MASTER OF PATHOLOGY

Anatomic Pathology
Haematology
Medical Microbiology
Chemical Pathology
Forensic Pathology
Medical Immunology
Medical Genetics

GUIDE TO TRAINEES AND TRAINERS

October 2016

CONTENT PAGE NUMBER

1. MASTER OF PATHOLOGY PROGRAMME

1.1 INTRODUCTION

The Master of Pathology is a 4 year post-graduate programme with the primary objective of producing a competent specialist who will lead the laboratory and provide the diagnostic and consultation services to the clinicians. The programme is comprised of stage 1 of one year duration and stage 2 of three years duration. The training centers include public universities' teaching hospitals (closed system) and the accredited hospital of Ministry of Health (open system).

1.1.1. VISION

The Master of Pathology strives to be the academic programme for local and international students, providing the highest standard of pathology education and training to produce a competent pathologist.

1.1.2. MISSION

a. To meet the requirements of the nation in the field of pathology.
b. To create an environment that is conducive for achieving academic, service and research excellence in pathology.
c. To produce competent pathologists who will provide quality clinical services and laboratory management.
d. To consolidate and improve training programme for the development of quality human resources in the field of pathology.
e. To promote internationalisation of academic, research and service activities related to pathology.

1.1.3. ENTRY REQUIREMENTS

Candidates who wish to pursue Master of Pathology need to

a. have a valid medical Degree from a university recognized by Malaysian Medical Council (MMC).
b. be registered with the MMC.
c. complete at least 3 years of medical service.
d. pass the entrance examination and/or
e. pass an interview.

All candidates must pass the entrance examination before he or she can be eligible for the interview for selection into the programme.

For foreign candidates, requirements a-e above are applied, plus

a. Possess a Temporary Practicing Certificate issued by the MMC before starting practice.
b. Undergo clinical or laboratory attachment at a minimum of 3 months before joining the programme with satisfactory supervisor report.
c. Proof of proficiency in the English language. Candidates must obtain a minimum score of 6.0 in IELTS or 550 in TOEFL (obtained within 2 years prior to date of enrolment)

The Entrance Examination:

a. The examination consists of TWO True-False Multiple Choice Question papers. Each paper consists of 60 questions with 5 responses.The first paper consists of basic anatomic pathology, forensic pathology, microbiology and immunology questions. The second paper consists of basic haematology, chemical pathology and genetic questions.
b. Marking system: A computerised marking system will be used. There will be minus marking of 0.5 marks for wrong answer. The minimum mark for each question is 0 (no carryover of negative marks).
c. The pass mark is 50% and the candidate will be called for an interview. Those who obtain a mark between 45 -49% may be considered for interview.
d. The result of the entrance exam is validfor 2 years.
e. The examination will be conducted annually by one of the conjoint universities.

1.1.4. INTAKE SCHEDULE

Once a year usually in June.

1.1.5. STAGES OF THE PROGRAMME

The 4-year course will be divided into two Stages: Stage 1 and Stage 2.

The Stage 1 course is of one year duration of General Pathology in four major disciplines of pathology i.e. Anatomic Pathology, Haematology, Medical Microbiology and Chemical Pathology with some input from immunology, genetics and forensic pathology. Stage 1 training is only done in universities.

At the end of the Stage 1 course the candidate will sit for an examination in General Pathology (Part 1 examination) and must pass this examination in order to proceed to the Stage 2 course.

The Stage 2 course is of three years duration. The candidate can opt for one of the following disciplines: Anatomic Pathology, Haematology, Medical Microbiology, Forensic Pathology, Chemical Pathology, Immunology and Medical Genetics. During the Stage 2 course the candidate shall undertake a research project and submit a research project report. At the end of the Stage 2 course the candidate must sit and pass an examination (Part 2 examination) in order to be awarded the degree of Master of Pathology.

Stage 2 training may be undertaken in the universities (Closed System) or in accredited training centers under Ministry of Health or public hospitals (Open System). However, candidates in the Open System will do the last year of training in the respective university.

1.1.6 DURATION

The maximum duration permitted to complete the course is seven years. The maximum duration permitted to complete the Stage 1 course is two years and the maximum duration permitted to complete the Stage 2 course is five years.

1.2. TRAINING PROGRAMME

1.2.1. IN-SERVICE TRAINING PROGRAM

This is an in-service training program and candidates are expected to be responsible for their own learning. Nevertheless, all candidates are also required to attend orientation and intensive courses as well as distance learning programs conducted by the universities. Lecturers from the universities will monitor the candidates in Ministry of Health laboratories on a regular basis.

1.2.2. SUPERVISORS

The supervising pathologist at the center of training is required to check on the progress of the candidate, keep track of the candidate's practical skills through the maintenance of a log book and conduct regular sessions with the candidate. Supervising pathologist is required to submit progress report to the university at least at the end of a posting but not less than once every six months. All supervisors shall be formally appointed by the university concerned. For the Open System, academic staff from university will be appointed as the main supervisor and those from Ministry of Health will be appointed as co-supervisor by the respective university.

1.2.3. LEVELS OF COMPETENCE

The candidate is expected to acquire a range of skills during the period of training. For each specific skill, the level of competence expected will be determined. For this purpose, a uniform scale of measurement of competence is adopted as stated below;

Level 1: Observer status only
Level 2: Assistant status
Level 3: Able to perform under close and direct supervision
Level 4: Able to perform under indirect supervision
Level 5: Able to perform unsupervised

1.2.4. RESEARCH

For the Stage 2, the candidate shall plan and undertake a research project and write up a dissertation. This is to introduce the candidate to research methodology, data analysis and report writing.

To facilitate this task all candidates are required to undergo training in research methodology conducted by the university concerned.

Supervisor and co-supervisors for the dissertation shall be appointed by the university. The dissertation supervisor and co-supervisor can also be from the training supervisors.

The candidate must present the research proposal at the departmental level prior to submission to the post graduate committee in the second semester of Year 2.

The dissertation is to be submitted 6 months before the start of Part II Professional Examination. Each dissertation will be assessed by an external or internal examiner appointed by the university.

The dissertation will be marked either as:

1. acceptable unconditionally
2. acceptable subject to minor corrections
3. resubmission due to major corrections and re-examination
4. not acceptable

A satisfactory report of the dissertation is a prerequisite for sitting the Part II Professional Examination.

Candidates are encouraged to publish their dissertation in scientific journals before graduating from the programme.

1.2.5. ELECTIVE POSTINGS

Elective postings can be undertaken when deemed necessary by the individual discipline. Where the posting is essential in order for the candidate to acquire necessary skills, the posting should be considered a compulsory posting even if it is done outside the primary center of training. Overseas postings may be considered if it is consistent with the individual university's regulations.

1.2.6. READING MATERIALS

A list of required reading materials will be given to all candidates. A list of required journals will be prepared by each discipline. All Ministry of Health hospitals undertaking training should facilitate the availability of these journals.

1.2.7. ACCREDITATION OF TRAINING CENTERS

a. All centers of training should have facility for electronic communication for effective and efficient communication between students and teachers.

b. Details on the guidelines on accrediting the training centers are published in a separate book. (Master of Pathology – Guidelines for accreditation of training centers)

1.2.8. COURSE STRUCTURE

<table>
<tr><th>STAGE 1</th><th colspan="3">STAGE 2</th></tr>
<tr><td>YEAR 1
2 semesters
(48 weeks of T&L,log book)</td><td>YEAR 2
2 semesters
(48 weeksT&L,in-service
training, log book, and research activity)</td><td>YEAR 3
2 semesters
(48 weeks T&L, in-service
training, log book, and research activity)</td><td>YEAR 4
2 semesters
(48 weeks T&L, in-service
training, log book, and research activity)</td></tr>
<tr><td></td><td>Semester 1</td><td>Semester 3</td><td>Semester 5</td></tr>
<tr><td rowspan="5">TCL: Lectures

SCL: Practical, Seminar, Case Study, Journal Critique.

SDL: Writing case book.

Rotation:
-10 weeks in every discipline of Pathology.
- Orientation week (1 week)
- Intensive course (2 weeks)
- Study leave (3 weeks)

Total= 46 weeks</td><td>SCL: in-service training in laboratory/ward/clinic/mortuary at University Hospital or MOH Hospital.</td><td>SCL: in-service training in laboratory/ward/clinic/mortuary at University Hospital or MOH Hospital.</td><td>SCL: in-service training in laboratory/ward/clinic/mortuary at University Hospital or MOH Hospital.</td></tr>
<tr><td>TCL: Research methodology and preparation of research proposal.

SCL: Practical, Seminar, Case Study, Journal Critique</td><td>SCL: Practical, Seminar, Case Study, Journal Critique</td><td rowspan="2">SDL : Carrying out research activity / writing case book

** Submission and assessment of dissertation, log book and case book to examiner(s).</td></tr>
<tr><td>SDL: Case book writing / research proposal writing</td><td>SDL : Carrying out research activity / writing case book
.</td></tr>
<tr><td>Semester 2</td><td>Semester 4</td><td>Semester 6</td></tr>
<tr><td>SCL: in-service training in laboratory/ward/clinic/mortuary at University Hospital or MOH Hospital.</td><td>SCL: in-service training in laboratory/ward/clinic/mortuary at University Hospital or MOH Hospital.</td><td>SCL: in-service training in laboratory/ward/clinic/mortuary at University Hospital or MOH Hospital.</td></tr>
<tr><td>PART 1 PROFESSIONAL EXAMINATION
(2 weeks)</td><td>SDL : Carrying out research activity / writing case book</td><td>SDL : Carrying out research activity / writing case book</td><td>ASSESSMENT of dissertation, log book and case book
and
PART 2 PROFESSIONAL EXAMINATION
(2 weeks)</td></tr>
</table>

*T& L = Teaching and Learning; TCL = Teacher-centered Learning; SCL = Student-centered Learning;
SDL = Self-directed Learning; MOH = Ministry of Health

1.3. STAGE 1 MASTER OF PATHOLOGY PROGRAMME

1.3.1. OBJECTIVES

a. Primary objective

The primary objective of the Stage 1 course is for the candidate to attain basic knowledge and practical competence in Pathology.

b. Specific objectives

i. To acquire basic theoretical knowledge in Pathology.
ii. To acquire basic practical competence in the performance and interpretation of common laboratory tests including autopsies.
iii. To acquire basic knowledge in laboratory management including laboratory organization, quality control and laboratory safety.

1.3.2. 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.

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

2. ANATOMIC PATHOLOGY MODULE

2.1. GENERAL INTRODUCTION

Anatomic pathology is a medical specialty that is concerned with the diagnosis of diseases based on their macroscopic, microscopic and ancillary studies. The ultimate aim is for the trainees to be able to recognize pathological changes that leads to the diagnosis of diseases, its clinical correlation and pathogenesis.

2.2. VISION

To produce competent, ethical, highly motivated anatomic pathologist of international standing.

2.3. MISSION

To inspire lifelong learning, advance knowledge and skillful anatomic pathology diagnosticians and laboratory consultants

2.4. PROGRAMME DESCRIPTION

This is a four-year programme comprising stages 1 (year 1) and 2 (years 2, 3 and 4) .Stage 1 is an in-campus training. It is a foundation year during which the trainees are exposed to all four major disciplines namely Anatomic Pathology, Hematology, Chemical Pathology and Medical Microbiology, incorporating elements of immunology, forensic, molecular pathology, medical genetics and transfusion medicine. Upon successful completion of the first stage, the trainees continue to be trained in Anatomic Pathology and Laboratory Management.

2.5. LEARNING OUTCOMES

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

a. Apply the theoretical and practical knowledge in the fields of Anatomic Pathology.
b. Perform and interpret diagnostic pathology tests in the fields of Anatomic Pathology.
c. Display communication and teamwork skills in the provision of pathology patient care services

2.6. STAGE 1: ANATOMIC PATHOLOGY MODULE

2.6.1 INTRODUCTION

Phase 1 training focuses on understanding general pathology with some input on common systemic pathology. The competency technical requirement is generally at level 3 (mainly) and level 4 (for simple common diseases).

2.6.2 LEARNING OUTCOMES

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

a. Apply the basic theoretical and practical knowledge in the fields of Anatomic Pathology, Haematology, Medical Microbiology and Chemical Pathology.
b. Perform and interpret basic diagnostic pathology tests in the fields of Anatomic Pathology.
c. Display communication and teamwork skills in the provision of pathology patient care services Apply the professional values, attitude and ethics while working in the hospital's diagnostic laboratories
d. Apply the professional values, attitude and ethics while working in the hospital's diagnostic laboratories.

2.6.3 LEARNING OBJECTIVES

a. General objective
   i. To attain level 3 competence in the gross and microscopic examination, interpretation and reporting of tissue specimens.
   ii. To acquire knowledge of the principles of techniques involved in the preparation and staining of paraffin and frozen sections.

b. Specific objectives

   i. To recognize pathological changes by macroscopic and microscopic examination (Competence level 3)
   ii. To be able to identify common artifacts and their causes. (Competence level 3)
   iii. To diagnose and report on surgical pathology specimens. (Competence level 3)
   iv. To recognize the circumstances where ancillary tests are necessary. (Competence level 3)
   v. To understand the medico-legal implications of Anatomic Pathology reports. (Competence level 5)
   vi. To inculcate good and safe laboratory practice. (Competence level 3).
   vii. To perform and report on clinical and forensic autopsies. (Competence level 3)

2.6.4. COURSE CONTENT

a. THEORY

   i. Pre-requisite knowledge**:**
      - Anatomy and histology of the human body.
      - Applied physiology of all organ-systems.
      - Basic cellular biology in various organ systems.

   ii. Knowledge to be acquired

- 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

b. PRACTICAL

i. Pre-examination of surgical specimens
- Receiving of specimen (adequacy, labelling)

ii. Examination of surgical specimen
- Principles of specimen fixation.
- Macroscopic description of surgical specimens, trimming and selection ofblocks, embedding of all common tissues.
- Principle of tissue processing from tissue grossing to slide preparation
- Understand the principle and the application of
  - Haematoxylin and Eosin (H & E) staining.
  - Histochemistry eg; Ziehl Neelson, fungi, iron, mucin, fat, muscle fibers, reticulin, elastin and collagen.
  - Immunohistochemistry
  - Enzyme histochemistry
  - Immunofluorescence

iii. Post-examination of surgical specimens
- Record keeping and disease indexing; familiarity with a widely used system e.g. SNOMED.
- Liaison with other clinical specialties; Participation in regular clinicopathological meetings and patient-care discussion.

iii. Laboratory safety precautions
iv. Understand the principle of laboratory management system.

2.6.5. COURSE STRUCTURE

a. Duration: 10 weeks
b. Methods: The trainees will be exposed to various teaching-learning methodologies:

i. Student centered learning e.g.; seminar, tutorials/slide sessions, journal club, CME/CPC, e- learning
ii. Apprenticeship training, lectures

2.6.6. TEACHING PROGRAMME

a. TRAINING SCHEDULE

Preparation and reporting of stained tissue sections:

i. 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)
ii. Examine routine H&E stained sections of surgical specimens and submit 50 histopathological reports

b. Autopsy:

Perform 10 autopsies under supervision including gross dissection, trimming, and interpretation of gross and microscopic findings and submit THREE full autopsy reports and SEVEN summaries. This requirement may be achieved over the first year of training rather than limited to anatomic pathology posting.

b. Intensive course covering the following topics:
i. General and systemic pathology
ii. Quality management system and laboratory safety

2.6.7. RECOMMENDED TEXTBOOKS/JOURNALS/REFERENCES

a. Textbooks

i. Robbins & Cotran Pathologic Basis of Disease. Authors; Vinay Kumar MBBS MD FRCPath, Abul K. Abbas MBBS; Nelson Fausto MD; Jon Aster MD; W B Saunders – 9th edition, 2015
ii. Histology for Pathologist by Stacey E Mills MD, 4th edition, 2012
iii. Wheater's Basic Pathology: A Text, Atlas and Review of Histopathology by Geraldine O'Dowd (latest edition) @ Wheater's Basic Histopathology by Alan Stevens. James S. Lowe, Barbara Young., 6th edition, 2014
iv. Theory and Practice of Histological Techniques. Bancroft JD and Stevens A.. Churchill Livingstone., 7th edition, 2013.
v. The Practice of Surgical Pathology: A beginners's guide to the diagnostic process by Diana Weedman Molavi, 2008.
vi. Rosai, Juan. *Rosai and Ackerman's Surgical Pathology*. Tenth ed. 2 vols: Mosby Elsevier, 2011.
vii. Lester, Susan C. *Manual of Surgical Pathology*. Third ed.: Mosby, 2010
viii. WHO Classification of Tumour Series

b. Recommended Journals

i. Pathology. Official Journal of the Royal College of Pathologists of Australasia.
ii. Journal of Clinical Pathology.
iii. The Journal of theAssociation of Clinical Pathologists.
iv. Other relevant pathology journals.

