



SARDAR PATEL UNIVERSITY
University Road P. B. 10
Vallabh Vidhyanagar-388120 (Gujarat)
NAAC accredited with Grade 'A'
(10-01-2023 to 09-01-2028)

Phone: 0692-226808/85; Email: exam_spu@spuvvn.edu; Website: www.spuvvn.edu

The Government of India notified the **National Commission for Allied and Healthcare Professions (NCAHP) Act on March 28, 2021**. As a common regulatory body, the NCAHP Act provides for regulation and maintenance of standards of education and services by Allied and Healthcare Professionals.

Medical Laboratory Sciences (MLS)

Semester II- Histology and Cytopathology

Code	COURSE NAME	L/P	C	Hours	IA	ESE	Total
M02MLSHC							
M02MLSHC01	Translational Anatomy and Cell Dynamics	4	4	60	30	70	100
M02MLSHC02	Essentials of Histology	4	4	60	30	70	100
M02MLSHC03	Essentials of Cytopathology	4	4	60	30	70	100
M02MLSHC04	Cancer epidemiology and Digital Pathology	2	2	30	30	70	100
	Practical						
M02MLSHC05	Translational Anatomy and Cell Dynamics Practical	2	2	60	30	70	100
M02MLSHC06	Essentials of Histology Practical	2	2	60	30	70	100
M02MLSHC07	Essentials of Cytopathology Practical	2	2	60	30	70	100
M02MLSHC08	Cancer epidemiology and Digital Pathology Practical	2	2	60	30	70	100
	Total	22	22	450	240	560	800

L: Lecture, T: Tutorial; P: Practical, C: Credit; I: Internal Assessment; ESE: End Semester Examination

Course name: Translational Anatomy and Cell Dynamics **Total credits: 4 (60 hours)**

Course Rationale: This course explores human anatomy with a translational focus, linking structural insights to cellular functions, pathologies, and laboratory diagnostics. Understanding cell architecture, behavior, and dynamics in health and disease states, can especially serve in terms of targeted therapies towards oncology and regenerative medicine.

Learning Outcome: At the end of the course, Students would be able to:

- Correlate gross and microscopic anatomy with pathological conditions observed in clinical specimens.
- Recognize anatomical features in histological slides, including landmarks essential for identifying normal versus diseased tissue.
- Apply anatomical knowledge to orient, section, and analyze tissue samples correctly in histopathology laboratories.
- Integrate anatomical context with digital and molecular diagnostics, enhancing interpretation of tissue-based assays and biomarker localization.



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UNIT	M02MLSHC01 Translational Anatomy and Cell Dynamics	C=4 (60hr)
I	Translational anatomy of diagnostic relevance: Overview of systems-based gross anatomy with diagnostic relevance, Surface landmarks and anatomical variations, Regional vs. systemic anatomy, Importance of anatomy in grossing and sectioning protocols, Anatomical changes in disease: atrophy, hypertrophy, neoplasia, regeneration.	12
II	Organ-Specific Applied Anatomy: Histotechnology-oriented anatomical structure of major systems: • Integumentary (skin biopsies, dermatopathology) • Respiratory (lung, nasal mucosa, bronchi) • Gastrointestinal tract (liver, pancreas, stomach, intestines) • Genitourinary (kidney, bladder, reproductive organs) • Endocrine (thyroid, adrenal, pituitary) • Nervous system (brain regions, spinal cord, peripheral nerves)	12
III	Microanatomy and Tissue Architecture in Health and Disease: Functional tissue units and compartmentalization, Epithelial, connective, muscular, and nervous tissue orientation, Normal vs. pathological tissue organization, Tumor margins, cellular localization, lymphovascular structures. Microscopic and gross anatomy of nervous and endocrine systems, Advanced cell organelle functions (Golgi, ER, lysosomes, peroxisomes), Lab relevance in hormone-secreting tumors, neurodegeneration	12
IV	Cell Biology in Health and Disease: Structure and function of cellular organelles, Cell cycle regulation and checkpoints, Apoptosis vs. necrosis – pathways and implications, Cellular senescence and aging, basics of stem cells and regenerative biology	12
V	Applications in Laboratory and Translational Research: Histopathology and cytopathology applications., In vitro models: spheroids, organoids, and lab-on-chip systems., Cellular imaging and live-cell tracking techniques, Molecular diagnostics: cell signaling assays, immunofluorescence, IHC, Application of AI in anatomical image interpretation, Role of anatomy and cell biology in forensic and personalized medicine, Ethical issues in cell and tissue research	12
	Total	60

