Medical Laboratory Technology

(Medical Laboratory Technology | Medical Laboratory Technology Support Assistant | Phlebotomy Technician)

Mississippi Curriculum Framework

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The Office of Curriculum and Instruction (OCI) was founded in 2013 under the Division of Workforce, Career, and Technical Education at the Mississippi Community College Board (MCCB). The office is funded through a partnership with The Mississippi Department of Education (MDE), who serves as Mississippi's fiscal agent for state and federal Career and Technical Education (CTE) Funds. The OCI is tasked with developing statewide CTE curriculum, programming, and professional development designed to meet the local and statewide economic demand.

For information, please contact curriculum@mccb.edu

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ADOPTION OF NATIONAL CERTIFICATION STANDARDS

The following national certifications have been adopted for the Medical Laboratory Technology curriculum: ASCP©. Board of Certification Medical Laboratory Technician, MLT (ASCP©) and International Medical Laboratory Technician MLT (ASCP©).

The ASCP©. Board of Certification (BOC) is a recognized leader in certification of medical laboratory professionals. By earning credentials from the ASCP©. BOC, laboratory professionals demonstrate their competence to carry out their responsibilities in this critical profession. In turn, they reap the benefits of better job prospects, higher salaries and the respect of colleagues. Long considered the "gold standard," BOC certification is sought out by seven times as many laboratory professionals as any other lab professional credentialing organization.

Industry Credentials, Certifications, And Professional Licensure

See the "Industry Credentials, Certifications, and Professional Licensure"
https://www.mccb.edu/assessment

Industry Job Projection Data

A summary of occupational data is available from the Mississippi Department of Employment Security.
https://mdes.ms.gov/information-center/labor-market-information/

Articulation

Check with the local community college CTE administration for articulation agreements.

Dual Enrollment

See the "Procedures Manual for Dual Enrollment and Accelerated Programs"
http://www.mississippi.edu/cjc/dual_enrollment.asp

Research Abstract

In the spring of 2023, the Office of Curriculum and Instruction (OCI) met with the different industry members who made up the advisory committees for the Medical Laboratory Technology program. An industry questionnaire was used to gather feedback concerning the trends and needs, both current and future, of their field. Program faculty, administrators, and industry members were consulted regarding industry workforce needs and trends.

Industry advisory team members from the colleges involved with this program were asked to give input related to changes to be made to the curriculum framework. Specific comments related to fundamental skills needed in this program include having the capability of performing testing, ability to lift 20 pounds, critical thinking skills, ability to multi-task, able to interview under a behavior based interview, positive attitude, be able to work different shifts, competence, legible handwriting, and computer skills and must be organized. Pre-employment requirements stated include Medical Laboratory Technician certification, graduate of a NAACLS accredited program, passed background check and drug screening, 2 or 4-year program of study and maintain 36 hours of CEU's every 3-4 years for everyone entering the field after 2004. Most hospitals require ASCP©. eligibility or certification to hire.

Based on industry visits, the need was identified for clinical hour breakouts with flexibility in clinical hour scheduling. Therefore, colleges now have 2 options for clinical course scheduling. A breakdown of the clinical course sequences is listed below. Both options are equal in overall student learning outcomes, semester credit hours, and clinical hours. Please see course pages for student learning outcome details.

Clinical Course Sequence – Option 1

Course Number	Course Name	Semester Credit Hours	Lecture Hours	Clinical Hours	Total Contact Hours
MLT 2916	Clinical Practice I	4-6	0	12-18	180-270
MLT 2925	Clinical Practice II	4-5	0	12-15	180-225
MLT 2935	Clinical Practice III	4-5	0	12-15	180-225
	Totals	12-16	0	36-48	540-720

Clinical Course Sequence – Option 2

Course Number	Course Name	Semester Credit Hours	Lecture Hours	Clinical Hours	Total Contact Hours
MLT 2944	Clinical Practicum I	3-4	0	9-12	135-180
MLT 2954	Clinical Practicum II	3-4	0	9-12	135-180
MLT 2964	Clinical Practicum III	3-4	0	9-12	135-180
MLT 2974	Clinical Practicum IV	4	0	9-12	135-180
	Totals	12-16	0	36-48	540-720

Revision History:

2011, Revised, Research and Curriculum Unit, Mississippi State University
2017, Revised, Office of Curriculum and Instruction, Mississippi Community College Board
2023, Revised, Office of Curriculum and Instruction, Mississippi Community College Board

Program Description

The **Medical Laboratory Technology Medical Lab Support Assistant Pathway** is a 30-hour certificate emphasizing laboratory entry-level skills to include safety standards, infection control, quality assurance, and healthcare communication. The Medical Laboratory Technology Medical Lab Support Assistant plays an essential role in healthcare. Assisting other medical laboratory professionals, they are responsible for collecting, testing, measuring, recording, and analyzing specimens in cooperation with the rest of the laboratory team. These assistants work in a variety of settings, including physician's offices, hospitals, clinics, corporate laboratories and other medical testing facilities. This program is designed to help students prepare for the Certified Medical Laboratory Assistant (CMLA) exam by American Medical Technologists (AMT).

The **Medical Laboratory Technology Program** curriculum is a 2-year Associate of Applied Science degree program of study that prepares individuals to work in a medical laboratory. As members of the health-care delivery team, clinical laboratory personnel are responsible for assuring reliable and accurate laboratory test results that contribute to the diagnosis, treatment, prognosis, and prevention of physiological and pathological conditions. This program is designed to meet the standards and requirements for careers in clinical laboratory science. At career entry, the medical laboratory technician will be able to perform routine clinical laboratory tests (such as hematology, clinical chemistry, immunohematology, microbiology, serology/immunology, coagulation, molecular, and or emerging diagnostics) as the primary analyst making specimen oriented decisions on predetermined criteria. Upon successful completion of the AAS program, the student will be eligible to take a national certification examination. This program is accredited by the National Accrediting Agency for Clinical Laboratory Science (NAACLS), 5600 North River Road, Suite 720, Rosemont, IL, 60018, and (773) 714-8880.

The **Phlebotomy Technician Program** curriculum is a 15-hour, 1-semester certificate program of study that prepares individuals to work in a hospital or other healthcare setting. As members of the health-care delivery team, phlebotomy technician personnel are responsible for the collection, transport, and processing of blood and non-blood specimens for analysis. Phlebotomy personnel perform venipunctures and capillary punctures and perform waived and point of care testing using standard protocol, adhering to all standards governing patient and employee safety. Phlebotomy personnel display ethical and moral attitudes and principles and good communication skills to gain and maintain the confidence of patients, professional associates, and the community. This program is designed to meet the standards and requirements for careers in phlebotomy. At career entry, the phlebotomy technician will be able to demonstrate entry-level competencies in the areas of infection control and safety, information systems as they relate to job responsibilities, collection and transportation of blood specimens via venipuncture and capillary puncture, explain and perform the collection and transport of non-blood specimens, perform waived and point-of-care testing, and have a basic understanding of age-specific or psycho-social considerations related to patients, identification of pre-analytical errors, phlebotomy collection equipment, anatomy and physiology of body systems, quality assurance, along with professional communication skills.

Medical Laboratory Technology Pathway Options

Medical Laboratory Technology Support Assistant

Course Hours	Certificate/Degree
30- hour	Career Certificate
Total 60-63 hours	MLT AAS Degree

Medical Laboratory Technology

Course Hours	Certificate/Degree
45-48 hours	No exit certificate
15 hours Academic	No exit certificate
Total 60-63 hours	MLT AAS Degree

Phlebotomy Technician Pathway Options

Phlebotomy Technician 15-hour certificate

Course Hours	Certificate/Degree
15 hours	Career Certificate

*Phlebotomy is a 15-hour certificate. Upon re-enrollment, PBT 1113 and PBT 1123 may count as electives for MLT-SA and MLT.

