# MLT-2990: ADVANCED MLT APPLICATIONS

## Cuyahoga Community College

### Viewing: MLT-2990 : Advanced MLT Applications

**Board of Trustees:**

January 2022

**Academic Term:**

Fall 2022

**Subject Code**

MLT - Medical Laboratory Technology

**Course Number:**

2990

**Title:**

Advanced MLT Applications

**Catalog Description:**

Manual laboratory skills related to clinical chemistry, hematology, coagulation, body fluids, microbiology, parasitology, mycology, immunohematology/serology are refined. The operation and maintenance of laboratory equipment, function verification, analysis of quality control and application of corrective action is studied and performed. Emphasis on organization, increased speed, accuracy, confidence and independent performance. Case studies are analyzed, data interpreted and findings are correlated to clinical significance and differential diagnoses. Advanced concepts in parasitology, mycology, immunohematology/serology, principles of education, molecular diagnostics, point of care, information systems and troubleshooting are introduced.

**Credit Hour(s):**

6

**Lecture Hour(s):**

1

**Lab Hour(s):**

15

### Requisites

**Prerequisite and Corequisite**

MLT-1000 Introduction to Medical Laboratory Technology, MLT-1491 Urinalysis and Body Fluids, MLT-2461 Hematology, MLT-2471 Immunohematology, MLT-2501 Clinical Chemistry, and concurrent enrollment in MLT-2482 Clinical Microbiology and departmental approval.

### Outcomes

**Course Outcome(s):**

Perform activities related to professional behavior, test analyses, instrument maintenance, interpersonal relations, regulatory agencies, assessment and evaluation and general laboratory outcomes such as:

**Objective(s):**

1. Obtain skill competency check-off list and verification of completion all assignments.
2. Perform all necessary quality controls (QC) within specified ranges.
3. Perform all troubleshooting functions to attain a satisfactory outcome.
4. Document all quality control, function verification, maintenance, troubleshooting.
5. Demonstrate safe and accountable behaviors in accordance with College of American Pathologists (CAP) and Occupational Safety and Health Administration (OSHA).
6. State the reference and critical ranges for each test.
7. Recognize proper samples for testing, and causes for rejection.
8. Identify sources of interferences in testing.
9. Assess test results by correlating laboratory data with other essential data.
10. Evaluate laboratory data to assure personnel safety.

11. Check for common procedural/technical problems in laboratory data.
12. Organize supplies, samples, instruments etc. to provide most efficient workflow.
13. Recognize and report abnormal test restults and/or the need for additional testing based on laboratory data.
14. Recognize possible inconsistent results/sources of error in laboratory data.
15. Recognize related disease states.
16. Evaluate laboratory data and take corrective action according to predetermined criteria.
17. Indentify critical values and apply appropriate reporting protocol and documentation.
18. Verify test results for reporting.
19. Organize workflow allowing for multitasking, optimize time.
20. Minimize waste of supplies and reagents.
21. Apply prior knowledge and skills to attain speed in performing testing with accuracy, precision, and with minimal supervision.
22. Work independently as required and as a team member if required.
23. Effectively communicate with peers and staff, written and verbally.
24. Perform all function verification and maintenance tasks as appropriate.
25. Perform all start-up and shut-down/clean-up functions as appropriate.

---

**Course Outcome(s):**

Perform phlebotomy procedures.

**Objective(s):**

1. Assess subjects for suitable venipuncture/capillary sites.
2. Perform blood collection in accordance with Clinical and Laboratory Standards Institute (CLSI) standards of care.
3. State the proper order of draw and type of tube for given tests.
4. State the stipulations of the Health Insurance Portability and Accountability Act (HIPAA), including what constitutes protected health information (PHI).

---

**Course Outcome(s):**

Utilize skills to perform urinalysis and body fluid procedures.

**Objective(s):**

1. Select and apply appropriate confirmatory tests and interpret accurately.
2. Perform microscopic urinalysis comparing results with laboratory data.
3. Perform manual cell counts on body fluids comparing results with laboratory data.
4. Recognize sources of error in testing, and apply appropriate troubleshooting skills.