Suggested Readings:

1. Drake, R, L. et al (2020). Gray's Anatomy for Students (Second ed.). New Delhi, India: Elsevier.
2. Mescher, A, L. (2021). Junqueira's basic histology: text and atlas (16th ed).
3. Lodish, H. F. (2000). Molecular cell biology. 4th ed. W.H. Freeman.
4. Young, B. et al (2015). Wheater's Functional Histology: A Text and Colour Atlas (Sixth ed.). New Delhi, India: Elsevier.
5. Rizzo, D. C. (2015). Fundamentals of anatomy and physiology (4th ed.). Cengage Learning.
6. Ross, M, H., Pawlina, W. (2011). Histology: a text and atlas: with correlated cell and molecular biology (6th ed.).



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7. Bancroft, J. D., & Gamble, M. (Eds.). (2008). Theory and practice of histological techniques. Elsevier health sciences.

Course: Essentials of Histology

Total Credits: 4 (60 hours)

Course Rationale: This course equips students with foundational and applied competencies in Histology and Histopathology. By exploring the microscopic architecture of cells and tissues, learners will develop diagnostic insight into disease mechanisms and tissue responses. Emphasis will be placed on laboratory organization, specimen processing, cytological techniques, routine and specialized staining, and the interpretation of morphological changes. Through this, students gain readiness to contribute meaningfully to diagnostic histopathology, cytopathology, and integrated laboratory medicine.

Learning Outcome: At the end of the course the students will be able to:

- Apply principles and techniques for tissue fixation, processing, and staining in histological practice.
- Demonstrate proper specimen collection and handling to uphold diagnostic standards.
- Interpret cellular and tissue morphology across organ systems, correlating with physiological and pathological changes.
- Utilize emerging digital tools and automation in histology for quality assurance and diagnostic support.

UNIT	M02MLSHC02 Essentials of Histology	C=4 (60hr)
I	Introduction to Histology and Cell Architecture: Scope and relevance of histology in laboratory medicine, Microscopic anatomy overview, Histological terminology and classification of tissues, Cellular organelles and nuclear-cytoplasmic relationships	7
II	Cell Biology and Cytological Architecture: Cell membrane, cytoskeletal elements, and intracellular junctions, Nucleus, nucleolus, and chromatin organization, Cell cycle phases and mitotic activity in tissues, Apoptosis and cellular degeneration markers.	7
III	Tissue Preparation and Processing: Fixation techniques: chemical principles and types, Processing steps: dehydration, clearing, embedding, Microtomy principles and troubleshooting, Frozen sections and cryostat applications.	10
IV	Staining Techniques and Interpretation: Principles of staining: dye-tissue interactions, Routine stains: H&E, Romanowsky stains, Special stains: PAS, Masson's trichrome, Reticulin, Alcian blue, Histochemical techniques in tissue differentiation, Stain validation, control tissues, and interpretative accuracy.	12
V	Systemic Histology – Organ-Based Structure: Microscopic anatomy of major systems: Integumentary System – epidermal layers, dermis, adnexa; Musculoskeletal System – bone histology, cartilage types, marrow; Respiratory System – nasal mucosa to alveoli; Gastrointestinal Tract – from esophagus to colon; Hepatobiliary System – liver lobules, bile ducts; Renal System – nephron architecture, filtration interfaces; Endocrine Organs – thyroid, adrenal, pituitary	16



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	microstructure; Reproductive Organs – ovarian and testicular histology; Nervous System – cortex layers, cerebellum, peripheral nerves; Lymphatic & Immune Organs – lymph nodes, spleen, thymus.	
VI	Emerging Trends and Digital Histology Histology automation: tissue processors, automated strainers; Digital slide scanning and image analysis; AI-assisted diagnosis and computational histology; Role of LIS and telepathology in modern laboratories; Ethical and regulatory aspects of digital diagnostics	10
	Total	60

Suggested Readings:

- Bancroft, J. D., & Gamble, M. (Eds.). (2008). Theory and practice of histological techniques. Elsevier health sciences.
- Ramakrishnan, S., & Sulochana, K. N. (Eds.). (2012). Manual of Medical laboratory techniques. Jaypee Brothers Medical Publishers Pvt. Ltd.
- Culling, C. F. A., & Taylor, H. E. (1963). Handbook of histopathological techniques (including museum technique).
- Nayak, R., & Nayak, R. (2018). Exam Preparatory Manual for Undergraduates: Pathology. Jaypee Brothers Medical Publishers
- Carson, F. L., & HLADIK, C. (2015). Histotechnology. A self-instructional text, American-Society.
- Curran, R. C., & Crocker, J. (2000). Curran's atlas of histopathology.

