

NAAC Criterion 2: Teaching Learning and Evaluation

2.6 Student Performance and Learning Outcomes

2.6.1: The Institution has stated the learning outcomes and graduate attributes as per the provisions of the Regulatory bodies and the University; which are communicated to the students and teachers through the website and other documents





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Additional Information



GUIDELINES FOR COMPETENCY BASED POSTGRADUATE TRAINING PROGRAMME FOR MD IN ANATOMY

Preamble:

The purpose of PG education is to create specialists who would provide high quality health care and advance the cause of science through research & training.

These guidelines would help to achieve a uniform level of training of MD Anatomy to post graduate students throughout the country. The student, after undergoing the training, should be able to deal effectively with the needs of the medical community and should be competent to handle all problems related to the specialty of Anatomy and recent advances in the subject. The post graduate student should also acquire skills in teaching anatomy to medical and para-medical students and be able to integrate teaching of Anatomy with other relevant subjects, while being aware of her/his limitations.

The purpose of this document is to provide teachers and learners illustrative guidelines to achieve defined outcomes through learning and assessment. This document was prepared by various subject-content specialists. The Reconciliation Board of the Academic Committee has attempted to render uniformity without compromise to purpose and content of the document. Compromise in purity of syntax has been made in order to preserve the purpose and content. This has necessitated retention of “domains of learning” under the heading “competencies”.

SUBJECT SPECIFIC LEARNING OBJECTIVES

The **Goal** of MD Anatomy is to train a doctor to become a competent teacher and researcher in Anatomy who:

1. Is aware of *contemporary advances and developments* in the field of Anatomy.
2. Has *acquired the competencies* pertaining to the subject of Anatomy that are required to be practiced at all levels of health system.
3. Is able to discharge responsibilities and participate in National Health Education Programme.
4. Is oriented to the *principles of research methodology*.
5. Has acquired *skills in educating* medical and paramedical professionals.
6. Has acquired *skills in effectively communicating* with the students and colleagues from various medical and paramedical fields.
7. Has acquired skills of integrating anatomy with other disciplines as and when needed.
8. Has acquired qualities of a good teacher capable of innovations in teaching methodology.

9. Has been able to demonstrate adequate management skills to function as an effective leader of the team engaged in teaching and research.

After completing the three year course in MD Anatomy the student should have achieved competence in the following:

1. Knowledge of Anatomy

- 1.1. Acquire competencies in gross and surface anatomy, neuroanatomy, embryology, genetics, histology, radiological anatomy, applied aspects and recent advances of the above mentioned branches of anatomy to clinical practice. These are given in detail in subsequent sections.

2. Practical and Procedural skills

- 2.1 Acquire mastery in dissection skills, embalming, tissue preparation, staining and museum preparation.

3. Training skill in Research Methodology

- 3.1 Acquire skills in teaching, research methodology, epidemiology & basic information technology.
- 3.2 Acquire knowledge in the basic aspects of Biostatistics and research methodology.
- 3.3 Has knowledge to plan the protocol of a thesis, carry out review of literature, execution of research project and preparation of report.
- 3.4 Has ability to use computer applications Microsoft office (Microsoft word, excel, power point), Internet, Searching scientific databases (e.g. PubMed, Medline, Cochrane reviews).
- 3.5 Acquire skills in paper & poster preparation, writing research papers and Thesis.

4. Professionalism, attitude and communication skills:

- 4.1 Develop honest work ethics and empathetic behavior with students and colleagues.
- 4.2 Acquire capacity of not letting his/her personal beliefs, prejudices, and limitations come in the way of duty.
- 4.3 Acquire attitude and communication skills to interact with colleagues, teachers and students.

5. Teaching Anatomy

- 5.1 Practicing different methods of teaching-learning.
- 5.2 Making presentations of the subject topics and research outputs.

6. Problem Solving

- 6.1 Demonstrate the ability to identify applied implications of the knowledge of anatomy and discuss information relevant to the problem, using consultation, texts, archival literature and electronic media.
- 6.2 Demonstrate the ability to correlate the clinical conditions to the anatomical/ embryological/hereditary factors.
- 6.3 Demonstrate the ability to evaluate scientific/clinical information and critically analyze conflicting data and hypothesis.

SUBJECT SPECIFIC COMPETENCIES

At the end of the course, the student should have acquired following competencies:

A. Cognitive domain

1. Describe gross anatomy of entire body including upper limb, lower limb, thorax, abdomen, pelvis, perineum, head and neck, brain and spinal cord.
2. Explain the normal disposition of gross structure, and their interrelationship in the human body. She/He should be able to analyze the integrated functions of organs systems and locate the site of gross lesions according to deficits encountered.
3. Describe the process of gametogenesis, fertilization, implantation and placenta formation in early human embryonic development along with its variation and applied anatomy.
4. Demonstrate knowledge about the sequential development of organs and systems along with its clinical anatomy, recognize critical stages of development and effects of common teratogens, genetic mutations and environmental hazards. She/He should be able to explain developmental basis of variations and congenital anomalies.
5. Explain the principles of light, transmission and scanning, compound, electron, fluorescent and virtual microscopy.
6. Describe the microscopic structure of various tissues & organs and correlate structure with functions as a prerequisite for understanding the altered state in various disease processes.
7. Demonstrate knowledge about cell and its components, cell cycle, cellular differentiation and proliferation.
8. Describe structure, number, classification, abnormalities and syndromes related to human chromosomes.
9. Describe important procedures in cytogenetics and molecular genetics with its application.
10. Demonstrate knowledge about single gene pattern inheritance, intermediate pattern and multiple alleles, mutations, non-mendelian inheritance, mitochondrial inheritance, genome imprinting and parental disomy.
11. Describe multifactorial pattern of inheritance, teratology, structure gene, molecular screening, cancer genetics and pharmacogenetics.
12. Demonstrate knowledge about reproduction genetics, assisted reproduction, prenatal diagnosis, genetic counseling and ethics in genetics.

13. Explain principles of gene therapy and its applied knowledge.
14. Describe immune system and cell types involved in defense mechanisms of the body. Also explain gross features, cytoarchitecture, functions, development and histogenesis of various primary and secondary lymphoid organs in the body.
15. Demonstrate knowledge about common techniques employed in cellular immunology and histocompatibility testing.
16. Demonstrate applications of knowledge of structure & development of tissue-organ system to comprehend deviations from normal.
17. Demonstrate knowledge about recent advances in medical sciences which facilitate comprehension of structure function correlations and applications in clinical problem solving.
18. Explain collection, maintenance and application of stem cells, cryobanking and principles of organ donation from recently dead bodies.
19. Demonstrate knowledge about surface marking of all regions of the body.
20. Able to interpret various radiographs of the body, normal CT Scan, ultrasound and MRI.
21. Demonstrate knowledge about different anthropological traits and use of related instruments.
22. Demonstrate knowledge about outline of comparative anatomy of whole body and basic human evolution
23. Demonstrate knowledge about identification of human bones, determination of sex, age, and height for medico legal application of anatomy

B. Affective domain

1. Demonstrate self-awareness and personal development in routine conduct. (*Self-awareness*)
2. Communicate effectively with peers, students and teachers in various teaching-learning activities. (*Communication*)
3. Demonstrate
 - a. Due respect in handling human body parts & cadavers during dissection. (*Ethics & Professionalism*)
 - b. Humane touch while demonstrating living surface marking in subject/patient. (*Ethics & Professionalism*)
4. Acquire capacity of not letting his/her personal beliefs, prejudices and limitations come in the way of duty.
5. Appreciate the issues of equity and social accountability while exposing students to early clinical exposure. (*Equity and social accountability*)

C. Psychomotor domain

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

1. Identify, locate and demonstrate surface marking of clinically important structures in the cadaver and correlate it with living anatomy.
2. Acquire mastery in dissection skills, embalming, tissue preparation, staining and museum preparation.
3. Locate and identify clinically relevant structures in dissected cadavers.
4. Locate and identify cells & tissues under the microscope.
5. Identify important structures visualized by imaging techniques, specifically radiographs, computerized tomography (CT) scans, MRI and ultrasonography.
6. Demonstrate various movements at the important joints and actions of various groups of muscles in the human body.
7. Demonstrate anatomical basis of common clinical procedures expected to be performed by a basic medical doctor.
8. Demonstrate different methods of teaching-learning and make presentations of the subject topics and research outputs.

Specific practice based competencies:

Name/Description of practice based competencies
<p>1. Gross anatomy:</p> <ol style="list-style-type: none"> 1.1 Procurement, Embalming and Preservation of human cadavers 1.2 Preparation of tanks for preserving bodies 1.3 Dissection of cadaver 1.4 Window dissection of important regions 1.5 Preparation of specimens for museum with display <ol style="list-style-type: none"> a) soft parts b) models c) charts 1.6 Preparation and preservation of human bones / skeleton as assigned by the faculty
<p>2. Histology</p> <ol style="list-style-type: none"> 2.1 Preparation of common fixatives embalming fluid 10% formalin, Bouin's fluid etc 2.2 Making paraffin blocks and section cutting and mounting 2.3 Preparation of staining set for H and E staining and staining paraffin sections with the stain 2.4 Making celloidin, araldite, gelatin blocks and their section cutting 2.5 Processing hard tissues, decalcification of bones, block making and sectioning, preparation of ground sections of calcified bones. 2.6 Frozen section cutting on freezing microtome and cryostat 2.7 Honing and Stropping of microtome knives, including sharpening by automatic knife sharpener 2.8 Histology file in which LM and EM pictures of all the organs and tissues of the body should be drawn and a small description of salient features written

<p>3. Histochemical Methods</p> <p>3.1 Practical classes for staining of glycogen, mucopolysaccharides, alkaline phosphatase acid phosphatase, and calcium</p>
<p>4. Cytogenetics</p> <p>4.1 Preparation of media, different solutions, stains etc.</p> <p>4.2 Preparation of buccal smear for sex chromatin Human chromosome preparation from peripheral blood and karyotyping.</p> <p>4.3 Banding techniques (G and C)</p> <p>4.4 Making of Pedigree charts for study of patterns of inheritance.</p> <p>4.5 Chromosomal Analysis.</p>
<p>5. Neuroanatomy:</p> <p>5.1 Dissection of brain and spinal cord for teaching and learning purpose</p> <p>5.2 Preparation of brain and spinal cord macroscopic and microscopic sections and identification of different parts in them.</p> <p>5.3 Discussions on clinical problems related to neurological disorders and anatomical explanation for the same.</p>

Syllabus

A post graduate student, after three years of training in M.D. (Anatomy) should have acquired knowledge in the following aspects of anatomy:

Gross anatomy

Section - I

Gross Anatomy of entire body including upper limb, lower limb, thorax, abdomen, pelvis, perineum, head and neck, brain and spinal cord

Section - 2

Developmental anatomy/embryology

- General embryology: gametogenesis, fertilization, implantation and placenta, early human embryonic development.
- Systemic embryology: development of organ systems and associated common congenital abnormalities with teratogenesis.
- Physiological correlations of congenital anomalies.