---

**Course Outcome(s):**

Perform functions in microbiology

**Objective(s):**

1. Perform identification from planting through identification (ID) and susceptibility on unknown samples.
2. Operate the Microscan or other instrumentation.
3. Correlate manual tube identification, API brand strip and Microscan results.
4. Perform acid-fast bacilli (AFB) sputum digestion (N-acetyl cysteine) on simulated sample.

---

**Course Outcome(s):**

Discuss and/or perform functions related to general laboratory operations.

**Objective(s):**

1. Draw flow chart of pre-analytical, analytical and post-analytical processes.
2. Research and discuss new concepts and principles in laboratory testing.
3. Review and apply principles of quality control and quality assurance.
4. Determine course of action based on Westgard rules by analyzing quality control data.
5. Analyze data for source and type of error, and select appropriate corrective action.
6. Explain a new test method selection/validation studies and interpret associated parameters.
7. Determine method sensitivity and specificity by calculating associated parameters and analyzing data.

8. Review the CAP checklist and inspect a local laboratory.
9. State the standard sections and information which should be found in a procedural method.
10. Prepare a solution of a given concentrations by following standard operating procedures.
11. Correctly manipulate serologic and volumetric manual pipettes; automatic fixed and automatic adjustable pipettes.
12. Perform accurate pipette calibrations.
13. Properly operate the analytical balance (to the milligram place)
14. Properly operate the pH meter.
15. Observe the operation of the autoclave, noting safety protocol.
16. Observe the walk-in refrigerator; note the temperature controls and proper documentation.
17. State the function of the biomedical engineering department in a hospital.
18. Identify laboratory journals and review articles as assigned.
19. Recall the implications of correct coding and ordering of laboratory procedures and add-ons.
20. Describe and/or perform functions of information systems.

---

**Course Outcome(s):**

Perform specific techniques, identifications and interpret results in mycology.

**Objective(s):**

1. Accurately identify mycology organisms from photos/slides.
2. Perform lactophenol cotton blue (CB) test, and accurately interpret results.
3. Demonstrate wet prep technique for yeast.

---

**Course Outcome(s):**

Perform specific techniques and identification of organisms in parasitology.

**Objective(s):**

1. Accurately identify parasitic organisms from photos/slides.
2. Perform testing for the identification of giardia/cryptosporidium.
3. Perform Scotch tape preps for enterobius vermicularis for identification.
4. Demonstrate wet prep technique for trichomonas.

---

**Course Outcome(s):**

Perform selected Point of Care Testing (POCT).

**Objective(s):**

1. Perform tests using selected kits and instrumentation.
2. Employ quality control protocol.
3. Review results comparing data for accuracy.
4. Perform troubleshooting when necessary and follow up on issues.
5. Compare and contrast POCT methods to alternative methods, including sensitivity and specificity.
6. Discuss how results are reported and stored.

---

**Course Outcome(s):**

Discuss educational terms and methodologies.

**Objective(s):**

1. Describe the characteristics and qualities of an effective instructor.
2. Define basic educational terms
3. Explain the purpose and use of the three domains of learning, citing examples.
4. Explain the purpose and use of the three modified taxonomy levels for the cognitive domain.
5. Demonstrate laboratory technical skills to other laboratory personnel, and evaluate performance and comprehension.
6. Diagram the steps in the performance of a technical skill/procedure.
7. Construct five objectives in each the three domains for a technical skill.
8. Make an evaluation tool consisting of five questions in the cognitive domain at various taxonomy levels, stating the level for each question.

9. Evaluate five technical skills/components of skill sets by designing a checklist to evaluate the psychomotor domain.
10. Evaluate five affective domain qualities in a bench instructor performing technical instruction by creating an evaluation checklist.

---

**Course Outcome(s):**

Describe the Laboratory Information System (LIS).

