis, principles of management, prevention and control of common parasitic infections.

vi. Basic concept of emerging infectious diseases

vii. Antimicrobial agents and multidrug-resistant organisms.

viii. Basic principles of infection prevention and control.

ix. Sterilization and disinfection.

x. Basic principles of molecular techniques.

xi. Immunology: The organization of immune system, innate and adaptive immunity and aberrations of immune responses (immunodeficiency, hypersensitivity and autoimmunity).

PRACTICAL SKILLS TO BE ACQUIRED

i. Perform and read Gram stain, acid fast stain and India ink stain

ii. Culture, isolation, identification and antimicrobial sensitivity test for common bacterial pathogens

iii. Rapid serological test and their interpretation (E.g. dipstick/ICT/LA/RPR/TPPA)

iv. Enzyme/chemiluminescence immunoassay and their interpretation

v. Immunofluorescence tests and their interpretation

vi. Immunoblot tests and their interpretation

vii. Molecular method and their interpretation

viii. Viral isolation and identification

ix. Culture and identification of fungi

x. Identification of common parasites in clinical specimens

xi. Laboratory automation and information system

Teaching Method

i. Learning and teaching activities 3-4 sessions per week (each session 1-2hours).

ii. Candidate competency is monitored via logbook assessment and verificationby lecturer and/or technical personnel.

6. **CHEMICAL PATHOLOGY MODULE**

To acquire knowledge on

CLINICAL ASPECTS
Competencies in the chemical pathology of diseases

i. Generic aspects
ii. Biological variability
iii. Gastrointestinal tract
iv. Hepatobiliary system
v. Renal System
vi. Acid Base Imbalance
vii. Water and Electrolytes
viii. Proteins
ix. Cardiovascular System
x. Metabolic and endocrine
xi. Endocrinology – Pituitary, thyroid, adrenal, reproductive system
xii. Calcium, magnesium, phosphate and metabolic bone disorders

xiii. Clinical Enzymology
xiv. Biochemical genetic
xv. Toxicology
xvi. Cancer

LABORATORY TECHNICAL COMPETENCIES

i. Basic laboratory techniques
ii. Factors influencing laboratory results
iii. Laboratory instrumentation
iv. Laboratory automation
v. Spectrometric methods
vi. Osmometry
vii. Electrometric methods
viii. Electrophoresis
ix. Chromatography
x. POCT

LABORATORY MANAGEMENT COMPETENCIES

i. General
ii. Total Quality Management (QA/QC/QMS)
iii. Laboratory Safety

Teaching methods will be student-centered and teacher-centered consisting of:

i. Lectures
ii. Seminar
iii. Clinical cases studies
iv. Journal club
v. CME sessions
vi. Submission of a satisfactorily completed log book
vii. Practical will be acquired through attachment during laboratory rotations

7. MEDICAL IMMUNOLOGY MODULE

To acquire knowledge on

THEORETICAL ASPECTS

i. Organization of the immune system
ii. Antigen and antibody reactions
iii. Complement & Cytokines
Major Histocompatibility Complex Immune Response
iv. Hypersensitivity
Immunodeficiency
Autoimmunity and autoimmune disease
v. Tumour immunology
Transplantation immunology

Practical

i. Agglutination:
- Rheumatoid Factor/ C-Reactive Protein/RPR
ii. Immunoflourescence:
- Anti-Nuclear Antibody/Anti-dsDNA /
iii. Anti-Smooth Muscle Antibody /Anti- Mitochondrial Antibody / Anti-Neutrophil Cytoplasmic Antibody
iv. Turbidometry/nephelometry:
-C-Reactive Protein
- ImmunoglobulinG, ImmunoglobulinA,
v. Immunoglobulin IgM, Complement3, Complement 4
vi. Immunoassay :
ELISA/EIA/FEIA fluoroenzyme immunoassay (FEIA)/
vii. Immunoblot - Anti-Cardiolipin Antibody
- Extractable Nuclear Antigen - Alpha-FetoProtein
- Allergen Specific IgE Test

viii. Immunophenotyping
- Lymphocyte subsets

It is student-centered and teacher-centered consisting of

1. Lectures for the theoretical 10 topics
2. Seminars which involve case presentation, theoretical aspect of the disease and immune-diagnosis and principle of management
    - Seminar 1 – Autoimmunity
    - Seminar 2 – Immunodeficiency
    - Seminar 3 – Hypersensitivity
3. Laboratory attachment

8. **MEDICAL GENETICS MODULE**

To acquire knowledge on

i. Introduction to Medical Genetics
ii. Introduction to Molecular Genetics
iii. Introduction to Human Cytogenetics
iv. Cytogenetic analysis - Methods and Applications
v. Principles of inheritance in genetics disorders
vi. Introduction to Genetics Counselling
vii. Overview of DNA technology applications in medicine
viii. Cancer genetics (molecular and cytogenetics techniques)
ix. Genetics Basis of Human Cancer

Practical

i. PCR
ii. Karyotyping
iii. DNA extraction
iv. FISH analysis
v. Pedigree drawing and analysis

Teaching Method

1. Various lectures as well as laboratory practical sessions for cytogenetic and molecular techniques.
2. During the postings, the candidate shall maintain a log book and performance to the supervisor's satisfaction a list of procedures.