Course name: Essentials of Cytopathology

Total credits: 4 (60 hours)

Course Rationale: This course explores the structure, function, and morphology of normal and abnormal cells. This will aid students to identify various types of cytological specimens and understand their clinical relevance. The course also allows to apply knowledge gained for staining techniques and microscopy in the identification of normal and pathological cytology.

Learning outcomes: At the end of the course students will be able to:

- Demonstrate knowledge of cellular morphology and identify cytological features of normal and diseased states.
- Perform and troubleshoot cytological specimen preparation, staining, and slide screening techniques.
- Interpret cytological findings in gynecological, exfoliative, fluid-based, and aspiration cytology with clinical correlation.

UNIT	M02MLSHC03 Essentials of Cytopathology	C=4 (60hr)
I	General Principles of cytology and its application: Fundamentals: Cell structure and organelles, Cell cycle, division, and death, Cytoskeletal and nuclear changes in disease, Basics of microscopy and image analysis, Cytodiagnosis in various disease, comparison of cells normal vs disease, Molecular cytology and its role in diagnostics	5



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II	Exfoliative Cytology: Introduction to Exfoliative Cytology : Definition and scope Types of exfoliation: spontaneous vs. mechanically induced Advantages and limitations in clinical diagnostics Sample Collection Techniques: General principles of collection and fixation Specific site-based collection: Respiratory tract: sputum, bronchial washings Urinary tract: voided urine, bladder washings Female genital tract: Pap smear (conventional and liquid-based cytology) Serous cavities: pleural, peritoneal, and pericardial fluids Nipple discharge, oral cavity, gastrointestinal tract	10
III	Interventional Cytology: 1. Introduction to Interventional Cytology Definition, scope, and evolution Indications and contraindications Role in minimally invasive diagnosis 2. Fine Needle Aspiration Cytology (FNAC) Techniques: Palpation-guided, USG-guided, CT-guided Needle types, aspiration vs. non-aspiration (capillary) technique FNAC of common sites: breast, thyroid, lymph node, salivary gland, soft tissue 3. Sample Collection, Smear Preparation Smear techniques (pull, squash, drop, spray) Cell block preparation and liquid-based cytology	15
IV	Slide Preparation and Staining: Smearing techniques Fixatives used for exfoliative samples Staining methods: Papanicolaou stain (Pap stain) Hematoxylin and Eosin May-Grünwald Giemsa (MGG) Special stains for infection (Ziehl–Neelsen, PAS) Microscopic Interpretation: Criteria for adequacy and cellular preservation, Identification of normal epithelial cells and reactive changes, Recognition of inflammatory and infectious processes, Cellular atypia and malignancy: cytomorphological features, Use of scoring systems (e.g., Bethesda system for cervical cytology)	10
V	Cytodiagnosis and reporting: Rapid On-Site Evaluation (ROSE) Concept, purpose, workflow, Adequacy assessment criteria, Communication with clinicians and radiologists Ancillary Techniques in Interventional Cytology Immunocytochemistry (ICC) Flow cytometry on FNAC samples Molecular testing (e.g., PCR, FISH on aspirates)	10



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VI	Quality Assurance: Specimen rejection criteria, Internal quality control and proficiency testing, Documentation and reporting format Non-diagnostic and inadequate samples, Artifacts and misinterpretation, Error reduction and internal QC measures	10
	Total	60

Suggested Readings:

1. Koss, L.G. and Melamed, M.R. (2005) Koss' diagnostic cytology and its histopathologic bases. 5th Edition, JB Lippincott, Philadelphia.
2. ComBibbo, M., & Wilbur, D. (2014). Comprehensive cytopathology. Elsevier Health Sciences.
3. Cibas, Edmund S, and Barbara S Ducatman. Cytology: Diagnostic Principles and Clinical Correlates. Fifth edition. Philadelphia, PA: Elsevier, 2021.

Course Name: Cancer Epidemiology and Digital Pathology **Total Credits: 2 (30 hours)**

Course outcome: To equip students with an integrated understanding of cancer burden, population-level trends, risk profiling, and cutting-edge digital tools used in cancer diagnostics and reporting.