**Objective(s):**

1. Determine the requirements for an LIS based on size laboratory.
2. Describe data acquisition and transfer.
3. Describe the daily and cyclic monitoring and maintenance.
4. Describe the security systems in place for the LIS.
5. Describe the back-up systems and contingency plans for system down time.
6. Describe the possible LIS output content and forms of output.
7. Describe interfaces to other systems.
8. Describe the functions of middleware and its applications.
9. Describe reflexive testing, stating examples.
10. Use the Electronic Health Record (EHR)
11. Train on the proper use of the EHR.
12. Procure/create and input various case studies into the EHR.
13. Utilize the EHR for mock lab data.
14. Apply critical thinking skills to solve case studies.

---

**Course Outcome(s):**

Discuss professional behaviors.

**Objective(s):**

1. State the importance of promptly arriving at the lab/returning to the lab after breaks.
2. State the importance of documentation in all function verification, preventive, maintenance, trouble logs, and shift logs, etc.
3. Describe the significance of performing proficiency testing and indicate when to perform.

---

**Course Outcome(s):**

Employ skills used in clinical chemistry.

**Objective(s):**

1. Perform serial dilutions, correctly calculate the final concentration, and state the dilution factor.
2. Perform start up and function verification of equipment and instrumentation, and document.
3. Properly operate all given instruments and equipment to obtain valid laboratory results.
4. Perform standardization, calibration, and controlling functions, and document properly.
5. Perform function verification and start up a spectrophotometer; properly use it for readings.
6. Recognize the need for dilutions, and apply the appropriate dilution techniques.
7. Properly prepare standard curve on graph paper, obtaining correct unknown results.
8. State the limitations of each procedure.
9. Recognize out of control situations and apply appropriate troubleshooting techniques.
10. Discuss case histories; analyze tests results then correlate with disease state.
11. Use critical thinking skills to troubleshoot case and lab studies, and apply corrective actions.

---

**Course Outcome(s):**

Employ skills used in hematology/coagulation.

**Objective(s):**

1. Perform manual cell counts within stated accuracy and precision limits.
2. Perform differential counts on normal and abnormal smears within 10% of known values.
3. Identify disease based on results of complete blood count (CBC)/differential counts performed on abnormal smears.
4. Perform sickle cell screen, sedimentation rates, manual reticulocytes, blood smear prep.
5. Discuss case histories; analyze tests results then correlate with disease state.

6. Process a run of samples by operations automated coagulation instruments, including setup, QC, and output of results.
7. Process advanced coagulation studies as available and correlate results to disease state.
8. Use critical thinking skills to troubleshoot case and lab studies, and apply corrective actions.

---

**Course Outcome(s):**

Perform advanced procedures in immunohematology.

**Objective(s):**

1. Confirm common causes of transfusion reactions encountered in the laboratory.
2. Perform routine manual and gel typing studies, within acceptable limits.
3. Set-up and operate the gel system according to standard operating procedures.
4. Interpret investigation results of a transfusion reaction.
5. Perform and interpret a direct antiglobulin test (DAT) from a pre and post transfusion sample for a transfusion workup.
6. Repeat type, screen and cross match on pre and post transfusion samples to determine if a transfusion reaction is due to an alloantibody.
7. Discuss case histories correlating test results with probable cause of disorder.
8. Perform necessary follow-up procedures to troubleshoot problems.
9. Perform antibody screens as necessary, within acceptable limits.
10. Discuss special studies and procedures related to transplants- donor and recipient criteria and Human Leukocyte Antigen (HLA).

---

**Course Outcome(s):**

Perform functions in molecular diagnostics.

**Objective(s):**

1. Perform start up and function verification procedures for the thermo cycler.
2. Research and perform a routine Polymerase Chain Reaction (PCR) application using the thermo cycler.
3. Describe and/or utilize separation techniques (like electrophoresis) to identify output.