2.7. STAGE 2: ANATOMIC PATHOLOGY MODULE

2.7.1 INTRODUCTION

This is a 3-year training programme. The first 2 years are held in teaching and / or public hospitals, while the final year is in-campus. The focus is on advanced understanding and application of general and systemic pathology in greater detail. The competency technical requirement at exit is generally at level 5.

2.7.2 LEARNING OUTCOMES

At the end of the 3-year program in phase 2 the students shall be able to:

a. Acquire and apply diagnostic skills in anatomic pathology.
b. Develop critical thinking and apply scientific approach in anatomic pathology data interpretation.
c. Participate in external quality assurance program
d. Acquire knowledge on research methodology and conduct research ethically.
e. Acquire communication skills and be responsible in patient care.
f. Acculturate ethical value and professionalism.
g. Develop laboratory management skills

2.7.3 LEARNING OBJECTIVES

a. General objective

i. To understand anatomic pathology in greater detail from basic to systemic pathology including autopsy with technical requirement of level 5 in most tasks.
ii. To behave as a competent anatomic pathologist in training; in diagnosis and clinical pathology consultations.

b. Specific objectives

i. To attain level 5 competence in macroscopic and microscopic pathology (histopathology).
ii. To attain level 5 in cytopathology.
iii. To attain level 5 in clinical and at least level 4 medico-legal autopsy.
iv. To attain level 5 in frozen sections and specialized pathology (level 4 to 5) (eg; renal pathology, neuromuscular pathology, perinatal pathology).
v. To acquire level 4 competence in the management and organization of the diagnostic anatomic pathology laboratory services.
vi. To acquire level 4 competence in the planning, conduct and write-up of a simple research project.

2.7.4 COURSE CONTENT

a. THEORY

Pre-requisite knowledge
• Anatomy & histology of human body • Applied physiology of all systems • Basic clinical & radiological knowledge
Knowledge to be acquired
• Applying theoretical knowledge into the clinical practice (including surgical pathology, cytopathology, autopsy and laboratory management) • Ability to discuss differential diagnoses of the disease • Keep up-to-date with theoretical knowledge and ancillary studies of diseases • Understand the basic research project (proposal, literature review, methodology and statistical analysis) • Understand medico-legal issues related to anatomic pathology services

b. PRACTICAL

Skill to be acquired	Level of Competence
Perform:	
Grossing surgical specimens	5
Fine needle aspiration cytology (FNAC)	5
Autopsy	4 to 5
Interpretation:	
Routine surgical pathology including renal, liver, muscle biopsies & rectal suction	5
Ancillary studies	5
Recognise common ultrastructural changes of diagnostic significance	4
Frozen sections	5
Cytopathology - FNA, Gynae and non-gynae cases	5
Record keeping and disease indexing (eg SNOMED)	5
Laboratory management skills including Quality Assurance programme	4
Provide active consultancy services in regular patient care discussion	5
Participate in CME/CPC	5
Ability to carry out basic research project (proposal, literature review, methodology, laboratory work and statistical analysis)	4

c. NUMBER OF PROCEDURES TO BE UNDERTAKEN AND ASSESSED*

Procedure	Number to be undertaken	Number of reports for assessment
Routine surgical pathology (variety of cases including all systems)	4000	100
Frozen sections	80	20
Routine autopsies	80	20
Cytology		
Non-gynae	400	30
Gynae	400	50
FNA	100	30

*****Assessed via log books

2.7.5. COURSE STRUCTURE

a. YEAR 2

i. Orientation
ii. Performing technical procedures in histopathology lab*
iii. Laboratory postings with rostered call duties
iv. Forensic posting (4 to 8 weeks)
v. Research Project including attending of research methodology workshop, Good Clinical Practice (GCP) and submission of proposal

*Assessed via log books

b. YEAR 3

i. Laboratory postings with rostered call duties
ii. Elective / specialty training
iii. Forensic posting (4 to 8 weeks)
iv. Research Project including attending of research methodology workshop

c. YEAR 4

i. Laboratory postings with rostered call duties
ii. Forensic posting (4 to 8 weeks)
iii. Submission and assessment of dissertation
iv. Examination (refer to examination chapter)

2.7.6. TEACHING PROGRAMME

a. The teacher: student ratio is 1: 2
b. The student shall learn primarily through in-service training in an independent and self-directed manner.

c. The formal teaching programme is individualized according to the on call schedule and comprise of discussion sessions, written assignments, slide interpretation and other practical skills.
d. Continuous assessment comprises of attendance, performance during on call, supervisor's and research progress reports.
e. The student shall plan, undertake and write up a research project, which is to be submitted by the end of the first semester of final year.
f. The student is expected to attend and participate actively in all regular CPCs, cytology CME, forensic CME and journal club presentations of the department.
g. The student is encouraged to attend and present at relevant scientific meetings conducted by professional bodies/universities.
h. The students are expected to gain knowledge and experience from the elective/specialty posting

2.7.7. RESEARCH PROJECT

a. The students shall engage in research activities where they will be exposed to research proposal, methodology and statistical data analysis to produce a dissertation.
b. A supervisor will be appointed to oversee and advise the research projects conducted.
c. The proposal shall be delivered within the time frame set and must be approved by the Department. Data collection shall be commenced after the ethical approval by the ethics committee.
d. Supervision reports must be provided by the supervisor every six months.
e. A dissertation can be written and organized according to the instructions given by the post-graduate office.
f. The students must submit a complete dissertation six (6) months prior the phase II final assessment.
g. For the final submission, the students must submit two (2) copies of the dissertation in hard binding.
h. Satisfactory of the assessment dissertation is a pre-requisite to sit for the Part II Examination.

2.7.8. RECOMMENDED TEXTBOOKS/JOURNALS/REFERENCES

The following texts or their equivalents are recommended (Latest edition preferable):

a. General & Basic Pathology

i. Rosai, Juan. *Rosai and Ackerman's Surgical Pathology*. Tenth ed. 2 vols: Mosby Elsevier, 2011.
ii. Stacey E Mills, Joel K Greenson, Jason L Hornick, Teri A Longacre, Victor E Reuter. *Sternberg's Diagnostic Surgical Pathology*. Sixth ed. 2 vols: Wolters Kluwer Health, 2015.
iii. Lester, Susan C. *Manual of Surgical Pathology*. Third ed.: Mosby, 2010
iv. Paolo Gattuso, Vijaya B Reddy, Odile David, Daniel J Spitz, Meryl H Habar. *Differential Diagnosis in Surgical Pathology*. Third ed.: Elsevier Saunders, 2014.

v. Fletcher, Christopher D M. *Diagnostic Histopathology of Tumors*. Fourth ed. 2 vols: Elsevier, 2013.
vi. Recent Advances in Histopathology Series. Edited by Patrick Gallagher Massimo Pignatelli.
vii. S Kim Suvarna, Christopher Layton, John D Bancroft. *Bancroft's Theory and Practice of Histological Techniques*. Seventh ed.: Churchill Livingstone, 2012.

b. Systemic Pathology

i. Adam Greenspan, Dariusz Borys. *Radiology and Pathology Correlation of Bone Tumors: A Quick Reference and Review*. First ed.: Wolters Kluwer, 2016.
ii. Aliya N Husain, J Thomas Stocker, Louis P Dehner. *Stocker and Dehner's Pediatric Pathology*. Fourth ed.: Wolters Kluwer, 2016.
iii. Andrea T Deyrup, Gene P Siegal. *Practical Orthopedic Pathology: A Diagnostic Approach*. Pattern Recognition Series. Edited by Mark R Wick Kevin D Leslie: Elsevier, 2016.
iv. David E Elder, Rosalie Elenitsas, Misha Rosenbach, George F Murphy, Adam I Rubin, Xiaowei Xu. *Lever's Histopathology of the Skin*. Eleventh ed.: Wolters Kluwer, 2015.
v. David G Hicks, Susan C Lester. *Breast*. Diagnostic Pathology. Second ed.: Amirsys Elsevier, 2016.
vi. Edward F McCarthy, Frank J Frassica. *Pathology of Bone and Joint Disorders, with Clinical and Radiolographic Correlation*. Second ed.: Cambridge University Press, 2015.
vii. Lester DR Thompson, Bruce M Wenig, Susan Muller, Brenda Nelson. *Head & Neck*. Diagnostic Pathology. Second ed.: Elsevier, 2016.
viii. Margaret Ashton-Key, Penny Wright, Dennis Wright. *Diagnostic Lymph Node Pathology*. Third ed.: CRC Press, 2016.
ix. Peter C Burger, Bernd W Scheithauer, BK Kleinschmidt-DeMasters, Fausto J Rodriguez, Tarik Tihan, Ayca Ersen, Elisabeth J Rushing. *Neuropathology*. Diagnostic Pathology. Second ed.: Amirsys Elsevier, 2016.
x. Robert B Colvin, Anthony Chang, A Brad Farris III, Neeraja Kambham, Lynn D Cornell, shane M Meehan, Helen Liapis, Joseph P Gaut, Stephen M Bonsib, Surya V Seshan, Sanjay Jain, Christopher P Larsen. *Kidney Diseases*. Diagnostic Pathology. Second ed. 2016.
xi. Robert D Odze, John R Goldblum. *Odze & Goldblum Surgical Pathology of the Gi Tract, Biliary Tracy and Pancreas*. Third ed.: Elsevier Saunders, 2015.
xii. Robert J Kurman, Lora Hedrick Ellenson, Brigitte M Ronnett. *Blaustein's Pathology of the Female Genital Tract*. Sixth ed.: Springer, 2011.
xiii. Syed A Hoda, Edi Brogi, Frederick C Koerner, Paul Peter Rosen. *Rosen's Breast Pathology*. Fourth ed.: Lippincott Williams & Wilkins, 2014.
xiv. WHO Classification of Tumour Series

c. Cytopathology

i. Dorothy L Rosenthal, Eva M Wojcik, Daniel FI Kurtycz, .*The Paris System for Reporting Urinary Cytology*. First ed.: Springer, 2016.
ii. Edmund S Cibas, Barbara S Ducatman. *Cytology: Diagnostic Principles and Clinical Correlates*. Fourth ed.: Elsevier Saunders, 2014.
iii. Ritu Nayar, David C Wilbur. *The Bethesda System for Reporting Cervical Cytology: Definitions, Criteria and Explanatory Notes*. Third ed.: Springer International Publishing, 2015.
iv. Svante R Orell, Gregory F Sterrett. *Orell & Sterrett's Fine Needle Aspiration Cytology*. Fifth ed.: Churchill Livingstone Elsevier, 2012.
v. Syed Z Ali, Edmund S Cibas. *The Bethesda System for Reporting Thyroid Cytopathology: Definitions, Criteria and Explanatory Notes*. First ed.: Springer, 2010.

d. Forensic Pathology

i. Catanese, Charles. *Color Atlas of Forensic Medicine and Pathology*. First ed.: CRC Press, 2016.
ii. Micheal T Sheaff, Deborah J Hopster. *Post Mortem Technique Handbook*. First ed.: Springer, 2005.
iii. Pekka Saukko, Bernard Knight. *Knight's Forensic Pathology*. Fourth ed.: CRC Press, 2016.
iv. Suvarna, S Kim. *Atlas of Adult Autopsy: A Guide to Modern Practice*. First ed.: Springer, 2016.
v. Vincent J DiMaio, Dominick DiMaio. *Forensic Pathology*. Second ed.: CRC Press, 2001.

e. Journals

i. Pathology and cytopathology-related journals

3. HAEMATOLOGY MODULE

3.1. INTRODUCTION

The Master of Pathology (Haematology) programme is a post-graduate programme with the primary objective of producing a competent specialist (laboratory haematologist) who will lead the laboratory and provide the diagnostic and consultation services to the clinicians. The programme is comprised of stage 1 of one year duration and stage 2 of three years duration. The training centers include public universities' teaching hospitals (closed system) and the accredited hospital of Ministry of Health (open system).

3.2. VISION

The Master of Pathology (Haematology) strives to be the academic programme for local and international students, providing the highest standard ofhaematology education and training to produce a competent laboratory haematologist.

3.3 MISSION

a. To further create an environment which is conducive for achieving academic, service and research excellence in haematological field.
b. To consolidate and improve training and development of quality human resources in the field of haematological sciences.
c. To meet the requirements of the nation in the field of laboratory haematology.
d. To provide exemplary and quality in all haematological related services.
e. To acquire and provide technology transfer in the field of laboratory haematology.
f. To produce a competent haematological consultant for services and training activities.
g. To promote internationalisation of academic, research and service activities relating to haematology field.
h. To provide future specialists in subspecialty area of haematology.

3.4. PROGRAMME DESCRIPTIONS

This programme required four (4) years of training. The Stage 1 course (one year duration) involves ten (10) weeks of training in Haematology and Transfusion Medicine Laboratory and ten (10) weeks of training in each of the other three (3) major sub-disciplines of pathology i.e. Anatomic Pathology, Medical Microbiology and Chemical Pathology with some input from immunology, genetics and forensic pathology. The primary objective of the Stage 1 course is for the candidate to acquire basic knowledge and practical competence in haematology and transfusion medicine. Stage 1 training is done in universities' teaching hospitals (closed system). The candidates must pass the Part 1 examination in order to proceed to Stage 2 course.

Stage 2 course is a 3-year in-service training and candidates are expected to be responsible for their own learning. The candidate shall undertake a research project and submit a research dissertation report. At the end of the Stage 2 course the candidate must pass Part 2 examination in order to be awarded the degree of Master of Pathology (Haematology).

3.5. STAGE 1: HAEMATOLOGY MODULE

3.5.1. INTRODUCTION

Students will be posted in haematology department for 10 weeks. During the posting,students will be exposed to the theory and practical in haematology and transfusion medicine. There will be teaching sessions in the form of lectures, seminars, slides review, journal review, clinico-pathological correlation sessions and small group discussion on selected topics. The student is also expected to learn independently and self-directed learning through case study, bench work and patient management.

3.5.2. LEARNING OBJECTIVES

a. General objective:

To acquire knowledge of the common haematology disorders, including routine laboratory diagnosis, laboratory safety and basic quality assurance programme.

b. Specific objectives:

i. To describe the aetiologies, epidemiology, pathogenesis, clinical and laboratory features of common haematological disorders.
ii. To describe the basic principles of laboratory investigations of common haematological disorders.
iii. To perform and interpret basic laboratory tests for the common haematological disorders.
iv. To describe the basic principles of routine transfusion medicine procedures.
v. To perform and interpret routine transfusion medicine procedures and to manage common transfusion problems.