Learning Outcome: At the end of the course students will be able to

- Interpret cancer trends using epidemiological tools and global databases
- Correlate tumor biology with diagnostic and prognostic markers
- Demonstrate understanding of digital pathology systems and workflow
- Apply integrated epidemiological and digital pathology tools to cancer diagnostics
- Critically assess ethical, technical, and translational aspects of digital pathology

UNIT	M02MLSHC04 Cancer epidemiology and Digital Pathology	C=2 (30hr)
I	Principles of Cancer Epidemiology: Definitions, concepts, and scope of cancer epidemiology, Cancer classification, Risk factors: genetic, environmental, lifestyle, occupational, Descriptive vs. analytical epidemiological studies, Cancer registries, cohort studies, and surveillance systems	6
II	Global and Regional Cancer Trends: GLOBOCAN, WHO, and IARC databases and tools; Common cancers by geography, gender, and age; Cancer disparities: socioeconomic and environmental determinants; Public health policies, screening guidelines (e.g., HPV, breast, colorectal); Epidemiology of emerging cancers and rare tumors	6
III	Tumor Biology and Molecular Basis of Cancer: Oncogenes, tumor suppressor genes, and hallmarks of cancer, Cancer immunology: immune escape, tumour microenvironment, Pathways of metastasis and angiogenesis, Molecular diagnostics: PCR, FISH, NGS, liquid biopsy, Biomarkers in cancer diagnosis, prognosis, and therapy monitoring	6
IV	Digital Pathology Tools and Workflow: Fundamentals of digital slide scanning and virtual microscopy, Image analysis and whole-slide imaging (WSI) systems, AI and machine learning algorithms in pathology, Quality assurance,	6



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	interoperability, and regulatory frameworks, Role of digital pathology in telepathology, consultation, and education	
V	Applications in Diagnostics, Screening, and Research: Integration of epidemiological data with digital histopathology, Use of AI in cancer grading and biomarker quantification, Personalized medicine and predictive pathology, Digital pathology in multicenter trials, biobanks, and data mining, Ethical and data privacy considerations in digital pathology	6
	Total	30

Suggested books

1. DeVita, V. T., Jr., Lawrence, T. S., & Rosenberg, S. A. (2023). DeVita, Hellman, and Rosenberg's cancer: Principles & practice of oncology (12th ed.).
2. Hameed, M., & Hanna, M. G. (2024). Digital Pathology: Implementation in Clinical Practice with AI Applications. Elsevier.
3. WHO GLOBOCAN Reports and IARC Monographs
4. Latest publications in the selected field from WHO
5. Coleman, W. B., & Tsongalis, G. J. (Eds.). (2007). Molecular diagnostics: for the clinical laboratorian. Springer Science & Business Media.
6. Kumar, V., Abbas, A. K., Aster, J. C., & Deyrup, A. T. (Eds.). (2022). Robbins & Kumar basic pathology, e-book: Robbins & Kumar basic pathology, e-book. Elsevier Health Sciences.

UNIT	M02MLSHC05 Translational Anatomy and Cell Dynamics Practical	C=2 (60hr)
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1. Identification of cell and tissue types under light microscope (H&E, special stains)
2. Correlating anatomical landmarks with histological slides
3. Application of AI in anatomical image interpretation
4. Virtual dissection and 3D anatomical visualization using software.
5. Clinical case discussions (normal vs pathological tissue morphology)

UNIT	M02MLSHC06 Essentials of Histology Practical	C=2 (60hr)
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1. Demonstrate receiving, handling, and labelling and specimen rejection criteria of cytological specimen.
2. Prepare and compare fixation using formalin, Bouin's solution, and alcohol-based fixatives. Record effects on tissue integrity.
3. Tissue Processing & Embedding – fixation, dehydration, clearing, impregnation
4. Demonstrate the procedure for knife sharpening - Honing & stropping
5. Perform section cutting of tissue block using a microtome
6. Perform Hematoxylin and Eosin staining with emphasis on nuclear-cytoplasmic contrast and reagent preparation.



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7. Perform mounting of the stained section
8. Special Stains (PAS, Masson's Trichrome)- PAS for carbohydrates and Trichrome for collagen. Assess specificity and interpret stained slides.
9. Identify organs/tissues under microscope (skin, liver, kidney, etc.) and correlate with histological descriptions.