Section - 3

Histology and histochemistry

Cell Biology:

- Cytoplasm - cytoplasmic matrix, cell membrane, cell organelles, cytoskeleton, cell inclusions, cilia and flagella.
- Nucleus - nuclear envelope, nuclear matrix, DNA and other components of chromatin, protein synthesis, nucleolus, nuclear changes indicating cell death.
- Cell cycle - mitosis, meiosis, cell renewal.
- Cellular differentiation and proliferation.
- **Microscopic structure of the body:**
- Principles of light, transmission and scanning, electron, fluorescent, confocal and virtual microscopy.
- The systems/organs of body - Cellular organization, light and electron microscopic features, structure - function correlations, and cellular organization.

Section - 4

Neuroanatomy:

- Brain and its environment, Development of the nervous system, Neuron and Neuroglia, Somatic sensory system, Olfactory and optic pathways, Cochleovestibular and gustatory pathways, Motor pathways, Central autonomic pathways, Hypothalamo-hypophyseal system, Limbic system, Basal ganglia, Reticular system, Cross Sectional anatomy of brain and spinal cord.
- Detailed structure of the central nervous system and its applied aspect.

Section - 5

Genetics

- Human Chromosomes - Structure, number and classification, methods of chromosome preparation banding patterns. Chromosome abnormalities, Autosomal and Sex chromosomal abnormalities syndromes, Molecular and Cytogenetics.
- Single gene pattern inheritance: Autosomal and Sex chromosomal pattern of inheritance, Intermediate pattern and multiple alleles, Mutations, Non-Mendelian inheritance, Mitochondrial inheritance, Genome imprinting, parental disomy.
- Multifactorial pattern of inheritance: Criteria for multifactorial inheritance, Teratology, Structure gene, Molecular Screening, Cancer Genetics - Haematological malignancies, Pharmacogenetics.

- Reproduction Genetics - Male and Female Infertility, Abortuses, Assisted reproduction, Preimplantation genetics, Prenatal diagnosis, Genetic Counseling and Ethics of Genetics.
- Principles of Gene therapy and its applied knowledge.

Section - 6

Immunology

- Immune system and the cell types involved in defense mechanisms of the body. Gross features, cytoarchitecture, functions, development and histogenesis of various primary and secondary lymphoid organs in the body.
- Biological and clinical significance of the major histocompatibility complex of man including its role in transplantation, disease susceptibility/resistance and genetic control of the immune response.
- Common techniques employed in cellular immunology and histocompatibility testing.
- Molecular hybridization and PCR technology in immunology research particularly mechanism of antigen presentation, structural and functional relevance of the T cell receptor, genetic control of the immune response. Molecular basis of susceptibility to disease.

Section - 7

Applied anatomy and recent advances

- Clinical correlations of structure and functions of human body. Anatomical basis and explanations for clinical problems.
- Applications of knowledge of development, structural (microscopy), neuro anatomy to comprehend deviations from normal.
- Recent advances in medical sciences which facilitate comprehension of structure function correlations and applications in clinical problem solving.
- Collection, maintenance and application of stem cells, cryobanking and principles of organ donation from recently dead bodies.

Section - 8

• Surface Marking and Radiology

Surface marking of all regions of the body. Interpretation of normal radiographs of the body including special contrast procedures including barium studies, cholecystography, pyelography, salphingography. Normal CT Scan, MRI and Ultrasound.

- **Anthropology**
Different anthropological traits, Identification and use of Anthropological instruments.
- **Forensic Medicine:**
Identification of human bones from their remains and determination of sex, age, and height. for medico legal application of Anatomy.
- **Outline of comparative anatomy of the whole body and basic human evolution**

Departmental Resources:

It is mandatory for the department of Anatomy to develop at least three of the following laboratories, in addition to the other facilities. The laboratory should be involved in active research in at least one well defined field.

1. Histology
2. Immunology
3. Electronmicroscopy/ Fluorescence microscopy/ confocal and other forms of microscopy laboratories
4. Developmental anatomy
5. Anthropometry
6. Neuroanatomy
7. Cytogenetics
8. Imaging technique for Radiological Anatomy

TEACHING AND LEARNING METHODS

Teaching methodology

During the course, students should have formal training in teaching and research. The sessions should be in the form of:

1. **Didactic Teaching**
Topics in gross, surface and cross sectional anatomy, microanatomy, embryology, neuroanatomy, histochemistry, and genetics taught by faculty members.
2. **Training in communication skills** - journal club, seminars, demonstrations, tutorials, lectures, quizzing.
3. Hands-on experience - techniques in microanatomy, neuroanatomy, gross anatomy, embryology, histochemistry, genetics, microscopy. Embalming and preservation of cadavers
4. Teaching: participate in the teaching and training programme of undergraduate students and interns.
5. Participate in seminars, symposia, group-discussions and Journal clubs.

6. Educational technology - preparation of Audio Visual aids for teaching, posters/manuscripts for presentation in conferences/workshops and publication in journals.
7. Participation in formulating evaluation methods: Setting objective questions, Short Answer Questions, Multiple Choice Questions and Objective Structured Practical Examination (OSPE).
8. Prepare teaching modules and museum specimens.
9. Participation in organization of symposia/workshops
10. Explain and interpret normal radiological anatomy and sectional anatomy of the human body as studied by various imaging techniques.
11. Comprehend and demonstrate surface and living anatomy of the human body.
12. Relate forensic anatomy to the study with medico-legal aspects of bone in particular.
13. Explain the general principles of Anatomy Act and Organ Transplantation Act.
14. Comprehend ethical aspects of biomedical research.
15. Comprehend the basis of disposal of biomedical waste.
16. Comprehend horizontal integration of various subdivisions of anatomy with relevant physiology and biochemistry.
17. **Log Book:** Every student should maintain a logbook in which a record of the practical exercises completed should be entered. The Log books shall be checked and assessed periodically by the faculty members imparting the training.
18. A postgraduate student of a postgraduate degree course in broad specialities/super specialities would be required to present one poster presentation, to read one paper at a national/state conference and to present one research paper which should be published/accepted for publication/sent for publication during the period of his postgraduate studies so as to make him eligible to appear at the postgraduate degree examination.
19. Department should encourage e-learning activities.

ASSESSMENT

FORMATIVE ASSESSMENT:

Formative assessment should be continual and should assess medical knowledge, procedural & academic skills, interpersonal skills, professionalism, self directed learning and ability to practice in the system.

During the three year training period,

- A record of all theoretical, practical and experimental work done by the post graduate student and its assessment will be kept and shall be available for examiners at the time of the final practical and viva voce examination and
- There will be periodical examinations during the course of training. The pre-final theory and practical examination will be conducted by the faculty of the

concerned college. During last six months the post graduate student will have weekly assessment tutorials conducted by the faculty. All activities will be evaluated.

General Principles

Internal Assessment should be frequent, cover all domains of learning and used to provide feedback to improve learning; it should also cover professionalism and communication skills. The Internal Assessment should be conducted in theory and practical/clinical examination.

Quarterly assessment during the MD training should be based on:

- 1. Journal based / recent advances learning**
- 2. Patient based /Laboratory or Skill based learning**
- 3. Self directed learning and teaching**
- 4. Departmental and interdepartmental learning activity**
- 5. External and Outreach Activities / CMEs**

The student to be assessed periodically as per categories listed in postgraduate student appraisal form (Annexure I).

SUMMATIVE ASSESSMENT:

The summative examination would be carried out as per the Rules given in **POSTGRADUATE MEDICAL EDUCATION REGULATIONS, 2000.**

The Post Graduate examination will be in three parts:

1. Thesis:

Every post graduate student shall carry out work on an assigned research project under the guidance of a recognised Post Graduate Teacher, the result of which shall be written up and submitted in the form of a Thesis. Work for writing the Thesis is aimed at contributing to the development of a spirit of enquiry, besides exposing the post graduate student to the techniques of research, critical analysis, acquaintance with the latest advances in medical science and the manner of identifying and consulting available literature.

Thesis shall be submitted at least six months before the Theory and Clinical / Practical examination. The thesis shall be examined by a minimum of three examiners; one internal and two external examiners, who shall not be the examiners for Theory and Clinical examination. A post graduate student shall be allowed to appear for the Theory

and Practical/Clinical examination only after the acceptance of the Thesis by the examiners.

2. Theory

The examinations shall be organised on the basis of 'Grading' or 'Marking system' to evaluate and to certify post graduate student's level of knowledge, skill and competence at the end of the training. Obtaining a minimum of 50% marks in 'Theory' as well as 'Practical' separately shall be mandatory for passing examination as a whole. The examination for M.D./ MS shall be held at the end of 3rd academic year. An academic term shall mean six month's training period.

There shall be four theory papers.

Paper I: Gross Anatomy

Paper II: Embryology, Microscopic Anatomy and Genetics

Paper III: Neuroanatomy

Paper IV: Applied Human Anatomy and recent advances in anatomical Sciences

Theory Papers

Paper I: Gross Anatomy

- a). Gross Anatomy of whole human body i.e. upper limb, lower limb thorax, abdomen, pelvis, head and neck
- b). Method of preservation of human body and its parts, radiological anatomy, sectional anatomy.