**** Students that complete this option must re-apply to the above option.**

SUGGESTED COURSE SEQUENCE – Medical Laboratory Technology Support Assistant

30-hour Career Certificate Required Courses

			SCH Breakdown				Certification Information
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Clinical	Total Contact Hours	Certification Name
MLT 1112 PBT 1113 PBT 1123	Fundamentals of Medical Laboratory Technology/Phlebotomy **OR** Phlebotomy **and** Phlebotomy Practicum	2	1	2		45	Certified Medical Lab Assistant (CMLA) through the AMT
MLT 1212	Urinalysis/ Body Fluids	2	1	2		45	
MLT 1313	Hematology I	3	2	2		60	
MLT 1515 MLT 1532 MLT 1543	Clinical Chemistry **OR** MLT Chem I and MLT Chem II	5	3	4		105	
	Clinical Course Sequence**	3-4			9-12	145-180	
	Math Elective*	3					
	Biological Science Elective*	3-4					
	Chemistry Elective*	3-4					
	Instructor Approved Electives	3-6					
	TOTAL	**30 hours**					

Medical Laboratory Technology, AAS (includes completing the 30-hour career certificate outline)

			SCH Breakdown				Certification Information
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Clinical	Total Contact Hours	Certification Name
MLT 1324	Hematology II	4	2	4		90	ASCP©. Board of Certification Medical Laboratory Technician, MLT (ASCP©.) And International Medical Laboratory Technician MLT (ASCP©). American Medical Technologists (AMT)
MLT 1413	Immunology/ Serology	3	2	2		60	
MLT 2424	Immunohematology	4	2	4		90	
MLT 2522	Pathogenic Microbiology I	2	1	2		45	
MLT 2614	Pathogenic Microbiology II	4	2	4		90	
	Clinical Course Sequence**	9-12	0	0	27-36	405-540	
	Instructor Approved Electives	1-4					
	Totals	**30**					

**Total clinical courses minimum of 12 hours for AAS option.

SUGGESTED COURSE SEQUENCE – Medical Laboratory Technology

Medical Laboratory Technology Required Courses

			SCH Breakdown				Certification Information
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Clinical	Total Contact Hours	Certification Name
MLT 1112 PBT 1113 PBT 1123	Fundamentals of Medical Laboratory Technology/Phlebotomy **OR** Phlebotomy **and** Phlebotomy Practicum	2	1	2		45	ASCP©. Board of Certification Medical Laboratory Technician, MLT (ASCP©.) and International Medical Laboratory Technician MLT (ASCP©.). American Medical Technologists (AMT)
MLT 1212	Urinalysis/ Body Fluids	2	1	2		45	
MLT 1313	Hematology I	3	2	2		60	
MLT 1324	Hematology II	4	2	4		90	
MLT 1413	Immunology/ Serology	3	2	2		60	
MLT 1515 MLT 1532 MLT 1543	Clinical Chemistry **OR** MLT Chem I **and** MLT Chem II	5	3	4		105	
MLT 2424	Immunohematology	4	2	4		90	
MLT 2522	Pathogenic Microbiology I	2	1	2		45	
MLT 2614	Pathogenic Microbiology II	4	2	4		90	
	Instructor approved electives	7					
	Clinical Course Sequence*	12-16	0	0	48	720	
	Totals	**45-48**	**16**	**26**	**48**		

Clinical Course Sequence Options*

Option 1	**Course Name**	Semester Credit Hours	Lecture	Lab	Clinical	Total Contact Hours	
MLT 2914-6	Clinical Practice I	4-6	0		12-18	180-270	
MLT 2924-5	Clinical Practice II	4-5	0		12-15	180-225	
MLT 2934-5	Clinical Practice III	4-5	0		12-15	180-225	
	Totals	**12-16**	**0**		**36-48**	**540-720**	

Option 2	**Course Name**	Semester Credit Hours	Lecture	Lab	Clinical	Total Contact Hours	
MLT 2943-4	Clinical Practicum I	3-4	0		9-12	135-180	
MLT 2953-4	Clinical Practicum II	3-4	0		9-12	135-180	
MLT 2963-4	Clinical Practicum III	3-4	0		9-12	135-180	
MLT 2973-4	Clinical Practicum IV	3-4	0		9-12	135-180	
	Totals	**12-16**	**0**		**36-48**	**540-720**	

General Education Core Courses – Medical Laboratory Technology

To receive the Associate of Applied Science Degree, a student must complete all of the required coursework found in the Career Certificate option, Technical Certificate option and a minimum of 15 semester hours of General Education Core. The courses in the General Education Core may be spaced out over the entire length of the program so that students complete some academic and Career Technical courses each semester or provided primarily within the last semester. Each community college will specify the actual courses that are required to meet the General Education Core Requirements for the Associate of Applied Science Degree at their college. The Southern Association of Colleges and Schools (SACS) Commission on Colleges Standard 2.7.3 from the Principles of Accreditation: Foundations for Quality Enhancement1 describes the general education core.

Section 2.7.3 In each undergraduate degree program, the institution requires the successful completion of a general education component at the collegiate level that (1) is substantial component of each undergraduate degree, (2) ensures breadth of knowledge, and (3) is based on a coherent rationale. For degree completion in associate programs, the component constitutes a minimum of 15 semester hours or the equivalent. These credit hours are to be drawn from and include at least one course from the following areas: humanities/fine arts, social/behavioral sciences, and natural science/mathematics. The courses do not narrowly focus on those skills, techniques, and procedures specific to a particular occupation or profession

General Education Courses

			SCH Breakdown			Contact Hour Breakdown		Certification Information
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Contact Hours	Lecture	Lab	Certification Name
	Humanities/Fine Arts	3						
	Social/Behavioral Sciences	3						
	Math Elective*	3						
	Biological Science Elective*	3/4						
	Chemistry Elective*	3/4						
	TOTAL	**15/17**						

***Meets NAACLS requirements**

[1] Southern Association of Colleges and Schools Commission on Colleges. (2017). *The principles of accreditation: Foundations for quality enhancement*. Retrieved from https://sacscoc.org/app/uploads/2019/08/2018PrinciplesOfAcreditation.pdf

[2] NAACLS .Standards for Accredited and Approved Programs (2016). *National Accrediting Agency for Clinical Laboratory Sciences* https://www.naacls.org/getattachment/d5a69a7a-7323-439e-9db8-1f0ea000b718/2012-Standards-Edited.aspx

Electives listing

			SCH Breakdown				Contact Hour Breakdown		
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Externship	Total Contact Hours	Lecture	Lab	Externship
SSP 1003	Smart Start	3							
MLT 2711	Medical Laboratory Technology Seminar	1							
MLT 2723	Certification Fundamentals for Medical Laboratory Technology	3							
PBT 1113	Phlebotomy	3	2	2		60			
PBT 1123	Phlebotomy Clinical Practice	3			9	135			
	Other Instructor Approved Elective(s) per local community college								

SUGGESTED COURSE SEQUENCE –Phlebotomy Technician

Career Certificate Required Courses/ 15-Hour Certificate

			SCH Breakdown				Certification Information
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Clinical	Total Contact Hours	Certification Name
PBT 1113	Phlebotomy	3	2	2		60	
PBT 1123	Clinical Practice	3			9	135	
	Instructor approved electives	9					
	Totals	**15**					