APPENDIX II

STAGE 2: MEDICAL MICROBIOLOGY

INTRODUCTION

Guided self-learning is a major component of the clinical microbiology module. The need for the self-learning experience are provided in the form of seminar/journal club presentations, validating laboratory results, clinical consultations and ward visits. Bench-working provides an avenue for acquiring competency in conducting laboratory works and understanding procedures of specimen handling and processing, as well as enabling students to be critical of laboratory processes especially in cases of non-conformities. Throughout the module, students are also encouraged to participate in quality management system and hospital/community infection control measures. By the end of the stage 2 training, all-rounded specialists in clinical microbiology are produced that are confident in their knowledge and skills which enable them to function effectively in a clinical management team.

LEARNING OBJECTIVE

General objective

To acquire knowledge and skill in laboratory diagnosis of infectious diseases and immunological diseases

Specific objectives

a. To evaluate the quality of specimen and to perform specimen reception/rejection for microbiological diagnosis
b. To acquire knowledge and skill in media preparation, QC and trouble shooting
c. To acquire knowledge and skill in performing and interpreting the culture in bacteriology, virology, mycology and mycobacteriology.
d. To acquire knowledge and skill in performing and interpreting the antibiotic susceptibility test (AST)
e. To acquire knowledge and skill in performing and interpreting the immunoassay for serodiagnosis and immunological diseases
f. To acquire knowledge and skill in diagnosis of common parasitic diseases
g. To acquire knowledge and skill in performing and interpreting molecular diagnosis for infectious diseases
h. To acquire knowledge and skill in infection control and outbreak management
i. To acquire knowledge and skill in laboratory management and quality management system
j. To acquire skill in performing research in clinical microbiology

COURSE CONTENT

i. THEORETICAL ASPECTS

As for Stage 1 but at a higher level of knowledge, skill and responsibility.

ii. PRACTICAL ASPECTS

Nature of skill	Level of Competence		
	Year II	Year III	Year IV
Processing clinical and environmental specimens	3	4	5
Knowledge on media preparation and quality assessment	4	5	5
Validating and reporting results	3	4	5
Solving technical problems in the laboratory	2	3	4
Activities relating to accreditation and QA	2	3	4
Involve in the implementation of hospital antibiotic policy	2	2	3
Participate in public health programmes	2	3	3
Provide consultation on antimicrobial chemotherapy	3	4	4
Laboratory management	2	3	4
Undertake research project	3	4	4
Effective presentation	3	4	5
Participate in the implementation of hospital infection control programmes	2	3	4

Research Aspects

The student is expected to have general knowledge on conducting research and should be able to come out with research proposal. The student will be taught on research methodology, good clinical practice, statistical analysis and scientific writing. This proposal need to be presented in the department and submitted to local human/animal ethical committee for approval. The student has to conduct the research with in the candidature and submit the dissertation at least six months before final examination for assessment.

COURSE STRUCTURE

YEAR 2

Orientation (1 week)	Research Methodology Workshop	Laboratory and clinical work	Vacation 4 weeks (2 weeks every 6 months)

	(2 weeks)	(45 weeks) Submission of 2 case reports formatted for journal publication.	
		Research Project	

YEAR 3

Laboratory and clinical work (38 weeks)	Elective postings (10 weeks)	Presentation of dissertation. Submission of dissertation and 2 case reports formatted for journal publication.	Vacation 4 weeks (2 weeks every 6 months)
Research Project			

YEAR 4

Laboratory and clinical work (40 weeks)	Study Leave (6 weeks)	Examination (2 weeks)	Vacation 4 weeks (2 weeks every 6 months)

TEACHING PROGRAMME

i. The teacher: student ratio will be 1: 3

ii. The candidates must understand and comply with the requirements of quality management system (MS ISO15189, ISO 9001, etc.) in each institution.

iii. There will be formal sessions in the form of case presentations, seminars, journal reviews, and small group discussions on selected topics.
iv. Candidates are expected to participate actively in continuous professional development (CPD) activities of each department/institution.
v. Candidates are required to undertake elective postings relevant to the programme. The elective may be a laboratory or a clinical posting.
vi. Candidates are to submit a report on each elective posting.
vii. Candidates are expected to undertake routine duties of including laboratory rounds, clinical consultations, outbreak management, laboratory management and laboratory quality assurance activities under supervision of clinical microbiologists.
viii. Candidates are required to plan, undertake and write up a research project that has to be submitted at the end of Year III (at least 6 months before their Professional 2 examination)
ix. Candidates are required to submit 4 case reports at the end of Year III. .(at least 6 months before their Professional 2 examination)

x. Candidates are to fulfil the training requirements as determined in the logbook.
xi. Candidates are required to participate in the teaching and learning activities of the academic programmes.

LEARNING OUTCOMES

At the end of the programme, the candidate shall be able to:

i. perform microbiology laboratory tests; and interpret and validate examination results in relation to patients available clinical information and previous results.
ii. demonstrate competency in handling specimens, including collection and processing, storage, retention and disposal of clinical samples, data storage, data retrieval and laboratory information management.
iii. participate in laboratory management related to personnel, technical, equipment, reagents and consumables, services and financial matters.
iv. implement and monitor laboratory safety procedures.

v. undertake relevant quality assurance activities pertaining to microbiology laboratory accreditation.
vi. provide consultation in the management of infectious diseases and immunologically mediated diseases, control of hospital infections and antibiotic policy.
vii. apply knowledge and skills to management of infectious diseases in the community.
iii. participate in education and training programme in Medical Microbiology.
ix. update knowledge on the advances in Medical Microbiology.
xi. conduct research projects.
xii. display professional ethics, values, attitudes and legal requirements relevant to the practice.