Paper II: Embryology, Microscopic Anatomy and genetics

- a). General Principles of genetics, Cytogenetic as applicable to medicine and different genetic disorders, gene therapy.
- b). General Embryology, Systemic Embryology, methods of experimental embryology, clinically oriented embryology and teratology
- c). Histology (including fine structure) of tissues and organs of the body.
- d). Principles of light, transmission and scanning electron microscopy, confocal, virtual microscopy.

Paper III: Neuroanatomy

Neuroanatomy - gross and applied aspects

Paper IV: Applied Human Anatomy and recent advances in medical sciences

- (a) Clinical and applied aspect of Anatomy
- (b) Recent advances in the application of knowledge of anatomy on human

- body
- (c) Collection, maintenance and uses of stem cells
 - (d) Cryobanking
 - (e) Basics of principles of organ donation from recently dead bodies.

3. Practicals: spread over a minimum of 2 days

First Day Practical:

(a): Gross Anatomy

Dissection and related viva voce

(b): Histology

Spotting (10 spots) and viva voce

Techniques paraffin block making, section cutting. Staining (H and E stain) with related viva

Second Day Practical:

- a) Microteaching of a short topic to assess teaching skills
- b) A short synopsis of the thesis work should be presented by the post graduate student
- c) Grand viva including Gross anatomy, cross sectional anatomy, radiological Anatomy, Surface Anatomy, Embryology

Practical and Oral/Viva-Voce Examination

Practical Examination to be organized as per details given below:

Dissection on cadaver
Histology spotting
Histological techniques
Surface Marking
Radiology
Teaching ability
Thesis presentation

Oral/Viva-voce Examination

Grand viva

On dissected parts of the whole human body including nervous system, and Embryology models, teratology, skeletal system including short bones, embalming techniques and genetics, radiographs, MRI, CT & ultrasonographs.

Recommended reading:

Books (latest edition)

Gross Anatomy:

1. Susan Strandring: Gray's Anatomy: The anatomical basis of clinical practice, Churchill Livingstone Elsevier.
2. Dutta A.K. Human Anatomy vol. I-III Current Publisher.
3. Dutta A.K. Principle of General Anatomy. Current Publisher.
4. Romanes. Cunningham's Manual of Practical Anatomy vol. I-III, Oxford.
5. Keith and Moore Clinical Oriented Anatomy. Lippincot Williams and Wilkins.
6. R.S Snell. Clinical Anatomy by regions. Lippincot Williams and Wilkins.
7. J.V. Basmajin. Grant's Method of Anatomy. Williams and Wilkins.
8. R.J. Last. Anatomy Regional and Applied. Churchill Livingston.
10. Lee McGregar. Surgical Anatomy. K.M. Varghese.
11. A.G. R Deckeg, D.J du Pless Lee. Mc Gregor's Synopsis of Surgical Anatomy. Varghese Publishing House.
12. Snell. Clinical anatomy by regions. Lippincotts, Williams and Wilkins.
13. S. Chummy Sinnatanmy. Last's Anatomy Regional and Applied. Churchill Livingston.
14. Hollinshed W Henry. Anatomy for surgeons. Vol. I-III Lippincotts, Williams and Wilkins.
15. Vishram Singh. Clinical and Surgical Anatomy. Elsevier.
16. Vishram Singh. Textbook of general anatomy. Elsevier.
17. Frank H. Netter. Atlas of Human Anatomy. Saunders Elsevier.

Histology

1. Young B. and Heath J. Wheater's Functional Histology. Churchill Livingstone.
2. M.H. E Ross. Histology: A textbook and atlas. Williams and Wilkins.
3. V. Bharihoke. Text book of human histology. Delhi AITBS.
4. Difiore's. Atlas of histology with functional co-relation.
5. Bloom and Fawcett. Text book of histology.
6. Carlton's. Histology Technique.
7. E.C. Clayden. Practical of section cutting and staining.
8. D W Cormack. Ham's Histology. Lippincotts, Williams and Wilkins.
9. Bloom and Fawcett. Textbook of Histology.

Genetics

1. J.S Thompson and Thompson . Genetics in medicine. W.B. Saunders and Co. Philadelphia, London.
2. George Fraser and Oliver Mayo. Text book of Human Genetics. Blackwell Scientific Publications London, Oxford Edinburg, Melbourne.
3. Hann Sellwenger and Jame Simpson. Chromosomes of Man. Sparsher's International Medical Publications.

Embryology

1. Hamilton, Boyd. and Mossman. Human Embryology.
2. TW Sadler. Langman's Medical Embryology. Lippincotts, Williams and Wilikins.
3. Keith L Moore and T.V.N. Persaud. The Developing Human. Saunders.
4. Rani Kumar. Text book of embryology. I.K. International New Delhi

Neuroanatomy

1. Richard S. Snell. Clinical Neuroanatomy for Medical Students. Williams and Wilkins.
2. A. Parent. Carpenter's Human neuroanatomy. Williams and Wilkins.
3. Vishram Singh. Clinical Neuroanatomy. Elsevier.
4. A. K. Dutta. Essentials of Neuroanatomy. Current books international.
5. John A. Kiernan. Barr's the human nervous system, Lippincott, Williams and Wilkins.

Statistics

1. David E. Matthews and Vernon T. Farewell. Using and Understanding Medical Statistics. Karger.

Radiology

1. T.B. Moeller et.al. Sectional Anatomy CT and MRI Vol. I, II, III New York. Theme Stuttgart.
2. J.B. Walter et.al. Basic Atlas of Sectional Anatomy with correlated imaging. Saunders Elsevier.

Surface anatomy

1. SP John, Lumley editors. Surface Anatomy, The Anatomical basis of clinical examination. London: Churchill Livingstone.
2. A. Halim. and A.C. Das. Surface Anatomy Lucknow. ASI, KGMC.

Journals

03-05 international Journals and 02 national (all indexed) journals

Postgraduate Students Appraisal Form
Pre / Para /Clinical Disciplines

Name of the Department/Unit :

Name of the PG Student :

Period of Training : FROM.....TO.....

Sr. No.	PARTICULARS	Not Satisfactory			Satisfactory			More Than Satisfactory			Remarks
		1	2	3	4	5	6	7	8	9	
1.	Journal based / recent advances learning										
2.	Patient based /Laboratory or Skill based learning										
3.	Self directed learning and teaching										
4.	Departmental and interdepartmental learning activity										
5.	External and Outreach Activities / CMEs										
6.	Thesis / Research work										
7.	Log Book Maintenance										

Publications

Yes/ No

Remarks* _____

*REMARKS: Any significant positive or negative attributes of a postgraduate student to be mentioned. For score less than 4 in any category, remediation must be suggested. Individual feedback to postgraduate student is strongly recommended.

SIGNATURE of ASSESSEE

SIGNATURE OF CONSULTANT

SIGNATURE OF HOD

**NATIONAL MEDICAL COMMISSION
Postgraduate Medical Education Board**

D 11011/1/22/AC/Guidelines/22

Date: 02-11-2022

**GUIDELINES FOR COMPETENCY BASED
POSTGRADUATE TRAINING
PROGRAMME
FOR
M.D. IN PATHOLOGY**

National Medical Commission

GUIDELINES FOR COMPETENCY BASED POSTGRADUATE TRAINING PROGRAMME FOR MD IN PATHOLOGY

Preamble

The purpose of PG education is to create specialists who would provide high quality health care and advance the cause of science through research & training.

This programme is meant to standardize Pathology teaching at postgraduate level throughout the country in order to achieve uniformity in teaching and create suitable manpower with appropriate expertise. The postgraduate student in pathology should be sufficiently trained, professionally competent and confident in handling, and processing, and diagnosis related to histopathology (surgical pathology), cytopathology, and hematology with reasonable working knowledge in blood banking, laboratory medicine, medical statistics, and ancillary techniques with understanding of general principles and methodology.

The purpose of this document is to provide teachers and learners illustrative guidelines to achieve defined outcomes through learning and assessment. This document was prepared by various subject-content specialists. The Reconciliation Board cum Expert group of NMC has attempted to render uniformity without compromise to the purpose and content of the document. Compromise in purity of syntax has been made in order to preserve the purpose and content. This has necessitated retention of “domains of learning” under the heading “competencies”.

SUBJECT SPECIFIC LEARNING OBJECTIVES

At the end of the MD training programme in Pathology, the student should achieve the following goals:

1. Knowledge of Pathology

1.1. Make a diagnosis based on histopathology (surgical pathology) and cytopathology specimens, blood and bone marrow examination and various tests of Laboratory Medicine (clinical pathology, clinical biochemistry) as well as Blood Banking (Transfusion Medicine).

- 1.2. Interpret clinical and laboratory data with reasonable accuracy and prepare a succinct and lucid report
- 1.3. Compose reports following standard protocols including synoptic reporting
- 1.4. Interpret and correlate clinical and laboratory data so that clinical manifestations of diseases can be explained.
- 1.5. Advise on the selection of appropriate specimens and tests necessary to arrive at a diagnosis in a problematic case including molecular tests.
- 1.6. Correlate clinical and laboratory findings with pathology findings at autopsy, identify miscorrelations and the causes of death due to diseases (apart from purely metabolic causes).
- 1.7. Maintain quality control of all tests by being part of Internal Quality Control Monitoring program.
- 1.8. Make and record observations systematically and maintain accurate records of tests and their results for reasonable periods of time. Identify problems in the laboratory, offer solutions thereof and maintain a high order of quality control.
- 1.9. Should be aware of safe and effective disposal of laboratory waste and ensure minimization risk of exposure to infection and accidents to laboratory personnel.

2. Teaching and training

- 2.1. Should be able to teach Pathology to undergraduates, postgraduates, nurses and paramedical staff including laboratory personnel.
- 2.2. The postgraduate student should be able to teach effectively and assess undergraduate medical and allied health science students so that they become competent healthcare professionals.

3. Research

- 3.1. Plan, execute, analyze, and present research work independently or as part of a team.
- 3.2. The postgraduate student in Pathology should acquire knowledge and skills to be able to conduct a research project from the planning to the publication stage and become a life-long learner.

4. Professionalism, Ethics and Communication skills

- 4.1. The postgraduate student should learn and apply principles of professionalism, ethics, and effective communication in conduct of routine pathology services, research, and routine work.

