GUJARAT TECHNOLOGICAL UNIVERSITY
Integrated Master of Science (Biotechnology)
Semester: 7
Subject Name: Histopathological Techniques
Subject Code: 1370410

Prerequisite: Students should have a fundamental understanding of cell biology, pathology, and microscopy techniques. Basic knowledge of tissue processing, cytological staining, and diagnostic pathology is beneficial.

Rationale: This course provides a comprehensive understanding of histopathological and cytological techniques used in clinical diagnostics and research. It covers tissue processing, histological staining, cytological sample preparation, immunohistochemistry, and digital pathology. Emphasis is placed on cancer diagnostics, molecular pathology, and automated histopathological techniques, equipping students for careers in pathology labs, hospitals, and research institutes.

Course Scheme:

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
				Theory		Practical		
L	T	PR	C	ESE (E)	PA(M)	ESE (V)	PA (I)	
0	0	4	2	0	0	0	50	50

Course Content:

Sr. No.	Course Content	No. of Hours	% of Weightage

1	**Unit 1: Fundamentals of Histopathology and Cytology**
	• Introduction to Histopathology and Cytopathology
	  ○ Scope, Importance, and Clinical Applications
	  ○ Difference Between Histopathology and Cytology
	• Cellular and Tissue Organization in Health and Disease
	• Fixation and Tissue Preservation Techniques
	  ○ Chemical and Physical Fixatives
	  ○ Fixation Artifacts and Troubleshooting
	• Grossing and Sectioning of Tissues for Microscopic Examination
		12	**20**

2	**Unit 2: Histological Staining Techniques** • Hematoxylin and Eosin (H&E) Staining • Special Stains for Histopathology ○ PAS (Periodic Acid-Schiff), Masson's Trichrome, Reticulin Stain	**12**	**20**

	• Immunohistochemistry (IHC) and Immunofluorescence Techniques ○ Antibody Selection, Antigen Retrieval, Enzyme-Conjugated Detection • Automated Histopathology Staining and AI-Driven Image Analysis • Histopathological Diagnosis of Common Diseases (Cancer, Tuberculosis, Liver Cirrhosis, etc.)		

3	**Unit 3: Cytological Techniques and Sample Processing**
	• Types of Cytology: Exfoliative and Fine Needle Aspiration Cytology (FNAC)
	• Collection and Processing of Cytological Samples
	  ○ Pap Smear, Bronchial Washings, Pleural and Peritoneal Fluids
	• Staining Techniques for Cytology
	  ○ Papanicolaou Staining, Giemsa Staining, MGG Staining
	• Cytopathology of Common Diseases (Cervical Cancer, Thyroid Lesions, Lung Cancer, etc.)
	• Automation in Cytology: Liquid-Based Cytology and AI in Cancer Diagnosis
		12	**20**

4	**Unit 4: Molecular Techniques in Histopathology and Cytopathology** • Fluorescent In Situ Hybridization (FISH) and Comparative Genomic Hybridization (CGH) • PCR and RT-PCR in Pathological Diagnosis ○ HPV Detection, Genetic Mutations in Cancer • Next-Generation Sequencing (NGS) for Personalized Pathology • Digital Pathology and AI-Based Image Analysis • Tissue Microarrays for High-Throughput Analysis	**12**	**20**
5	**Unit 5: Quality Control and Emerging Trends in Histopathology** • Quality Control and Accreditation in Histopathology Labs (NABL, CAP, ISO Standards) • Challenges in Histopathology and Cytology: Artifacts, Sample Contamination	**12**	**20**

	• Forensic Applications of Histopathology and Cytopathology • 3D Histopathology and Bioprinting for Disease Modeling • Future Trends: AI and Digital Pathology, Whole Slide Imaging (WSI), and Telepathology		

Reference Books:

1. Wheater's Functional Histology: A Text and Colour Atlas – Barbara Young
2. Histotechnology: A Self-Instructional Text – Freida L. Carson
3. Theory and Practice of Histological Techniques – John D. Bancroft
4. Cytopathology: A Volume in Foundations in Diagnostic Pathology Series – Michael T. Sheaff
5. Molecular Pathology in Clinical Practice – Debra G. B. Leonard

Course Outcome:

After Completion of the Course, Student will able to:

Sr. No	Course Outcomes	RBT Level
1	Describe histopathological and cytological techniques used in diagnostics.	UN, RM, AP
2	Apply different histological and cytological staining methods for disease diagnosis.	UN, RM, AP
3	Analyze molecular techniques in pathology, including PCR, IHC, and NGS.	AP, AN, CR
4	Evaluate quality control measures and emerging AI-based histopathology tools.	AN, EL, CR
5	Integrate histopathological and cytological techniques into clinical and forensic pathology.	AP, CR

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

List of Experiments:

1. Tissue Fixation and Processing for Histological Examination
2. H&E Staining and Interpretation of Normal and Pathological Tissues
3. Special Staining Techniques: PAS, Masson's Trichrome, Reticulin
4. Preparation and Staining of Cytological Smears (Pap Smear, FNAC, Giemsa Staining)
5. Immunohistochemistry (IHC) for Cancer Diagnosis
6. Fluorescence In Situ Hybridization (FISH) for Genetic Abnormalities
7. AI-Based Digital Pathology Analysis for Cancer Diagnosis
8. Tissue Microarray Construction and Analysis

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