***Clinical laboratory rotation/observation can be incorporated wherever possible**

UNIT	M02MLSHC07 Essentials of Cytopathology Practical	C=2 (60hr)
	1. Preparation and staining of Pap smears and other exfoliative samples 2. Identification of cells from different anatomical sites 3. Interpretation exercises with normal, reactive, and malignant cells 4. Comparative analysis of conventional vs. liquid-based cytology	
	Cytopreparation Techniques • Smear techniques (crush, imprint, FNAC smears) • Cell block preparation • LBC sample preparation	
	Staining Techniques • PAP, H&E, MGG, Toluidine blue • Special stains (PAS, Ziehl-Neelsen, Alcian Blue) • Immunocytochemical markers (ER, PR, TTF-1, Ki67, etc.)	
	Microscopic Evaluation • Identification of normal vs abnormal cells • Cytodiagnosis in inflammatory, benign, and malignant lesions • Cervical cytology (Bethesda system) interpretation • Effusion fluid cytology with diagnostic pearls	
	Case Discussions & Reporting • Integrating cytological, clinical, and histological data • FNAC case discussions with differential diagnosis • Writing structured cytology reports	
	Visit / Demo (Optional) • Digital cytology/automated screening system • Cytogenetic/molecular lab interface with cytology	



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UNIT	M02MLSHC08 Cancer Epidemiology and Digital Pathology Practical	C=2 (60hr)
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1. Cancer Registry Data Interpretation - Access and analyze data from sources like NCRP, GLOBOCAN, SEER for specific cancer types and regions.
2. ICD-O Coding Exercise- cancer classification using ICD-O-3 codes for site, histology, behavior, and grade.
3. Tumor Board Case Review (Simulated)- cases study- clinical features, pathology, staging, and therapy decisions.
4. Virtual Slide Review: Common Cancers- Interpret digital histopathology slides (e.g., breast, cervical, colorectal) using whole-slide imaging tools.
5. Staining Pattern Recognition- Compare H&E and IHC markers on tumor slides: ER, PR, HER2, Ki-67, p53, etc.
6. AI in Pathology Demo- Explore basic AI software or simulations for image classification, feature detection, and tumor grading.
7. Digital Pathology Workflow Simulation- Understand slide scanning, image storage, data annotation, and telepathology platforms.



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Semester III- Histology and Cytopathology

Code	COURSE NAME	L/P	C	Hours	IA	ESE	Total
M03MLSHC01	Diagnostic Histopathology	4	4	60	30	70	100
M03MLSHC02	Cytological Techniques	4	4	60	30	70	100
M03MLSHC03	Immunohistochemistry & Diagnostic Markers	4	4	60	30	70	100
M03MLSHC04	Molecular Techniques in Histopathology & Cytology	2	2	30	30	70	100
	Practical						
M03MLSHC05	Diagnostic Histopathology Practical	2	2	60	30	70	100
M03MLSHC06	Cytological Techniques Practical	2	2	60	30	70	100
M03MLSHC07	Immunohistochemistry & Diagnostic Markers Practical	2	2	60	30	70	100
M03MLSHC08	Molecular Techniques in Histopathology & Cytology Practical	2	2	60	30	70	100
	Total	22	22	450	240	560	800

L: Lecture, T: Tutorial; P: Practical, C: Credit; I: Internal Assessment; ESE: End Semester Examination

Course Name: Diagnostic Histopathology

Total Credits: 4 (60 hours)

Course Rationale: This course delves into complex diagnostic patterns in histopathology, emphasizing integration of advanced staining techniques, immunopathology, and molecular pathology with histomorphology. Students will explore diagnostic algorithms, rare entities, and challenging differentials in routine and subspecialty pathology with emphasis on clinicopathological correlation and laboratory interpretation support.

Learning Outcome: At the end of the course students will be able to:

- Implement and interpret complex diagnostic workflows using histological and molecular tools.
- Engage confidently in diagnostic discussions and multidisciplinary tumor boards.
- Recognize limitations and pitfalls in interpretation and resolve them with evidence-based approaches.
- Conduct audits and propose improvements for diagnostic accuracy and laboratory quality.

UNIT	M03MLSHC01 Diagnostic Histopathology	C=4 (60hr)
I	Diagnostic Histology and Applied Morphology: Cellular adaptation and tissue response: hypertrophy, metaplasia, dysplasia; Inflammatory histology: acute, chronic, granulomatous; Tissue changes in degeneration, necrosis, apoptosis; Histologic architecture of tumors and neoplastic transformations; Correlation	12