3.5.3. COURSE CONTENT

a. THEORETICAL ASPECTS

Haematology:

i. Haemopoiesis and normal haemostasis
ii. Red cells disorders:
- Anaemias: Nutritional anaemias, anaemia of chronic disease and aplastic anaemia
- Haemolyticanaemias
- Thalassaemia and common haemoglobinopathies.

iii. White cell disorders:
- Benign – Infections, leukaemoid reaction

- 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

b. PRACTICAL ASPECTS

PRACTICAL SKILL TO BE ACQUIRED	Level of interpretation competency
Automated full blood cell count	5
Full blood picture	5
Perform a manual differential count	5
Bone marrow examination	3
Reticulocyte count	5
ESR estimation	5
G6PD screening	5
Hb analysis	4
Routine coagulation screen – PT, APTT, Mixing tests, TT, FDP, D-Dimer, Fibrinogen, bleeding time	5
Special coagulation tests factor assay, inhibitor, thrombophilia	4
ABO, Rhesus grouping	5
Antibody screen, antibody identification, antihuman globulin test	5
Cross matching	5
Component preparation and storage*	Not applicable

Scale of practical competency of all the above listed test is level 3 except for * (level 1)
Note: Scale for competency of practical aspect

Level 1: Observer status only
Level 2: Assistant status
Level 3: Able to perform/interpret under close and direct supervision
Level 4: Able to perform/interpret under indirect supervision
Level 5: Able to perform/interpret unsupervised

3.5.4. COURSE STRUCTURE

Haematology (lectures, seminars, case presentations and practical/slide sessions)	Transfusion medicine (lectures, seminars, casepresentations and practical sessions)
10 weeks	

3.5.5. TEACHING PROGRAMME

The formal teaching programme will comprise of:

a. Orientation and intensive courses at the university.

b. Supervision by pathologists according to the log book, informal and formal teaching sessions.

3.5.6. LEARNING OUTCOMES

At the end of this posting students should be able to:

a. Understand the basic sciences involving common haematological disorders and immunohaematological problems.
b. Understand principle of laboratory investigations, interpret results and make diagnosis of common haematological disorders and transfusion problems.
c. Outline the principle of management of the above mentioned problems.

3.5.7. RECOMMENDED TEXTBOOKS/JOURNALS/REFERENCES

a. Text Books:

i. Pettit JE and Hoffbrand AV. Essential Haematology. (Latest edition.) Blackwell Scientific
ii. Dacie and Lewis. Practical Haematology.(Latest edition.) Churchill Livingstone.
iii. Hoffbrand AV and Pettit JE. Clinical Haematology (Atlas) Gower Medical Publishing. London. (Latest edition)
iv. Denise M. Harmening. Modern Blood Banking and Transfusion Practices (Latest edition)
v. Michael F. Murphy. Practical Transfusion Medicine.(Latest Edition)

3.6 STAGE 2: HAEMATOLOGY MODULE

3.6.1. INTRODUCTION

Stage 2 course is a three (3) year programme involving an in-service training programme in which candidates are expected to be responsible for their own learning. Stage 2 training is done in universities' teaching hospitals and in accredited Ministry of Health hospital. The candidates are expected to acquire a range of skills during the period of training involving laboratory management, quality assurance, general and special haematology services, transfusion medicine, relevant genetic testing. For each specific skill the level of competence

expected will be determined. The candidate shall undertake a research project and submit a research dissertation. At the end of the Stage 2 course, the candidate must pass Part 2 examination in order to be awarded the degree of Master of Pathology (Haematology).

3.6.2. LEARNING OBJECTIVE

a. General objective:

To acquire competent skills and knowledge of routine and special laboratory tests and services, laboratory management and quality assurance programme relevant to haematology and blood transfusion.

b. Specific objectives:

i. To acquire practical skills and interpret routine and special haematological tests.
ii. To gain knowledge in the management of a hospital haematology laboratory and blood transfusion services.
iii. To be able to provide specialist advice as relevant to patient care.
iv. To identify cases which require further consultation and take appropriate action.
v. To conduct and write-up a scientific research project competently.

3.6.3. COURSE CONTENT

a. THEORETICAL ASPECTS

Haematology:

i. Haemopoiesis and its clinical relevance
ii. Red cells disorders:
- Anaemias: Nutritional anaemias, anaemia of chronic disease and aplastic anaemia
- Haemolyticanaemias
- Thalassaemia and haemoglobinopathies.
- Congenital anaemias

iii. White cell disorders:
- Benign – Infections, leukaemoid reaction, storagedisease, congenital anomalies of WBC
- Leukaemias, multiple myeloma, myeloproliferative neoplasms, myelodysplastic syndrome and lymphoproliferative neoplasm

iv. Bone marrow failure and infiltration
v. Bleeding disorders- acquired and inherited bleeding disorders caused by vascular and platelet abnormalities, coagulation disorders
vi. Thrombophilia - acquired and inherited disorders
vii. Genetic aspect of haematological disease
viii. Haematological changes in systemic diseases
ix. Paediatrichaematological disorders

x. Quality assurance in haematology

Transfusion Medicine:

i. Donor and recipient management
ii. Type, preparation, storage and clinical use of blood components
iii. ABO, Rh and other clinically important blood group systems and antibody
iv. Blood group discrepancies
v. Compatibility testing and management of blood incompatibility
vi. Blood transfusion in special groups
vii. Near misses, transfusion errors, complications of blood transfusion
viii. Haemolytic disease of the newborn
ix. Stem cell transplantation
x. Genetic aspect of transfusion medicine
xi. Transfusion microbiology
xii. Quality assurance in blood transfusion

b. PRACTICAL ASPECTS

PRACTICAL SKILL TO BE ACQUIRED	Level of performance competency
Routine Haematology tests and procedures:	
Full blood picture	4
Reticulocyte count – manual and automated	4
Automated cell counting	4
ESR	4
Bone marrow aspirate and trephine biopsies staining techniques:	
Bone Marrow staining (Romanowsky- MGG, Perl's stain, and H&E	3
Cytochemical staining (PAS, Acid Phosphatase, Myeloperoxidase, esterase, NAP score)	3
Immunohistochemistry	3
Special Haematology investigations:	
Haemoglobin analysis	3
Staining for inclusion bodies	3
Sickle cell screen	3
OFT	3
Ham's test	3
G6PD screen and assay	3
Kleihauer test	3
Urine for haemosiderin	3
Serum and red cell folate	3
Serum B12	3
Serum ferritin	3
Flow cytometry	3
CSF cytospin	3
Serum and urine protein electrophoresis, immune fixation and serum immunoglobulin	3

Haemostasis and Thrombosis	
Routine coagulation test (PT/INR, aPTT)	5
Serum fibrinogen, thrombin time. D-dimer	3
Coagulation factor assay	3
Inhibitor screening and assay	3
Platelet function testing	3
von Willebrand assay	3
Thrombophilia work-up	3
Blood Banking and Transfusion Medicine	
Donor selection, counseling and management	5
Component processing	3
Component and reagent quality control	4
Blood grouping	5
Blood Compatibility testing,	5
Antibody screening and identification	5
Antiglobulin test	5
Specialized immunohaematology tests e.g. elution test, autoadsorption test…etc	3
Antibody titration	3
Apheresis technique	3
Platelet Antibodies testing	3
Platelet cross matching	3
Blood Screening and confirmation tests (Hepatitis B, C, HIV tests,VDRL)	3 3
Stem cell collection, processing and cryopreservation	2
HLA typing	3
CD34 enumeration	3
Genetic tests:	
Cytogenetics – karyotyping, FISH	2
PCR based techniques	2
Laboratory Management:	
Quality Management activities	5
Quality assurance scheme	
Laboratory accreditation	

Scale of <u>interpretation competency</u> of all the above listed tests is level 5.

Note: Scale for competency of practical aspect

Level 1: Observer status only
Level 2: Assistant status
Level 3: Able to perform/interpret under close and direct supervision
Level 4: Able to perform/interpret under indirect supervision
Level 5: Able to perform/interpret unsupervised

c. RESEARCH ASPECT

i. Research methodology (basic & intermediate statistic, scientific writing and writing).
ii. Protocol preparation and presentation.
iii. Ethical application.

3.6.4. COURSE STRUCTURE

a. YEAR 2: 52 weeks

Orientation	Research activities	Haematology laboratory work	Blood transfusion	Electives**	Attending conferences/ seminars	Leave
1 week	2 weeks: Workshop * Research project preparation	16 weeks	16 weeks	12 weeks	1 week	4 weeks (2 weeks every 6 months)
* The weightage of work should be around: Laboratory work 60%, Clinical work 20%, Research 20% **Electives : Attachments in National Blood Centre, Genetic Laboratory and others.						

b. YEAR 3: 52 weeks

Clinical adult Haematology	Paediatrichae m-atology/ oncology	Research activities	Haematology and transfusion laboratory / and electives**	Attending conferences/ seminars/intensiv e course	Leave
24 weeks		* Research project preparation and writing	22 weeks	2 weeks	4 weeks (2 weeks every 6 months)
* The weightage of work should be around: Laboratory work 40%, Clinical work 40%, Research 20%. **Electives: Attachments in National Blood Centre, Genetic Laboratory and others.					

c. YEAR 4: 52 weeks (including study leave and examination)

Haematology and transfusion Laboratory work	Attending conferences/ seminars	Research activities*	Study week	Examination	Leave
41 weeks	1 week	Research project writing and submission	4 weeks	2 weeks	4 weeks (2 weeks every 6 months)
* The weightage of work should be around: Laboratory work 80%, clinical work 10%, Research 10%.					

Total requirement for entire stage 2 course training:

Haematology	: 60 weeks
Transfusion	: 36 weeks
Electives	: 18 weeks
Clinical	: 24 weeks
Study week	: 4 weeks
Examination	: 2 weeks
Total	: 144 weeks

3.6.5. TEACHING PROGRAMME

a. The teacher to student ratio is not more than 1:3 for the closed system and 1:2 for the open system.
b. There will be mainly student-centered learning. The student is expected to learn primarily through in-service via an independent and self-directed manner through reading, bench work, patient management and consultation activities.
c. The formal teaching programme comprises of seminars, case or journal presentations, discussion sessions, slide reviews, results interpretations, and practical skills.
d. Candidates shall undertake clinical postings / elective postings in other departments/units/centers. The postings / rotations are as below:
    i. Adult haematology/oncology
    ii. Paediatric haematology/oncology
    iii. National blood centre (optional)
    iv. Genetic laboratory (optional)
    v. Others (optional)

e. Candidates are expected to undertake routine and on-call duties of a laboratory haematologist including slide reading and interpretation, test/result interpretation, validation and consultation.
f. Candidates shall plan, undertake and write up a research project which is to be submitted by the end of the third year.
g. Candidates are expected to attend and participate actively in all regular Clinical Pathologic Conferences (CPC), slide reviews and journal club presentations of the department.
h. Candidates are expected to attend relevant scientific meeting conducted by professional bodies/universities.
i. Candidates are encouraged to involve in teaching and learning of undergraduate students.

3.6.6. LEARNING OUTCOMES

At the end of the programme course, students should be able to practice as a laboratory haematologists who are capable of:

a. providing independent specialist level of practices at different hospital settings including laboratory quality assurance activities.
b. practicing evidence based medicine to decide and innovate the best possible management to any specific haematological diseases.
c. conveying effectively and ethically all important messages to patients, peers, scholarly communities and society pertaining to related healthcare services.

d. performing effective communication at all level in the organization and society.
e. being a manager of a laboratory organisation.
f. conducting and presenting original work in related discipline.
g. generating, designing, implementing and adopting integral part of medical related research processes which meet requirement of good clinical practice and medical ethics.

3.6.7. RESEARCH

Research project activities	Year
Title selection, Proposal preparation and presentation	Year 2
Ethical application	Year 2
Collecting data	Year 2 and 3
Statistical analysis	Year 3
Writing	Year 3
Submission	End of year 3 till 6 months before the final examination

Assessment of dissertation:

a. Dissertation progression form by main supervisor every 6 months.
b. The research project dissertation will be examined by 2 internal examiners assigned by each university.
c. The examiners are needed to indicate the summary of the recommendation either the candidate's dissertation is:
   Scale 1. acceptable without correction
   Scale 2. acceptable with correction (minor)
   Scale 3. resubmitted for reexamination (major)
   Scale 4. unacceptable as prerequisite for examination.

The research report can be in the usual dissertation format or other types such as manuscript format

3.6.8. RECOMMENDED TEXTBOOKS/JOURNALS/REFERENCES

a. Text Books:

i. Hoffbrand AV, Catovsky D, Tuddenham EGD. Postgraduate Haematology latest edition. Blackwell Publishing.
ii. American Blood Bank Association.Technical Manual (Latest Edition)
iii. Lewis SM, Bain BJ, Bates I. Dacie and Lewis Practical Haematology. Latest Edition. Churchill Livingstone
iv. Swerdlow SH et al. WHO Classification of Tumours Pathology and Genetics of Tumours of Haemopoietic and Lymphoid tissue. Latest Edition. International Agency for Research on Cancer
v. Hoffbrand AV, Pettit JE Color Atlas of Clinical Hematology. Latest Edition.

b. Reference Books:

a. Williams WJ, Beutler E, Erslev AJ, Lichtman MA Haematology latest edition. McGraw-Hill 1991
b. Wintrobe MM. Clinical Haematology .Latest Edition. Lera Fibiger.
c. Bain BJ. Leukaemia Diagnosis. latest edition. Blackwell Publishing 2003
d. Goodright SH, Hathaway WE Disorder of Haemostasis and Thrombosis- A Clinical Guide. Latest edition, McGraw- Hill.
e. Soiffer RJ Stem Cell Transplantation for Hematologic Malignancies (latest edition)
f. Lanzkowsky P. Manual of Paediatric Hematology and Oncology latest edition. Elsevier Academic Press 2005
g. Harmening DM. Modern Blood Banking and Transfusion Practices. Latest edition. Jean-Francois Vilain
h. Weatherall,DJ, Clegg JB The Thalassaemia Syndromes. Latest edition Wiley Blackwell Publisher
i. Leach M, Drummond M, Doig A. Practical Flow cytometry in Haematology Diagnosis. Latest edition, Wiley Blackwell Publisher
j. Bain BJ. Haemaglobinopathy Diagnosis. Latest edition. Blacwell Publishing.

c. Journals:

a. British Journal Of Haematology
b. American Society Of Hematology
c. Transfusion
d. Transfusion Medicine
e. Blood
f. Seminar in Hematology
g. Journal Of Haemostasis and Thrombosis
h. VoxSanguinis
i. International Journal Of Laboratory Hematology
j. Blood Review

d. Useful Websites

a. http://www.freemedicaljournals.com/
b. http://www.blackwellpublishing.com/ijlh
c. http://www.sciencedirect.com/
d. http://transfusionguidelines.org.uk.com
e. http://ovidsp.ovid.com/ovidweb.cgi
f. http://www.hematology.org/
g. https://www.scopus.com/

4.0. MEDICAL MICROBIOLOGY MODULE

4.1. INTRODUCTION

The Master of Pathology (Medical Microbiology) programme is 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.

4.2 VISION

To provide education and training of the highest standard and competency in research and innovation in the field of Clinical Microbiology

4.3. MISSION

a. To produce recognized professionals in the field of Clinical Microbiology.
b. To produce specialists that meet the needs of the country

4.4. PROGRAMME DESCRIPTION

Master of Pathology (Medical Microbiology) is a four-year programme for training of qualified doctors to become specialists in the field of Clinical 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 clinical microbiology research is also provided.

Modes of training include lectures, seminar/journal presentation, bench-work, clinical attachment and consultation. Apprenticeship in an accredited medical microbiology laboratory provides training in laboratory result validation and the laboratory management system. The students are also provided with training in infection control and outbreak management. The course is divided into Stage 1 and Stage 2.

