UT Medical Center Medical Laboratory Science
Course Descriptions

Required courses for the program:

MLS 410 **Clinical Microbiology Lecture** **4 Credit Hours**
MLS 411 **Clinical Microbiology Laboratory (Clinical Experience)** **4 Credit Hours**

Description: Clinical aspects of microbiology, including bacteriology, mycology, and parasitology. Emphasis on pathogenic bacteria and fungi, their sources, methods of culture, techniques of identification, and evaluation of antibiotic sensitivity. Gross and qualitative chemical examination of feces and methods of identification of protozoa and helminth parasites of man.

MLS 420 **Clinical Chemistry Lecture** **5 Credit Hours**
MLS 421 **Clinical Chemistry Laboratory (Clinical Experience)** **5 Credit Hours**
Note: MLS 421 includes Clinical Immunology laboratory

Description: Clinical aspects of biochemistry, including overview of principles and instrumentation with emphasis on practical laboratory application of analytical procedures, specimen collection and handling, significance of results, and quality assurance. Includes analysis of blood and other body fluids for blood gas content, electrolytes, enzymes, hormones, therapeutic drugs, toxicology, and other constituents of clinical interest, utilizing both automated and manual techniques.

MLS 430 **Hematology/Clinical Microscopy - Lecture** **4 Credit Hours**
MLS 431 **Hematology/Clinical Microscopy – Laboratory (Clinical Experience)** **4 Credit Hours**

Description: Principles, theories, and instrumentation related to qualitative and quantitative evaluation of cellular elements of blood and other body fluids; factors of hemostasis; quantitative chemical analysis of urine; and renal function studies. Emphasis is placed on microscopic identification of cells and the significance and correlation of laboratory data.

MLS 440 **Clinical Immunohematology - Lecture** **3 Credit Hours**
MLS 441 **Clinical Immunohematology - Laboratory (Clinical Experience)** **3 Credit Hours**

Description: Theory and practice in blood bank operation, including identification of erythrocyte antigens and antibodies and their normal and abnormal immunology. Standard technical practices are used in evaluating blood typing, cross-matching, antibody detection, and preparation of blood components for transfusion. Safety control methods standard to efficient blood banking.

MLS 450 **Clinical Serology and Immunology - Lecture** **2 Credit Hours**

Description: Performance and interpretation of a broad range of clinical serological and immunological procedures with emphasis on principles and clinical correlation. Formal lecture series included

MLS 470 **Orientation and Basic Techniques - Lecture** **1 Credit Hour**

Description: For facilitation of students from campus to hospital community and clinical laboratory. Introduction to medical terminology, ethics, and health team concepts. Orientation to basic techniques including procedures for collection and handling of specimens, principles of operation of many laboratory instruments, review of laboratory math, and introduction to quality control procedures. Portions of the course extend over entire clinical year

MLS 480 **Principles of Supervision and Education in Management** **1 Credit Hour**

Description: Seminars in basic principles of management, supervision, and education theories and methods. Comprehensive examination covers entire course.

Clinical Laboratory Experiences

In each clinical laboratory course, students receive a set of objectives the student must fulfill during the clinical experience and a list of all procedures, instruments, and tests that must be observed, learned, and in most cases, performed competently during the clinical experience. During clinical experiences, students receive individualized instruction from clinical laboratory instructors in the laboratory section. Students perform tests using actual patient specimens under the direct supervision of instructors. Students become proficient in laboratory testing using a wide variety of laboratory techniques and instruments.

If during a clinical experience, for a reason beyond the control of the student and clinical laboratory instructors, the student is unable to observe or perform testing using a required procedure, instrument, or reagent, alternate assignments will be given to allow the student to fulfill the objective(s). Options include, but are not limited to:

1. Manual test procedures to observe and perform tests
2. Testing procedures on a similar instrument
3. Mock or archived specimens for which the test result is known
4. Student laboratory assignments
5. Opportunity to observe the procedure at an alternate site (as an observer only)
6. Virtual laboratory exercises using a computer in the student laboratory

Where possible, all students will be allowed to learn specified procedures in the clinical laboratory. Use of alternate learning experiences will be used only when conventional laboratory experiences are not possible.

General Course Objectives

The following course objectives are provided to allow applicants and current students to understand the nature of the course and scope of instruction in each course in the program. The general objectives do not intended to encompass the entire body of knowledge covered in the course.