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	with biopsy findings and resection specimens; Integration with cytopathology for comprehensive diagnosis.	
II	Diagnostic Strategies in Histopathology Pattern-based diagnostic approach: architectural vs cytological, Diagnostic pitfalls and mimickers, Use of histochemical and immunohistochemical panels, Integrating histology with clinical, radiologic, and laboratory findings, Role of frozen sections and intraoperative consultations	12
III	Subspecialty Diagnostic Histopathology Hematopathology: Lymph node biopsies, classification of lymphomas, bone marrow pathology, Neuropathology: Gliomas, demyelinating disorders, CNS infections, Dermatopathology: Interface dermatitis, cutaneous lymphomas, bullous disorders, Soft Tissue and Bone Tumors: Histologic subtypes, grading, molecular diagnostics Frozen sections	12
IV	Advanced Diagnostic Frameworks Structured histopathology reports, Diagnostic algorithms based on pattern recognition: glandular, papillary, spindle, blue cell, etc., Integrated histo-cyto-molecular correlation, Frozen section interpretation and real-time reporting challenges, Pitfalls in biopsy diagnosis and mimickers, Tumor grading, staging, and margin assessment from a histopathology perspective	12
V	Quality Assurance, Laboratory Practice, and Research Diagnostic audits and interobserver variability, Reporting formats: structured reporting and SNOMED codes, Internal and external quality control in histopathology, Research in histopathology: retrospective analysis, biobanking, AI training sets, Ethical considerations in diagnostic	12
	Total	60

Suggested Readings:

1. Rosai, J. (2009). Rosai And Ackerman's Surgical Pathology. Juan Rosai. The Lung and Pleura. Elsevier, 387-406.
2. Fletcher, C. D. (2007). Diagnostic histopathology of tumors: 2-volume set with CD-ROMs. Elsevier Health Sciences.
3. Mills, S. E. (2015). Sternberg's diagnostic surgical pathology. Lippincott Williams & Wilkins
4. WHO Classification of Tumors

Course Name: Cytological techniques

Total Credit: 4 =60 hours

Course Rationale: The course is equipped for students to create foundational and advanced cytological preparation and staining techniques. To train them to use cytological tools, equipment, and interpretation of smears. It will also make them familiarize with quality control, biosafety, and automation in cytology and develop competence in exfoliative, fluid-based, and FNA cytology.

Learning Outcome: By the end of the course, students will be able to:

- Explain the principles, indications, and clinical relevance of various cytological techniques.



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- Demonstrate proficiency in specimen collection, fixation, and preparation methods for cytological examination
- Perform and interpret key cytological staining methods including Papanicolaou and Romanowsky stains
- Identify and distinguish cytological features of normal, reactive, and pathological conditions in various organ systems

UNIT	M03MLSHC02 Cytological techniques	C=4 (60hr)
I	Principles and Types of Cytological Specimens: Introduction to cytology: definition, scope, clinical significance, Types of specimens: exfoliative, abrasive, aspirated (FNAC), body fluids, Fixation principles: cytological fixatives and preservation, Collection techniques: gynecologic vs. non-gynecologic specimens	12
II	Cytopreparation Techniques: Smear preparation: direct, sedimentation, filtration, cytocentrifugation, Liquid-based cytology (LBC) vs. conventional smears, Cell block technique: indications and method, Preparation for ancillary testing (IHC, molecular)	12
III	Cytological Staining and Special Techniques: Romanowsky stains (May-Grünwald Giemsa, Leishman), Papanicolaou staining technique and interpretation, Special stains: PAS, Ziehl-Neelsen, mucicarmine in cytology, Artifacts and troubleshooting in staining	12
IV	Microscopy and Morphological Interpretation: Cellular features of normal, reactive, and malignant cells, Cytomorphology of commonly examined tissues (cervical, thyroid, respiratory tract, urine, serous fluids), Screening techniques and reporting systems (e.g., Bethesda system)	12
V	Automation, Quality Assurance, and Lab Management: Automated slide processors and screeners, Digital cytology and AI-based tools, Internal and external quality control in cytology, Safety protocols, documentation, record keeping	12
	Total	60

Suggested Readings:

1. Koss, L.G. and Melamed, M.R. (2005) Koss' diagnostic cytology and its histopathologic bases. 5th Edition, JB Lippincott, Philadelphia.
2. ComBibbo, M., & Wilbur, D. (2014). Comprehensive cytopathology. Elsevier Health Sciences.
3. Cibas, Edmund S, and Barbara S Ducatman. Cytology: Diagnostic Principles and Clinical Correlates. Fifth edition. Philadelphia, PA: Elsevier, 2021.
4. Orell, S. R., Sterrett, G. F., & Whitaker, D. (2005). Fine needle aspiration cytology.
5. WHO Classification of Tumours Series (Latest edition for organ systems)



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Course Name: Immunohistochemistry and Diagnostic markers

Total Credit: 4 (60 hours)

Course Rationale: This course provides in-depth knowledge and hands-on skills in Immunohistochemistry (IHC), emphasizing its application in clinical diagnostics, cancer biology, and biomarker discovery. Students will explore IHC principles, reagents, quality control, and marker interpretation across various disease states.