4.5. **STAGE 1:MEDICAL MICROBIOLOGY MODULE**

4.5.1. INTRODUCTION

Stage 1 M. Path posting in medical microbiology component comprises 10 weeks teaching sessions. The teaching components include series of lectures, bench-work, seminars, case discussions related to medical microbiology subject and infection control. For bench rotation in the laboratory, students are required to achieve certain level of competency. At the end of posting the students will be assessed.

4.5.2. LEARNING OBJECTIVE

General objective:

To acquire a working knowledge of the running of a diagnostic microbiology laboratory servicesand basic management of infectious diseases

Specific objectives:

a. To acquire knowledge and microbiology laboratory skills in the diagnosis of combined infectious diseases
b. To acquire knowledge on management of medical microbiology laboratory in accordance with quality management system
c. To acquire knowledge on laboratory safety and infection control

4.5.3. COURSE CONTENT

a. 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).

b. PRACTICAL ASPECTS

PRACTICAL SKILLS TO BE ACQUIRED	Level of Competence
Perform and read Gram stain, acid fast stain and India ink stain	3
Culture, isolation, identification and antimicrobial sensitivity test for common bacterial pathogens	2
Rapid serological test and their interpretation (E.g. dipstick/ICT/LA/RPR/TPPA)	1
Enzyme/chemiluminescence immunoassay and their interpretation	1
Immunofluorescence testsand their interpretation	1
Immunoblot testsand their interpretation	1
Molecularmethodand their interpretation	1
Viral isolation and identification	1
Culture and identification of fungi	1
Identification of common parasites in clinical specimens	2
Laboratory automation and information system	1

4.5.4. TEACHING PROGRAMME

The 10-week formal teaching programme will comprise:

	Components	Duration (weeks)
1.	Bacteriology	5
2.	Virology	2
3.	Mycology	1
4.	Parasitology	1
5.	Immunology	1

a. Learning and teaching activities 3-4 sessions per week (each session 1-2hours).
b. Candidate competency is monitored via logbook assessment and verificationby lecturer and/or technical personnel.

4.5.5. LEARNING OUTCOMES

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

a. describe the aetiologies, epidemiology and basic mechanisms of pathogenesis of infectious diseases by systemic approach.
b. describe the basic principles of diagnosis, antimicrobial treatment, prevention and control of infectious diseases in the hospital and community.
c. perform and interpret basic laboratory tests for the diagnosis of infectious diseases.

d. describe the basic principles of sterilization and disinfection and relate their practical applications in the laboratory and hospital.
e. apply the principles of laboratory safety in microbiology diagnostic practice
f. describe the host immune system and explain the host response to infection
g. apply the principles of molecular and immunological techniques for the diagnosis of infectious diseases and immunologically mediated diseases.

4.5.6. RECOMMENDED TEXTBOOKS

The following texts or their equivalents are recommended (latest edition preferable):

a. Jawetz, Melnick&Adelberg's. Medical Microbiology.
b. Richard Goering, Hazel M Dockrell, Mark Zuckerman, Derek Wakelin, Ivan, Roitt, Cedric Mims, Peter L Chiodini. Mim's Medical Microbiology.
c. Warren Levinson.Review of Medical Microbiology and Immunology.

4.6. STAGE 2:MEDICAL MICROBIOLOGY MODULE

4.6.1. INTRODUCTION

Guided self-learning is a major component of the medical 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, hospital/community infection control activities, continuous medical education activities and undergraduate teachings. 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.

4.6.2. LEARNING OBJECTIVE

a. General objective

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

b. Specific objectives

i. To evaluate the quality of specimen and to perform specimen reception/rejection for microbiological diagnosis
ii. To acquire knowledge and skill in quality assessment of culture media, cell culture and reagents

iii. To acquire knowledge and skill in performing and interpreting the laboratory diagnosis in bacteriology, virology, mycology, parasitology and immunology
iv. To acquire knowledge and skill inperforming and interpreting antimicrobialsusceptibility tests (AST) and managing drug resistant pathogens
v. To acquire knowledge and skill in performing and interpreting molecular diagnosis for infectious diseases
vi. To acquire knowledge and skill in infection control and outbreak management
vii. To acquire knowledge and skill in the laboratory management system
viii. To acquire skill in performing research in clinical microbiology

4.6.3. COURSE CONTENT

a. THEORETICAL ASPECTS

i. Concepts and application of laboratory safety including biosafety and biosecurity.
ii. In-depth knowledge on bacteriology: morphology, cultural characteristics, aetiology, epidemiology, pathogenesis, clinical manifestation, laboratory diagnosis, principles of management, prevention and control of bacterial infections.
iii. In-depth knowledge on virology: morphology, transmission, replication, aetiology, epidemiology, pathogenesis, clinical manifestation, laboratory diagnosis, principles of management, prevention and control of viral infections.
iv. In-depth knowledge on mycology: morphology, cultural characteristics, aetiology, epidemiology, pathogenesis, clinical manifestation, laboratory diagnosis, principles of management, prevention and control of fungal infections.
v. In-depth knowledge on parasitology: morphology, lifecycle, aetiology, epidemiology, pathogenesis, clinical manifestation, laboratory diagnosis, principles of management, prevention and control of parasitic infections.
vi. In-depth knowledge on immunology: epidemiology, pathogenesis, clinical manifestation, laboratory diagnosis, principles of management of immunological diseases
vii. Management and control of emerging and re-emerging infectious diseases
viii. Policies on antimicrobial usage and management of drug-resistant pathogens.
ix. In-depth knowledge on health-care associated infection and outbreak management

b. PRACTICAL ASPECTS

Nature of skill	Level of Competence		
	Year II	Year III	Year IV
Processing clinical and environmental specimens	3	4	5
Quality assessment on culture media and reagents	4	5	5
Quality assessment on cell culture and preparation	2	2	2
Validating and reporting results (Infectious and immunological diseases)	3	4	4
Solving technical problems in the laboratory	2	3	4
Activities relating to accreditation and QA	2	3	4
Participatein hospital antimicrobialstewardship program	2	3	4
Participate in public health communicable diseases programmes	2	3	3
Provide consultation on antimicrobial chemotherapy	3	4	4
Laboratory management	2	3	4
Undertake research project and write scientific reports	3	4	4
Effective presentation and communication	3	4	5
Participate in the implementation of hospital infection control programmes	2	3	4

* Change the level of competency in the log book

c. 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 within the candidature and submit the dissertation at least six months before final examination for assessment.

4.6.4. COURSE STRUCTURE

a. YEAR 2

Orientation (1 week)	Research Methodology Workshop (2 weeks)	Laboratory and clinical work(45 weeks). Submission of 3case reports at the end of academic year.	Vacation 4 weeks (2 weeks every 6 months)
		Research Project	

b. YEAR 3

Laboratory and clinical work (38 weeks)	Elective postings (10 weeks)	Presentation of dissertation. Submission of dissertation and 3case reports at the end of academic year.	Vacation 4 weeks (2 weeks every 6 months)
Research Project			

c. YEAR 4

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

4.6.5. TEACHING PROGRAMME

a. The teacher: student ratio will be 1:2
b. The candidates must understand and comply with the requirements of quality management system (MS ISO15189, ISO 9000, etc.) in each institution.
c. There will be formal sessions in the form of case presentations, seminars, journal reviews, and small group discussions on selected topics.
d. Candidates are expected to participate actively in continuous medical education (CME) activities of each department/institution.
e. Candidates are required to undertake elective postings relevant to the programme. The elective may be a laboratory or a clinical posting.
f. Candidates are to submit a report on each of the elective posting.
g. 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.
h. Candidates are required to plan, undertake and write up a research project that has to be submitted at least 6 months before their Professional 2 examination.
i. Candidates are required to submit 6case reports at the end of Year III.
j. Candidates are to fulfil the training requirements as determined in the logbook.
k. Candidates are required to participate in the teaching and learning activities of the academic programmes.

<u>Candidates in the open system:</u>

a. The university shall appoint an academic supervisor/honorary lecturer from the host institution to monitor and periodically provide progress report (every six monthly) to the university.
b. Following unsatisfactory report, candidate will be recalled to the university for counselling and appropriate corrective measures.
c. Candidates should attend formal teaching at the university, whenever possible.

4.6.6. LEARNING OUTCOMES

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

a. Demonstrate competency in handling specimens, including collection and processing, storage, retention and disposal of clinical samples, data storage, data retrieval and laboratory information management.
b. Undertake relevant quality assurance activities pertaining to microbiology laboratory accreditation.
c. Interpret and validate laboratory examination results in relation to relevant clinical history.
d. Provide consultation in the management of infectious diseases and immunologically mediated diseases, control of hospital infections and antibiotic policy.
e. Manage the laboratory effectively in relation to personnel, technical, equipment, reagents and consumables, services and financial matters.
f. Conduct research competently in accordance to Good Clinical Practice
g. Display professional ethics, values, attitudes and legal requirements relevant to the practice

4.6.7. RESEARCH

a. A research project is compulsory for Medical Microbiology Stage 2 programme and the candidate have to pass the research dissertation as a prerequisite for the Stage 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.

b. 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.

c. The dissertation must be written in English. The candidate can submit the dissertation/research report in Traditional format or Manuscript ready format [for publication in peer-reviewed journal].

d. 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/research report is acceptable unconditionally as partial fulfillment of the requirement for the Masters Degree.
Scale 2: The candidate's dissertation is acceptable as partial fulfillment 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.

e. Candidates will be informed of the Scale awarded following approval by the Examiners' Sub-committee. A candidate awarded a Scale4 will be barred from taking the Part 2 final examination.

4.6.8. RECOMMENDED TEXTBOOKS/JOURNALS/REFERENCES

a. The following texts or their equivalents are recommended (latest edition preferable):

i. Mandell, Douglas & Bennet. Principles and Practice of Infectious Diseases.
ii. Stephen D Allen, MD, William M Janda. Koneman Color Atlas of Diagnostic Microbiology. Washington C Winn
iii. Jawetz, Melnick & Adelberg's. Medical Microbiology.
iv. Richard Goering, Hazel M Dockrell, Mark Zuckerman, Derek Wakelin, Ivan Roitt, Cedric Mims, Peter L Chiodini. Mim's Medical Microbiology.
v. Patrick R Murray, Ellen Jo Baron, James H Jorgensen, Michael A Pfaller, Robert H Yolken. Manual of Clinical Microbiology.
vi. Larry M. Baddour, Sherwood L Gorbach. Therapy of Infectious Diseases.
vii. Michael Loeffelholz, Richard L. Hodinka, Benjamin Pinsky, Stephen Young. Clinical Virology Manual
viii. Monica Cheesbrough. District Laboratory Practice in Tropical Countries

b. Recommended Journals

i. American Journal of Infection Control
ii. BMC Infectious Diseases
iii. Clinical and Experimental Immunology
iv. Clinical infectious diseases
v. Current Opinions in Infectious Diseases
vi. Emerging infectious diseases
vii. Journal of Clinical Microbiology
viii. Journal of hospital infection
ix. Journal of Immunology
x. Journal of Clinical Virology
xi. Lancet Infectious Diseases
xii. Reviews in Clinical Microbiology

c. Recommended Guidelines

i. Relevant Clinical and Laboratory Standards Institute (CLSI) or other reference laboratorydocuments e.g. Performance Standards for Antimicrobial Disk Susceptibility Tests
ii. Malaysian clinical practice guidelines
iii. IDSA, CDC, WHO guidelines

5.0. CHEMICAL PATHOLOGY MODULE

5.1. INTRODUCTION

Chemical Pathology or Clinical Biochemistry is a discipline of pathology. It is a medical discipline devoted to obtain, explore and employ chemical knowledge and chemical methods of investigation, in order to procure knowledge about normal and abnormal chemical processes in man. These processes are studied on a general level, in order to get insight into human health and disease and on a patient-specific level for diagnostic or monitoring purposes. Other main task of chemical pathologists is direction and supervision of a laboratory department in a hospital or health service, where the role involves bridging the gap between rapidly developing laboratory technology and the growing knowledge on characteristics of disease.

This module is designed to produce chemical pathologists with an in depth knowledge of the chemistry of disease and procedures and analytical techniques used in a medical laboratory. They are also competent in laboratory procedures and able to interpret and impart laboratory findings and their implication, in consultation with colleagues.

5.2. VISION

To produce high quality postgraduate Master's course, centre of academic excellence and a leader in research and innovation in the field of Chemical Pathology.

5.3. MISSION

To impart graduates with wide spectrum of knowledge and skills providing exemplary services in medical care meeting the requirements of the nation.

5.4. PROGRAMME DESCRIPTION

This programme is a 4-year programme, which is divided into Stage 1 and Stage 2. Stage 1 course is a one-year programme and Stage 2 course is a 3-year programme. Stage 1 course is of general pathology embarking in 4 major sub-disciplines of pathology and Stage 2 course is a 3-years course in the discipline of Chemical Pathology.

5.5. **STAGE 1: CHEMICAL PATHOLOGY MODULE**

5.5.1. INTRODUCTION

Stage 1 is of one year course before embarking into becoming a chemical pathologist. Its syllabus is composed of fundamental biochemical knowledge which, will enable candidates to use most appropriately as applied to clinical requirements, i.e. diagnosis of disease and planning and monitoring of therapy. They will acquire knowledge of the common clinical disorders and understand the basic principles of laboratory utilization in the diagnosis and management of

disease. They will also be taught on some of the common methods and instruments.

5.5.2. LEARNING OBJECTIVE

a. General objective:

To acquire knowledge on clinical and laboratory aspect of chemical pathology in relation to common disorders

b. Specific objectives:

i. To acquire knowledge and understanding in the clinical aspects of chemical pathology
ii. To acquire knowledge on the principles and applications in analytical techniques and instrumentation in chemical pathology
iii. To acquire basic knowledge in the management of chemical pathology laboratory

5.5.3. COURSE CONTENT

The course consists of 3 major areas: Clinical, Technical and Laboratory Management. These 3 major areas are covered theoretically and practically.

a. 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

b. 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

c. LABORATORY MANAGEMENT COMPETENCIES

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

5.5.4. TEACHING PROGRAMME:

a. Orientation and intensive courses
b. Supervision from the in-house chemical pathologist and biochemist through informal and formal teaching sessions (Topics that are not well-covered during the course will be addressed in the intensive course).
c. 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

d. Practical will be acquired through attachment during laboratory rotations

5.5.5 LEARNING OUTCOME

At the end of the modulecandidates will

a. Understand the basic concept in Chemical Pathology
b. Understand the common principles of laboratory techniques in producing precise and accurate Chemical Pathology results.
c. Able to analyze and interpret biochemical tests.
d. Understand the strategies for investigations of diseases.
e. Understand the basic principles of laboratory quality management

5.5.6 RECOMMENDED TEXTBOOKS/JOURNALS/REFERENCES

a. TEXTBOOKS (LATEST EDITION):

i. William J. Marshall & Stephen K. Bangert. Clinical Chemistry.
ii. Phillip Mayne & Phillip D. Mayne. Clinical Chemistry in Diagnosis and Treatment.
iii. R. N. Walmsley, L. R. Watkinson, and H. J. Cain. Cases in Chemical Pathology: A Diagnostic Approach.

b. REFERENCE TEXTBOOKS (LATEST EDITION):

i. Burtis CA, Ashwood ER &Bruns DE, Tietz Textbook of Clinical Chemistry and Molecular Diagnostics.
ii. Kaplan LA &Pesce AJ. Clinical Chemistry: Theory, Analysis,Correlation.
iii. Carl A. Burtis, Edward R. Ashwood& David E. Bruns. Tietz Fundamentals of Clinical Chemistry.
iv. Michael L Bishop, Edward P Fody, and Larry E Schoeff. ClinicalChemistry: Techniques, Principles, Correlation.