MLS 410/MLS 411

MLS 410 and MLS 411 are required courses in the clinical microbiology progression. After completing the microbiology courses, the student will, with 78% accuracy:

1. Describe proper specimen collection, handling, and transport techniques for specific infectious diseases and/or body sites.
2. Explain the principle of the Gram stain and perform the test, describing what is seen, under the microscope, quantitating cells, and correctly describing organisms.
3. Explain principles involved in isolating bacteria, interaction of isolation media, and identification of bacteria by colonial growth and reactions on various identification media.
4. Explain principles involved in the MIC method of susceptibility testing.
5. Log cultures on the computer, properly labeling and numbering specimens, preparing a lab worksheet for all specimens, and checking set-up chart for media and proper procedure.
6. Using sterile technique, inoculate the specified media with specimen and make a direct smear when appropriate.

7. Streak agar plates for isolation and growth and place them in the specified incubator.
8. Set up cultures for anaerobes if specified on the set-up chart, using Gas pak pouches.
9. Read and interpret culture growths of specimens previously set up, set up the necessary biochemicals for identification of said organisms, and evaluate the organisms recovered for pathogenicity.
10. Perform serological slide agglutination tests according to the package insert for identification and confirmation of Salmonella and Shigella.
11. Identify suspicious colonies on the plates and set up necessary biochemicals for identification and interpret results.
12. Perform antimicrobial sensitivities using the MIC and tube methods.
13. Use knowledge of the various isolation, identification media, reactions which take place and the significance of each to correctly set up, isolate, identify, and determine sensitivity of organisms encountered in the laboratory.
14. Describe the acid-fast organisms encountered in clinical laboratories, correlating each with disease states each can produce and tests used in the isolation and identification of each.
15. Set up cultures for Mycobacteria on LJ media and MGIT tubes using decontamination and concentration methods when necessary, preparing slides for acid-fast staining.
16. Perform necessary tests to identify mycobacteria.
17. Describe morphologic characteristics of the clinically significant parasites infesting man.
18. Explain basic isolation techniques for examining parasites.
19. Microscopically examine pinworm preps, showing presence or absence of eggs.
20. Describe procedure and perform testing on stools, making a direct mount, performing necessary stains, and examining for and identifying trophozoites and cysts.
21. Concentrate specimen, making one wet prep slide for direct examination and one slide to be trichrome stained.
22. Examine slides for any ova or parasites, correctly identifying organisms and explaining life cycles and treatments.
23. State morphologic characteristics of the clinically-significant fungi, sketching and describing the forms.
24. Demonstrate correct biohood technique when handling mycology and mycobacteria specimens.
25. Set up cultures for fungi on appropriate media at both room temperature and 37°, examine and identify using appropriate media and biochemical tests.
26. Explain current laboratory methods in basic virology including cell culture and methods for the detection of viral antigens.
27. Clearly isolate each organism utilizing proper handling of pathogenic organisms to protect self and other laboratory scientists.
28. Demonstrate a professional attitude with patients, laboratory employees, and other health professionals encountered.

MLS 420 / MLS 421

MLS 420 and MLS 421 are required courses in the clinical chemistry progression. After completing the clinical chemistry courses, the student will, with 78% accuracy:

1. Perform basic maintenance, calibration, quality control, reagent inventory, and patient testing on chemistry instruments.

2. State principles, clinical significance, and reference range of each basic chemistry test covered.
3. Explain the use of each chemistry test, including clinical significance and test principle.
4. Correlate chemistry tests with organ system, function, and common disease states.
5. Explain the importance of acid-base balance, considering how balance is maintained, role of electrolytes and proteins in the process, and roles of kidneys and lungs in maintaining the balance.
6. Given case studies involving chemistry tests, determine the disease state or condition associated with the results.
7. Discuss toxicology and therapeutic drug monitoring with respect to test method, common drug names, substances measured, and conditions associated with the drugs.
8. Discuss the nature and action of hormones, considering organs producing the hormones and targets of the hormones, hormone testing including test use, result interpretation, reflexive testing protocols, and clinical conditions associated with abnormal results.
9. Discuss the roles of vitamins and minerals in health, and their use as cofactors in other laboratory quality control (QC) testing in chemistry, including frequency, levels, standard deviations, and validity of testing.
10. Perform and interpret QC testing in chemistry, troubleshooting when results are out of range.
11. Explain processes for analysis and validation of new test methods, including precision, sensitivity, specificity, quality control, method correlation, reference range validation, data collection, and statistical analysis.
12. Explain the SI unit of measurement, and given data, convert results to the SI units.
13. Apply Beer's law to interpretation of chemical analysis in the medical lab.
14. Explain the principles of testing in each chemistry and immunoassay instrument, including components, interferences, purpose of testing, benefits, and limitations.
15. Demonstrate correct calibration and use of pipettes.
16. Describe the chemical composition of carbohydrates, lipids, proteins, enzymes, and hormones.
17. For each system and category of chemistry tested, correlate analytes tested with test methodology, composition, clinical significance, and reference ranges.
18. Correlate all tests of renal, liver, intestinal, pancreatic, cardiac, protein, water maintenance, iron, and hemoglobin metabolism with methods, systems, reflex tests, and laboratory assessment of disease.
19. Correlate each test with specimen requirements and preanalytical, analytical, and postanalytical errors caused.
20. Perform calculations related to laboratory tests.
21. Explain enzyme kinetics and correlate to test methodologies.
22. Correlate wavelengths used in chemistry tests with test methods and interferences.
23. Explain interferences caused by hemolysis, icteria, and lipemia giving reasons for the interferences.

