



**MS, CYTOTECHNOLOGY/MOLECULAR CYTOLOGY (MSCMC)**

YEAR 1 FALL			YEAR 1 SPRING		
Code	Course Name	Credits	Code	Course Name	Credits
CYT 610	Cytopathology of Female Genital Tract	4	CYT 630	Exfoliative Non-Gynecologic Cytopathology II	2
CYT 620	Exfoliative Non-Gynecologic Cytopathology I	2	CYT 650	Cytopreparatory Techniques II	1
CYT 640	Cytopreparatory Techniques I	1	CYT 660	Fine Needle Aspiration Cytology I	3
BHS 610	Cellular Pathophysiology and Histology I	3	BHS 620	Cellular Pathophysiology and Histology II	3
BHS 730	Advanced Good Laboratory Practices/Lab Management	3	BHS 745	Molecular Diagnostics	3
BHS 740	Genetics/Molecular Basis of Disease	4	BHS 765	Grand Rounds in Pathology	1
ETH 610	Ethics in Research	1	BIO 650	Research Design	2
PSC 672	Experimental Design and Data Analysis	2			
<b>Total Credits</b>		<b>20</b>	<b>Total Credits</b>		<b>15</b>
<b>SUMMER SESSION 1</b>			<b>SUMMER SESSION 2</b>		
CYT 670	Fine Needle Aspiration Cytology II	3	CYT 770	Clinical Practicum I	3
BHS 750	Flow Cytometry	3	BHS 760	Advanced Topics in Biotechnology- Student's FNA Portfolio	3
BHS 755	In Situ Hybridization- Principle, protocol and applications	2			
<b>Total Credits</b>		<b>8</b>	<b>Total Credits</b>		<b>6</b>
<b>YEAR 2 FALL</b>					
Code	Course Name	Credits			
CYT 780	Clinical Practicum II	6			
BHS 790	Capstone Project	3			
<b>Total Credits</b>		<b>9</b>			

**Year 1 - Fall**

**Cytopathology of the Female Genital Tract (CYT 610)**

This course will present the basic principles of Cytopathology applied to the cellular samples obtained from the female reproductive system. Topics covered are the gross and microscopic anatomy, physiology and pathology of the cervix. This course will establish a foundation for identifying and understanding the basic epithelial cell types. Benign, reactive, and infectious conditions will be discussed. Infectious organisms and the cellular changes they produce will be identified. Pre-malignant and malignant conditions will be discussed and identified on cytologic specimens obtained primarily from the Pap Test. In the laboratory students will learn in an experiential setting by examining both pre-diagnosed and unknown cases from the FGT that demonstrate a wide variety of benign to malignant conditions. Infectious organisms and the

cellular changes they produce will be identified. Cellular changes induced by therapies and environmental entities will be examined and criteria to identify these will be discussed. (4 credits)

### **Exfoliative Non-Gynecologic Cytopathology I (CYT 620)**

This course will present the basic principles of cytopathology applied to the cellular samples obtained from a variety of body sites through brushings, washings and scrapings. Gross and microscopic anatomy, physiology and pathology of these sites will be explored. Specimens from the Respiratory Tract and Gastro-intestinal Tract will be examined. This course will expand on the foundation for identifying and understanding the basic epithelial cell types begun in Introduction to Cytology and Cytology of the FGT. Benign, reactive and infectious conditions will be discussed. Infectious organisms and the cellular changes they produce will be identified. Atypical and malignant conditions and their cellular appearance on a variety of cytologic specimens will be explored. Cellular changes induced by therapies and environmental entities will be discussed and their role in rendering a final diagnosis will be recognized. In the laboratory students will learn in an experiential setting by examining both pre-diagnosed and unknown cases from these sites that demonstrate a wide variety of benign to malignant conditions. Infectious organisms and the cellular changes they produce will be identified. Cellular changes induced by therapies and environmental entities will be examined and criteria to identify these will be discussed. (2 credits)