5.6. STAGE 2: CHEMICAL PATHOLOGY MODULE

5.6.1. INTRODUCTION

In stage 2, the candidates will be trained based on in depth the knowledge in clinical, analytical biochemistry, molecular genetics, therapeutic drug monitoring and toxicology and laboratory management. They will acquire in-depth knowledge of the common clinical disorders and the role of laboratory utilisation in the diagnosis and management of disease. They will also be taught on setting the standard of patient care through the diagnostic and monitoring services of their laboratory and practicing effective laboratory utilisation. They will be exposed to critical appraisal, management, budgetary and administrative skills and knowledge of automation, electronic data processing, laboratory information systems and acquire knowledge in accreditation throughout their training.

5.6.2. LEARNING OBJECTIVE

a. General objectives

i. To acquire knowledge in basic and specialized Chemical Pathology testing
ii. To apply the knowledge on clinical aspects and management of patient
iii. To apply knowledge and be competent in techniques/methodologies and instrumentation
iv. To apply knowledge and skill in the management of the laboratory

b. Specific objectives

i. To acquire consultant level skill in interpretation of laboratory tests results and provision of authoritative advice
ii. To critically analyse and competent in techniques/methodology and instrumentation, conversant with the performance and limitations of various methods adopted in chemical pathology for patient care.
iii. To organise the service planning and resource management, financial control and monitoring of service delivery.
iv. To apply total quality management system, laboratory accreditation and laboratory safety.
v. To formulate planning and conduct of research and development in chemical pathology

vi. To acquire competence in the planning and conduct of research and development in chemical pathology

5.6.3. COURSE CONTENT

a. THEORETICAL ASPECT:

i. Clinical biochemistry
- Physiology and chemical pathology of body systems: kidneys, respiratory system, gastrointestinal tract, liver, pancreas, cardiovascular system, endocrine system, immune system, metabolism of carbohydrate, protein and lipids.
- Principles of investigation and interpretation of clinical and laboratory results
- Diagnosis and monitoring disorders of above organs and systems

ii. Analytical biochemistry
- Principles and applications of analytical techniques in chemical pathology

iii. Molecular genetics

iv. Therapeutic drug monitoring and toxicology

v. Laboratory management
- Laboratory management: budget, manpower management, equipment and reagents – its procurement, evaluation and maintenance, quality control and assessment including total quality management.

b. PRACTICAL ASPECT:

Practical skill to be acquired	Level Of Competence
Photometry and spectrophotometry	5
Chromotography	4
Electrophoretic techniques	5
Turbidimetry/nephelometry	5
Immunoassay	5
Atomic absorption spectroscopy	3
Electrometric methods	5
Automated clinical chemistry analysis	5
Molecular techniques	3

c. RESEARCH ASPECT:

i. Research methodology
- Introduction to research
- Constructing research proposal
- Literature review
- Research design
- Sample size estimation

ii. Biostatistics in research
- Technique & tools

iii. Critical appraisal

5.6.4. COURSE STRUCTURE

a. YEAR 2

Orientation (1 week)	Research Methodology Workshop (2 weeks)	Laboratory & Clinical Work (45 weeks)	Leave 4 weeks (2 weeks every 6 months)
	Research Project, activity and case reports #		

b. YEAR 3

Laboratory and Clinical Work (44 weeks)	External posting (4 weeks)	Leave 4 weeks (2 weeks every 6 months)
Research project, activity and case reports #		

c. YEAR 4

Intensive Course (1 weeks)	Laboratory and Clinical work (41 weeks)	Study Leave (4 weeks)	Examination (2 weeks)	Leave 4 weeks (2 weeks every 6 months)
Submission of project and case reports				

*Intensive course will be conducted at least once during the three-year period
2 cases to be submitted annually for review.

5.6.5. TEACHING PROGRAMME

a. The teacher: student ratio will be 1:2 or 1:3
b. There will be student-centered learning. The student is expected to learn primarily through in-service in an independent and self-directed manner through reading, bench work, patient management and patient consultation.
c. There will be formal sessions in the form of seminar (2 per semester), journal review, clinico-pathological correlation sessions and small group discussion on selected topics.
d. Candidates shall undertake postings/rotations in research and other centers away from the university or hospital. The recommended postings /rotations are as below:
   i. Drug and Toxicology Laboratory, HKL
   ii. Endocrinology, Putrajaya Hospital– clinical / laboratory based
   iii. Nephrology – clinical / laboratory based
   iv. Paediatric – clinical / laboratory based
   v. ICU – clinical / laboratory based (POCT)
   vi. IMR – IEM and others

e. Apart from postings / rotations mentioned above, the candidate is also encouraged to do an external posting in the field he/she is interested in within the scope of Chemical Pathology for a further period of 4-6 weeks eg. Proteomics, Inborn error of metabolism (IEM), Endocrinology, Molecular Medicine, Drug & Toxicology etc.

f. Special clinical rounds: Candidates are encouraged to attend ward rounds and specialist clinics of selected specialties e.g. CICU, renal dialysis unit, ICU, SCN, neonatal and pediatric units, metabolic and endocrine units.
g. Candidates are expected to undertake all routine duties of a chemical pathologist including clinical duties, screening, validation and on-call duties.
h. For students in the open system, the host universities shall conduct visits at least once every 3 months for 2-3 days duration to conduct seminars, result interpretation sessions, tutorials, problem oriented case-studies, clinical presentations and check on the student's progress advise and check on the progress of the research report organize intensive course
i. The student is also required to plan, undertake and write up a research project which has to be submitted by end of the 3rd year.
j. The candidate is also required to submit 6 case reports over the three year as schedule
   i. 2nd year – 2 cases
   ii. 3rd year – 2 cases
   iii. 4th year – 2 cases

To be eligible to sit the Stage 2 Examination, the candidates must fulfill these criteria:

- Submission of satisfactorily completed log book
- Submission of 6 case write up: 2 cases per year
- Submission of Research project by end of 3rd year

Upon failure to fulfill the above criteria, the candidate is barred from sitting the final exam and will sit for the examination the following academic session provided satisfactory submission.

5.6.6. LEARNING OUTCOMES

At the end of the course candidates will

a. Understand the medical, scientific and technological principles of Clinical Biochemistry and its interrelationship with other disciplines.
b. Have a detailed knowledge of the applications of Clinical Biochemistry for the diagnosis and monitoring of human disease and its contribution to biomedical research.
c. Be able to assess the effectiveness of individual tests, strategies and protocols for the investigation of disease
d. Acquire a detailed knowledge of laboratory techniques, instrumentation and informatics
e. Understand and apply the principles of laboratory management.
f. Update knowledge of new trends in methodologies, molecular diagnostics and total laboratory automation.
g. Developed skills in laboratory, clinical and, scientific research.

5.6.7. RESEARCH PROJECT

It is absolutely necessary that the student should have knowledge on conducting research. He / she should be familiar with the research methodology, literature review, ethics in research and application of biostatistics in research. Each student will be assigned a dissertation work in the field of Chemical Pathology. The content of the dissertation shall be evaluated before the final examination.

5.6.8 RECOMMENDED TEXTBOOKS/JOURNALS/REFERENCES

a. RECOMMENDED TEXTBOOKS (LATEST EDITION):

i. Marshall WJ &Bangert SK, Clinical Chemistry
ii. Phillip Mayne, Clinical Chemistry: Diagnosis and Treatment.
iii. Walmsley, Cases in Chemical Pathology.
iv. Westgard

b. REFERENCE TEXTBOOKS (LATEST EDITION):

i. Burtis CA, Ashwood ER & Bruns DE, Tietz Textbook of Clinical Chemistry and Molecular Diagnostics,.
ii. Kaplan LA, Pesce AJ & Kazmierczak SC, Clinical Chemistry: Theory, Analysis, Correlation,
iii. Burtis, CA &Ashwood ER, Tietz Fundamentals of Clinical Chemistry,
iv. Michael Bishop, Clinical Chemistry, Principles, Procedures, Correlation.

c. JOURNALS

i. Journal of Clinical Chemistry
ii. Annals of Clinical Biochemistry
iii. ClinChimActa
iv. Scandinavian Journal of Laboratory Investigations
v. Journal of Clinical Pathology

d. RECOMMENDED WEBSITES

i. http://www. westgard.com
ii. http://aacb.asn.au
iii. www.uptodate.com
iv. http://www.aacc.org
v. http://www.nacb.org

6.0. FORENSIC PATHOLOGY MODULE

6.1 INTRODUCTION

Forensic pathology module is a 4-year educational programme, which prepares the students to deliver advanced forensic pathology services at an expert level to the police and relevant agencies according to the Malaysian Law. At the moment, the MPath (Forensic Pathology) is only offered in Universiti Kebangsaan Malaysia (UKM).

6.2. VISION

The Forensic Pathology Module UKM Medical Centre will be the university's finest in the integration of teaching, research and service.

6.3. MISSION

The mission of the Forensic Pathology Module is to provide rich educational experience through hands-on, practical approach to forensic pathology education that will enable students to reach the highest levels of intellectual achievement and personal growth. The programme will provide open, welcoming, creative and adaptable teaching and research environments for its studentsand staff. The programme outcomes will have a positive impact on the global forensic pathology and law enforcement communities, and on society as a whole.

6.4. PROGRAMME DESCRIPTION

The candidates are required to perform postmortem examination under lecturer's supervision, prepare postmortem report, visit to the scene of crime, perform histology and other laboratory analysis and attend court proceedings. Candidates are also required to undertake relevant elective postings to acquire advanced skills and knowledge.

6.5. **STAGE 1: FORENSIC PATHOLOGY MODULE**

The Stage 1 forensic pathology programme follows the teaching programme of the Stage 1 Anatomic Pathology programme and has the similar learning objectives/outcomes and course content.

6.6. **STAGE2: FORENSIC PATHOLOGY MODULE**

6.6.1. INTRODUCTION

The Stage 2 Forensic pathology module is a 3-year educational programme (year 2 till year 4), which prepares the students to deliver advanced forensic pathology services at an expert level to the police and relevant agencies according to the Malaysian Law.

6.6.2. LEARNING OBJECTIVE

a. General objectives:

i. To attain competence in the performing, interpreting, reporting of forensic autopsies.
ii. To be able to form expert opinion from forensic investigations which include the scene of death/crime, autopsies, laboratory results and other relevant findings.
iii. To acquire a working knowledge of the organisation and management of forensic pathology services appropriate to the socio-economic environment.

b. Specific objectives:

i. To attain competence in performing forensic autopsies.
ii. To attain competence in interpretation of autopsy findings.
iii. To attain competence in writing forensic autopsy reports.
iv. To attain competence in gross and microscopic examination, interpretation and reporting of tissues obtained at forensic autopsy.
v. To attain competence in performing forensic frozen section.
vi. To recognise forensic case, that requires referral and further consultation with senior colleagues, and takes appropriate action.
vii. To attain competence in examining the scene of death/crime, advising the investigating officer on the collection of relevant samples and drawing initial conclusions to guide the direction of police investigation.
viii. To acquire skill and competence in presenting forensic cases in a court of law.
x. To have exposure to management of a mass disaster.
xi. To attain competence in collecting relevant samples and to perform certain procedures pertinent to forensic science and toxicology.
xii. To acquire knowledge of laws related to medical and forensic practice in Malaysia.
xiii. To acquire knowledge of the management of a routine forensic pathology laboratory and its network.
xiv. To acquire knowledge on some of the medico-legal systems around the world.

6.6.3. COURSE CONTENT

a. THEORETICAL ASPECTS

ForensicPathology Course Content:

i. Crime of scene examination
ii. Death due to heat and burn
iii. Death due to natural causes
iv. Death related to sexual assault
v. Abortion, infanticide and maternal death

vi. Forensic aspect of non-accidental injury
vii. Electrocution
viii. Expert witness and court procedures
ix. Forensic postmortem and certification of death
x. Forensic toxicology
xi. Gunshot and explosion deaths
xii. Identification
xiii. Injuries and wounds
xiv. Introduction of forensic pathology
xv. Mass disaster
xvi. Negligence and anaesthetic death
xvii. Postmortem changes
xviii. Road traffic accident
xix. Asphyxial death and drowning
xx. To be based on available forensic syllabus. In addition, the content should also cover:
    - Trouble shooting
    - Quality control and quality assurance
    - Research methodology
    - Laboratory management: budget, manpower management, accreditation, laboratory safety.

b. PRACTICAL ASPECTS

Nature of skill	*Year II*	*Year III*	*Year IV*
Autopsy	3	4	5
Grossing	3	4	5
Staining –*HPE*	4	5	5
Staining - special stains (*PAS*, Oil Red, Congo Red, Sudan Black, Grocott, *AFB*)	2	3	4
Frozen section	3	4	5
Other procedures: electron microscopy, atomic absorption spectrophotometry, gas chromatography, *HPLC*, *GCMS*, *DNA* fingerprinting	1	2	2
HPE slide reporting	4	5	5

A candidate is expected to perform a total of 400 autopsies during the three-year period. All post-mortem reports will be signed by the supervising pathologist during the Years II and III training period. The candidate can initial post-mortem reports performed during Year IV. It is the responsibility of all candidates specialising in Forensic Pathology to ensure that they obtain **written authorisation** from the Director-General of Health of Malaysia before they enter Year II in order for them to perform the autopsies and to present evidence in court.

The candidate is expected to perform grossing at least twice a week and brain sectioning at least once a month.

The candidate is expected to maintain a log book recording all autopsies, court attendances, *HPE* reporting, grossing and staining and instrumentation.

6.6.4. COURSE STRUCTURE

a. YEAR 2

Orientation 1 week	Research Methodology Workshop 2 weeks	Laboratory, mortuary and field work 45 weeks	Leave 4 weeks (2 weeks every6 months)
		Research Project	

b. YEAR 3

Laboratory, mortuary and field work 47 weeks	Intensive course 1 week	Leave 4 weeks (2 weeks every 6 months)
Research project		

c. YEAR 4

Laboratory, mortuary and field work 41 weeks	Intensive course 1 week	Study Leave 4 weeks	Examination 2 weeks	Leave 4 weeks (2 weeks every 6 months)

6.6.5. TEACHING PROGRAMME

a. The teacher: student ratio will be 1: 2
b. There will be no formal lectures. The student is expected to learn primarily through in-service training in an independent and self-directed manner through reading, laboratory, mortuary and field work.
c. There will be formal sessions in the form of seminars, journal reviewand small group discussion on selected topics.
d. Candidates are required to undertake relevant elective postings eg. to a forensic science laboratory, *DNA* fingerprinting laboratory and other forensic centres.
e. Candidates are expected to undertake all routine duties of a forensic pathologist including laboratory, mortuary and call duties.
f. For students posted outside universities, the mother university will
    i. conduct visits at least once every 3 months for 2 - 3 days duration to conduct seminars, slide sessions, tutorials, mortuary presentations and check on the student's progress
    ii. advice and check on the progress of the research report.
    iii. organise intensive courses at least once a year

g. The student is also required to plan, undertake and write up a research project and /or manuscript which has to be submitted by the end of the third year.
h. The candidate is also required to submit a case book consisting of 10 cases collected over the three-year period.

6.6.6. LEARNING OUTCOMES

At the end of this module the candidate should be able to:

a. Discuss relevant basic knowledge required in order to perform forensic postmortems,
b. Evaluate preliminary information received from the police and relevant agencies to decide whether the case warrants consultation with the superior officer or pathologist,
c. Demonstrate relevant basic skill in performing forensic postmortems,
d. Request and interpret the clinical and laboratory investigations relevant to the forensic case investigated,
e. Draw conclusions from the postmortem findings (history, physical signs, laboratory results),
f. Communicate opinion to the police and/or relevant agencies with regards to the postmortem findings,
g. Write complete postmortem report to be submitted to the police and/or relevant agencies,
h. Present the postmortem findings and conclusions to the court as an expert.