MLS 430 / MLS 431

MLS 430 and MLS 431 are required courses in the clinical hematology/urinalysis progression. After completing the hematology series, the student will, with 78% accuracy:

1. Demonstrate correct use of compound microscope, explaining the mechanisms of operation

2. List and describe specimen collection requirements for hematology, coagulation, urinalysis, and body fluid testing explaining preanalytical variables that adversely affect results.
3. Discuss anatomy, physiology, biochemistry, production, and maturation of erythrocytes, leukocytes, and thrombocytes.
4. Visually identify and list functions of hematologic cells found in blood and marrow.
5. Classify and discuss the etiologies of erythrocyte and leukocyte disorders.
6. Explain the use of hematology indices for quality control and identification of errors.
7. Identify cells based upon morphology and state if they are normal or abnormal, explaining why.
8. Classify and describe causes of disorders associated with abnormal blood or body fluid cells.
9. Describe all routine and special hematology, coagulation, urinalysis, and body fluid tests with respect to principles, procedures, and techniques, use, reference ranges, significance of the test, and clinical conditions in which abnormal results are found.
10. Calculate and interpret results for routine and special hematology, coagulation, urinalysis, and body fluid tests.
11. Discuss, perform, and interpret quality control testing on all hematology, coagulation, and urinalysis procedures.
12. Explain instrument operation principles and procedures for hematology, urinalysis, and coagulation.
13. Apply the basic principles, procedures, and techniques used for laboratory testing of urinalysis, body fluids, hematology, and coagulation procedures, including specimen collection, quality control, and sources of error.
14. Perform preventive and as-needed maintenance on hematology, coagulation, and urinalysis analyzers, effectively troubleshooting instrument problems.
15. Accurately perform all automated and manual hematology tests, including cell estimates, WBC differential counts, and hemacytometer counts.
16. For all hematology, coagulation, urinalysis, and body fluid tests, discuss the procedures for standardization/calibration, quality control, identification of system, random errors, validation of test results, alternative testing methods, and routine maintenance.
17. Explain how basic, specialized, and diagnostic lab tests are used in the diagnosis and management of disorders involving blood and body fluids and disorders of hemostasis.
18. Discuss the anatomy, physiology, formation, and functions of urine, cerebrospinal, serous, synovial, and seminal fluids.
19. Identify, either visually or from written description, normal, reactive, and malignant cells commonly found in blood, urine, and body fluids, and explain their significance.
20. Explain the structure and functions of the kidney.
21. Perform urinalysis dipstick testing, demonstrating proper technique to avoid testing errors.
22. State the principle for each physical and chemical urinalysis test.
23. Given a slide with microscopic urinalysis formed elements, identify the elements, state if they are abnormal, and identify the clinical condition(s) in which they are found.
24. Describe the appearance and composition of each of the following fluids, if normal: CSF, serous, synovial, semen, and amniotic, stating the function of each fluid.
25. Describe and perform the test for CSF cell count, WBC differential, protein, and glucose.
26. Calculate a sperm count when provided with the necessary raw data.
27. Classify joint disorders and associate with abnormal laboratory results.
28. Differentiate between transudate and exudates.
29. Discuss test interferences in hematology, urinalysis, and coagulation testing.
30. Calculate and interpret results for urinalysis, body fluid, hematology and coagulation tests.