### **Cytopreparatory Techniques I (CYT 640)**

This course will develop the skills necessary to prepare a wide variety of specimens and teaches how to select and apply the appropriate staining technique for each. Students will learn to develop a Cytology Preparation Manual and how to comply with all State, OSHA and Federal regulations in a working laboratory. Emphasis will be placed on safe, efficient and effective handling techniques. Students will make a collection of representative slides from a variety of body sites using expired specimens donated from clinical affiliates. (1 credit)

### **Cellular Pathophysiology and Histology I (BHS 610)**

This course surveys the biochemical and molecular mechanisms underlying disease processes and precipitating cellular change and death. Events of cellular energetics, signaling, gene expression and mutations will be highlighted. The morphological, pathological and clinical correlates of these cellular events will be presented after a histological foundation is established. Basic concepts of cell swelling, inflammation, atrophy, apoptosis, necrosis, dysplasia, anaplasia and neoplasia will be illustrated and identified through microscopy. Once principles are established, a systems approach is taken to demonstrate system-specific pathology. (3 credits)

### **Genetics/Molecular Basis of Disease (BHS 740)**

This course lays down the foundation in basic genetic concepts with the objective of understanding the heritability and/or molecular basis of disease. Recent evidence and diagnostic procedures suggest that genetic diseases make up a large proportion of the total disease burden in both pediatric and adult populations. Today's health care practitioner and biomedical scientist must understand the science of medical genetics and the consequences of altered genomics and proteomics. Advances in the development of new and more accurate methods of diagnosing hereditary disease have led to a greater "genetic awareness" and recognition that genetics plays a role in all areas of medicine. Using a wide spectrum of examples it will illustrate the impact of mutations as found in thalassemias, sickle cell anemia, cystic fibrosis, familial Amyotrophic Lateral Sclerosis and Huntington's Disease as causes of

disease. It will also discuss genetics as a predisposing factor, such as in the case of birth defects, breast cancer, Alzheimer's Disease, alcoholism and some autoimmune disorders. Environmentally-induced mutagenesis and carcinogenesis and the role of oncogenes and tumor suppressor genes will be a particular focus of the second half of the course. (4 credits)

Pre-Requisites: CHE 311/312

### **Ethics in Research (ETH 610)**

This course includes a discussion format based on ethical issues involved in the research process. Students will have focused reading on the ethical issues involved in research and then will apply the readings to case studies during discussion. Topics covered will include, but are not limited to: morality and research ethics, ethical issues before research committees, ethical issues involving human and animal subjects, reporting of research and conflict of interest. (1 credit)

### **Experimental Design and Data Analysis (PSC 672)**

This course is required for all Pharmaceutical Sciences graduate students and provides students with a basic knowledge of experimental design and biostatistics. Students will learn how to design experiments and analyze the results. The course will cover single factor experiments, multiple factors, full factorial and fractional factorial designs and screening designs, the fundamentals of hypothesis testing and relevant biostatistics. (2 credits)

### **Advanced Good Laboratory Practices/Lab Management (BHS 730)**

This course provides training in the principles of good laboratory practice for personnel of laboratories who wish to produce test results that are fit for the purpose and which would stand up to the scrutiny of inspection. This allows for the reliability, retrieval and accountability for test results. These procedures are applicable to diagnostic laboratory procedures, research, forensic and in the drug safety and development sector. Topics include safety, Clinical Laboratory Improvement Act of 1988 (CLIA) government regulations, and quality assurance in the laboratory. Students will learn and apply management and quality assurance skills and concepts applicable to different laboratory settings, including specimen collection, and performance per CLIA'88-and /or moderate-complexity testing. Students will also demonstrate competency in a wide variety of techniques used to collect, process and test specimens. (3 credits)