SUBJECT SPECIFIC COMPETENCIES

A. COGNITIVE DOMAIN

A postgraduate student upon successfully qualifying the MD (Pathology) examination should have acquired the following BROAD theoretical competencies and should be:

- Capable of offering an accurate diagnostic opinion in a given clinical situation with an appropriate and relevant sample of tissue, blood, body fluid, etc. for the purpose of diagnosis.
- Conversant with the standard operating procedures of various laboratories including histopathology, cytopathology, hematology and laboratory medicine
- Able to teach and share his knowledge and competence with others. The student should be imparted training in teaching methods in the subject which may enable the student to take up teaching assignments in Medical Colleges/Institutes.
- Capable of pursuing clinical and laboratory-based research. He/she should be introduced to basic research methodology so that he/she can conduct fundamental and applied research.

At the end of the course, **the student should have acquired the following competencies as a diagnostician:**

Surgical pathology

- Be conversant in the histogenesis and pathophysiological processes associated with various diseases.
- Should be able to identify problems in the histopathology laboratory and offer viable solutions.
- Possess the background knowledge necessary for the evaluation and reporting of Surgical Pathology.
- Conversant with the various equipment used in the histopathology laboratory.
- Should have knowledge of automation and quality assurance in histopathology.

Cytopathology

- Possess the background knowledge necessary for the evaluation and reporting of Cytopathology.

- Demonstrate familiarity with, and guide clinical/radiology residents in keeping with the clinical information on the choice of site, collection, preservation, transport, type of preparation and method of obtaining various cytological specimens.
- Conversant with the various equipment used in the cytopathology laboratory.
- Should have knowledge of automation and quality assurance in cytopathology.

Hematology

- Demonstrate ability to utilize the principles of the practice of Hematology for the planning of tests, interpretation, and diagnosis of diseases of the blood and bone marrow.
- Conversant with the various equipment used in the hematology laboratory.
- Should have knowledge of automation and quality assurance in hematology.

Laboratory medicine

- Demonstrate familiarity with the normal range of values of the chemical content of body fluids, significance of altered values, and interpretation thereof.
- Possess knowledge of the following specialized organ function tests and relative utility and limitations of each and significance of altered values:
 - (i) Renal function test
 - (ii) Liver function test
 - (iii) Endocrine function test
 - (iv) Tests for malabsorption
- Principles, advantage and disadvantages, scope, and limitation of automation in laboratory.
- Learn the principle and methodology of quality control in the laboratory.

Transfusion medicine

- Possess knowledge of basic immunology, ABO and Rh groups, minor blood groups and their clinical significance, transfusion therapy, pre-transfusion testing, transfusion related infections, transfusion reactions and quality control in blood bank.

Autopsy pathology

- Conversant with the technique of autopsy.
- Possess sufficient understanding of the various disease processes so that meaningful clinico-pathological correlation can be made.

Immunopathology

- Demonstrate familiarity with current concepts of structure and function of the immune system, its aberrations, and mechanisms thereof.
- Demonstrate familiarity with the scope, principles, limitations, and interpretations of the results of ELISA techniques, HLA typing, immunofluorescence, and immunoelectrophoresis.

Immunohistochemistry and flow cytometry

- Demonstrate familiarity with the principles and procedures of performing immunohistochemistry including automation in procedure and interpretation.
- Demonstrate familiarity with the principles and procedures of performing flow cytometry.

Cytogenetics and Molecular biology

- Demonstrate familiarity with the principles of molecular biology especially related to the understanding of disease processes and its use in various diagnostic tests at least including but not limited to in-situ hybridization, polymerase chain reaction, Sanger Sequencing and Next generation sequencing.

Electron microscopy

- Demonstrate familiarity with the principles and techniques of electron microscopy and the working of the electron microscope.
- Demonstrate familiarity with the tissue processing and staining methods for electron microscopy, including immune-labelling techniques and use of semi-thin sections.

Enzyme histochemistry

- Demonstrate familiarity with the principles, use and interpretations of common enzyme histochemical procedures.

Quality Control

- Demonstrate familiarity with various quality control programmes running in the department, both internal and external quality.
- Demonstrate familiarity with inter and intra assay variations, batch variations, validation of chemicals and instruments.

Laboratory Safety and Good clinical lab practices

- Demonstrate familiarity with good lab practices and safety, record maintenance of capital equipment and consumables, purchase specifications, approximate costs of reagents and equipment, maintenance of store logbooks, etc.

Biomedical Waste Management

- Demonstrate familiarity with disposal methods for each specimen, reagents, instruments, autoclaving techniques, recycling of products and e-waste.

At the end of the course, **the student should have acquired the following competencies as a teacher:**

- Demonstrate familiarity with different modes, methods, and principles of teaching including microteaching.

At the end of the course, **the student should have acquired the following competencies as a researcher:**

- Conversant with the principles of basic and applied research methodology, literature search, study design, sample size estimation, selection of controls, and appropriate application of medical statistics.
- Possess knowledge about the methods of writing thesis and/or a research paper with the prescribed instructions, as expected of international standards.
- Conversant with the use of digital slide imaging, algorithms to evaluate findings in imaging, morphometry, and application of artificial intelligence.

B. AFFECTIVE DOMAIN

1. The student will show integrity, accountability, respect, compassion and dedicated patient care. The student will demonstrate a commitment to excellence and continuous professional development.
2. The student should demonstrate a commitment to ethical principles relating to providing patient care, confidentiality of patient information and informed consent.
3. The student should show sensitivity and responsiveness to patients' culture, age, gender and disabilities.
4. The student should demonstrate a commitment to ethical principles relating to research conduct and research publication.

C. PSYCHOMOTOR DOMAIN

1. Able to perform grossing of biopsy and surgical specimens including gross diagnosis and taking appropriate sections/ samples necessary for diagnosis, comprehensive staging, and ancillary testing.
2. Conversant in histopathology tissue processing techniques and troubleshooting, cutting of paraffin and frozen sections, making imprint smears, and staining, and immunohistochemistry.
3. Able to collect specimens by routinely performing non-invasive out-patient procedures such as venipuncture, finger-prick, fine needle aspiration of superficial lumps and bone-marrow aspirates, making smears and staining, and provide appropriate guidance to colleagues performing procedure such as a biopsy or an imaging guided biopsy including on-site microscopic assessment of specimen adequacy.
4. Perform an autopsy, dissect various organ complexes and display the gross findings.
5. Conversant with the function, handling, and routine care of equipment in the laboratory and quality assurance.
6. Able to teach and share his knowledge and competence with others. The student should be imparted training in teaching methods in the subject which may enable the student to take up teaching assignments in Medical Colleges/Institutes.
7. Able to pursue clinical and laboratory-based research. He/she should be introduced to basic research methodology so that he/she can independently conduct fundamental and applied research.

Syllabus

Course contents:

It is difficult to give a precise outline of the Course Contents for post graduate training. A postgraduate is supposed to acquire not only the professional competence of a well-trained specialist but also academic maturity, a capacity to reason and critically analyze scientific data as well as to keep himself abreast of the latest developments in the field of Pathology and related sciences. The study of Anatomic Pathology includes all aspects of Pathology as encompassed in the branches of General and Systemic Pathology. Only the broad outlines are provided.

A. COGNITIVE DOMAIN

A) General Pathology:

Normal cell and tissue structure and function:

- The changes in cellular structure and function in diseases.
- Causes of disease, its pathogenesis, reaction of cells, tissues, organ systems, and the body to various sub lethal and lethal injuries.
- Cellular adaptation, cell injury, and cell death.
- Mechanism, morphology and examples of cell injury, necrosis, apoptosis, autophagy, and newer forms of cell death including necroptosis and pyroptosis.
- Sub cellular and cellular responses and adaptation to injury.
- Intracellular and intercellular accumulations, pathological calcification, and cell aging.

Acute and chronic inflammation:

- Vascular and cellular events in acute inflammation, chemical mediators, outcome, and morphological patterns of acute inflammation.
- Chronic inflammation with special reference to granulomatous inflammation.
- Systemic effects and effects of deranged inflammation.
- Tissue renewal and repair: Regeneration healing and fibrosis.
- Control of normal cell proliferation and tissue growth, mechanism of tissue regeneration, repair by healing and fibrosis.
- Extracellular matrix and cell matrix interactions.

Hemodynamic disorders, thromboembolic disease, and shock:

- Edema, hyperemia, congestion, and hemorrhage.
- Normal Hemostasis, thrombosis, DIC, embolism, infarction, and shock.

Genetic Disorders

- Principles of genetics, normal karyotyping.
- Mutations, Mendelian disorders, disorders with multifactorial inheritance cytogenetic disorders involving autosomes and sex chromosomes.
- Single gene disorders with nonclassic inheritance.
- Diagnosis of genetic disorders involving molecular and genetic techniques.

Neoplasia

- Definition, nomenclature, and biology of tumor growth
- Molecular basis of cancer with special reference to carcinogenic agents and molecular basis of multistep carcinogenesis.
- Epidemiology and clinical features of tumors.

- Grading, staging and laboratory diagnosis of cancer.

Infectious Diseases

- Pathology and general principles of microbial pathogenesis, special techniques for diagnosing bacterial, fungal, parasitic, and viral infections.

Environmental and nutritional pathology

- Common environmental and occupational exposures leading on to diseases.
- Nutritional deficiencies and obesity related disorders.

Disease of Infancy and Childhood

- Congenital anomalies, birth injuries, diseases of neonates, inborn errors of metabolism, tumor, and tumor like lesions of infancy and childhood.

Immunopathology

- Innate immunity- Role of phagocytic cells, complement, mast cells & humoral mechanisms.
- Specific Acquired Immunity- Details about antibody production & action, Brief principles about memory, Ag specificity & vaccination.
- Cell involved in Immune response- T- Lymphocytes, B-lymphocytes, macrophages, dendritic cells, and natural-killer cells.
- Cytokines with details about their properties and functions.
- Structure and function of histocompatibility molecules and disease association.
- Disorders of the immune system.
- All hypersensitivity reactions.
- Autoimmune disorders with special reference to SLE, Rheumatoid arthritis, Sjogren's syndrome, systemic sclerosis, polyarteritis nodosa and other vasculitides, Mixed connective tissue disorders and inflammatory disorders.
- Immunodeficiency syndrome – Acquired with emphasis on AIDS.
- Amyloidosis including pathogenesis, special stains & clinical correlation.
- Transplant rejection in detail.
- Graft vs Host Disease.