6.6.7. RESEARCH DISSERTATION

The candidate is expected to undertake a research project of common topics in forensic pathology, and write a research project report and/ or a manuscript for publication in the local and/or international forensic journals.

6.6.8. RECOMMENDED TEXTBOOKS/JOURNALS/REFERENCES

a. Textbooks

i. Saukko P, Knight B (1991) *Forensic Pathology* (4th ed.)
   - London: Edward Arnold.
ii. DolinakD, MatshesE, Lew EO (2005) *Forensic Pathology*:*Principles and Practice* (1st ed.) USA: Elsevier Academic Press.
iii. Wahid SA (1993) *Patologi Forensik*. Kuala Lumpur: Dewan Bahasa dan Pustaka.
iv. Krogman WM, Iscan MY (1986) *The Human Skeleton in Forensic Medicine* (2nd ed.)Springfield: Charles C Thomas.
v. Payne-James J, Jones R, Karch SB, ManloveJ (2011) *Simpson's Forensic Medicine* (13th ed.)Boca Raton: CRC Press.
vi. Knight B(1992) *Legal Aspects of Medical Practice* (5th ed.)Edinburgh: Churchill Livingstone.
vii. SpitzWU, Spitz DJ (2006)*Spitz* and *Fisher's*:*Medicolegal Investigation of Death*. Springfield:Charles C Thomas.
viii. Adelson L (1974) *The Pathology of Homicide*. Springfield: Charles C Thomas.
ix. Camps FE (1976) *Gradwohl's Legal Medicine*. Bristol: John Wright & Sons.
x. Gordon I, Shapiro HA, Berson SD (1987) *Forensic Medicine*: *A Guide to Principles* (3rd ed.)Edinburgh: Churchill Livingstone.

xi. DiMaio VJM (1985) *Gun shot wounds*: *Practical aspects of firearms*. *Ballistics and Forensic Techniques*. New York: Elsevier.
xii. Taylor AS, Mant AK (1984) *Taylor's Principles and Practice of Medical Jurisprudence*. Edinburgh:Churchill Livingstone.
xiii. Mason JK (1989) *Paediatric Forensic Medicine and Pathology*. London: Chapman and Hall Medical.

b. Journals

i. Medicine, Science, Law
ii. International Journal Legal Medicine
iii. Forensic Science International
iv. American Journal Forensic Medicine Pathology
v. Journal Forensic Science
vi. Journal Forensic Science Society
vii. Journal Forensic Legal Medicine

7.0. MEDICAL IMMUNOLOGY MODULE

7.1 INTRODUCTION

The Master of Pathology (Medical Immunology) programme is to produce immune-pathologists whom are knowledgeable in theoretical and practical aspect of laboratory diagnoses, helping in management of immune-mediated diseases and in managing the laboratory (staff, quality, troubleshooting, safety and training). The specialists produced are competent and able to provide consultations on patients' management, hence provide a communication link between the Immunology laboratory and the clinician.

7.2. VISION

To be the core education provider for Master of Pathology (Medical Immunology) in Malaysia

7.3. MISSION

To satisfy the requirement for postgraduate education in the field of Medical Immunology for pathologist in Malaysia and internationally

To provide education and training of high quality in producing medical postgraduates to practice Medical Immunology

7.4. PROGRAMME DESCRIPTION

This program is a 4 - year programme and is divided into two stages, Stage 1 (Year 1) and stage 2 (Year 2 - 4). The stage 1 conjoint programme was started from year 2004/2005 intake. At the moment, the MPath (Immunology) is only offered in Universiti Sains Malaysia (USM).

Modes of training include lectures, seminar/journal presentation, bench-working, clinical and laboratory attachment and consultation. The knowledge in laboratory quality management is acquired throughout the training period by taking part in QMS activities.

7.5. STAGE 1: MEDICAL IMMUNOLOGY MODULE

7.5.1. INTRODUCTION

In USM, Medical Immunology input is delivered in a well-structured program for 2 weeks (i.e. lectures, laboratory attachment, seminars). For bench rotation in the laboratory, students are required to achieve certain level of competency. At the end of posting the students will be assessed.

7.5.2. LEARNING OBJECTIVE

a. GENERAL OBJECTIVE:
    i. To acquire knowledge of basic immunology and immunopathology

b. SPECIFIC OBJECTIVES:

i. To acquire knowledge on components of immune system and immune response
ii. To acquire knowledge on various mechanisms of immune mediated diseases (e.g., autoimmunity, hypersensitivity, immunodeficiency, tumour immunology) and transplantation immunology
iii. To understand the principles of various immunological tests and their clinical significance

7.5.3. COURSE CONTENT

a. THEORETICAL ASPECTS

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

b. PRACTICAL ASPECTS

Practical skill to be acquired	**Level of competence**
1. Agglutination: - Rheumatoid Factor/ C-Reactive Protein/RPR	5
2. Immunoflourescence: - Anti-Nuclear Antibody/Anti-dsDNA / Anti-Smooth Muscle Antibody /Anti-Mitochondrial Antibody / Anti-Neutrophil Cytoplasmic Antibody	1
3. Turbidometry/nephelometry: - C-Reactive Protein - Immunoglobulin G, ImmunoglobulinA, Immunoglobulin IgM, Complement3, Complement 4	1
4. Immunoassay : ELISA/EIA/FEIA fluoroenzyme immunoassay (FEIA)/ Immunoblot - Anti-Cardiolipin Antibody - Extractable Nuclear Antigen - Alpha-FetoProtein - Allergen Specific IgE Test	1
5. Immunophenotyping - Lymphocyte subsets	1

7.5.4. TEACHING PROGRAMME

It is student-centered and teacher-centered consisting of

a. Lectures for the theoretical 10 topics
b. 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
c. Laboratory attachment

7.5.5. LEARNING OUTCOMES

At the end of the posting the candidate should be able to:

a. Describe the components of the immune system ie. organs, cells and their Functionsand mediators (antibody, cytokines, TNF, IFN and complement)
b. Define the innate and acquired immune system
c. Understand general principles of agglutination, precipitation, turbidometry, immunoflourescence, and immunoassay techniques
d. Describe the complement activation pathways
e. Describetypes and functions of cytokines
f. Describe the structure and biological functions of MHC class I and II molecules
g. Describe theacquired immune response
h. describe primary and secondary phases of the immune response and its application.
i. Explain various mechanisms, laboratory investigations and principle of
j. Management of immunodeficiency, hypersensitivity and autoimmunity
k. Describe cancer antigens, mechanisms of the immune response against cancers,immune evasion and cancer immunotherapies
l. Understand the principles of transplantation and HLA test

7.5.6. RECOMMENDED TEXTBOOKS/JOURNALS/REFERENCES

a. Parslow TG, Stites DP, Terr Al, Imboden JB. Medical Immunology. Lange Medical
b. Books/McGraw-Hill Medical Publishing Division.
c. Stites DP, Terr Al, Parslow TG. Basic & Clinical Immunology (latest edition). Lange
d. Medical Books/McGraw-Hill Medical Publishing Division.
e. Roitt I, Brostoff J, Male D. Immunology (latest edition). Mosby
f. Abul K.Abbas, Andrew H. Lichtman, Shiv Pillai. Cellular &Molecular Immunology(7th Edition). Elsevier Saunders.

7.6. STAGE 2: MEDICAL IMMUNOLOGY MODULE

7.6.1. INTRODUCTION

The Stage 2 programme is of three years duration in the sub-discipline of Medical Immunology. This programme may only be undertaken in USM as a closed system.

It is a guided self-learning module where knowledge acquisition is emphasized during seminar/journal club presentations, performing test, reporting and validating laboratory results, clinical consultations and ward/clinic visits. Throughout the module, students haveto participate in laboratory quality management system.

During the Stage 2 programme the candidate shall undertake a research project and submit a research project report. At the end of the Stage 2 programme the candidate must sit and pass Part 2 examination in order to be awarded the degree of Master of Pathology (Medical Immunology). After completing Stage 2, the graduates are competent in their knowledge and skills as Immunopathologist.

7.6.2 LEARNING OBJECTIVES:

a. GENERAL OBJECTIVE:

i. To acquire knowledge of advanced immunology, diagnostic and immunopathology

b. SPECIFIC OBJECTIVES:

i. To acquire knowledge of advanced immunology
ii. To acquire knowledge and practical skills in conducting the laboratory tests
iii. To acquire competence for administering and interpreting laboratory
iv. tests associated with clinical conditions
v. To acquire experience, knowledge and skill for diagnosis and consultation of immune-mediated diseases
vi. To acquire knowledge/skills in the laboratory quality management system
vii. To acquire skills in providing specialist assistance to clinical colleagues
viii. To acquire knowledge in quality teaching in immunology
ix. To be able to conduct research and thesis writing

7.6.3. COURSE CONTENT

a. THEORETICAL ASPECTS

i. <u>Advanced Immunology:</u>

- Immune response
- Cytokines and complement

- Immunomodulators and immunoregulation
- Hypersensitivity reactions
- Tolerance and autoimmunity
- Transplantation immunology
- Tumor immunology
- Immunotherapy

ii. <u>Immunopathology:</u>

- Immunodeficiency diseases
- Allergic diseases
- Systemic Autoimmune Diseases
- Immune mediated respiratory diseases
- Immune mediated musculoskeletal diseases
- Immune mediated endocrine diseases
- Immune mediated hematological diseases
- Immune mediated neurological diseases
- Immune mediated gastrointestinal diseases
- Immune mediated renal diseases
- Neoplastic diseases and the immune system
- Immunologic diseases involving other organ systems (vascular, skin, reproductive, etc)
- Cancer immunotherapy
- Organ and bone marrow transplantation

b. PRACTICAL ASPECTS

Practical skill to be acquired	**Level of competence**
1. Agglutination - Rheumatoid Factor, C-Reactive Protein	5
2. Immunoflourescence - Anti-Nuclear Antibody/ Anti-dsDNA, Anti-Smooth Muscle Antibody/Anti-Mitochondrial Antibody, Anti-Neutrophil Cytoplasmic Antibody and Others	5
3. Turbidometry/nephelometry - C-Reactive Protein - Immunoglobulin G, Immunoglobulin A, Immunoglobulin IgM, Complement3, Complement 4 - Specific antibody response: • Pre and post pneumococcal vaccination • Pre and post tetanus vaccination	5
4. Immunoassay: ELISA/EIA/FEIA fluoroenzyme immunoassay (FEIA)/ Immunoblot - Anti-Cardiolipin Antibody - Extractable Nuclear Antigen - Alpha-FetoProtein - Allergen Specific IgE Test	5

5. Flowcytometry - Immunophenotyping(Lymphocyte subsets) - CD40 Ligand Assay - BTK function test - Switch Memory B cells - Lymphocyte Transformation Test - dihydrorhodamine(DHR)	3
6. Lymphocyte proliferation Test	3
7. Phagocytic Function Test: - Chemiluminescence - nitro blue tetrazolium test (NBT)	3
9. HLA Test: - HLA typing - Cross matching - HLA antibody Test	2

c. RESEARCH ASPECTS

The student is expected to have general knowledge on conducting research and should be able to come out with research proposal. 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 within the candidature and submit the dissertation at least six months before final examination as prerequisite.

7.6.4. COURSE STRUCTURE

* Postings at various clinical disciplines are compulsory in order to gain knowledge and experience related to immunology.

a. YEAR II

Orientation-LQMS **1 week**	Research Methodology Workshop & Biostatistics, Good Clinical Practice, Critical Appraisal & Bioethics, Communication Skills **2 weeks**	Proposal preparation & Research Protocol presentation **4 weeks**	Laboratory Immunology postings **37 weeks**	Blood bank/ Haematolo-gy posting **4 weeks**	Leave 4 weeks (2 weeks every 6 months)
Research Project					

b. YEAR III

Postings at various clinical disciplines: • Medical & Paediatrics (Immunodeficiency diseases; HRPZ II), • Haemato Oncology, HUSM • Haematopoeitic Stem Cell Transplantation (Ampang Hospital). **20 weeks**	Laboratory postings: • Allergy & Immunology Research Center (IMR), • Medical Microbiology & Immunology Department (UKM), • Immunology Laboratory (IPPT,Bertam), • Human Genome Centre,HUSM • Molecular Technology-Vaccinology (PPSK) • Laboratory Immunology postings **28 weeks**	Leave 4 weeks (2 weeks every 6 months)
Research Project		

c. YEAR IV

Postings at various clinical disciplines at HUSM: • Nephrology • Rheumatology • Respiratory • Skin • ENT **20 weeks**	Laboratory postings at HUSM: • Serology (Microbiology Department) • Endocrine Laboratory • Tissue Bank Unit **20 weeks**	Study Leave **6 weeks**	Examination **2 weeks**	Leave 4 weeks (2 weeks every 6 months)
Research project				

* This program schedule is flexible in terms of time and duration.

To be eligible for sitting Part II Examination, the candidates must submit:

- 3 case reports in publishable format
- log book
- dissertation

7.6.5. TEACHING PROGRAMME

a. The lecturer:student ratio is 1:1
b. No formal teaching. The emphasis is on knowledge acquisition through self-directed learning, daily laboratory activities, including reporting of laboratory results under supervision, writing up case reports, presentations in journal club and seminars.
c. Various postings in laboratory and ward/clinic with supervision.
d. Candidates are expected to assist in teaching of undergraduates.
e. Candidates are required to attend and take part in clinico-pathology/ immunology conferences and research presentation.

7.6.6. LEARNING OUTCOMES

At the end of the posting the candidate should be able to:

a. Recall immune system and immune response.

b. Recall the complement system (understand the components, activationpathways and biological activities and diseases)
c. Describe immunogenetics: polymorphism, generation of diversity and rearranginggene families
d. Describe T cell receptors: structure, function and antigen binding.
e. Describe receptor-ligand interactions: adhesion molecules, complementreceptors, Fc receptors and signal transduction.
f. Describe the cytokines: for each cytokine, understand the origin, structure, effect,site of action (receptor), metabolism, regulation and gene activation.
g. Describe the inflammatory mediators (e.g. leukotrienes, prostaglandins and PAF:for each, understand the origin, structure, effect, site, metabolism and regulation).
h. Describe immunomodulation and immunoregulation (tolerance: clonal selection,suppression and antigen paralysis, cell-cell interactions, idiotype networks: inhibition and stimulation and mechanism of autoimmunity
i. Describe hypersensitivity reactions: types, mechanisms/pathogenesis, diseaseexamples.
j. Describe histocompatibility complex: major and minor antigens and principles ofcross- matching, allograft rejection mechanism, graft-versus-host reaction mechanism and HLA-typing
k. Describe tumor immunology(tumor markers, oncogenes, principles of cancertherapy.
l. Describe immunotherapy (drug, antibodies,and recombinant molecules)
m. Describe immunodeficiency diseases (primary immunodeficiency,secondary immunodeficiency: HIV infection and AIDS, cancer,leukemia, malnutrition and etc.)
n. Describe allergic diseases eg. eczema/allergic dermatitis/ allergic rhinitis, asthma etc (types of allergen, mechanisms/pathogenesis, laboratory investigations and management- eg. allergen immunotherapy etc.)
o. Describe systemic autoimmune diseases (systemic lupus erythematosus, Sjogren, systemic sclerosis, rheumatoid arthritis, polymyositis/dermatomyositis, mixed connective tissue disease).
p. Describe immune mediated respiratory diseases (Allergic rhinitis/hayfever, asthma, hypersensitivity pneumonitis, pulmonary fibrosis and relateddisorders).
q. Describe immune mediated musculoskeletal disease and vasculitis.
r. Describe immune mediated endocrine diseases (auto-immune thyroiditis,auto-immune diabetes mellitus (Type 1),autoimmune primary adrenalInsufficiency,autoimmune polyendocrinopathy.
s. Describe immune mediated haematological diseases (autoimmune hemolyticanemia, idiopathic thrombocytopenic purpura, pernicious anemia, plasma celldisorders,amyloidosis etc)
t. Describe immune mediated neurological diseases (multiple sclerosis, Guillain-Barre syndrome, myasthenia gravis etc).
u. Describe immune mediated renal diseases (IgA nephropathy, Goodpasture syndrome, glomerulonephritis etc.)
v. Describe immunologic diseases involving other organ/systems (immune mediated dermatoses, immune mediated gastrointestinal diseases, immune mediated reproductive diseases).
w. Describe neoplastic diseases and the immune system (leukemia/lymphomas,and neoplasia associated with immunodeficiencies.
x. Describe cancer immunotherapy.

y. Describe organ and haematopoeitic stem cell transplantation.