## **Year 1 - Spring**

### **Exfoliative Non-Gynecologic Cytopathology II (CYT 630)**

This course will present the basic principles of cytopathology applied to the cellular samples obtained from a variety of body sites through brushings, washings and scrapings. Gross and microscopic anatomy, physiology and pathology of these sites will be explored. Specimens from the Genital Urinary System, Body Cavity Fluids and Cerebral Spinal Fluid will be examined. Benign, reactive and infectious conditions will be discussed. Infectious organisms and the cellular changes they produce will be identified. Atypical and malignant conditions and their cellular appearance on a variety of cytologic specimens will be explored. Cellular changes induced by therapies and environmental entities will be discussed and their role in rendering a final diagnosis will be recognized. In the laboratory students will learn in an experiential setting by examining both pre-diagnosed and unknown cases from these sites that demonstrate a wide variety of benign to malignant conditions. Infectious organisms and the cellular changes they

produce will be identified. Cellular changes induced by therapies and environmental entities will be examined and criteria to identify these will be discussed. (2 credits)

### **Cytopreparatory Techniques II (CYT 650)**

This course will develop the skills necessary to prepare a wide variety of specimens and teaches how to select and apply the appropriate staining technique for each. Students will learn to develop a Cytology Preparation Manual and how to comply with all State, OSHA and Federal regulations in a working laboratory. Emphasis will be placed on safe, efficient and effective handling techniques. Students will make a collection of representative slides from a variety of body sites using expired specimens donated from clinical affiliates. (1 credit)

### **Fine Needle Aspiration Cytology I (CYT 660)**

This course will present the basic principles of cytopathology applied to the cellular samples obtained through fine needle aspiration (FNA) from a variety of body sites where lesions can be identified by Radiological techniques. Gross and microscopic anatomy, physiology and pathology of these sites will be explored. Specimens from the Breast, Thyroid Glands, Salivary Glands and Lymph Nodes will be examined. Benign, reactive and infectious conditions will be discussed. Infectious organisms and the cellular changes they produce will be identified. Atypical and malignant conditions and their cellular appearance will be explored. Cellular changes induced by therapies and environmental entities will be discussed and their role in rendering a final diagnosis will be recognized. In the laboratory students will learn in an experiential setting by examining both pre-diagnosed and unknown cases from these sites that demonstrate a wide variety of benign to malignant conditions. Infectious organisms and the cellular changes they produce will be identified. Cellular changes induced by therapies and environmental entities will be examined and criteria to identify these will be discussed. (3 credits)

Pre-Requisites: CYT 630

### **Cellular Pathophysiology and Histology II (BHS 620)**

This course surveys the biochemical and molecular mechanisms underlying disease processes and precipitating cellular change and death. Events of cellular energetics, signaling, gene expression and mutations will be highlighted. The morphological, pathological and clinical correlates of these cellular events will be presented after a histological foundation is established. Basic concepts of cell swelling, inflammation, atrophy, apoptosis, necrosis, dysplasia, anaplasia and neoplasia will be illustrated and identified through microscopy. Once principles are established, a systems approach is taken to demonstrate system-specific pathology. (3 credits)

### **Molecular Diagnostics (BHS 745)**

This course is an application of molecular concepts to the identification of infectious agents, genetic risk of disease, presence and/or occurrence of mutations as a consequence of infections or toxic exposure. The use of genomic profiles as biomarkers associated with cancer and cancer risk, autoimmunity and hereditary disorders, as well as determination of histocompatibility will be discussed and performed. Biotechnology as a diagnostic and investigative tool will be discussed. In the laboratory students will learn and perform basic molecular techniques such as DNA and RNA isolation, RT-PCR, Northern and Southern blots. Students will also be exposed to the utility of microarrays and bioinformatics in medicine. (4 credits)

### **Grand Rounds in Pathology (BHS 765)**

Case presentations and discussion in surgical pathology, forensics, and radiation oncology in the medical grand rounds format. This one credit course will have a series of sessions with pathologists and/ or other specialty physicians from hospitals in the Capitol District presenting a series of interesting cases. The presentations will illustrate patient symptomatology, the entire process of diagnostics and patient management and clinical outcomes thus integrating diagnostic testing and their critical role in optimal patient outcomes. (1 credit)