31. For all hematology, urinalysis, coagulation, and body fluid testing, apply knowledge obtained in theory and case studies to correctly interpret patient results.
32. Correlate patient information with laboratory results to determine the validity of results obtained, and to determine if additional testing is needed.

MLS 440 / MLS 441

MLS 440 and MLS 441 are required courses in the clinical immunohematology progression. After completing the immunohematology courses, the student will, with 78% accuracy:

1. Describe preservation, storage techniques/temperature for whole blood and other blood components; list indications for use of each component and demonstrate preparation of selected components.
2. Describe ABO, Rh, and other common blood group systems considering genetics, subgroups, and test methods for each
3. Perform ABO, Rh, and other common blood group testing, interpret results and resolve discrepancies in testing for each system.
4. Discuss common problems encountered in compatibility testing with solutions for each.
5. Perform appropriate antibody identification panels and other techniques to identify compatible units.
6. Discuss symptoms and causes of transfusion reactions; list required testing for investigating transfusion reactions.
7. List steps in screening donors and obtaining and processing a unit of donor blood.
8. Discuss techniques used to diagnose, prevent, and treat hemolytic disease of the newborn.
9. List problems encountered in patients with autoimmune hemolytic anemia and paraproteinemias, including techniques for solving them.
10. Describe techniques used in blood bank for reagent and equipment QC.

MLS 450

Immunology / Molecular Diagnostics MLS 450:
After completing MLS 450, the student will, with 78% accuracy:

1. Describe the body's natural barriers against harmful agents.
2. Distinguish specific and non-specific response to foreign materials.
3. Outline and describe the process of B and T cell maturation and proliferation.
4. Describe classification of immunoglobulins, explaining the origin and purpose of each.
5. List components of complement describing the two complement pathways.
6. Describe six factors which effect antigen-antibody reactions in vivo.
7. Differentiate between cell-mediated and humoral immunity describing each process.
8. Explain the responses and response time for primary and secondary immune response, correlating with classifications of immunoglobulins involved at each stage.
9. Explain antigen presentation mechanism for T and B cells.
10. Correlate the CD markers used for flow cytometry with diseases or clinical conditions.
11. Explain the test principle, procedure, and special consideration for flow cytometry testing.
12. Describe the various mechanisms of immune response regulation.
13. Explain the process for hypersensitivity reactions.

14. Differentiate primary and secondary immunodeficiency disease.
15. Outline mechanisms that help explain the etiology of autoimmune disease.
16. Describe the mechanism of immunity to microbes, tumors, and transplantation.
17. Discuss the ANA test and the interpretation of results, correlating result patterns with clinical disease states for both fluorescent ANA and ELISA testing.
18. Discuss methodologies for in-vivo testing for patient immune function
19. Discuss special considerations needed for pediatric, geriatric, and immunocompromised patients in serologic testing.
20. Explain the principle and purpose of test methods for agglutination, hemagglutination, EIA, EMIT, ELISA, FPIA, MEIA, electrophoresis, and immunofixation.
21. For each test methodology, outline procedure steps, state the purpose of reagents, and explain interfering substances.
22. Explain diagnostic sensitivity, diagnostic specificity, positive and negative predictive values, giving formulas for each.
23. Perform each immunology test using proper technique, pipetting, and procedures.
24. Interpret test results and give clinical significance of abnormal results for clinical serology and immunology procedures.
25. Perform serial dilutions for immunology testing.
26. Explain the RPR test principle, steps in the procedure, results, interferences, interpretation, and confirmation testing.
27. Describe the importance of serological testing in diagnosis of autoimmune disease, giving examples of specific tests
28. Describe the currently used tests for syphilis, HIV, and hepatitis, comparing their usefulness at various stages of the diseases.
29. Define basic terminology in molecular diagnostics
30. Describe concepts that provide the foundation for implementing and adapting new techniques and assays.
31. Describe nucleic acid chemistry: replication, transcription, and translation.
32. Explain the principle of nucleic acid isolation from blood and solid tissues.
33. Explain extraction, purification, quantification, and storage of DNA and RNA for analysis.
34. Explain the principle of polymerase chain reaction (PCR), reverse transcriptase PCR, and other amplification techniques.
35. Perform PCR and real-time PCR.
36. Explain the principle of nucleic acid electrophoresis and hybridization including Southern and Northern blots.
37. Perform representative electrophoresis techniques.
38. Explain preparation of nucleic acid probes and analysis.
39. Explain the principle of fluorescent in situ hybridization (FISH).
40. Explain DNA chip technology and other advanced methods.
41. Interpret results in context of other laboratory and clinical data.
42. Apply molecular diagnostic techniques in the diagnosis of microbiological, hematological, thrombotic, and genetic disorders.
43. Explain comparison and selection of appropriate molecular diagnostic methods.
44. Explain steps needed in implementing molecular testing in the laboratory.
45. Discuss ethical considerations of molecular test results such as privacy and discrimination.