B) Systemic Pathology:

The study of normal structure and function of various organ systems and the etiopathogenesis, gross and microscopic alterations of structure of these organ systems in disease and functional correlation with clinical features.

Blood vessels, lymphatic and veins

- Normal morphology, congenital anomalies, atherosclerosis, hypertensive vascular disease.
- Inflammatory and neoplastic diseases of all the vessels.

Heart

- Normal morphology, its blood supply and effect of aging on heart.
- Ischemic, Hypertensive, valvular, congenital heart diseases.
- Cardiomyopathies
- Myocardial disorders
- Pericardial diseases.
- Tumors of the heart.

Lungs and Mediastinum

- Congenital anomalies
- Obstructive and restrictive pulmonary diseases
- Diseases of vascular origin
- Infections of Lung
- Infections of Mediastinum
- Tumors of lung
- Lung transplantation
- Diseases of pleura
- Thymus – Developmental, autoimmune, and inflammatory disorder and tumors.

Head and Neck

- Oral cavity: - inflammatory disease, Preneoplastic lesions and tumors.
- Diseases of teeth and supporting structures.
- Upper airways and ear – congenital anomalies, infections, and tumors.
- Salivary glands – Infections autoimmune disorders and tumors.

Gastrointestinal Tract

- Congenital anomalies, infections, inflammatory and vascular disorders and tumors of esophagus, stomach, small and large intestines, appendix, and anal canal.
- Diseases of the peritoneum, Omentum and Mesentery Retroperitoneum.
- Inflammatory and neoplastic lesions.

Liver

- Normal morphology with general features of hepatic disease including LFTs.
- Infectious, autoimmune drug induced metabolic and circulatory disorders of liver.

- Hepatic diseases associated with pregnancy, neonates, organ and bone marrow transplantation.
- Liver transplantation pathology.
- Cysts, Nodules, and tumors of liver.

Biliary tract

- Congenital anomalies, injuries, Infection, inflammation, of Gallstones and tumors of gall bladder and extra hepatic bile ducts. Pancreas.
- Congenital anomalies, pancreatitis, and neoplasms of pancreas.

Kidney

- Clinical manifestations of renal diseases
- Congenital anomalies
- Diseases affecting glomeruli, tubules, interstitium and blood vessels.
- Cystic diseases of kidney
- Nephrolithiasis
- Tumors of kidney
- Kidney Transplant pathology

Lower urinary tract and male genital system

- Congenital anomalies, inflammation and tumors of bladder, ureter, urethra, penis, testis, epididymis, and Scrotum.
- Inflammation, enlargement, and tumors of prostate.

Female genital tract

- Physiology, cytology and histology of female genital tract, menstrual disorders, and hormonal abnormalities.
- Congenital anomalies, inflammation, preneoplastic and neoplastic lesions of vulva, vagina, cervix, uterus, fallopian tubes, ovaries and mesonephron.
- Gestational and placental disorders.

Breast

- Inflammations, benign epithelial lesions, and tumors of the breast.
- Diseases of male breast.

Endocrine System

- Normal hormonal levels and functions of all the endocrine glands.
- Hypo and hyperactivity of glands of endocrine system i.e., pituitary, thyroid, parathyroid, pancreas, adrenals, and pineal gland.

- Autoimmune diseases, inflammations and tumors affecting these glands,
- Neuroendocrine tumors,

Skin and Subcutaneous tissue

- Disorders of pigmentation and melanocytes,
- Inflammatory, vesiculobullous, and infectious disease,
- Proliferative lesions and Tumors of the epidermis, dermis, and skin appendage.

Musculoskeletal system

- Bone Modelling, growth, and development, genetic and acquired abnormalities in bone cells, matrix and structure, fractures, necrosis and infections of bones, tumors and tumor-like lesions,
- Joints: Arthritis, tumor, and tumor-like lesions.
- Soft tissue: Tumors and tumor-like lesions.

Peripheral nerves and skeletal muscles

- General reactions of motor units.
- Inflammatory, infectious, hereditary, metabolic, and traumatic neuropathies.
- Atrophy, dystrophy, myopathies of the skeletal muscles.
- Diseases of neuromuscular junction.
- Tumors of peripheral nerves and skeletal muscles.

Skull and Central Nervous System

- Degenerative, metabolic, toxic, demyelinating, infectious, cerebrovascular malformations, and traumatic injuries.
- Tumors.

Eye and Orbit

- Infections, inflammatory, congenital diseases and neoplasms of orbit, eyelid, conjunctiva sclera, uvea, cornea, retina, and optic nerves.

C) Hematology and Transfusion medicine

The study of Hematology includes all aspects of the diseases of the blood and bone marrow.

This would involve the study of the normal, and the causes of diseases and the changes thereof.

Biology of stem cell and Hematopoiesis

- Overview of stem cell biology and cellular biology of hematopoiesis.
- Transcription factors and humoral regulation in normal and malignant hematopoiesis.
- Interaction between hematopoietic stem cells, progenitor cell and stromal compartment of bone marrow.

- Stem cell homing & mobilization.

Erythroid maturation, differentiation, and abnormality

- Pathobiology of human erythrocyte & Hemoglobin Anemia.
- Approach to anemia in adults and children in: Clinical correlation & diagnostic modalities.
- Classification of anemias (Morphological, pathophysiological, and based on erythropoiesis i.e., proliferative vs non-proliferative).
- Iron deficiency anemia including iron metabolism and differential diagnosis from other microcytic hypochromic anemias.
- Disorder of iron metabolism including iron overload.
- Anemia of chronic disorders with special reference to infections, collagen vascular disorders, inflammation etc.
- Megaloblastic anemia and other causes of megaloblastosis.
- Definition, approach, and classification of hemolytic anemia.
- Lab diagnosis of Hemoglobin disorders and hereditary anemia like Thalassemia and related hemoglobinopathies, sickle cell anemia.
- Hemoglobin associated with altered Oxygen affinity.
- Red blood cell enzymopathy, membrane disorder, autoimmune hemolytic anemia, non-immune hemolytic anemia, paroxysmal nocturnal hemoglobinuria.
- Approach to Pancytopenia/ Cytopenia.
- Bone marrow failure syndrome.
- Porphyria.

WBC disorders, complement and immunoglobulin biology

- Normal granulopoiesis.
- Acquired and congenital disorders of phagocytosis (neutrophil, monocyte, eosinophil, and macrophages).
- Disorder of leukocyte number, function, and morphology.

Storage disorder

Hematological responses to Infections

- Viral disorders - Infectious mononucleosis, Hepatitis, and dengue.
- Parasitic infections - Malaria, Kala azar.

Hematological malignancies

- Conventional & molecular cytogenetic and immunohistochemical basis of hematological malignancies.

- Classification (WHO, ICC).
- Their basis and diagnostic approach to various hematological malignancies.
- Pathophysiology, prognostic factors, cytochemistry, cytogenetics of various leukemias.
- Pathophysiology and classification of MDS, MPN/MDS, myeloproliferative disorders.
- Pathophysiology of Non-Hodgkin's lymphoma, Clinical staging of Hodgkin's lymphoma.
- Role of molecular cytogenetics and immunohistochemistry in Hodgkin's and Non-Hodgkin's lymphoma and lymphoproliferative disorders.
- AIDS related and Transplant related lymphomas.
- Plasma cell dyscrasias and gammopathies.
- Mastocytosis.
- Role of chemotherapy and antineoplastic agents based on molecular mechanism of hematological malignancies, clinical use of hematopoietic growth factors.

Hematopoietic stem cell transplantation

- Role and indications of HST, immunodeficiency state, hematological Malignancies and Non-hematological disorders.
- Practical aspect of umbilical cord stem cells transplantation.
- Peripheral stem cell collection.
- Role of stem cell in tissue repair.
- Complications of Hematopoietic stem cell transplant.
- Gene therapy and genetic engineering.

Prenatal diagnosis of genetic hematological diseases

Hemostasis & Thrombosis

- Megakaryocyte and platelet structure.
- Molecular basis of platelet function, activation.
- Role of blood vessel, coagulation system and fibrinolytic system in hemostasis.
- Clinical and lab evaluation of bleeding and coagulation disorders.
- Clinical & diagnostic aspects of factor deficiencies including hemophilia, von Willebrand disease, DIC, Vitamin K deficiency.
- Thrombotic and non-thrombotic purpura.
- Hereditary and acquired platelet disorders and its management.
- Thrombophilia (Inherited & acquired).
- Lab evaluation and management of hypercoagulable states.

Human blood group antigen and antibody and Immuno-hematology

- Selection of donor and screening..
- Principle, indication and storage of red blood cells, WBC, platelet, and plasma transfusion.
- Various methods of component separation and plasma derivatives with special reference to Fresh frozen plasma, cryo-precipitates, platelet concentrate, single donor plasma, albumin, and Immunoglobulin.
- Graft Rejection, GVH diseases, Transfusion Reactions, Blood grouping & cross matching.
- Blood bank audit.
- Apheresis

Hematological manifestations of systemic diseases

- Liver disorders, renal disorders, infections, cancers, parasitic diseases, AIDS, pregnancy, and surgical patients.

Spleen and its disorders

D) Laboratory Medicine (Clinical Pathology including Parasitology)

- Principles of testing, indications, values with ranges in normal and diseased states in relation to:
 - Liver function tests
 - Renal function tests
 - Endocrine function tests
 - Body fluid analysis including stool, urine, semen, CSF, etc.
- Principles of laboratory automation, trouble shooting, and quality assurance.

D) Special techniques

The student is expected to acquire a general acquaintance of techniques and principles and to interpret data in the following fields:

- Immunopathology,
- Electron microscopy,
- Histochemistry,
- Immunohistochemistry,
- Cytogenetics and in-situ hybridization,
- Molecular Biology,
- Digital Pathology and image analysis,

- Maintenance of records,
- Information retrieval, use of Computer and Internet in medicine.