Medical Laboratory Technology Courses

Course Number and Name: MLT 1112 Fundamentals of Medical Laboratory Technology/Phlebotomy

Description: The course includes an overview of the field of Medical Laboratory Technology, as well as familiarization with laboratory safety, microscopes, glassware, and equipment. It also includes laboratory organization, medical ethics, and employment opportunities. Basic laboratory specimen collection techniques are introduced.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
2	1	2	45

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Explain the relationship between medical ethics and professionalism to the field of clinical laboratory science. Lab Operations I
    a. Discuss the history of the clinical laboratory, and state the major organizational structure of the hospital laboratory. Lab Operations I.A.C.D.E
    b. Discuss the importance and impact of medical ethics on patient care, especially confidentiality of test results as required by current federal and state regulations. Lab Operations I.E
    c. Differentiate among the roles of various health care professionals. Lab Operations I.A.C.D.E
    d. Explain the responsibilities of each classification of laboratory staff. Lab Operations I.A, IV
    e. State the regulatory and professional agencies related to laboratories and discuss their functions. Lab Operations I.A, E
    f. Discuss federal regulations that impact laboratory operations and management. Lab Operations I.A.D.E
    g. Discuss employment opportunities available to the graduates of Medical Laboratory Technology Programs.
2. Recommend and implement currently approved laboratory safety procedures. Lab Operations II
    a. Discuss the common laboratory hazards to include the following:
        (1) Chemical Lab Operations II.A.2,3,5
        (2) Fire Lab Operations II.A.2, 3, 5; II.B.
        (3) Biological Lab Operations II.A.1, 2, 3, 4, II.B.
        (4) Mechanical Lab Operations II.A.2, 3, 4, II.B
        (5) Electrical Lab Operations II.
    b. Describe and demonstrate the proper method for handling and disposing of biological hazards. Lab Operations II.A.1, 2, 3, 4
    c. Describe and/or demonstrate the use of basic laboratory safety equipment. Lab Operations II.A.2, 3
    d. Describe basic first aid procedures. Lab Operations II.B
    e. Demonstrate compliance with standard precautions. Lab Operations II.A.1, 2, 3, 4
    f. Discuss and select the appropriate isolation technique for various clinical conditions. Lab Operations II.A.1,2,3,4
    g. Demonstrate knowledge of SDS by reading and interpreting Material Safety Data Sheets. Lab Operations II.A
3. Select and use basic equipment to perform selected laboratory skills. Lab Operations IV
    a. List the basic tests performed in each of the major departments of the laboratory and explain their purpose.
        1. Blood Banking ASCP BOC Blood Banking I.B, II.B.1,3, V.A-B
        2. Urinalysis ASCP BOC Urinalysis and Body Fluids I.A-C
        3. Chemistry ASCP BOC Chemistry I.A.2, B.2, C.2; II.A.2.b, B.2.b, III.A.2.b, 3.2.b, IV.A.2.b, B.2.b, C.3.b, D.3.b
        4. Hematology ASCP BOC Hematology I., III.A, IV C.1,2

5. Immunology ASCP BOC Immunology I.A.1
6. Microbiology ASCP BOC Microbiology I.A, B,C
7. Lab Operations ASCP BOC Lab Operations

b. Perform introductory laboratory skills to include the following Lab Operations I.A-C, Lab Operations I. IV.A.:
   (1) Pipetting
   (2) Use and care of glassware
   (3) Use and care of microscopes
   (4) Use and care of other lab equipment

4. Explain and practice laboratory specimen collection techniques. Lab Operations I.A, Lab Operations I. IV.A.
   a. Perform basic laboratory specimen collection techniques, including phlebotomy. Blood Banking, I.A-B; Chemistry I.A.2.b; II.A.2.b; III.A.2.b, IV.A.2.b, B.2.b, C.3.b, D.3.b; Microbiology I.A.B, Lab Operations I.A, II
   b. Demonstrate protocols used in identification of specimens and the procedures used to maintain accurate patient identity. Microbiology I.A.1, IV.A, Lab Operations I.A.
   c. Discuss complications encountered in specimen collection.
   d. Select an appropriate method of resolving problems of specimen collection.
   e. Employ measures to maintain patient confidentiality. Lab Operations I.D

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Medical Laboratory Technician, MLT and International Medical Laboratory Technician, MLT (ASCP©.)

Laboratory Operations

I. Quality Assessment/Troubleshooting
   A. Preanalytical, Analytical, Postanalytical
   B. Quality Control
   C. Point-of-care Testing (POCT)
   D. Compliance
   E. Regulation (e.g., proficiency testing, competency assessment, accreditation standards)

II. Safety
   A. Safety Programs and Practices
      1. Prevention of infection with blood borne pathogens
      2. Use of personal protective equipment (PPE)
      3. Safe work practices
      4. Packaging and transportation of specimens and microorganisms
      5. Safety data sheets (SDS) for chemicals and reagents
   B. Emergency Procedures (e.g., needle sticks, splashes to mucous membranes, fire)

III. Laboratory Mathematics
   A. Concentration, Volume, and Dilutions
   B. Molarity, Normality
   C. Standard Curves
   D. Mean, Median, Mode, and Confidence Intervals
   E. Sensitivity, Specificity, and Predictive Value

IV. Manual/Automated Methodology and Instrumentation
   A. Basic Laboratory Equipment
   B. Spectrophotometry and Photometry
   C. Mass Spectrometry
   D. Osmometry
   E. Electrophoresis
   F. Electrochemistry
   G. Fluorometry
   H. Nephelometry
   I. Flow Cytometry
   J. Molecular Methods
   K. Automated Microbiology Processors
   L. Hematology Instrumentation

Blood Banking
I. Blood Products
A. Processing
1. Testing
2. Labeling
B. Storage
1. Anticoagulants/additives
2. Temperature requirements
3. Transportation
V. Serologic and Molecular Testing
A. Routine Tests
1. Blood grouping tests
2. Compatibility tests
a. Antibody detection
b. Crossmatch
3. Antibody identification/clinical significance
4. Direct antiglobulin testing B. Reagents
1. Antiglobulin sera
2. Blood grouping sera
3. Reagent red cells

Urinalysis and Body Fluids
I. Urinalysis
A. Physical
1. Color and clarity
2. Specific gravity/osmolality
B. Chemical
1. Reagent strip
2. Confirmatory tests
C. Microscopic
1. Cells
2. Casts
3. Crystals
4. Microorganisms
5. Contaminants
6. Artifacts CHEMISTRY

Multiple listings: I.A.2, B.2, C.2; II.A.2.b, B.2.b, III.A.2.b, 3.2.b, IV.A.2.b, B.2.b, C.3.b, D.3.b Special precautions, specimen collection and processing, troubleshooting, and interfering substances

Hematology
I. Hematology Physiology (to include blood, body fluids, and bone marrow)
A. Production
B. Destruction
C. Function
III. HEMATOLOGY LABORATORY TESTING
A. Cell Counts (to include blood and body fluids)
1. Manual
2. Automated IV. Hemostasis
B. Laboratory Determinations
1. PT/INR
2. APTT
Immunology
I. Principles of Immunology
A. Immune System Physiology

1. Primary and secondary response

Microbiology

I. Pre-analytic Procedures
  A. Specimen Collection and Transport
    1. Patient identification and specimen labeling
    2. Specimen collection
    3. Specimen transport systems and conditions for all organisms
  B. Specimen Processing
    1. Specimen prioritization and rejection criteria
    2. Biosafety cabinet and personal protective equipment
    3. Specimen preparation methods and applications
    4. Media
    5. Inoculation of media
    6. Incubation conditions (e.g., temperature, atmosphere, duration)
    7. Preparation methods for slides used for stains
  C. Stains: Procedure, Principle, and Interpretation
    1. Gram
    2. Acid-fast

