



MS, CLINICAL LABORATORY SCIENCES (MSCLS)

| YEAR 1 FALL | | | YEAR 1 SPRING | | |
|----------------------|---|-----------|----------------------|--------------------------|-----------|
| Code | Course Name | Credits | Code | Course Name | Credits |
| CLS 610 | Clinical Microbiology I | 4 | CLS 660 | Immunochemistry | 4 |
| CLS 655 | Urinalysis and Body Fluids | 2 | CLS 640 | Clinical Chemistry | 4 |
| CLS 650 | Clinical Hematology and Hemostasis | 4 | CLS 620 | Clinical Microbiology II | 4 |
| ETH 610 | Ethics in Research | 1 | BIO 650 | Research Design | 2 |
| PSC 672 | Experimental Design and Data Analysis | 2 | CLS 630 | Clinical Immunology | 4 |
| Total Credits | | 13 | Total Credits | | 18 |
| YEAR 2 FALL | | | YEAR 2 SPRING | | |
| Code | Course Name | Credits | Code | Course Name | Credits |
| CLS 770 | Clinical Practicum I | 9 | CLS 780 | Clinical Practicum II | 9 |
| BHS 740 | Genetics/Molecular Basis of Disease | 4 | BHS 745 | Molecular Diagnostics | 3 |
| BHS 730 | Advanced Good Laboratory Practices and Lab Mgmt | 3 | CLS 760 | Clinical Correlations | 3 |
| | | | BHS 790 | Capstone | 3 |
| Total Credits | | 16 | Total Credits | | 18 |

Year 1 - Fall

Clinical Microbiology I (CLS 610)

This course will focus on the study of aerobic bacteria. The diagnostic techniques involved in identifying the organisms, the significance of different organisms in various clinical specimens, the presentation of microbial disease states and the application of principles of infection control will be presented. The student will be familiarized with the methods used for transport, processing, identification and reporting of bacteria from specimens taken from the human body. Students will analyze and record laboratory data, comply with all safety procedures and learn to determine drug susceptibility, drug resistance and identify sources of infection. (4 credits)

Urinalysis and Body Fluids (CLS 655)

This course includes the medical biochemistry of renal function and the interpretation of urinalysis and body fluid (spinal fluid, seminal fluid, and other body fluids) testing. Emphasis is on clinical significance and interpretation of laboratory results, specimen collection and preservation, biochemical test procedures, clinical microscopy and cytology of urine sediment. (2 credits)

Clinical Hematology and Hemostasis (CLS 650)

This course will address the evaluation of blood cells and body fluids in the clinical hematology laboratory. The lecture and laboratory will highlight physiology, pathophysiology and laboratory testing of blood and bone marrow cells, evaluation of hemostasis and hemostatic disorders and the laboratory evaluation of formed elements found in other body fluids. (4 credits)

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)

Year 1 - Spring**Immunoematology (CLS 660)**

Immunoematology is the laboratory application of immunologic principles to the identification of appropriate blood and blood products for transfusion and body tissues for transplant. The course will cover characteristics of red cell and white cell specific antigens, donor qualification and blood processing as well as the techniques for identification of auto- and allo-antibodies important to transfusion medicine and transfusion service specific regulations and quality control requirements. (4 credits)

Clinical Chemistry (CLS 640)

This combined lecture/laboratory course focuses on basic concepts of laboratory instrumentation, troubleshooting techniques and the operation, evaluation and selection of instruments. Lectures emphasize chemical measurements of physiologic indicators of normal and abnormal human metabolism and address the elements of clinical chemistry and its application to diagnosis and treatment of patients. The significance of lipids, carbohydrates, proteins, enzymatic measurements, acid-base balance as they apply to diagnoses of cardiovascular, pulmonary, renal and metabolic diseases is emphasized through hands-on measurement and correlation with pathophysiology. (3 credits)

Clinical Microbiology II (CLS 620)

This course follows similar principles as CLS550, but will focus on the study of medically relevant parasites and fungi. Students will also learn key aspects of mycological, and anaerobic infections. By participating in both classes CLS550 and CLS560 students will become proficient in traditional microbiology, as well as contemporary immune- and molecular-based identification technology. (4 credits)

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)

Clinical Immunology (CLS 630)

The content of this course includes development of the immune system, immunoglobulin structure and genetics, antigen-antibody reactions, the major histocompatibility complex and antigen presentation, and immune responses to infectious organisms and tumors. The lecture and laboratory will focus on diagnostic techniques employed in the identification of viral and bacterial diseases and the diagnosis of autoimmune diseases, allergies, immune deficiencies and AIDS. (4 credits)

Year 2 - Fall

Clinical Practicum I (CLS 770)

Students will participate in a number of experiential exercises in the affiliated hospital and laboratory sites. Rotations will include Clinical Microbiology, Clinical Chemistry, Immunohematology, Hematology and Coagulation, Immunology/Serology and Molecular Diagnostic testing. The clinical practicum experience will include specimen tracking, performance of routine analyses, demonstration of specialty testing, observation of automated instrumentation and management processes, including quality control and quality assurance activities. (9 credits per semester)

Pre-Requisites: Completion of all required CLS 600 level courses

Genetics and 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 or equivalent

Advanced Good Laboratory Practices and Laboratory Management (BHS 739)

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 2 - Spring

Clinical Practicum II (CLS 780)

Students will participate in a number of experiential exercises in the affiliated hospital and laboratory sites. Rotations will include Clinical Microbiology, Clinical Chemistry, Immunohematology, Hematology and Coagulation, Immunology/Serology and Molecular Diagnostic testing. The clinical practicum experience will include specimen tracking, performance of routine analyses, demonstration of specialty testing, observation of automated instrumentation and management processes, including quality control and quality assurance activities. (9 credits)

Pre-Requisites: Completion of all required CLS 600 level courses

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)

Clinical Correlations (CLS 760)

Students will evaluate a series of case studies which integrate all disciplines of laboratory diagnostic medicine. The cases will require knowledge of laboratory test result normal, factors that affect the accuracy of laboratory test results, quality management principles, and the ability to integrate diverse information to arrive at a diagnosis, corrective action or quality improvement recommendation. (2 credits)

Pre-Requisites: CLS 780

Capstone (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. (3 credits)