---

**Methods of Evaluation:**

1. Quizzes, oral and written
2. Presentations
3. Observation of laboratory performance
4. Practical competency evaluation
5. Final written exam
6. Final laboratory competency practical exam

**Course Content Outline:**

1. Professional behavior, test analyses, instrument maintenance, interpersonal relations, regulatory agencies, assessment and evaluation
   a. Competency checklist and completion verification
   b. Organization for optimum workflow
   c. Multitasking through time optimization
   d. Efficient use of supplies and reagents
   e. Speed and accuracy in test performance
   f. Independent and team member performance
   g. Written and verbal communication with staff and peers
   h. Verification and maintenance functions
   i. Operational and maintenance functions
   j. Quality Control
   k. Effective trouble shooting
   l. Documentation of all laboratory operations including problem solving
   m. Observation of CAP and OSHA regulations
   n. Reference and critical ranges for tests
   o. Rational for accepting or rejecting a sample for testing
   p. Sources of interference in testing

q. Test assessment
    i. Clinical or other laboratory data
    ii. Physiologic processes
    iii. QC data
    iv. Alternative methodologies
r. Evaluation of laboratory data
    i. Personal safety
    ii. Procedural/technical problems
    iii. Abnormal results and additional follow-up testing
    iv. Inconsistent results or errors
    v. Disease state relationships
    vi. Protocol for corrective action
    vii. Reporting protocol and documentation of critical values
    viii. Test result verification

2. General laboratory
    a. Flow chart of pre-analytical, analytical and post-analytical processes
        i. Test coding and ordering
        ii. New concepts in laboratory testing
            1. Nanotechnology
            2. Robotics
            3. Molecular diagnostics
        i. Principles of quality control and quality assurance
            1. Course of action
            2. Error identification and corrective action
            3. Method selection and validation studies
        ii. CAP Checklist and inspection
        iii. Procedure manuals/methods
        iv. Reagent/control preparation
        v. Pipette manipulations
        vi. Pipette calibrations
        vii. Operation of analytical balance
        viii. Operation of pH meter
        ix. Operation of autoclave
        x. Documentation for walk-in refrigerator
        xi. Function of biomedical engineer
        xii. Laboratory journals and review articles
3. Information Systems
    a. Laboratory Information System (LIS)
        i. Size requirements for an LIS
        ii. Data acquisition and transfer
        iii. Monitoring and maintenance
        iv. Security systems
        v. Back-up systems and contingency plans
        vi. LIS output content and forms of output
    b. Interfaces to other systems
    c. Middleware and its applications
    d. Reflexive testing
    e. Electronic Health Record (EHR)
        i. Use of an EHR
        ii. Case studies and EHR
        iii. EHR and mock lab data
        iv. Case studies solutions
4. Clinical Chemistry
    a. Serial dilutions
    b. Documentation of equipment start up and instrument function verification
    c. Valid laboratory results
    d. Documentation of standardization, calibration and QC
    e. Operation of spectrophotometer

   f. Dilutions and dilution techniques
   g. Use of a standard curve
   h. Procedure limitations
   i. Troubleshooting out of control situations
   j. Case histories and disease state
   k. Corrective actions in simulations and lab studies
5. Hematology/Coagulation
   a. Manual cell counts
   b. Normal and abnormal smears
   c. Disease identification from abnormal smears
   d. Sickle cell screen, sedimentation rates, manual reticulocytes, blood smear prep
   e. Case histories and disease correlation
   f. Operation of automated coagulation instruments
   g. Advanced coagulation studies and disease correlation
   h. Troubleshoot case histories and lab studies
6. Immunohematology
   a. Analysis of transfusion reactions
      i. Manual and gel typing studies
      ii. Gel system SOP
      iii. Investigation of results
      iv. DAT from pre & post transfusion workup
      v. Alloantibody
   b. Follow-up procedures for problems
   c. Antibody screens
   d. Special Studies and Procedures
      i. Transplants
      ii. Human Leukocyte Antigen (HLA)
   e. Case studies and disease correlation
7. Molecular Diagnostics
   a. Thermo cycler verification and start-up
   b. Thermo cycler for PCR
   c. Separation techniques
8. Phlebotomy procedures
   a. Suitable venipuncture/capillary sites.
   b. Blood collection
   c. Order of draw and tube for given tests
   d. HIPAA law and PHI
9. Urine and body fluids analyses.
   a. Manual cell counts on body fluids
   b. Microscopic urinalysis
   c. Trouble shoot sources of error in testing
   d. Confirmatory tests
10. Microbiology
   a. Identification and susceptibility
   b. Microscan or instrumentation
   c. Microscan results, manual tube identification and API strip correlation
   d. Simulated sample for AFB Sputum digestion (N-acetyl cysteine)
11. Mycology
   a. Mycology organisms from photos/slides
   b. Lacto phenol Cotton Blue (CB) tests
   c. Wet prep technique for yeast
12. Parasitology
   a. Parasitic organisms from photos/slides
   b. Giardia/cryptosporidium
   c. Scotch tape preps for enterobius vermicularis
   d. Wet prep for trichomonas
13. Point of Care Testing (POCT)