IV. Post-analytic Procedures
  A. Documentation Practices

Course Number and Name: MLT 1212 Urinalysis Body Fluids

Description: This course is an introduction to urinalysis and laboratory analysis of miscellaneous body fluids. It includes the basic principles of routine and special urine tests and specimen examination through laboratory work. Theory and test profiles are also presented for miscellaneous body fluids with correlation to diseased states.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
2	1	2	45

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Describe the formation and composition of urine. ASCP BOC Urinalysis I.D.
    a. Discuss the history and importance of urinalysis.
    b. Describe the functioning unit of the kidney. ASCP BOC Urinalysis I.D
    c. Trace the formation of urine. ASCP BOC Urinalysis I.D
    d. Discuss the special urinalysis screening test. ASCP BOC Urinalysis I. A, B, C
2. Explain the properties involved in the physical, chemical, and microscopic examinations of urine. Urinalysis I
    a. List and describe the physical characteristics of urine. Urinalysis I.A.
    b. List and describe the chemical characteristics of urine. Urinalysis I.B
    c. Identify the microscopic elements of urine. Urinalysis I.C
    d. Describe specimen collection and handling of urine to include the following: Lab Operations I, II
        (1) Special instructions to patient
        (2) Labeling of specimen
        (3) Specimen containers
        (4) Specimen preservation
3. Perform the testing involved in the physical, chemical, and microscopic examinations of urine.
    a. Perform the physical examination of urine including color, clarity, and specific gravity. Urinalysis I. A, B
    b. List and describe the principles of the reactions of the reagent strip testing of urinalysis. Urinalysis I.B
    c. Interpret chemical reactions of reagent strips. Urinalysis I.B
    d. Identify microscopic elements in the urine. Urinalysis I.C
    e. Correlate disease states with abnormal physical, chemical, and microscopic results. Urinalysis I.E
4. Describe the laboratory testing and the formation of other body fluids (i.e., synovial, CSF, seminal, serous body fluids, amniotic fluids, etc.). Urinalysis II
    a. List and describe physical, chemical, and microscopic tests performed on the following body fluids: synovial, CSF, seminal body fluids, serous body fluids, and amniotic
    b. fluids. Urinalysis II. A-C
    c. Correlate abnormal test results with disease states. Urinalysis II D-E

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II. Urinalysis & Body Fluids
1. Urinalysis
A. Physical
1) Color and clarity
2) Specific gravity /osmolality
B. Chemical
1) Reagent strip

2) Confirmatory tests
C. Microscopic
1) Cells
2) Casts
3) Crystals
4) Microorganisms
5) Contaminants
6) Artifacts
D. Renal Physiology
E. Disease States
2. Body Fluids (CSF, Amniotic, Synovial, Serous, Semen, Feces)
A. Physical
B. Chemical
C. Microscopic
D. Physiology
E. Disease States

Laboratory Operations

I. Quality Assessment/Troubleshooting
A. Preanalytical, Analytical, Postanalytical
B. Quality Control
C. Point-of-care Testing (POCT)
D. Compliance
E. Regulation (e.g., proficiency testing, competency assessment, accreditation standards)
II. Safety
A. Safety Programs and Practices
1. Prevention of infection with bloodborne pathogens
2. Use of personal protective equipment (PPE)
3. Safe work practices
4. Packaging and transportation of specimens and microorganisms
5. Safety data sheets (SDS) for chemicals and reagents
B. Emergency Procedures (e.g., needlesticks, splashes to mucous membranes, fire)
III. Laboratory Mathematics
A. Concentration, Volume, and Dilutions
B. Standard Curves
C. Mean, Median, Mode, and Confidence Intervals
IV. Manual/Automated Methodology and Instrumentation
A. Basic Laboratory Equipment
B. Spectrophotometry and Photometry
C. Mass Spectrometry
D. Osmometry
E. Electrophoresis
F. Electrochemistry
G. Fluorometry
H. Nephelometry
I. Flow Cytometry
J. Molecular Methods
K. Automated Microbiology Processors
L. Hematology Instrumentation

Course Number and Name: MLT 1313 Hematology I

Description: This course is a study of the function of blood, morphology, and maturation of normal cells, blood cell counts, differentials of white cells, and blood collection and handling

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Discuss and identify the origin and characteristics of normal blood cell lines. ASCP BOC Hema I.
    a. Identify sites of hematopoiesis. Hema I. A.
    b. Outline the development of the blood cell lines to include the following: Hema I. A.
        (1) Erythrocytes
        (2) Granulocytes
        (3) Lymphocytes
        (4) Monocytes
        (5) Megakaryocytes/platelets
    c. Differentiate morphologic and functional characteristics of developmental stages of each cell line. Hema I. A., C.
2. Perform routine manual and automated hematology procedures. ASCP BOC Hema III.
    a. State the principle of routine manual and automated hematology procedures. Hema III. A.-F.
    b. Prepare, stain, and evaluate manual peripheral blood smears. Hema III. B.
    c. Perform manual and automated cell counts. Hema III. A.
    d. Perform manual and automated hemoglobin and hematocrit determinations. Hema III. C., D.
    e. Calculate red blood cell (RBC) indices. Hema III. E.
    f. Correlate RBC indices with RBC morphology. Hema II. A. 1, Hema III. E.
    g. Identify and recognize factors that may alter test values. Hema III. A. 4.
    h. State normal reference ranges for hematologic test procedures. Hema III. A. – F.
3. Explain the role of hematology safety. ASCP BOC Laboratory Operations II.
    a. Identify appropriate hematology safety techniques. Laboratory Operations II. A., B.
    b. Demonstrate appropriate hematology safety techniques. Laboratory Operations II. A., B.
4. Explain and perform quality assurance procedures and interpret quality control data. ASCP BOC Hema III. & Laboratory Operations I.
    a. Select the quality control techniques used for routine hematology procedures. Hema III. A.- D.; Laboratory Operations I. A. – E.
    b. Perform quality control procedures. Hema III. A. – D.; Laboratory Operations I. B.
    c. Record and interpret quality control data. Hema III. A. – D.; Laboratory Operations B.
    d. Analyze quality control data to determine validity of hematology lab test results. Hema III. A. – D.; Laboratory Operations I. B.
5. Correlate clinical conditions with hematology test results. ASCP BOC Hema II and III.
    a. Correlate and verify automated cell counts and differentials with established criteria and/or peripheral smear exam. Hema II. A. & B.; Hema III. A. & B.
    b. Assess physiologic and pathologic causes for variations in hematologic data. Hema II. A. & B.