E) Instrumentation and automation

- Principles, indications, working, maintenance, and troubleshooting of equipment used in various laboratories:
 - Histopathology laboratory – Histopathology tissue processor, microtome, water bath, embedding station, Stainer, IHC Stainer, ultramicrotome, etc.
 - Microscopes – Immunofluorescence, FISH, Confocal, Electron, etc.
 - Cytopathology Laboratory – Centrifuge, Cyto centrifuge, Cytospin apparatus, liquid-based cytology, etc.
 - Hematology Laboratory – automated cell counter, flow cytometer, coagulometer, HPLC, Electrophoresis apparatus, immunoblot, etc.
 - Clinical Pathology – Photoelectric colorimeter, Spectrophotometer, pH meter, Centrifuge, Electrophoresis apparatus, ELISA Reader, chemiluminescence, etc.
 - Digital pathology – Whole slide scanners
 - Molecular pathology – PCR, Sanger sequencer, NGS sequencers, etc.
- Automation in Pathology.
- Good lab practices and safety, record maintenance of capital equipment and consumables, purchase specifications, approximate costs of reagents and equipment, maintenance of store logbooks, etc.

F) Quality assurance program

- Internal and external quality assurance methods.
- Intra assay variations, batch variations, validation of chemicals and instruments.

G) Establishment Act and Rules and regulations formed by Govt. or regulatory bodies

H) Biomedical Waste management

- Disposal methods for each specimen, reagents, instruments, autoclaving techniques, recycling of products and e-waste.

I) Biostatistics, Research Methodology and Clinical Epidemiology

J) Ethics and Medico legal aspects relevant to Pathology

K) Current topics and recent advances in pathology

B. PSYCHOMOTOR DOMAIN

Demonstrate following predominant Psychomotor domain competencies		
Sr. No.	Competency	Perform under supervision/ perform independently/ Observation only
I.	HISTOPATHOLOGY (SURGICAL PATHOLOGY)	
1.	Given the clinical and operative data, identify and systematically and accurately describe the chief gross anatomic alterations in the surgically removed specimens and be able to correctly diagnose common lesions received on an average day from the surgical service of an average teaching hospital	Independently
2.	Perform a systematic gross examination of the tissues including the taking of appropriate tissue sections and in special cases as in intestinal mucosal biopsies, muscle biopsies and nerve biopsies, demonstrate the orientation of tissues in paraffin blocks.	Independently
3.	Identify and systematically and accurately describe the chief histomorphological alterations in the tissue received in the surgical pathology service. He/she should also correctly interpret and correlate with the clinical data to diagnose routine surgical material received on an average day.	Independently
4.	Identify common problems in histopathology processing techniques (poor fixation, delayed fixation, poor staining, etc.,) including automated tissue processing machine troubleshooting and rectify common problems	Independently
5.	Operate and maintain common equipment in the histopathology laboratory such as microtome, water bath, cryostat, tissue processor, auto Stainer, etc.	Perform under supervision
6.	Process a tissue, make a paraffin block and cut sections of good quality on a rotary microtome	Perform under supervision
7.	Stain paraffin sections with hematoxylin and eosin stain and common special stains needed for diagnosis	Independently
8.	Cut a frozen section, stain and interpret the slide in correlation with the clinical data provided	Independently

9.	Standardize and validate new antibodies for immunohistochemistry with understanding of controls, clones, and dilutions	Independently
10.	Perform immunohistochemistry on paraffin sections using manual method	Independently
11.	Identify common problems in immunohistochemistry procedure (artifacts, inadequate retrieval, section floating, IHC failure, etc.) and rectify such problems	Independently
12.	Decide on the appropriate immunohistochemical panels for diagnosis, prognosis and predictive purposes in common disease conditions based on standard recommendations and interpret their results	Independently
13.	Write histopathology reports, including synoptic reports, wherever needed, following protocols and international standards. The reports should be succinct and lucid, with clinical notes and advice, as necessary.	Independently
II	CYTOPATHOLOGY	
1.	Perform fine needle aspiration of superficial lumps and make good quality smears including collection of material for cell block preparation and decide on the type of fixative and stain in a given case	Independently
2.	Prepare and stain good quality smears for cytopathological examination	Independently
3.	Provide appropriate guidance to colleagues performing procedure such as a biopsy or an imaging guided biopsy including on-site microscopic assessment of specimen adequacy.	Independently
4.	Decide on the technique of collection, preservation, transport and concentration of various exfoliative cytology specimens (such as filters, centrifuge, liquid-based cytology, cytospin, etc.)	Independently
5.	Perform on-site adequacy assessment in image guided sampling procedures and decide on sample triage for routine diagnosis (type of preparation, stain, etc.) and ancillary tests including microbiological and molecular tests	Independently
6.	Diagnose common cases received in a routine cytopathology laboratory and categorize them into negative, inconclusive and positive, using the correct technique of screening and dotting the slides	Independently

	for suspicious cells, correctly identify the type of tumor, if present, and the presence of organisms, fungi and parasites, if present	
7.	Perform preparations (cytospin smears, liquid-based cytology, cell blocks, etc.) of common cytological samples using equipment such as centrifuge, cytocentrifuge and liquid based cytology apparatus	Observation only
III	HEMATOLOGY	
1.	Perform venipuncture for peripheral blood collection and decide on appropriate collection tubes, storage, and anticoagulant based on indication	Independently
2.	Prepare good quality peripheral blood smears, stain and report peripheral blood counts and other findings including reticulocyte and platelet counts on cell counter and manually	Independently
3.	Perform bone marrow aspirates and biopsy, prepare good quality smears and imprints	Perform under supervision
4.	Perform bone marrow aspirate staining including stain for iron	Independently
5.	Perform cytochemical characterization of leukemia with special stains on bone marrow aspirates	Perform under supervision
6.	Perform and interpret coagulation profile including PT, APTT and FDP	Independently
7.	Perform and interpret sickling test and osmotic fragility test	Independently
8.	Describe accurately the morphologic findings in the peripheral and bone marrow smears, identifying and quantitating the morphologic abnormalities in disease states and arriving at a correct diagnosis in at least common cases referred to the Hematology clinic, given the relevant clinical data	Independently
9.	Given the clinical data, interpret the results of <ul style="list-style-type: none"> i. Red cell indices ii. Plasma hemoglobin iii. Hemosiderin in urine iv. Hemolytic anemia profile including HPLC, Hb electrophoresis etc. v. Hemoglobin and serum protein electrophoresis vi. Clotting time and other point of care tests for bleeding 	Independently

	<ul style="list-style-type: none"> vii. G6PD enzyme estimation viii. Platelet function tests including platelet aggregation and adhesion and PF3 release ix. Russell's viper venom time (RVVT) x. Coagulation Factor assays xi. Serum Fibrinogen xii. Screening for coagulation factor inhibitor, Bethesda Assay, xiii. Fibrin Degradation Products (FDP), D-Dimers xiv. Monitoring of anti-coagulant therapy xv. Thrombophilia profile (Lupus anticoagulant (LAC), Anticardiolipin Antibody (ACA), Activated Protein C Resistance (APCR), Protein C (Pr C), Protein S (Pr S) and Antithrombin III (AT III)) xvi. Serum ferritin, Serum iron and total iron binding capacity 	
10.	Interpret flow cytometry findings in the immunophenotyping of leukemia, CD34 enumeration, CD 3/CD 19 enumeration, PNH work up, etc.	Independently
11.	Interpret results of cytogenetics and molecular diagnostics in the work up of hematological diseases	Independently
12.	Prepare samples as appropriate for the indication, and operate equipment such as automated cell counter, flow cytometry, coagulometers, HPLC and electrophoresis apparatus	Observation only
IV	LABORATORY MEDICINE	
1.	Plan a strategy of laboratory investigation of a given case, given the relevant clinical history and physical findings in a logical sequence, with a rational explanation of each step; be able to correctly interpret the laboratory data of such studies, and discuss their significance with a view to arrive at a diagnosis.	Independently
2.	Perform urine analysis including physical, chemical and microscopic, examination of the sediment as well as by Dipstick methods.	Independently
3.	Perform macroscopic and microscopic examination of feces and identify the ova and cysts of common parasites.	Independently

4.	Perform a complete examination: physical, chemical and cell content of Cerebrospinal Fluid (C.S.F), pleural and peritoneal fluid	Independently
5.	Perform semen analysis and interpret results in the context of clinical and hormone findings	Independently
6.	Perform quantitative estimation of blood/serum by automated techniques for common biochemical tests	Independently
7.	Prepare standard solutions and reagents relevant to common biochemical tests including the preparation of normal solution, molar solution and buffers	Independently
8.	Interpret and report common laboratory biochemical tests (LFT, KFT, endocrine function tests) with understanding of clinical implications	Independently
9.	Operate, maintain and troubleshoot common equipment used such as photoelectric colorimeter, Spectrophotometer, pH meter, Centrifuge, Electrophoresis apparatus, ELISA Reader, PCR, chemiluminescence, etc.	Perform under supervision
V	TRANSFUSION MEDICINE	
1.	Perform selection and bleeding of donors, ABO and Rh grouping and cross match, antibody screening and titer, selection of blood for exchange transfusion	Independently
2.	Resolve ABO grouping problems and outline measures for investigation of transfusion medicine	Independently
3.	Perform and interpret anti-globulin test in antenatal and neonatal work up	Independently
4.	Prepare blood components such as cryoprecipitates, platelet concentrates, fresh frozen plasma, single donor plasma, red blood cell concentrates, etc. and test blood for presence of pathogens including HBV, HCV, HIV, VDRL, Malaria, etc.	Observation only
VI	AUTOPSY	
1.	Perform an autopsy, dissect various organ complexes, and display the gross findings (Note: An improvised autopsy may also be arranged in places where full autopsy is not possible. Relevant organs from wet specimens in the museum with appropriate clinical history may be arranged for a detailed description and diagnosis. At least ten such	Independently (see Note)