MLS 470

MLS 470: Orientation to the Laboratory
After completing MLS 470, the student will, with 78% accuracy:

1. Describe policies to ensure professional and ethical conduct in a medical center.
2. Explain medical ethics, giving examples of unethical conduct.
3. Describe the components necessary in providing exceptional patient care.
4. List and explain each type of isolation, giving requirements for each, and organisms, conditions, or diseases requiring the isolation.
5. Explain the importance of following infection control procedures.
6. Define standard precautions and universal precautions, differentiating between them.
7. Describe the requirements for fire safety, explaining meaning and use of acronyms.
8. Demonstrate the use of SDS showing where information is found.
9. Explain proper labeling of chemicals, explaining the NFPA diamond.
10. Demonstrate proper use, storage, labeling, and discarding of biohazard materials.
11. Demonstrate proper use of PPE in laboratory settings.
12. List what cannot be taken into laboratory settings explaining why.
13. Demonstrate proper phlebotomy skills.
14. Explain preanalytical variables that affect patient test results.
15. List blood collection tubes, correlating color of cap, anticoagulant, order of draw, fill volume, and use.
16. Explain hazards to patient and caregiver of improper phlebotomy techniques.
17. Demonstrate capillary and venipuncture collections.
18. Demonstrate use of vacutainer and syringe in collections.
19. Given laboratory data, perform necessary laboratory calculations.
20. Explain use of quality control, quality assurance, and quality indicators in the laboratory.
21. List Westgard rules, explaining the use of each, and if the error is random or systematic.
22. Given quality control data, use Westgard rules to determine acceptability.
23. State required frequency of quality control for given tests.
24. Troubleshoot QC problems, providing corrective action for out-of-range results.

MLS 480

Laboratory Management MLS 480: After completing MLS 480, the student will, with 78% accuracy:

1. Define CLIA, explaining the origin, purpose, type and extent of regulations, governmental organization that oversees CLIA, and methods of enforcement of standards.
2. Explain waived, moderate and high complexity testing, and PPM as they relate to laboratory testing, providing examples of each type of test.
3. List the agencies that inspect laboratories, explaining the function of each, frequencies of inspections, criteria, and consequences of noncompliance with standards.
4. Explain the purpose of safety standards in the laboratory, agencies that regulate and enforce safety standards, and how it applies to the clinical laboratory.

5. Describe proficiency testing, explaining CLIA regulations, regulated and nonregulated tests, frequency of testing, agencies that provide proficiency testing, and consequences of failing proficiency testing.
6. Describe teambuilding in the laboratory, considering interpersonal and interdisciplinary communication, methods of teambuilding, and barriers to success.
7. Explain conflict and stress management, considering techniques, challenges, and coaching.
8. Describe principles and application of ethics to the medical setting, clinical laboratory setting and employees.
9. Explain professionalism of clinical laboratory scientists, considering principles, application, characteristics, and challenges faced.
10. Describe elements of professional career development, explaining ways of maintaining professionalism.
11. Identify education techniques for training students and new employees in the clinical laboratory, using objectives, criteria, and evaluations.
12. Describe methods of encouraging continuing education of staff including participation in professional organizations.
13. Demonstrate knowledge of research design and practice necessary to evaluate published studies as an informed consumer.
14. Identify critical pathways in the general medical and laboratory settings.
15. Explain how clinical decision making is utilized in laboratory management, as well as at the clinical laboratory bench.
16. Describe standards and requirements for employee performance improvement, providing components, coaching, planning, and evaluating.
17. Describe dynamics of healthcare delivery systems as they affect laboratory services.
18. Explain human resource management, including creating job descriptions, performance evaluation, efficient utilization of personnel, mentoring of personnel, analysis of workflow, and scheduling, analyzing, and improving staffing patterns.
19. Explain financial management as it applies to the laboratory, considering profit and loss, cost/benefit analysis, reimbursement, compliance, materials management.