Learning Outcome: At the end of the course students will be able to:

- Understand the principles and techniques of IHC.
- Master the selection and validation of diagnostic markers.
- Interpret IHC results in a diagnostic context.
- Apply knowledge of tumor and disease-specific biomarkers in histopathology.
- Ensure quality control and assurance in IHC laboratories.

UNIT	M03MLSHC03 Immunohistochemistry and Diagnostic markers	C=4 (60hr)
I	Molecular Foundations of Immunohistochemistry (IHC): Principle of antigen-antibody interaction, Types of antibodies used in diagnostics, Detection systems: Enzymatic (HRP/AP) and fluorescent, Role of gene expression and protein translation in IHC targets, Tissue Preparation for Molecular Studies: FFPE tissue handling, Antigen retrieval methods (heat/enzymatic), Optimization of fixation to preserve nucleic acids and proteins	12
II	Immunohistology of: Infectious disease, soft tissue, osseous neoplasma, Hodgkins lymphoma, non-hodgkins lymphoma, breast tissue, nervous system, skin tumors, endocrine tumors, pediatric neoplasms, immunocytology and others	12
III	Analysis through Immunohistochemistry (IHC): Diagnostic and Prognostic Markers: Cytokeratins, EMA, CD markers, BCL2, BCL6, Chromogranin, Synaptophysin, Desmin, Vimentin, SMA, S100, HMB-45, Melan-A, ER, PR, HER2, Lung, colon, prostate markers, Predictive markers and companion diagnostics, Pre-analytical and Analytical Factors: Fixation and tissue processing for IHC, Antigen retrieval methods (HIER, PIER), Blocking steps and reagent optimization, Controls: positive and negative, Troubleshooting: false positives/negatives	12
IV	Molecular Techniques in Immunohistologic Diagnosis: Polymerase Chain Reaction (PCR) Applications: HPV, B-cell/T-cell clonality, tuberculosis, Fluorescence In Situ Hybridization (FISH) application-HER2/neu, ALK rearrangement, Chromogenic In Situ Hybridization (CISH), Detection of EBV or HPV in tissue sections, Next-Generation Sequencing (NGS) overview, Gene panels used in solid tumor pathology	12
V	Quality Assurance and Accreditation: Standardization of protocols (CAP, ASCO, WHO), Internal and external quality controls (EQAS), Laboratory	12



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	accreditation (NABL, ISO), Documentation and result reporting, Regulatory and ethical considerations, Internal and external controls in IHC and molecular assays, Analytical vs. clinical validation	
	Total	60

Suggested Readings:

1. Dabbs, D. J. (2014). Diagnostic Immunohistochemistry: Theranostic and genomic application (4th ed.). Elsevier.
2. Bancroft, J.D. and Gamble, M. (2008) Theory and Practice of Histological Techniques. 6th Edition, Churchill Livingstone, Elsevier
3. Lester, S. C. (2010). *Manual of Surgical Pathology E-Book: Manual of Surgical Pathology*. Elsevier Health Sciences.
4. WHO Classification of Tumors

Course: Molecular techniques in histopathology and cytology

Total Credits: 2 (30 hours)

Course Rationale: This course provides in-depth knowledge and hands-on skills in Immunohistochemistry (IHC), emphasizing its application in clinical diagnostics, cancer biology, and biomarker discovery. Students will explore IHC principles, reagents, quality control, and marker interpretation across various disease states.

Learning Outcome: By the end of the course, students will be able to:

- Understand the principles and applications of molecular biology in tissue and cytological diagnosis.
- Apply techniques such as PCR, in situ hybridization, and molecular profiling for diagnostic and prognostic purposes.
- Correlate morphological findings with molecular alterations.
- Perform nucleic acid extraction and amplification from FFPE and cytology samples.