a. Kits and instrumentation
b. Quality control protocol
c. Accuracy of data
d. Issues and troubleshooting
e. Point of care methods versus alternative methods
f. Reporting and storage of results

14. Educational terms and methodologies
    a. Characteristics and qualities of an effective instructor
    b. Educational terms:
        i. Competence or competency
        ii. Objectives/outcomes
        iii. Curriculum
        iv. Articulation
        v. Continuing education unit (CEU)
        vi. Accreditation
        vii. Certification
        viii. Licensure
        ix. Registration
        x. Evaluation
    c. Three domains of learning
        i. Cognitive
        ii. Psychomotor
        iii. Affective
    d. Modified taxonomy levels for the cognitive domain
        i. Level 1: Recall of information (knowledge)
        ii. Level 2: Interpret -Understand information and applying it to other material or new
        iii. situations (comprehension/application)
        iv. Level 3: Problem solving (analysis/synthesis/evaluation)
    e. Instruction and evaluation
        i. Technical skill/procedure
        ii. Objectives for a technical skill
        iii. Evaluation tool
        iv. Checklist for psychomotor evaluation
        v. Evaluation checklist for instructor
15. Professional behaviors
    a. Break time responsibility
    b. Importance of documentation
    c. Proficiency testing and the quality of laboratory data

## Resources

ASCP Board of Certification. *Board of Certification Study Guide - Clinical Laboratory Certification Examinations*. 6th. Chicago, IL: ASCP Press, 2018.

Lehman, Donald and Chiasera, Janelle. *Success! In Clinical Laboratory Science*. 5th. NY, NY: Pearson, 2020.

Strasinger, Susan King and Di Lorenzo, Marjorie Schaub. *Urinalysis and Body Fluids*. 7th. Philadelphia, PA: F. A. Davis Company, 2021.

Carr, Jacqueline. *Clinical Hematology Atlas*. 6th. Independently published, 2021.

Ciesla, Betty. *Hematology in Practice*. 3rd. Philadelphia, PA: F.A. Davis Company, 2018.

Harmening, Denise. *Modern Blood Banking and Transfusion Practices*. 7th. Philadelphia, PA: F.A. Davis, 2019.

Miller, Linda and Stevens, Christine Dorresteyn. *Clinical Immunology and Serology: A Laboratory Perspective*. 5th. Philadelphia, PA: F.A. Davis, 2021.

Mahon, Connie and Lehman, Donald . *Textbook of Diagnostic Microbiology*. 6th. St. Louis, MO: Elsevier, 2019.

Sunheimer, Robert and Graves, Linda. *Clinical Laboratory Chemistry (Pearson Clinical Laboratory Science Series)*. 2nd. NY, NY: Pearson, 2018.

Turgeon, Mary Louise. *Linné & Ringsrud's Clinical Laboratory Science : Concepts, Procedures, and Clinical Applications*. 8th. St. Louis, MO: Elsevier, 2019.

Doucette, Lorraine. *Mathematics for the Clinical Laboratory*. 4th. St.Louis, MO: Elsevier, 2021.

Top of page
Key: 3028