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Hematology

I. Hematology Physiology (to include blood, body fluids, and bone marrow)
- A. Production
- B. Destruction
- C. Function

II. Hematology Disease States
- A. Erythrocytes
  - 1. Anemia
    - a. Microcytic
      - 1) Iron deficiency
      - 2) Thalassemia
      - 3) Sideroblastic
      - 4) Chronic inflammation
    - b. Normocytic
      - 1) Hereditary hemolytic
      - 2) Acquired hemolytic
      - 3) Hypoproliferative
      - 4) Acute hemorrhage
    - c. Macrocytic
      - 1) Megaloblastic
      - 2) Non-megaloblastic
    - d. Hemoglobinopathies
  - 2. Erythrocytosis
    - a. Relative
    - b. Absolute
- B. Leukocytes
  - 1. Benign leukocyte disorders
  - 2. Myeloid neoplasia
  - 3. Lymphoid neoplasia

III. Hematology Laboratory Testing
- A. Cell Counts
  - 1. Manual
  - 2. Automated
  - 3. Reticulocytes
  - 4. Spurious Results
- B. Differentials and Morphology Evaluation
- C. Hemoglobin
  - 1. Quantitative
  - 2. Qualitative
- D. Hematocrit
- E. Indices
- F. Hemolytic Indicators

Laboratory Operations

I. Quality Assessment / Troubleshooting
- A. Pre-Analytical, Analytical, Post-Analytical
- B. Quality Control
- C. Point of Care Testing
- D. Compliance
- E. Regulation

II. Safety
    A. Safety Programs and Practices
    B. Emergency Procedures
III. Laboratory Mathematics
    A. Mean, Median, Mode, and Confidence Intervals
IV. Manual/Automated Methodology and Instrumentation
    A. Basic Laboratory Equipment
    B. Flow Cytometry
    C. Molecular Methods
    D. Hematology Instrumentation

Course Number and Name: MLT 1324 Hematology II

Description: This course includes the study of abnormal cell morphology and diseases involving blood cells, test procedures used in laboratory diagnosis of hematological disease, normal and abnormal hemostasis, and diagnostic procedures for evaluation of bleeding abnormalities and anticoagulant therapy.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
4	2	4	90

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Discuss and identify the origin and characteristics of abnormal blood cells. ASCP BOC Hema I., II., III.
   a. Identify and describe physiology of each type of leukocyte. Hema I. A., II. B., III. B.
   b. Describe red blood cell (RBC) production to include hemoglobin synthesis and catabolism and RBC biochemistry. Hema I. A. – C.
   c. Identify abnormal RBC and white blood cell (WBC) morphology, inclusions, and cytochemical stains. Hema II. A. & B.; Hema III. B.
   d. Evaluate platelets. Hema II. C.; Hema III. B.

2. Correlate clinical conditions with abnormal hematology laboratory results. ASCP BOC Hema II., III., IV.
   a. Calculate and correlate RBC indices with microscopic morphology and disease states. ASCP BOC Hema II., III., IV.
   b. Assess lab data to identify major types of anemia. Hema II. A.; Hema III. A. – E.
   c. Recognize leukemic cells and assess lab data in major types of leukemia. Hema II. B.; Hema III. A. – E.
   d. Identify the clinical manifestations and cause(s) for hemostatic, thrombotic, and fibrinolytic disease states. Hema II. C.; Hema IV. A. – C.
   e. Research new concepts and emerging technologies to include bone marrow/stem cell transplant and molecular techniques in diagnosis and treatment of hematologic diseases. Hema II. A. – C.; Hema III. I. & J.

3. Describe the interaction of blood vessels, platelets, coagulation factors, and fibrinolytic systems in normal and abnormal hemostasis and thrombosis. ASCP BOC Hema IV.
   a. Describe the production and characteristics of coagulation factors. Hema IV. A.
   b. Evaluate coagulation test data for clinical significance in diagnosis and treatment of hemostatic and thrombotic disorders. Hema IV. A. – C.
   c. Explain the action and laboratory monitoring of anticoagulants in therapy of thrombotic disease. Hema IV. C.

4. Perform and interpret manual and automated hematology and coagulation procedures. ASCP BOC Hema III. & IV; Laboratory Operations I.
   a. Discuss the principle of manual and automated hematology coagulation procedures. Hema III. A. – J.; Hema IV. C.
   b. Operate and interpret results from hematology and coagulation instruments. Hema III. A. – E.; Hema IV. C.
   c. Assess results to evaluate validity and identify sources of error. Hema III. A. – E.; Hema IV. C.
   d. Propose solutions to correct erroneous results. Hema III. A. – E.; Hema IV. C.
   e. Interpret quality control data to assess validity of patient results. Hema III. A. – E.; Hema IV. C.; Lab Operations I. A. – D.

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Hematology

I. Hematology Physiology
    A. Production
    B. Destruction
    C. Function

II. Hematology Disease States
    A. Erythrocytes
        1. Anemia
        2. Erythrocytosis
    B. Leukocytes
        1. Benign leukocyte disorders
        2. Myeloid neoplasia
        3. Lymphoid neoplasia
        4. Hereditary anomalies
    C. Platelets
        1. Quantitative abnormalities
            a. Thrombocytopenia
            b. Thrombocytosis
        2. Qualitative defects

III. Hematology Laboratory Testing
    A. Cell Counts
        1. Manual
        2. Automated
        3. Reticulocytes
        4. Spurious Results
    B. Differentials and Morphology Evaluation
    C. Hemoglobin
        1. Quantitative
        2. Qualitative
    D. Hematocrit
    E. Indices
    F. Hemolytic Indicators
    G. Special Stains
    H. Other Studies
        1. ESR
        2. G6PD
        3. Heinz body
    I. Flow Cytometry Immunophenotyping
        1. Leukemia
        2. Lymphoma
        3. Lymphocyte subsets
        4. PNH
    J. Molecular and Cytogenetic Testing
        1. Recurring cytogenetic abnormalities (WHO classification)
        2. BCR/ABL1
        3. JAK2

IV. Hemostasis
- A. Physiology
  1. Coagulation pathways
  2. Fibrinolytic pathway
  3. Vascular system
- B. Disease States
  1. Coagulation factor deficiencies
     a. Acquired
     b. Hereditary
  2. Fibrinolytic system
  3. Hypercoagulable states
  4. DIC
- C. Laboratory Determinations
  1. PT/INR
  2. APTT
  3. Fibrinogen
  4. D-dimer
  5. Thrombin time
  6. Mixing studies
  7. Platelet function
  8. Hypercoagulability assessment
     a. Assays
     b. Molecular
  9. Anti-Xa

Laboratory Operations

I. Quality Assessment / Troubleshooting
- A. Pre-Analytical, Analytical, Post-Analytical
- B. Quality Control
- C. Point of Care Testing
- D. Compliance
- E. Regulation

II. Safety
- A. Safety Programs and Practices
- B. Emergency Procedures

III. Laboratory Mathematics
- A. Mean, Median, Mode, and Confidence Intervals

IV. Manual/Automated Methodology and Instrumentation
- A. Basic Laboratory Equipment
- B. Flow Cytometry
- C. Molecular Methods
- D. Hematology Instrumentation