UNIT	M03MLSHC04 Molecular techniques in histopathology and cytology	C=2 (30hr)
I	Molecular Biology Fundamentals in Tissue Diagnostics: DNA, RNA, and protein synthesis in pathological states, Gene mutations, translocations, amplifications relevant to neoplasia, Tumor suppressor genes and oncogenes (e.g., TP53, HER2, BRAF), Applications in cancer diagnostics and infectious disease detection	6
II	Pre-analytical and Analytical Considerations: Fixation and preservation of nucleic acids (FFPE vs fresh/frozen tissue), Nucleic acid extraction from FFPE blocks and cytology smears, Quality control and quantification (spectrophotometry, fluorometry)	6
III	Core Molecular Techniques: Polymerase Chain Reaction (PCR, RT-PCR, qPCR): principle and applications, In Situ Hybridization (ISH), Fluorescent ISH (FISH): diagnostic relevance, Microdissection techniques (manual and laser capture), Molecular markers in	10



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	specific cancers (e.g., EGFR, ALK, KRAS), Next-Generation Sequencing (NGS): overview and utility in diagnostics	
IV	Integration with Histopathology & Cytology: Molecular testing in solid tumors (lung, breast, colon, cervix), Molecular cytology: applications in exfoliative and fine-needle aspiration cytology, Liquid biopsy and cell-free DNA, Role of bioinformatics and digital pathology in molecular diagnostics	8
	Total	30

Suggested Readings:

1. Coleman, W. B., & Tsongalis, G. J. (Eds.). (2009). *Molecular pathology: the molecular basis of human disease*. academic Press.
2. Coleman, W. B., & Tsongalis, G. J. (Eds.). (2023). *Diagnostic molecular pathology: a guide to applied molecular testing*. Academic Press.
3. WHO Classification of Tumours
4. CAP/ASCO/CAP Guidelines on Molecular Testing in Oncology

UNIT	M03MLSHC05 Diagnostic Histopathology Practical	C=2 (60hr)
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1. Demonstrate receiving, handling, and labelling and specimen rejection criteria of cytological specimen.
2. Demonstrate cryostat usage for frozen sections. Compare morphology with paraffin sections.
3. Slide-based case diagnostics with clinical context
4. Identify organs/tissues under microscope (skin, liver, kidney, etc.) and correlate disease vs normal.
5. Tumor simulation: prepare and present pathology findings
6. Audit exercise: identify errors, revise diagnosis, and propose QC measures
7. Slide reading sessions: benign vs malignant
8. Recognizing tissue patterns (glandular, squamous, mesenchymal, hematopoietic)
9. Preparing a diagnostic report in standard format

***Clinical laboratory rotation/observation can be incorporated wherever possible**

UNIT	M03MLSHC06 Cytological techniques Practical	C=2 (60hr)
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1. Cervical smear preparation (manual and LBC method)
2. Fixation and staining: Pap and MGG
3. Urine and sputum cytology: processing and reporting
4. Cytoentrifuge use and body fluid smear preparation
5. FNA sample smear preparation using phantoms or clinical material



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6. Cell block preparation from fluid specimens
7. Application of special stains in cytology
8. Slide review sessions: benign, reactive, atypical, and malignant smears
9. Cytology report writing with terminology

***Clinical laboratory rotation/observation can be incorporated wherever possible**

UNIT	M03MLSHC07 Immunohistochemistry and Diagnostic Markers Practical	C=2 (60hr)
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1. Manual IHC staining using HRP-labeled secondary antibody and DAB
2. Hormonal Receptor Testing in Breast Tissue
3. Slide-based case diagnostics with clinical context
4. DNA Extraction from FFPE Tissues
5. PCR for Infectious Pathogens
6. Audit exercise: identify errors, revise diagnosis, and propose QC measures
7. Slide reading sessions: benign vs malignant
8. IHC Troubleshooting Workshop
9. Preparing a diagnostic report in standard format

***Clinical laboratory rotation/observation can be incorporated wherever possible**

UNIT	M03MLSHC08 Molecular techniques in histopathology and cytology Practical	C=2 (60hr)
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1. Extraction of DNA and RNA from FFPE tissue and cytology smears
2. Demonstration of fixation techniques and their effect on nucleic acid preservation (FFPE vs frozen)
3. Microdissection technique (manual or guided) for tumor cell enrichment
4. Spectrophotometric quantification of DNA/RNA (A260/280 ratio calculation)
5. Fluorometric quantification and sensitivity comparison
6. Gel electrophoresis for visualization of extracted nucleic acids
7. Setup and run of conventional PCR and RT-PCR
8. Demonstration/interpretation of real-time PCR (qPCR) data
9. Demonstration of In Situ Hybridization (ISH) and Fluorescent in Situ Hybridization (FISH)
10. Navigation of digital pathology platforms (virtual slides with molecular overlays)
11. Preparation of integrated molecular-histopathology report
12. Practice of documentation, labeling, and data entry for molecular tests

***Clinical laboratory rotation/observation can be incorporated wherever possible**