7.6.7. RESEARCH DISSERTATION

A research dissertation is compulsory for Medical Immunology Stage 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, criticize 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.

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 fulfillment of the requirement for the Masters Degree.
Scale 2:	The candidate's dissertation is acceptable as partial fulfillment 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.

7.6.8 RECOMMENDED TEXTBOOKS/JOURNALS/REFERENCES

a. TEXTBOOKS:

i. Paul W E .Fundamental Immunology (latest edition). Raven Press New York.
ii. Sigal. LH, Ron Y. Immunology and Inflammation (latest edition). Mc Graw-Hill Int edition.
iii. Chapel H., Haeney. M - Essentials of Clinical Immunology (latest edition). Blackwell Scientific Publication.
iv. Stites DP, Terr Al, Parslow TG. Basic & Clinical Immunology. (latest edition). Lange Medical Books/McGraw-Hill Medical publishing Division.
v. Watson JG. Bird AG Handbook of Immunological investigation. (latest edition). Wright London
vi. Brostoff J, Seaddin JK, Male D, Roitt IM. Clinical Immunology, (latest edition), Gower Medical Publishing.
vii. Lachmann PJ, Peters DK, Rosen FS, Walport MJ. Clinical Aspects of Immunology (latest edition) Blackwell Scientific Publication.
viii. Robert R. Rich, Thomas A Fleisher, Benyamiin P. Seqartz, William T Shearer, Warren Staber. Clinical Immunology. Principle and Practice Vol I & II. (latest edition)Mosby
ix. Abdul K. Abbas, Andrew H. Lichtman. Cellular and Molecular Immunology (latest edition) Elsevier Saunders
x. Oxford Handbook of Clinical Immunology. Gavin Spickett. Oxford University Press (ISBN 0-19-262721-X).
xi. Immunology for Medical Students. Roderick Nairn & Matthew Helbert. Mosby (ISBN 0-7234-3190-6)
xii. Parslow TG, Stites DP, Terr Al, Imboden JB. Medical Immunology. Lange MedicalBooks/McGraw-Hill Medical publishing Division.
xiii. Roitt I, Brostoff J, Male D. Immunology (latest edition). Mosby
xiv. Janeway's Immunobiology.

b. RECOMMENDED JOURNALS:

i. Annual Review of Immunology
ii. Immunity Journal
iii. Journal of Immunology
iv. Journal of Experimental Medicine
v. Trends in Immunology Journal
vi. Immunological Reviews Journal
vii. Journal of Allergy and Clinical Immunology
viii. Annals of Rheumatic diseases Journal
ix. Mucosal Immunology Journal
x. Allergy:European Journal of Allergy and Clinical Immunology

8.0. MEDICAL GENETICS MODULE

8.1 INTRODUCTION

Master Pathology (Medical Genetics) was started in 2010 in USM with the first graduate in 2014.This programme has been established and approved by Ministry of Health, Malaysia to be incorporated into Master of Pathology Programme.

The aim of this programme is to produce genetic pathologists who can contribute to the multidisciplinary range of skills required within pathology services to aid in the diagnosis, management and treatment of patients with disorders arising from genomic mutations.

Currently, USM is the only centre in Malaysia offering this programme. Up to now, 3 graduates are working in universities as well as government hospital and since its introduction, 8 candidates enrolled this programme.

8.2. VISION

Our vision is to produce medical genetic pathologists who able to propel the field of genetics and genomics for sustainable health care.

8.3. MISSION

This pioneering program positions the genetic pathologists to practise as medical specialists and manage genetic laboratory. Training is also targeted to equip the genetic pathologist to contribute effectively to diagnostic services, academic and research.

8.4. PROGRAMME DESCRIPTION

This is a course work post graduate programme which is divided into Stage 1 and Stage 2. To complete the course, the candidates need to complete a minimum of FOUR (4) years training and pass the Pro 1 and Pro 2 examinations compulsorily.

8.5. STAGE 1: MEDICAL GENETICS MODULE

8.5.1. INTRODUCTION

The Stage 1 course is of one year duration of General Pathology in various sub-disciplines of pathology including TWO (2) weeks in Medical Genetics.

At the end of the Stage 1 course the candidate will sit for an examination in General Pathology (Part 1 examination) and must pass this examination in order to proceed to the Stage 2 course.

8.5.2. LEARNING OBJECTIVE

a. General objective:
The primary objective of the Stage I course is to attain basic knowledge in medical genetics.

b. Specific objectives:
i. Acquire basic theoretical knowledge in medical genetics.
ii. Acquire basic understanding of the common laboratory techniques involved in cytogenetic and molecular genetics tests.
iii. Acquire basic knowledge of common genetic disorders and competence in pedigree drawing and analysis

8.5.3. COURSE CONTENT

a. BASIC KNOWLEDGE OF MEDICAL GENETICS

List of lectures:

Title	Hour
Introduction to Medical Genetics	1
Introduction to Molecular Genetics	1
Introduction to Human Cytogenetics	1
Cytogenetic analysis - Methods and Applications	1
Principles of inheritance in genetics disorders	1
Introduction to Genetics Counseling	1
Overview of DNA technology applications in medicine	1
Cancer genetics (molecular and cytogenetics techniques)	1
Genetics Basis of Human Cancer	1

*(topic of lectures might be varied or updated according to current needs)

b. LABORATORY TECHNICAL COMPETENCIES

Practical Session:

Skills	**Hour**	**Competence Level**
PCR	2	1
Karyotyping	2	1
DNA Extraction	2	3
Fluorescence *in situ* hybridization (FISH) analysis	2	1
Pedigree Drawing and Analysis	2	3

8.5.4. COURSE STRUCTURE

Candidates will be posted in Human Genome Centre for TWO (2) weeks to learn cytogenetic and molecular genetic techniques using whole blood samples. These two weeks posting will be filled up with various lectures as well as laboratory practical sessions for cytogenetic and molecular techniques.
During the postings, the candidate shall maintain a log book and performance to the supervisor's satisfaction a list of procedures.

8.5.5. TEACHING PROGRAMME

a. There will be formal sessions in the form of teaching and small group discussions on selected topics.
b. Practical sessions will be held in genetic laboratory for cytogenetic and molecular techniques.

8.5.6. LEARNING OUTCOMES

a. Candidates should be able to understand the basic concepts in medical genetic and its clinical diagnostic applications.
b. Candidates are expected to understand the basic mechanism in genetic disorders.
c. Candidates should understand the basic principles and applications of common cytogenetic and molecular tests.

8.5.7. RECOMMENDED TEXTBOOKS/JOURNALS/REFERENCES

a. Emery's Elements of Medical Genetics (14th Edition, 2011) by Peter D Turnpenny and Sian Ellard (editors) , Elsevier Churchill Livingstone
b. Human Molecular Genetics (2010) by T . Strachan and Andrew Read. ISBN: 13:9780815341499 / ISBN: 10: 0815341490.
c. Thompson & Thompson Genetics in Medicine (7th Edition 2007) by Robert L Nussbaum, Roderick R McInnes and Huntington P Willard. ISBN: 978 - 1-4160- 3080-5.

8.6. STAGE 2: MEDICAL GENETICS MODULE

8.6.1. INTRODUCTION

The Stage 2 course of Master of Pathology is THREE (3) years duration. The candidates will be placed at the Human Genome Centre, School of Medical Sciences, USM. There are three important aspects which are included during the programme; theoretical, practical and research.

Laboratory attachments will be carried out in Human Genome Centre USM, Medical Genetic Lab HKL/WCH as well as other institutions in Malaysia.

8.6.2. LEARNING OBJECTIVE

a. General objective:

The primary objective of the Stage 2 programme is for the candidate to attain advance knowledge and practical competence to direct and manage a genetic laboratory.

b. Specific Objectives:

To acquire consultant level skills in Medical Genetics in the following clinical and laboratory aspects:

i. Understand and attain competency with ability to provide consultancy services in cytogenetic and molecular genetic tests
ii. Familiarize with various genetic disorders and conversant with the basic concept of genetic counseling
iii. Gain expertise in test design, validation and proper quality control with competency in Laboratory management based on the concept of Laboratory Quality Management (LQM)
iv. Competent in the assessment, troubleshooting and interpretation of laboratory data and bioinformatics
v. To be able to conduct a research project and familiarize with bioinformatics tools
vi. Able to be innovative and adapt to the continuously evolving clinical needs in terms of diagnostic, therapeutics and personalized state of the art genomics in the Malaysian perspective

8.6.3. COURSE CONTENT

The course covers the theoretical component, laboratory technical skills, laboratory management and research component.

a. THEORETICAL COMPONENT

Tutorials/ seminars/ lectures

YEAR 2
Introduction to Clinical Genetics
Introduction to cell culture
Introduction to Cytogenetics and molecular cytogenetics - Prenatal diagnosis - Postnatal diagnosis - Cancer cytogenetics - Other tissue cytogenetics
Common molecular techniques in genetic tests
Advanced Molecular Techniques for Diagnosis of Genetic Disorder - microarray - NGS - droplet digital PCR
Introduction International System for Human Cytogenomics Nomenclature
YEAR 3
Cancer Genetics - Solid tumours - Haematological cancer
Population Genetics & Epidemiology
Bioinformatics
Research Human Ethics
Congenital Heart Defect/ Cardiogenetics
Mitochondrial Genetics &Neurogenetics
Genetic Counselling/ Risk Assessment
Laboratory risk assessment
Inborn Errors of Metabolism
Epigenetics
Introduction to Stem Cell & its application

Pharmacogenomics
Birth defects
Introduction to Gene Therapy
Personalized medicine and precision medicine
Ethical and soft skills management
Use and misuse of genetic tests
Introduction to biobanking
Non- invasive techniques (liquid biopsy) in genetic testing

b. LABORATORY TECHNICAL SKILLS

Practical Skills To Be Acquired	Level of Competence
Mutational analysis using PCR-RFLP	5
Karyotyping for whole blood and bone marrow samples	5
DNA extraction	5
Analysis and Hereditary Pedigree	5
DNA sequencing analysis	3
Fluorescence *in-situ* Hybridization (FISH) analysis	4
Mutational screening using dHPLC	3
Real-Time quantitative PCR and other PCRs	2
Comparative Genomic Hybridization (CGH)	2
Microarray and Gene Expression analysis	2

c. LABORATORY MANAGEMENT

i. QMS Laboratory

- MS ISO 15189 accreditation for Cytogenetic Laboratory
- External Assurance Programme

d. RESEARCH COMPONENT

i. Designing and conduct of research project
ii. Submission of dissertation / manuscript
iii. Presentation at scientific meeting or publication in reputed journals

8.6.4. COURSE STRUCTURE

a. Year 2

Scope/Content	Duration (Week)	Placement
Orientation	1	Human Genome Centre, USM
Introduction of Medical/HumanGenetics	4	
Research Methodology and Medical Statistics	3	School of Medical Sciences, USM
Laboratory Quality Management System & Medical Genetic Testing	2	Human Genome Centre and/or Advanced Medical & Dental Institute, Bertam, USM

Clinical Genetics Part 1 Genetic Disorders in Pediatrics (Postnatal)	25	Paediatric Department, USM
Clinical Genetics Part 1 Genetic Disorders in Hematology	13	Hematology Department, USM
Holidays	4	

b. Year 3

Scope/Content	Duration (Week)	Placement
Cancer genetics - solid tumours - hemato-oncology	22	Pathology Department, USM Hematology Department, USM, Pathology Department, Faculty of Medicine, UKM UKM Medical Molecular Biology Institute (UMBI)
Population Genetics, Epidemiology, Bioinformatics and Ethical Issues	10	Human Genome Centre, USM
Clinical Genetics part 2 - Cardiogenetics - Neurogenetics - Neuropsychiatric genetics - Hepatobiliary genetics	8	School of Medical Sciences, USM, Genetics Laboratory, Hospital Kuala Lumpur / (Women and Children Hospital) WCH
Genetic Counselling	8	Human Genome Centre, USM Paediatrics Department, Faculty of Medicine, UM
Holidays	4	

Year 4

Scope/Content	**Duration (Week)**	**Placement**
Prenatal diagnosis	12	Genetics Laboratory, Hospital Kuala Lumpur/WCH and/or Human Genome Centre, USM &Genetics Laboratory Specialist and Human Reproductive Research Centre, LPPKN
Postnatal diagnosis (blood & bone marrow) (Chromosomal & DNA analysis)	30	Genetics Laboratory, Hospital Kuala Lumpur/WCH and/or Human Genome Centre, USM
Mitochondrial genetics	4	Human Genome Centre, USM &Specialised Diagnostic Centre, Institute for Medical Research (IMR, Kuala Lumpur)
Revision	2	Human Genome Centre, USM
Professional Examination II	2	School of Medical Sciences, USM
Holidays	2	

8.6.5. TEACHING PROGRAMME

a. Lecturer and student ratio Lecturer : Student (1:2)
b. Lectures will be held in the form of formal lectures, tutorials and laboratory practical, seminars and journal reviews, formal discussions etc
c. The candidates are expected to learn primarily through the hands-on and on job training in an independent. All units/departments involved in this program has an approved accreditation by "Jawatankuasa Bersama Pengkhususan Patologi" committee
d. Candidates will be posted at all the scheduled lab posting by rotation
e. Candidates may be posted outside the mother university to other institutions e.g. IMR,Hospital Kuala Lumpur or any other universities when deemed necessary in order to acquire necessary skills and exposure.
f. Candidates are encouraged to attend ward round and specialist clinics such as Oncology Hematology Unit, Neonatal Unit, Pediatrics Clinic/ward, or other clinics which are deemed important.
g. Candidates are expected to undertake all the routine duties of a medical geneticist in the laboratory and clinic, including authorizing the laboratory results.
h. Candidates are required to submit a log book of their course duties. The log book is a pre-requisite to sit for the Phase II examination
i. <u>General teaching methodology</u>:

   i. Several teaching methodologies will be carried out to ensure efficiency in teaching and learning
   ii. A detail synopsis will be prepared. Appropriate teaching museum films, list of books, magazines and monograph will be provided by the University
   iii. The university will provide the appropriate lecture notes, articles and manuscripts from the medical journals and magazines, reference books and audio visual materials as the teaching materials. The preparation will be done by the candidates and supervisors
   iv. The schedule for lectures, tutorials, demonstrations and laboratory practical will be fixed
   v. Candidates are required to attend Grand Ward Round at the clinical departments, according to the scheduled postings
   vi. Candidates are required to prepare and conduct a project and submit a case report based on the number decided by the department
   vii. Candidates are expected to participate actively in the Continuous Medical Education (CME) presentations, journal club presentations, seminars and conferences and other teaching and learning activities.
   viii. The university will decide other appropriate teaching methodologies when deemed necessary.

j. Formative assessment

   A. <u>Log book</u>

      i. Candidates will be required to maintain a log book to ensure the expected training and self-learning process are achieved. The log book must be reviewed by the supervisor.

ii. The completion of log book is a pre-requisite to sit for the Phase II examination
iii. The ownership of the log book belongs to the university
iv. Candidates will be posted routinely at other laboratories and centres outside the Human Genome Centre, USM, to acquire experience of different cases, facilities and expertise.