	improvised autopsies may be discussed by each candidate during the entire duration of the course)	
2.	Provide Provisional and Final Anatomic Diagnosis report, major findings correctly and systematically at autopsy, and the Autopsy Protocol as per prescribed instructions.	Independently
VII	MOLECULAR BIOLOGY	
1.	Interpret results of Polymerase Chain Reaction (PCR), real time PCR, Sanger Sequencing in a given clinical context.	Independently
2.	Interpret results of in-situ hybridization (fluorescent and chromogenic) in a given clinical context	Independently
3.	Prepare sample by appropriate methods and perform Polymerase Chain Reaction (PCR), real time PCR, Sanger Sequencing, and in-situ hybridization including troubleshooting	Observation only
VIII	IMMUNOPATHOLOGY	
1.	Interpret direct/ indirect immunofluorescence results in the context of common diseases of the skin, medical renal diseases and autoimmune diseases	Independently
2.	Prepare sample by appropriate methods and perform indirect immunofluorescence on a frozen section from skin/ renal biopsy	Perform under supervision
IX	ELECTRON MICROSCOPY	
1.	Interpret transmission electron microscopy results in common non-neoplastic and neoplastic diseases	Independently
2.	Prepare specimen by appropriate methods and process tissue for electron microscopy, interpret semi-thin sections and view ultra-thin sections under electron microscope	Observation only
X.	DIGITAL PATHOLOGY	
1.	Navigate and annotate whole slide scanned images	Independently
2.	Select and scan slides for digitalization and perform basic image analysis functions such as length measurements, enumeration, etc.	Observation only
XI.	TEACHING	
1.	Demonstrate different methods of teaching-learning and assessments	Independently
2.	Engage and teach undergraduates and paramedical staff in the form of small group teaching and demonstrations	Independently

3.	Engage in peer teaching in the form of presenting seminars and journal clubs and be able to use different modes of teaching including PowerPoint projections and charts	Independently
XII.	RESEARCH	
1.	Write the thesis (and/or a scientific paper) in accordance with the prescribed instructions, as expected of international standards	Independently

TEACHING AND LEARNING METHODS

General principles

Acquisition of competencies being the keystone of doctoral medical education, such training should be skills oriented. Learning in the program, essentially autonomous and self-directed, and emanating from academic and clinical work, shall also include assisted learning. The formal sessions are meant to supplement this core effort.

All students joining the postgraduate (PG) courses shall work as full-time (junior) residents/demonstrators during the period of training, attending not less than 80% of the training activity during the calendar year, and participating in all assignments and facets of the educational process. They shall maintain a logbook for recording the training they have undergone, and details of the procedures done during laboratory and clinical postings in real time. Maintenance of e-records of such procedures is encouraged.

The three-year training programme for the MD degree may be arranged in the form of postings to different assignments/laboratories for specified periods as outlined below. The period of such assignments/postings is recommended for 36 months with breaks only for examinations and mandatory postings. Posting schedules may be modified depending on needs, feasibility and exigencies. For facilities not available in the parent institution as well as for additional knowledge and skill, extramural postings may be undertaken. Departments may vary the postings slightly based on the clinical profile of the hospital, within the time period bands given below, however at least the lower limit for each of the four main components of the course must be covered during postings.

Posting schedule is given below:

S. No	Section/ Subject	Duration in months
(i)	Surgical Pathology, Autopsy, Immunohistochemistry	11-16
(ii)	Hematology, Laboratory Medicine, and Blood bank	8-10
(iii)	Cytopathology	6-9
(iv)	Basic Sciences, Immunopathology, Cytogenetics, Electron microscopy, Molecular Biology etc. and Research Techniques including Thesis	2-6
	Total	36 (including exam)

Teaching-Learning methods

This should include a judicious mix of demonstrations, symposia, journal clubs, clinical meetings, seminars, small group discussion, case-based learning, simulation-based teaching, self-directed learning, integrated learning, interdepartmental meetings, and any other collaborative activity with the allied departments. Methods with exposure to the applied aspects of the subject relevant to basic/clinical sciences should also be used. **The suggested examples of teaching-learning methods are given below but are not limited to these. The frequency of various below mentioned teaching-learning methods can vary based on the subject's requirements, competencies, workload and overall working schedule in the concerned subject. The Pathology resident is expected to sit in reporting every day, having seen the slides the previous day with written descriptions, which should be evaluated daily by the reporting faculty. This is the mainstay of training in all disciplines of Pathology.**

A. Lectures: Didactic lectures should be used sparingly. A minimum of 10 lectures per year in the concerned PG department is suggested. Topics to be selected as per subject requirements. All postgraduate trainees will be required to attend these lectures. Lectures can cover topics such as:

1. Subject related important topics as per specialty requirement
2. Recent advances
3. Research methodology and biostatistics
4. Salient features of Undergraduate/Postgraduate medical curriculum
5. Teaching and assessment methodology.

Topic numbers 3, 4, 5 can be done during research methodology/biostatistics and medical education workshops in the institute.

B. Journal club: Minimum of once in 1-2 weeks is suggested.

Topics will include presentation and critical appraisal of original research papers published in peer reviewed indexed journals. The presenter(s) shall be assessed by faculty and grades recorded in the logbook.

C. Student Seminar: Minimum of once every 1-2 weeks is suggested.

Important topics should be selected as per subject requirements and allotted for in-depth study by a postgraduate student. A teacher should be allocated for each seminar as faculty moderator to help the student prepare the topic well. It should aim at comprehensive evidence-based review of the topic. The student should be graded by the faculty and peers.

D. Student Symposium: Minimum of once every 3 months.

A broad topic of significance should be selected, and each part shall be dealt by one postgraduate student. A teacher moderator should be allocated for each symposium and moderator should track the growth of students. The symposium should aim at an evidence-based exhaustive review of the topic. All participating postgraduates should be graded by the faculty and peers.

E. Laboratory work/ Interactive slide and gross sessions: Minimum - once every 1-2 weeks.

Laboratory work, slide and gross specimen teaching sessions should be coordinated and guided by faculty from the department. Various methods like case-based discussions, oral or written quiz, etc. are to be used. Faculty from the department should participate in moderating the teaching-learning sessions.

F. Interdepartmental colloquium

Faculty and students must attend monthly meetings between the main Department and other department/s on topics of current/common interest or clinical cases. This includes institutional activities such as clinical combined rounds (CCR), clinic-pathological correlation conferences (CPC), and departmental activities like autopsy conferences.

G. a. Rotational clinical / community / institutional postings

Depending on local institutional policy and the subject specialty needs, postgraduate trainees may be posted in relevant departments/ units/ institutions. The aim would be to acquire more in-depth knowledge as applicable to the concerned specialty. Postings would be rotated

between various units/departments and details to be included in the specialty-based Guidelines. Few examples are listed below:

- Laboratory-based specialty units/departments e.g. Biochemistry / Microbiology/ Infection control unit/Laboratory Medicine, Hematology, Blood bank, Transplantation Immunology, Forensic Medicine, Proteomics, etc.
- Medical Education Unit (MEU) or Department of Medical Education (DOME): optional

G. b. Posting under “District Residency Programme” (DRP):

All postgraduate students pursuing MS/MS in broad specialties in all Medical Colleges/Institutions shall undergo a compulsory rotation of three months in District Hospitals/District Health System as a part of the course curriculum, as per the Postgraduate Medical Education (Amendment) Regulations (2020). Such rotation shall take place in the 3rd or 4th or 5th semester of the Postgraduate programme and the rotation shall be termed as “District Residency Programme” and the PG medical student undergoing training shall be termed as “District Resident”.

Every posting should have its defined learning objectives. It is recommended that the departments draw up objectives and guidelines for every posting offered in conjunction with the collaborating department/s or unit/s. This will ensure that students acquire expected competencies and are not considered as an additional helping hand for the department / unit in which they are posted. The PG student must be tagged along with those of other relevant departments for bedside case discussion/basic science exercises as needed, under the guidance of an assigned faculty.

Opportunities to present and discuss infectious disease cases through bedside discussion and ward/grand rounds with specialists / clinicians in different hospital settings must be scheduled to address antimicrobial resistance issues and strategies to deal with it.

H. Teaching research skills

Writing a thesis should be used for inculcating research knowledge and skills. All postgraduate students shall conduct a research project of sufficient depth to be presented to the University as a postgraduate thesis under the supervision of an eligible faculty member

of the department as guide and one or more co-guides who may be from the same or other departments.

In addition to the thesis project, every postgraduate trainee shall participate in at least one additional research project that may be started or already ongoing in the department. It is preferable that this project will be in an area different from the thesis work. For instance, if a clinical research project is taken up as thesis work, the additional project may deal with community/field/laboratory work. Diversity of knowledge and skills can thereby be reinforced.

I. Training in teaching skills

MEU/DOME should train PG students in education methodologies and assessment techniques. The PG students shall conduct UG classes in various courses and a faculty shall observe and provide feedback on the teaching skills of the student.

J. Logbook

During the training period, the postgraduate student should maintain a Logbook indicating the duration of the postings/work done in Wards, OPDs, Casualty and other areas of posting. This should indicate the procedures assisted and performed and the teaching sessions attended. The logbook entries must be done in real time. The logbook is thus a record of various activities by the student like: (1) Overall participation & performance, (2) attendance, (3) participation in sessions, (4) record of completion of pre-determined activities, and (5) acquisition of selected competencies.

The purpose of the Logbook is to:

- a) help maintain a record of the work done during training,
- b) enable Faculty/Consultants to have direct information about the work done and intervene, if necessary,
- c) provide feedback and assess the progress of learning with experience gained periodically.

The Logbook should be used in the internal assessment of the student, should be checked and assessed periodically by the faculty members imparting the training. The PG students will be required to produce completed logbook in original at the time of final practical examination. It should be signed by the Head of the Department. A proficiency certificate from the Head

of Department regarding the clinical competence and skillful performance of procedures by the student will be submitted by the PG student at the time of the examination.

The PG students shall be trained to reflect and record their reflections in logbook particularly of the critical incidents. Components of good teaching practices must be assessed in all academic activity conducted by the PG student and at least two sessions dedicated for assessment of teaching skills must be conducted every year of the PG program. The teaching faculty are referred to the MCI Logbook Guidelines uploaded on the Website.