### **Research Design (BIO 650)**

This graduate-level course will introduce students to the research methods used in the biological sciences. Topics to be covered include research design, data collection and documentation, critical literature review, preparation of a NIH-style grant application, and academic presentations and publications. Class discussions, workshops, and writing assignments will provide students with opportunities to both practice learned research methods as well as apply these methods toward the design of a potential thesis research project. (2 credits)

### **Summer Session - 1**

#### **Fine Needle Aspiration Cytology II (CYT 670)**

This course presents the basic principles of cytopathology applied to the cellular samples obtained through fine needle aspiration (FNA) from a variety of body sites where lesions can be identified by Radiological techniques. Gross and microscopic anatomy, physiology and pathology of these sites will be explored. Specimens from the Liver, Pancreas, Ovary, Kidney Adrenal Glands and Central Nervous System will be examined. The course will also include FNA of unusual lesions like: mediastinal lesions, bone and soft tissue lesions and pediatric tumors. Benign, reactive and infectious conditions will be discussed. Infectious organisms and the cellular changes they produce will be identified. Atypical and malignant conditions and their cellular appearance will be explored. Cellular changes induced by therapies and environmental entities will be discussed and their role in rendering a final diagnosis will be recognized. In the laboratory students will learn in an experiential setting by examining both pre-diagnosed and unknown cases from these sites that demonstrate a wide variety of benign to malignant conditions. Infectious organisms and the cellular changes they produce will be identified. Cellular changes induced by therapies and environmental entities will be examined and criteria to identify these will be discussed. (3 credits)

Pre-Requisites: CYT 660

#### **Flow Cytometry (BHS 750)**

This course introduces the principles and applications of flow cytometry through lectures and laboratory/group work. Major topics include: machine set-up and operation, fluorochromes and fluorescence, spectral overlap and compensation, experimental design, data collection and multi-parameter analyses, immunophenotyping, research application, clinical applications and disease diagnosis. (3 credits)

#### **In Situ Hybridization (BHS 755)**

This course is an introduction to the theory and application of molecular hybridization and in situ hybridization techniques. Selection of probes, their application and appropriate detection systems for both RNA and DNA in situ hybridization techniques will be discussed in lecture and

laboratory. A focus of the course will be the applications of hybridization techniques to the diagnosis and prognosis of human disease. (2 credits)

Pre-Requisites: BHS 650 or PSC 312

## **Summer Session - 2**

### **Clinical Practicum I (CYT 770)**

This course consists of two clinical rotations, the first one lasting seven weeks and the second for one week at two different clinical affiliate laboratories. Students rotate one week in a laboratory that deals with adjuvant methodologies such as molecular diagnostics, flow cytometry or proteomics. Students “shadow” a teaching cytotechnologist through their daily routine and participate in all laboratory activities as permitted. Students are expected to pre-screen cases that will later be re-screened by the teaching cytotechnologist, participate in preparation and staining of specimens, and any FNA, Tumor Board, Tissue Correlation and Patient Follow-up activities that their teaching cytotechnologist deems appropriate. (3 credits)

Pre-Requisites: CYT 670

### **Advanced Topics in Biotechnology (BHS 760)**

This course is an independent project required by students in the MS in Cytotechnology and Molecular Cytology Program. The students, under clinical preceptor and faculty advisement, compile FNA specimens from clinical rotations and create a presentation of case studies. Each case study includes patient history, cytologic and histologic findings, photographic images of the cases, ancillary testing results, and information on the entity involved. This project allows students to participate in various laboratory activities and strengthens their training. Only cytotechnology students, who have successfully completed training on campus and are in the clinical rotation phase of the program, are eligible. (3 credits)

## **Year 2 - Fall**

### **Clinical Practicum II (CYT 780)**

This course is a continuation of CYT 770 with two clinical rotations, scheduled as described for CYT 770. (6 credits)

Pre-Requisites: CYT 770

### **Capstone Project (BHS 790)**

The capstone project is a culminating experience blending all aspects of diagnostic laboratory practice and clinical research. Students will demonstrate the ability to read and analyze scientific literature, formulate case studies or project topics, prepare findings for oral presentation and complete a literature review with final paper or poster presentation.