Course Number and Name: MLT 1413 Immunology/ Serology

Description: This course covers the science of immunology and serology through the study of theories and processes related to natural body defenses. Included are basic antigen-antibody reactions, complement action, cellular response, humoral immune response, and the basic serological procedures used to aid in the detection of certain diseases. Throughout this course, special emphasis is placed on correlating laboratory results with the patient's probable condition.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Describe the body's immune defenses.
   a. Explain the principal mechanisms of acquired and natural immunity. Imm. I. A. 1-3, b. 1-3, C. 1-2, D. 1-2
   b. Describe the function of the cells of the immune system. Imm. I. A. 1-3
   c. Explain the components of natural immunity and their functions. Imm. I. A., 1-3
   d. List the characteristics of antigens. Imm. I. B. 1-3, C. 1-2
   e. Describe the primary immune response. Imm. I. A. 1-3, B. 1-3, C. 1-2
   f. Describe the secondary immune response. Imm. I. A. 1-3, B. 1-3, C. 1-2
   g. Differentiate among the five immunoglobulin classes and their functions. Imm. I.B. 1-3
   h. Outline the sequential steps of the classical and alternate complement pathways. Imm. I. D. 1-2
   i. Describe biologic functions associated with complement activation. Imm. I. D. 1-2
2. Describe the principles of immunoassays.
   a. Explain the principles of the commonly used immunoassays. Imm. I. C. 1-2; V. A, B, C, D, E, F, G; VI. A. B. C. (Lab Operations I. A, B, C, D, E; II. A. 1-5, B
   b. Evaluate physiological and pathological causes for variation in expected test results. Imm. I. C. 1-2; V. A, B, C, D, E, F, G; VI. A. B. C. (Lab Operations I. A, B, C, D, E; II. A. 1-5, B)
   c. Examine test results to identify and correct technical sources of error. Imm. I. C. 1-2; V. A, B, C, D, E, F, G; VI. A. B. C. (Lab Operations I. A, B, C, D, E; II. A. 1-5, B
3. Perform routine immunology/serology procedures with emphasis on accuracy and precision.
   a. Perform the commonly used immunoassay procedures. Imm. I. C. 1-2; V. A, B, C, D, E, F, G; VI. A. B. C. (Lab Operations I. A, B, C, D, E; II. A. 1-5, B)
   b. Summarize specimen requirements for commonly used immunoassay procedures. Imm. I. C. 1-2; V. A, B, C, D, E, F, G; VI. A. B. C. (Lab Operations I. A, B, C, D, E; II. A. 1-5, B)
   c. Demonstrate the use of proper quality control methods for each testing procedure. Lab Operations I. A, B, C, D, E; II. A. 1-5, B
   d. Interpret the validity of patient test results. Imm. VI. A, B, C) (Lab Operations I. A, B, C, D, E; II. A. 1-5, B
   e. Prepare accurate, simple, and serial dilutions.
   f. Calculate specimen concentrations involved in simple and serial dilutions.
4. Correlate results of immunological procedures with clinical conditions.
   a. Correlate the expected serologic test results for commonly encountered clinical conditions.
   b. Assess causes of false positive and false negative test results.

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I. Principles of Immunology
- A. Immune System Physiology
  1. Primary and secondary response
  2. B and T cells, macrophages
  3. Genetics
- B. Immunoglobulins
  1. Classes and subclasses
  2. Structure
  3. Biologic and physical properties
- C. Antigen-Antibody Interactions
  1. Principles
  2. Testing
     a. Principles
     b. Methods
- D. Complement
  1. Classical and alternative pathway mechanisms
  2. Biologic properties

II. Diseases of The Immune System
- A. Autoimmunity
  1. Systemic (e.g., SLE)
  2. Organ-specific (e.g., Graves disease)
- B. Hypersensitivity
  1. I, II, III, IV
- C. Immunoproliferative Diseases
  1. Monoclonal gammopathies (e.g., plasma cell myeloma, Waldenström macroglobulinemia)
- D. Immunodeficiency
  1. Hereditary (e.g., SCID)
  2. Acquired (e.g., HIV)

III. Transplantation
- A. Graft-versus-host Disease
- B. HLA Typing
- C. Tumor Immunology

IV. Infectious Disease Serology
- A. Clinical Significance and Epidemiology of Viral Pathogens (e.g., hepatitis [A, B, C], EBV, HIV, CMV, rubella, measles)
- B. Stages of Infection of Treponema pallidum and Borrelia burgdorferi
- C. Tuberculosis Infection (e.g., interferon-gamma release assay, PPD)

V. Serologic Procedures
- A. ANA
- B. Thyroid Antibodies
- C. Rheumatoid Factor
- D. Labeled Immunoassays (e.g., ELISA)
- E. Nontreponemal Syphilis Testing (e.g., RPR)
- F. Treponemal Syphilis Testing (e.g., MHATP)
- G. Cytokine Testing
- H. Immunofluorescence

VI. Test Results
- A. Interpretation
- B. Confirmatory Testing
- C. Disease State Correlation

Laboratory Operations

I. Quality Assessment/Troubleshooting
   A. Preanalytical, Analytical, Postanalytical (NAACLS requires these in all major area courses)
   B. Quality Control
   C. Point-of-care Testing (POCT)
   D. Compliance
   E. Regulation (e.g., proficiency testing, competency assessment, accreditation standards)

II. Safety
   A. Safety Programs and Practices
      1. Prevention of infection with bloodborne pathogens
      2. Use of personal protective equipment (PPE)
      3. Safe work practices
      4. Packaging and transportation of specimens and microorganisms
      5. Safety data sheets (SDS) for chemicals and reagents
   B. Emergency Procedures (e.g., needlesticks, splashes to mucous membranes, fire)

III. Laboratory Mathematics
   A. Concentration, Volume, and Dilutions
   B. Molarity, Normality
   C. Standard Curves
   D. Mean, Median, Mode, and Confidence Intervals
   E. Sensitivity, Specificity, and Predictive Value

IV. Manual/Automated Methodology And Instrumentation
   A. Basic Laboratory Equipment
   B. Spectrophotometry and Photometry
   C. Mass Spectrometry
   D. Osmometry
   E. Electrophoresis
   F. Electrochemistry
   G. Fluorometry
   H. Nephelometry
   I. Flow Cytometry
   J. Molecular Methods

Course Number and Name: MLT 1515 Clinical Chemistry

Description: This course is the study of human biochemistry as an aid in the diagnosis of disease processes. It includes chemistry procedures performed on body fluids for aiding in diagnosis of disease processes.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
5	3	4	105

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Describe chemistry test methods used to measure substances in the blood and other body fluids.
   a. Identify special safety procedures unique to clinical chemistry. ASCP Lab Operations II A
   b. Identify and discuss collection procedures and processing of specimens in clinical chemistry. ASCP Chemistry I.A.2.b, I.B.2.b, I.C.2.b, II.A.2.b, II.B.2.b, III.A.2.b, III.B.2.b, IV.A.2.b, IV.B.2.b, IV.C.3.b, IV.D.3.b.
   c. Describe the procedures for specimen collection related to drug screening (chain of command, legal regulation, etc.). IV.D.3.b.
   d. Describe the principles of selected chemistry methods to include the following:
      (1) Spectrophotometry and Photometry Lab Operations IV.B
      (2) Immunoassay Chemistry IV.C.3.1
      (3) Ion-selective electrodes Chemistry III.B.2.a
      (4) Carbohydrates, tolerance testing, glycated proteins Chemistry I.A.2.a, c, and d
      (5) Lipids Chem I.B.1.c and I.B.2.a
      (6) Enzymes Chem II.A.2.a
      (7) Heme Derivatives Chem I.C.2.a
      (8) Proteins and other Nitrogen-Containing Compounds Chem II.B.2.a
      (9) Clearances Chem II.B.2.c
      (10) Blood Gases Chem III.A.2.a
      (11) Electrolytes Chem III.B.2.a
      (12) Fluorescence Chem IV.A.2.a.1
      (13) Immunoassay Chem IV.A.2.a.2
      (14) Stimulation/Suppression Tests Chem IV.A.2.c.
   e. Discuss the collection procedures of therapeutic drug monitoring and interpretation of test results. Lab Operations I.A.; Chem II.C.1,4,5; II.D.1,4,5
2. Correlate health and disease states with chemistry test results.
   a. Describe and evaluate diseases and chemistry test results associated with abnormal metabolism including carbohydrate, protein, lipids and, heme derivatives. Chem I.A.1,3,4; B.1,3,4; C.1,3,4; Chem II.A.1,3,4; II.B.1,3,4
   b. Describe and evaluate diseases and chemistry test results associated with abnormal function including liver, kidney, heart, and endocrine.
   c. Describe and evaluate diseases and chemistry test results associated with abnormal metabolism, toxic effects, signs, symptoms and disease states including therapeutic drug monitoring and toxicology. Chem IV. C, D
   d. Describe and evaluate acid-base determination, blood gases, and electrolyte biochemical theory and physiology and test results with disease states. Chemistry III.A.1,3,4; III.B.1,4,5
3. Perform laboratory tests outlined by the test manufacturer to determine the presence and/or amount of substance(s) in the blood and other body fluids.
   a. Perform selected chemistry tests including manual and semi-automated methods. Lab Operations IV
   b. Demonstrate the operating techniques of the equipment used in the clinical chemistry laboratory, with emphasis on accuracy and precision. Lab Operations I. A, B, D, E; III.C.D.E
   c. Demonstrate calibration of selected instruments and test equipment. Lab Operations III.C.

d. Indicate when to refer to an appropriate source for repairs or consultation. Lab Operations I.A.B.D. E; III.C.D.