The following must be recorded in the log book:

- Place of training
- A list of patients examined
- A list of interpretations of laboratory tests done
- 100 case reports of karyotyping on blood samples (at least 50 cases shall be submitted)
- 50 case reports of karyotyping on bone marrow
- 50 case reports of prenatal diagnosis
- 10 cases of skin biopsy cytogenetics report
- 10 molecular diagnostic testing with DNA sequence amplification (PCR amplification)

B. Presentation at scientific meetings must be recorded
C. Publications (at least one local or international journal publications/case report prior to end of Year 4)
D. Attendance at Cytogenetics meetings and CME/Journal Club presentation

8.6.6. LEARNING OUTCOMES

a. Candidate has sufficient knowledge in genetic disorders, genetic counseling and the principles of various genetic tests
b. Candidate is competent in the performance of various cytogenetic and molecular genetic testing
c. Candidate becomes a specialist in test design, validation and proper quality control
d. Candidate is able to provide consultancy in laboratory diagnosis and expert interpretation of the test result
e. Candidate is competent in laboratory management and quality control
f. Candidate should be able to undertake research project independently
g. Candidate is professional, ethical, holistic, adaptive, marketable and an effective communicator

8.6.7. RESEARCH PROJECT

Candidates are required to plan, undertake a research project and write up a dissertation which has to be submitted 6 months prior to Year 4 final examination. Dissertation will be examined by internal and external examiners appointed by the university.

8.6.8. RECOMMENDED TEXTBOOKS/JOURNALS/REFERENCES

a. BOOKS

i. Shaffer LG, McGowan-Jordan J, Schmid M (eds). An International System for Human Cytogenetic Nomenclature (2013) ISBN: 978-3-318-02253-7
ii. Strachan T, Read A. Human Molecular Genetics. 4TH Edition. 2010. Garland Science Online *(accessed December 2015)*. ISBN 9780815341499
iii. Emery's Elements of Medical Genetics (14th Edition, 2011) by Peter D Turnpenny and Sian Ellard (editors) , Elsevier Churchill Livingstone
iv. Genetic disorders (2013) by Maria Pulu . ISBN: 978 - 953- 51- 0886-3.
v. Epigenetics Revolution (2012) by Nessa Carey . ISBN: 13: 9781848313477 / ISBN : 10: 1848313470.
vi. Human Molecular Genetics (2010) by T . Strachan and Andrew Read .ISBN : 13:9780815341499 / ISBN: 10: 0815341490.
vii. The Biology of Cancer (2013) by Robert A Weinberg. ISBN: 13: 9780815342205 / ISBN: 10: 0815342209.
viii. Thompson & Thompson Genetics in Medicine (7th Edition 2007) by Robert L, Nussbaum, Roderick R McInnes and Huntington P Willard. ISBN: 978 - 1- 4160- 3080-5.
ix. Gardner RJM, Sutherland GR Shaffer LG. Chromosome Abnormalities and Genetic Counselling. 4th Edition. 2011. Oxford Medicine Online *(accessed December 2015)*. Print ISBN-13: 9780195375336
x. Gersen, SL, Keagle MB. (Eds.) The Principles of Clinical Cytogenetics. 3rd Edition.2013. Springer. ISBN978-1-4419-1687-7.
xi. Swerdlow SH, Campo E, Harris NL, Jaffe ES, Pileri SA, Stein H, Thiele J, Vardiman JW (Eds). WHO Classification of Tumours of Haematopoietic and Lymphoid Tissues. 4th Edition, 2008. WHO Press *(accessed December 2015)*. ISBN-13 9789283224310, ISBN-10 9283224310

b. WEBSITES

i. RCPA Education Online *http://www.rcpa.edu.au/Education* (specifically the Ethics,Quality Management and Laboratory Safety eLearning modules)
ii. RCPA website: *http://www.rcpa.edu.au/Education/Disciplines/Genetic-Pathology*

c. INFORMATION ABOUT RARE GENETIC TESTS

i. NIH Genetic Testing Registry – *http://www.ncbi.nlm.nih.gov/gtr/(Accessed December 2015)*
ii. NCBI Gene Reviews – *http://www.ncbi.nlm.nih.gov/books/NBK1116/(Accessed December 2015)*
iii. EuroGentest – *http://www.eurogentest.org/(Accessed December 2015)*

d. QUALITY ASSURANCE/ BEST PRACTICE GUIDELINES

i. American College of Medical Genetics Standards and Guidelines for Clinical Genetics Laboratories *(Accessed December 2015)*
ii. European Molecular Genetics Quality Network:*http://www.emqn.org/emqn/Best+Practice (Accessed December 2015)*
iii. Association for Clinical Genetic Science *(part of the federated British Society for GeneticMedicine):http://www.acgs.uk.com/committees/quality-committee/best-practice-guidelines/ (Accessed December 2015)*
iv. Swiss Society of Medical Genetics: *http://sgmg.ch/wordpress/wp-content/uploads/2015/09/SGMG_Reporting_Guidelines.pdf(accessed December 2015)*
v. Human Genetics Society of Australasia Policies, Guidelines and Position Statements *(accessed December 2015)*
vi. NPAAC Guidelines: *http://www.health.gov.au/internet/main/publishing.nsf/Content/health-npaac-publication.htm(accessed December 2015)*
vii. European Research Network for evaluation and improvement of screening, Diagnosis and treatment of Inherited Disorders of Metabolism (ERNDIM) *(Accessed December 2015)*

9.0. EXAMINATION

9.1. STAGE 1 ASSESSMENT

9.1.1. Continuous Assessment

For purposes of continuous assessment:

a. 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.

b. The log book/ 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.

c. Unsatisfactory performance or non-fulfillment 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.

d. 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.

9.1.2. Prerequisites for sitting the Part 1 Examination

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

a. 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.

b. 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.

c. Satisfactorily completed all assignments [where applicable].

9.2. PROFESSIONAL PART 1 EXAMINATION

9.2.1. 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% (MCQ = 70% and Essay = 30%)
Practical	50%

The Theory examination per each module is for 60 minutes

a. Anatomic Pathology (20 MCQ and 1 essay]

b. Medical Microbiology (20 MCQ and 1 essay]

c. Hematology20 MCQ(20 MCQ and 1 essay]

d. Chemical Pathology (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 1: Anatomic Pathology (10 stations)and Medical Microbiology (10 stations)
OSPE 2: Haematology (10 stations) and Chemical Pathology(10 stations)

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

Allocation of marks in the Theory &Practical component

Anatomic Pathology	100
Medical Microbiology	100
Chemical Pathology	100
Hematology	100
Total mark	400

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 than40%

Repeat examinations:

a. A candidate who has failed may be allowed to repeat the examination after one year.
b. A candidate is allowed a maximum of **one** repeat examination.

9.3. STAGE 2 ASSESSMENT

9.3.1. Continuous assessment

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.

9.3.2. Prerequisites for sitting thePart 2 Examination

To be eligible to sit for the Final Examination the candidate must have:

a. 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.

b. completed all the required tasks to the supervisor's satisfaction. Submitted a research project report/dissertation accompanied by the supervisor's report. The research project report should be submitted at the end of Year 3 but not later than 6 months before the Final Examination. A revision of the research project report may have to be undertaken if necessary.

c. 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

9.4. PROFESSIONAL PART 2 EXAMINATION

The Part 2 examination will be held at the end of Year 4 and comprises:

a. theory papers
b. practical papers
c. viva-voce

Allocation of marks [for all disciplines]:

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

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

Criteria for pass:

a. Candidate must obtain an overall score of 50%

b. Candidate must pass BOTH the theory and practical components (The pass mark for each component is 50%).

c. Attending the viva is COMPULSORY

Repeat examinations:

a. *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. The student must achieve satisfactory continuous assessment to be eligible to sit for examination.

The candidate is only allowed to repeat examination twice consecutively for the same component (theory or practical). Upon failure of the second repeat attempt, the candidate is required to repeat both theory and practical components after a period of 6 months to 1 year based on conjoint exam board decision.

b. *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 Part 2 examination.

A candidate may be allowed to repeat the examination after one (1) year if:

i. obtained an overall score of less than 50% OR
ii. failed BOTH the theory and practical components OR
iii. an overall score of 50% or more, but has failed either the theory or the practical component and the conjoint exam board found that overall performance of the candidate is not satisfactory.

In this repeat examination, the candidate will be examined in the theory and practical components and be given a viva-voce. The student must achieve satisfactory continuous assessment to be eligible to sit for examination

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

The maximum duration permitted for the completion of the entire course is SEVEN (7) years.

10.0 EXAMINATION DETAIL PER EACH DISCIPLINE

10.1. ANATOMIC PATHOLOGY

Required assignments

100 histopathology reports
20 frozen section reports
20 autopsy reports
100 cytology reports
20 FNA reports

a. *Theory* 45%

Essay Paper I 5 essays	50%
Essay Paper II 5 essays	50%

b. *Practical* 45%

Autopsy	20%
Practical 1 (Surgical pathology)	40%
Practical 2 (Cytology and Special stains)	30%
Grossing	10%

c. *Viva-voce* 10%

10.2. HAEMATOLOGY

a. *Theory:* 45%

Essay Paper I (50%):

- 5 essays (1 compulsory integrated topics, remaining 4 from 5 choices)

Essay Paper II (50%):

- 5 essays (1 compulsory blood banking, remaining 4 out of 5 choices)

b. *Practical* 45%

OSPE (90%)

- OSPE Morphology (40%) : 9 stations x 20 minutes each
- OSPE Haemostasis/ Miscellaneous (20%) : 9 stations x 20 minutes each
- OSPE Transfusion (30%) : 9 stations x 20 minutes each

Clinical Case (10%) : 2 cases

c. *Viva-voce* 10%

10.3. CHEMICAL PATHOLOGY

Required assignments

6 case summaries
1 research report

a. *Theory* 45%

Essay Paper I 4 essays (50%)
Essay Paper II 4 essays (50%)

b. *Practical* 45%

OSPE : 12 stations x 10 minutes each(50%)
1 Long (3 hours) and 1 Short practical (2 hours) (50%)

c. *Viva-voce* 10%

10.4. MEDICAL MICROBIOLOGY

Required assignments

6 case reports
1 research report

a. *Theory* 45%

Essay Paper I 5 essays/MEQ/problem solving questions
Essay Paper II5 essays/MEQ/problem solving questions

b. *Practical* 45%

Long practical
OSPE

c. *Viva-voce* 10%

10.5. FORENSIC PATHOLOGY

Required assignments prior to final examination

100 autopsies with relevant grossing, staining and HPE reports
40 clinical forensic cases and reports
1 Case book (10 cases)
1 research project report and/or manuscript for publication

a. *Theory*

Essay Paper I 4 essays (from 5 choices) + 1 Clinical Forensic question
Essay Paper II4 essays (from 5 choices) + 1 Clinical Forensic question

b. *Practical*

Autopsy
Forensic histopathology
Short cases
Long case (+ Clinical Forensic questions)

c. *Viva-voce*

10.6. IMMUNOLOGY

The Phase II examination will be held at the end of Year IV and will comprise:

Theory Papers
Practical Papers
Viva-voce

Allocation of Marks

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

a.	Theory		45%
	MCQ	50%	
	Essay 1 & 2	50%	
b.	Practical		45%
	OSPE	50%	
	Long Practical	50%	
c.	Viva-Voce		10%
	TOTAL		100%

10.7. MEDICAL GENETICS

Required assignments:

1 research dissertation
50 case summaries of karyotyping on blood samples
50 case summaries of karyotyping on bone marrow
50 reports of prenatal diagnosis
10 cases of skin biopsy cytogenetics report
10 reports on DNA sequencing

a.	Theory (45%)		
	Paper I	ESSAY	50%
	Paper II	ESSAY	50%
b.	Practical (45%)		
	OSCE/OSPE		60%
	Long practical		40%
c.	Viva-voce		10%

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APPENDIX:

1.0 CONDUCT OF THE CONJOINT PATHOLOGY EXAMINATION

a. The universities participating in conjoint pathology program host the Part 1 and Part 2 Master of Pathology examinations by rotation.
b. The university conducting the conjoint examinations is called the hosting university.
c. The hosting university can only run the examination in which the program is offered in the university, for example, USM will not run a conjoint forensic examination for now because she does not offer the program.
d. The hosting university will appoint and bear the financial implications for the external examiner.
e. The hosting university shall appoint the Examination Coordinator
ALL lecturers and Ministry of Health specialists involved shall sign declaration of confidentiality.
f. Submission and vetting of questions shall be done in the hosting university within a stipulated time.
g. Conduct of the examination shall be the responsibility of the hosting university (Scheduling, printing, storing, distribution and invigilation etc).
h. All universities are involved in the marking of the answer scripts. Answer briefs are to be provided when relevant.
i. Marks are to be collated by the hosting university.
j. Announcement of results will be made in accordance with the rules and regulations of the individual university.
k. Answers scripts shall be kept by the hosting university for a minimum of 6 months or longer as stipulated by each university's rules and regulations.
l. All results are final.

1.1. EXAMINERS

1.1.1. Peer review is conducted through the Conjoint Board Examination by the appointment of the international and local external examiners.

a. External examiners:
External examiners may be invited from overseas or locally. For each discipline, one external examiner shall be responsible for both Part I and Part II examination.
b. Internal Examiners:
All lecturers who are members of the Faculty/School Board or honorary lecturers to the Faculty/School may be appointed as internal examiners and senior supervisors from Ministry of Health.
c. Criteria for internal examiners:

i. An examiner must have at least 3 years' experience after Master of Pathology or its equivalent.
ii. For the purpose of the dissertation assessment, an examiner shall have at least 2years' experience in the specialty.

1.2. TERM AND REFERENCE OF COORDINATOR OF THE EXAMINATIONS

1.2.1. Examination Coordinator of Hosting University

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a. Appoint internal examiners for Part I and Part II nominated by collaborating universities. Internal examiners – shall be senior lecturers or programme coordinators from various universities and MOH. [Normally the hosting university will appoint one Part 1 and 4 [or more] program coordinators for Part 2
b. Appoint Program coordinator of various disciplines
c. Appoint External examiners for the Part 1 and Part 2 and shall submit proposed names of external examiners (at least 10 months prior to examinations dates) to the dean and the collaborating universities.
d. Appoint Program coordinator; i.e. separate coordinators for Part 1 and Part 2 for various disciplines

1.2.2. Terms of Reference of Program Coordinator of Hosting University

a. Prepare examination schedule per each discipline and inform participating universities
b. Conduct meetings to vet the examination questions at least 3 months before examination.
c. Ensure candidates fulfill the prerequisites to sit for the examination.
d. Ensure the examination questions are prepared by the internal/external examiners and program coordinators at minimum of 3 months before examination.
e. The program coordinator aided by members of his/her examination committee is responsible to draft and finalize the examination blue-print. He/she is responsible to protect the confidentiality of the examinations.
f. The Examination questions drafts – shall be kept by the hosting university with stringent security measures.
g. Copies of examination drafts should be shredded.
h. The Program coordinator is responsible to the smooth running of the examination of the discipline he/she is responsible for.
i. Collate the examination marks and prepare the list of viva [if relevant].
j. Submit the final results to the Examination Coordinator so that the results could be communicated to the examination coordinators of participating universities
k. Ensure that the final results are endorsed by the external examiners and the examination coordinators before submitting to Examination Coordinator
l. After the examinations are over, the Program Coordinator could provide participating universities, the copies of the examinations