K. Course in Research Methodology

All postgraduate students shall complete an online course in Research Methodology within six months of the commencement of the batch and generate the online certificate on successful completion of the course.

Other aspects

- The Postgraduate trainees must participate in the teaching and training program of undergraduate students and interns attending the department.
- Trainees shall attend accredited scientific meetings (CME, symposia, and conferences) at least once a year.
- Department shall encourage e-learning activities.
- The Postgraduate trainees should undergo training in Basic Cardiac Life Support (BCLS) and Advanced Cardiac Life Support (ACLS).
- The Postgraduate trainees must undergo training in information technology and use of computers.

During the training program, patient safety is of paramount importance; therefore, relevant clinical skills are to be learnt initially on the models, later to be performed under supervision followed by independent performance. For this purpose, provision of skills laboratories in medical colleges is mandatory.

ASSESSMENT

FORMATIVE ASSESSMENT, i.e., assessment to improve learning

Formative assessment should be continual and should assess medical knowledge, patient care, procedural & academic skills, interpersonal skills, professionalism, self-directed learning and ability to practice in the system.

General Principles

Internal Assessment should be frequent, cover all domains of learning and used to provide feedback to improve learning; it should also cover professionalism and communication skills. The Internal Assessment should be conducted in theory and practical/clinical examination, should be frequent, cover all domains of learning and used to provide feedback to improve learning; it should also cover professionalism and communication skills.

Quarterly assessment during the MD training should be based on:

- Case presentation, case work up, case handling/management : once a week
- Laboratory performance : twice a week
- Journal club : once a week
- Seminar : once a fortnight
- Case discussions : once a fortnight/month
- Interdepartmental case or seminar : once a month

Note: These sessions may be organized and recorded as an institutional activity for all postgraduates.

- Attendance at Scientific meetings, CME programmes (at least 02 each)

The student to be assessed periodically as per categories listed in appropriate (non-clinical/clinical) postgraduate student appraisal form (Annexure I).

SUMMATIVE ASSESSMENT, i.e., assessment at the end of training

Essential pre-requisites for appearing for examination include:

1. **Logbook** of work done during the training period including rotation postings, departmental presentations, and internal assessment reports should be submitted.

2. At least **two presentations** at state/national level conference. One paper (thesis or non-thesis related work) should be published /accepted/publication draft in an indexed journal.

The summative examination would be carried out as per the Rules given in the latest POSTGRADUATE MEDICAL EDUCATION REGULATIONS. The theory examination shall be held in advance before the Clinical and Practical examination, so that the answer books can be assessed and evaluated before the commencement of the clinical/Practical and Oral examination.

The postgraduate examination shall be in three parts:

1. **Thesis**

Thesis shall be submitted at least six months before the Theory and Clinical / Practical examination. The thesis shall be examined by a minimum of three examiners; one internal and two external examiners, who shall not be the examiners for Theory and Clinical examination. A post graduate student in broad specialty shall be allowed to appear for the Theory and Practical/Clinical examination only after the acceptance of the Thesis by the examiners.

2. **Theory examination**

The examinations shall be organized based on 'Grading' or 'Marking system' to evaluate and to certify post graduate student's level of knowledge, skill, and competence at the end of the training, as given in the latest POSTGRADUATE MEDICAL EDUCATION REGULATIONS. Obtaining a minimum of 50% marks in 'Theory' as well as 'Practical' separately shall be mandatory for passing examination. The examination for M.D./ M.S shall be held at the end of 3rd academic year.

There shall be four theory papers (as per PG Regulations).

Paper I: Basic sciences as applied to the subject (general pathology, pathophysiology, immunopathology, and molecular biology).

Paper II: (Systemic pathology – surgical and cytopathology).

Paper III: (Hematology, transfusion medicine and laboratory medicine including instrumentation and quality control).

Paper IV: Recent advances in the subject.

The papers should have ideally one (01) structured long answer question which will evaluate comprehensive in-depth knowledge and 6-8 short answer questions.

3. Practical/clinical and Oral/viva voce examination

Practical examination

Practical examination should be spread at least over **two** days for each student and include various major components of the syllabus focusing mainly on the psychomotor domain.

Oral/Viva voce examination on defined areas should be conducted by each examiner separately. Oral examination shall be comprehensive enough to test the post graduate student's overall knowledge of the subject focusing on psychomotor and affective domain.

The final clinical examination in broad specialty clinical subjects should include:

- Cases pertaining to major systems (e.g., one long case and three short cases),
- Stations for laboratory, procedural and communication skills,
- Logbook Records and reports of day-to-day observation during the training,
- It is emphasized that Oral/viva voce examination shall be comprehensive enough to test the post graduate student's overall knowledge of the subject.

The practical examination in Pathology should follow general guidelines outlined below which may be modified according to local university guidelines and should be spread over at least two days. The following marks distribution is suggested:

Practical 500 marks (including 100 marks for internal assessment)

Section I: Histopathology: 150 marks

- Slides (12-15)
- Grossing/autopsy
- Long case (write a full description with clinical information provided) and/or 2 biopsy cases with ancillary tests reporting (written work only, no viva)

Section II: Cytopathology and histo/cyto techniques: 80 marks

- Slides (5-8)
- Histo/Cyto techniques
- Special stain exercise

- Immunopathology, OSPE, EM

Section III: Hematology, transfusion medicine and clinical pathology: 120 marks

- Slides
- Exercises
- Case study
- Blood bank
- Clinical pathology exercises and OSPE

Section IV: Viva, basic sciences, and communication skills: 50 marks

- Pedagogy/thesis presentation
- Oral viva
- Basic Sciences

Details of exercises in individual sections are given below:

I. Clinical Pathology:

- Discussion of a clinical case history.
- Plan relevant investigations of the above case and interpret the biochemistry findings.
- Two investigations should be performed including at least one clinical pathology exercise like CSF, pleural tap etc. analysis and complete urinalysis.

II. Haematology:

- Discuss hematology cases given the relevant history. Plan relevant investigations.
- Perform complete hemogram and at least two tests preferably including one coagulation exercise.
- Identify electrophoresis strips, osmotic fragility charts etc., interpretation of data from auto analyzers, HPLC and flow cytometry.
- Examine, report, and discuss around ten cases given the history and relevant blood smears and/or bone marrow aspirate smears and bone marrow biopsy interpretation.

III. Transfusion Medicine:

- Perform blood grouping
- Perform the necessary exercise like cross matching.
- Coomb's test, gel cards interpretation.

IV. Histopathology and cytopathology:

- Examine, report, and discuss 12-15 cases histopathology and 5-8 cytopathology cases, given the relevant history and slides.
- Perform a Hematoxylin and Eosin stain and any special stain on a paraffin section. Should be conversant with histopathology techniques including cryostat.
- Long case (write a full description with clinical information provided) and/or 2 biopsy cases with ancillary tests reporting

V. Autopsy:

- Given a case history and relevant organs (with or without slides), give a list of anatomical diagnosis in an autopsy case.

VI. Gross Pathology

- Describe findings of gross specimens, give diagnosis, and identify the sections to be processed. The post graduate student should perform grossing in front of the examiners for evaluation.

VII. Basic Sciences:

- 10-15 spots based on basic sciences be included
- Identify electron micrographs
- Identify gels, results of PCR, immunological tests including interpretation of Immunofluorescence pictures, etc.
- Identify histochemical and immuno-histochemistry stains

VIII. Teaching exercise

- Teach on a small topic for about 10 min or present dissertation and research
- General Viva-Voce (Grand Viva) – structured viva may be done separately or combined with above exercises

Recommended Reading:

Books (latest edition)

1. Histology for Pathologists. Stephen S. Sternberg (Ed), Raven Press, New York.
2. Robbin's Pathologic Basis of Disease Ramzi S.Cotran, Vinay Kumar, Stanley L Robbins WB Saunders Co., Philadelphia.
3. Ackerman's Surgical Pathology. Juan Rosai Mosby. St. Louis.
4. Diagnostic Surgical Pathology. Stephen S Sternberg. Lippincott, William Wilkins. Philadelphia.

5. Diagnostic Histopathology of Tumours. Christopher DM Fletcher (Ed). Churchill Livingstone. Edinburgh.
6. Manual & Atlas of Fine Needle Aspiration Cytology. Svante R Orell, et al London.
7. Theory and Practice of Histological Techniques, Bancroft JD, Stevens A, Turner DR, Churchill Livingstone, Edinburgh.
8. Diagnostic Cytology and its Histopathologic Basis, Koss LG, J.B. Lippincott, Philadelphia.
9. Comprehensive Cytopathology, Bibbo M, W.B. Saunders Co., Philadelphia.
10. Wintrobe's Clinical Hematology, Lee GR, Foerster J, Lupeus J, Paraskevas F, Gveer JP, Rodgers GN, Williams & Wilkins, Baltimore.
11. Atlas and Text of Hematology 4th edition. Singh T. Avichal Publishing Company.
12. Dacie and Lewis Practical Hematology, Bain BJ, Bates I, Laffan MA. Elsevier.
13. Bone Marrow Pathology, Bain BJ, Clark DM, Lampert IA, Blackwell Science, Oxford.
14. Henry's clinical diagnosis and management by laboratory methods
15. WHO classification of tumors. IARC Lyon.

Journals

03-05 international Journals and 02 national (all indexed) journals.

Student appraisal form for broad specialty non-clinical disciplines											
	Elements	Less than Satisfactory			Satisfactory			More than satisfactory			Comments
		1	2	3	4	5	6	7	8	9	
1	Scholastic aptitude and learning										
1.1	Has knowledge appropriate for level of training										
1.2	Participation and contribution to learning activity (e.g., Journal Club, Seminars, CME etc)										
1.3	Conduct of research and other scholarly activity assigned (e.g Posters, publications etc)										
1.4	Documentation of acquisition of competence (eg Log book)										
1.5	Performance in work based assessments										
1.6	Self-directed Learning										
2	Work related to training										
2.1	Practical skills that are appropriate for the level of training										
2.2	Respect for processes and procedures in the work space										
2.3	Ability to work with other members of the team										
2.4	Participation and compliance with the quality improvement process at the work environment										

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