4. Solve laboratory mathematics problems.
   a. Identify and utilize the basic units of measurement in the metric system. Lab Operations III.A
   b. List and perform dilution calculations. Lab Operations III.A.B.
   c. List and utilize different methods used to state concentrations of substances in clinical chemistry. Lab Operations III.A.B
   d. List and perform formulas and calculations for osmolality and anion gap. Chem III B.3
5. Perform quality control procedures as used in the clinical chemistry laboratory with emphasis on accuracy and precision. Lab Operations I, III.C.D
   a. List and describe various statistical methods used in clinical chemistry. Lab Operations I. III. IV
   b. Prepare quality control (QC) specimens, perform selected assays on QC specimens, and record results. Lab Operations I, III, IV
   c. Interpret QC data on selected clinical chemistry procedures. Lab Operations I, III, IV
   d. Document corrective action taken in troubleshooting instruments and out-of-range QC values. Lab Operations I, III, IV

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I. General Chemistry
   A. Carbohydrates
      1. Biochemical theory and physiology
         a. Metabolic pathways
         b. Normal and abnormal states
         c. Physical and chemical properties
      2. Test procedures
         a. Principles
         b. Special precautions, specimen collection and processing, troubleshooting, and interfering substances
         c. Tolerance testing
         d. Glycated proteins
      3. Test result interpretation
      4. Disease state correlation
   B. Lipids
      1. Biochemical theory and physiology
         a. Metabolic pathways
         b. Normal and abnormal states
         c. Physical and chemical properties
      2. 1) Lipoproteins
            2) Phospholipids
            3) Triglycerides
            4) Cholesterol
            5) Apolipoproteins
      3. Test procedures
         a. Principles
         b. Special precautions, specimen collection and processing, troubleshooting, and interfering substances
      4. Test result interpretation
      5. Disease state correlation
   C. Heme Derivatives
      1. Biochemical theory and physiology
         a. Metabolic pathways
         b. Normal and abnormal states
         c. Physical and chemical properties
            1) Hemoglobin

2) Bilirubin
3) Urobilinogen
4) Myoglobin

2. Test procedures
a. Principles
b. Special precautions, specimen collection and processing, troubleshooting, and interfering substances

3. Test result interpretation
4. Disease state correlation

II. Proteins and Enzymes

A. Enzymes

1. Biochemical theory and physiology
a. Metabolic pathways
b. Normal and abnormal states
c. Physical and chemical properties
1) LD
2) CK
3) AST/ALT
4) GGT
5) Lipase
6) Amylase
7) Alkaline phosphatase
8) Angiotensin converting enzyme

2. Test procedures
a. Principles
b. Special precautions, specimen collection and processing, troubleshooting, and interfering substances

3. Test result interpretation
4. Disease state correlation

B. Proteins and Other Nitrogen-Containing Compounds

1. Biochemical theory and physiology
a. Metabolic pathways
b. Normal and abnormal states
c. Physical and chemical properties
1) Proteins
2) Amino acids
3) Urea
4) Uric acid
5) Creatinine
6) Ammonia
7) Tumor markers
8) Cardiac markers

2. Test procedures
a. Principles
b. Special precautions, specimen collection and processing, troubleshooting, and interfering substances
c. Clearances

3. Test result interpretation
4. Disease state correlation

III. Acid-Base, Blood Gases and Electrolytes

A. Acid-Base Determinations (Including Blood Gases)

1. Biochemical theory and physiology

a. Henderson-Hasselbach equation
b. pH and H+ ion concentration
c. CO2 and O2 transport
d. Normal and abnormal states

2. Test procedures
a. Analytical principles
b. Special precautions, specimen collection and processing, troubleshooting, and interfering substances

3. Test result interpretation
4. Disease state correlation

B. Electrolytes

1. Biochemical theory and physiology
a. Sodium, potassium, chloride, CO2, bicarbonate
b. Calcium, magnesium, phosphorus, iron, TIBC
c. Trace elements
d. Normal and abnormal states

2. Test procedures
a. Principles
b. Special precautions, specimen collection and processing, troubleshooting, and interfering substances

3. Calculations (osmolality, anion gap)
4. Test result interpretation
5. Disease state correlation

IV. Special Chemistry

A. Endocrinology

1. Biochemical theory and physiology
a. Metabolic pathways
b. Normal and abnormal states
c. Mechanism of action
d. Physical and chemical properties
1) Steroid hormones (e.g., cortisol, estrogen, hCG)
2) Peptide hormones (e.g., insulin, prolactin)
3) Thyroid hormones
4) Catecholamines

2. Test procedures
a. Principles
1) Fluorescence
2) Immunoassay
b. Special precautions, specimen collection and processing, troubleshooting, and interfering subs
c. Stimulation/suppression tests

3. Test result interpretation
4. Disease state correlation

B. Vitamins and Nutrition

1. Biochemical theory and physiology
a. Metabolism and action
b. Normal and abnormal states
c. Properties

2. Test procedures
a. Principles
b. Special precautions, specimen collection and processing, troubleshooting, and interfering subs

3. Test result interpretation
4. Disease state correlation

C. Therapeutic Drug Monitoring
1. Pharmacokinetics
a. Therapeutic states
b. Toxic states
c. Metabolism and excretion
2. Chemical and physical properties
a. Aminoglycosides (e.g., gentamicin)
b. Cardioactive (e.g., digoxin)
c. Anticonvulsants (e.g., phenobarbital)
d. Antidepressants (e.g., lithium)
e. Immunosuppressants (e.g., tacrolimus)
3. Test procedures
a. Principles
1) Immunoassay
b. Special precautions, specimen collection and processing, troubleshooting, and interfering subs
4. Test result interpretation
5. Disease state correlation

D. Toxicology
1. Toxicokinetics
a. Toxic effects, signs and symptoms
b. Metabolism and excretion
2. Chemical and physical properties
a. Alcohols
b. Heavy metals (e.g., lead)
c. Analgesics (e.g., acetaminophen)
d. Drugs of abuse
3. Test procedures
a. Principles
1) Immunoassay
2) Enzymatic methods
b. Special precautions, specimen collection and processing, troubleshooting, and interfering sub
Test result interpretation
4. Disease state correlation

Laboratory Operations

I. Quality Assessment/Troubleshooting
A. Pre-analytical, Analytical, Post-analytical (NAACLS requires these in all major area courses)
B. Quality Control
C. Point-of-care Testing (POCT)
D. Compliance
E. Regulation (e.g., proficiency testing, competency assessment, accreditation standards)

II. Safety
A. Safety Programs and Practices
1. Prevention of infection with bloodborne pathogens
2. Use of personal protective equipment (PPE)
3. Safe work practices
4. Packaging and transportation of specimens and microorganisms
5. Safety data sheets (SDS) for chemicals and reagents
B. Emergency Procedures (e.g., needlesticks, splashes to mucous membranes, fire)

III. Laboratory Mathematics

A. Concentration, Volume, and Dilutions Molarity, Normality
B. Standard Curves
C. Mean, Median, Mode, and Confidence Intervals
D. Sensitivity, Specificity, and Predictive Value

IV. Manual/Automated Methodology and Instrumentation

A. Basic Laboratory Equipment
B. Spectrophotometry and Photometry
C. Mass Spectrometry
D. Osmometry
E. Electrophoresis
F. Electrochemistry
G. Fluorometry
H. Nephelometry
I. Flow Cytometry
J. Molecular Methods

Course Number and Name: MLT 1532 MLT Chem I

Description: This course is the study of human biochemistry as an aid in the diagnosis of disease processes. It includes chemistry procedures performed on body fluids for aiding in diagnosis of disease processes.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
2	2	1	

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Describe chemistry test methods used to measure substances in the blood and other body fluids.
   a. Identify special safety procedures unique to clinical chemistry. ASCP Lab Operations II A
   b. Describe the principles of selected chemistry methods to include the following:
      (1) Spectrophotometry and Photometry Lab Operations IV.B
2. Solve laboratory mathematics problems.
   a. Identify and utilize the basic units of measurement in the metric system. Lab Operations III.A
   b. List and perform dilution calculations. Lab Operations III.A.B.
   c. List and utilize different methods used to state concentrations of substances in clinical chemistry. Lab Operations III.A.B
3. Perform quality control procedures as used in the clinical chemistry laboratory with emphasis on accuracy and precision. Lab Operations I, III.C.D
   a. List and describe various statistical methods used in clinical chemistry. Lab Operations I. III. IV
   b. Prepare quality control (QC) specimens, perform selected assays on QC specimens, and record results. Lab Operations I, III, IV
   c. Interpret QC data on selected clinical chemistry procedures. Lab Operations I, III, IV
   d. Document corrective action taken in troubleshooting instruments and out-of-range QC values. Lab Operations I, III, IV

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Laboratory Operations

I. Quality Assessment/Troubleshooting
   A. Pre-analytical, Analytical, Post-analytical (NAACLS requires these in all major area courses)
   B. Quality Control
   C. Point-of-care Testing (POCT)
   D. Compliance
   E. Regulation (e.g., proficiency testing, competency assessment, accreditation standards)

II. Safety
   A. Safety Programs and Practices
      1. Prevention of infection with bloodborne pathogens
      2. Use of personal protective equipment (PPE)
      3. Safe work practices
      4. Packaging and transportation of specimens and microorganisms
      5. Safety data sheets (SDS) for chemicals and reagents
   B. Emergency Procedures (e.g., needlesticks, splashes to mucous membranes, fire)

III. Laboratory Mathematics
   A. Concentration, Volume, and Dilutions
   B. Molarity, Normality
   C. Standard Curves
   D. Mean, Median, Mode, and Confidence Intervals
   E. Sensitivity, Specificity, and Predictive Value

IV. Manual/Automated Methodology and Instrumentation
- A. Basic Laboratory Equipment
- B. Spectrophotometry and Photometry
- C. Mass Spectrometry
- D. Osmometry
- E. Electrophoresis
- F. Electrochemistry
- G. Fluorometry
- H. Nephelometry
- I. Flow Cytometry
- J. Molecular Methods

Course Number and Name: MLT 1543 MLT Chem II

Description: This course is the study of human biochemistry as an aid in the diagnosis of disease processes. It includes chemistry procedures performed on body fluids for aiding in diagnosis of disease processes.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	3	1	

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Describe chemistry test methods used to measure substances in the blood and other body fluids.
   a. Identify and discuss collection procedures and processing of specimens in clinical chemistry. ASCP Chemistry I.A.2.b, I.B.2.b, I.C.2.b, II.A.2.b, II.B.2.b, III.A.2.b, III.B.2.b, IV.A.2.b, IV.B.2.b, IV.C.3.b, IV.D.3.b.
   b. Describe the procedures for specimen collection related to drug screening (chain of command, legal regulation, etc.). IV.D.3.b.
   c. Describe the principles of selected chemistry methods to include the following:
      (1) Spectrophotometry and Photometry (Lab Operations IV.B)
      (2) Immunoassay Chemistry IV.C.3.1
      (3) Ion-selective electrodes Chemistry III.B.2.a
      (4) Carbohydrates, tolerance testing, glycated proteins (Chemistry I.A.2.a, c, and d)
      (5) Lipids Chem I.B.1.c and I.B.2.a
      (6) Enzymes Chem II.A.2.a
      (7) Heme Derivatives Chem I.C.2.a
      (8) Proteins and other Nitrogen-Containing Compounds Chem II.B.2.a
      (9) Clearances Chem II.B.2.c
      (10) Blood Gases Chem III.A.2.a
      (11) Electrolytes Chem III.B.2.a
      (12) Fluorescence Chem IV.A.2.a.1
      (13) Immunoassay Chem IV.A.2.a.2
      (14) Stimulation/Suppression Tests Chem IV.A.2.c.
   d. Discuss the collection procedures of therapeutic drug monitoring and interpretation of test results. Chem II.C.1,4,5; II.D.1,4,5 (Lab Operations I.A.)
2. Correlate health and disease states with chemistry test results.
   a. Describe and evaluate diseases and chemistry test results associated with abnormal metabolism including carbohydrate, protein, and lipids and, heme derivatives. Chem I.A.1,3,4; B.1,3,4; C.1,3,4; Chem II.A.1,3,4; II.B.1,3,4
   b. Describe and evaluate diseases and chemistry test results associated with abnormal function including liver, kidney, heart, and endocrine.
   c. Describe and evaluate diseases and chemistry test results associated with abnormal metabolism, toxic effects, signs, symptoms and disease states including therapeutic drug monitoring and toxicology. Chem IV. C, D
   d. Describe and evaluate acid-base determination, blood gases, and electrolyte biochemical theory and physiology and test results with disease states. Chemistry III.A.1,3,4; III.B.1,4,5
3. Perform laboratory tests outlined by the test manufacturer to determine the presence and/or amount of substance(s) in the blood and other body fluids.
   a. Perform selected chemistry tests including manual and semi-automated methods. Lab Operations IV
   b. Demonstrate the operating techniques of the equipment used in the clinical chemistry laboratory, with emphasis on accuracy and precision. Lab Operations I. A, B, D, E; III.C.D.E
   c. Demonstrate calibration of selected instruments and test equipment. Lab Operations III.C.

d.Indicate when to refer to an appropriate source for repairs or consultation. Lab Operations I.A.B.D. E; III.C.D.

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I. General Chemistry
- A. Carbohydrates
  1. Biochemical theory and physiology
     a. Metabolic pathways
     b. Normal and abnormal states
     c. Physical and chemical properties
  2. Test procedures
     a. Principles
     b. Special precautions, specimen collection and processing, troubleshooting, and interfering substances
     c. Tolerance testing
     d. Glycated proteins
  3. Test result interpretation
  4. Disease state correlation
- B. Lipids
  1. Biochemical theory and physiology
     a. Metabolic pathways
     b. Normal and abnormal states
     c. Physical and chemical properties
        1) Lipoproteins
        2) Phospholipids
        3) Triglycerides
        4) Cholesterol
        5) Apolipoproteins
  2. Test procedures
     a. Principles
     b. Special precautions, specimen collection and processing, troubleshooting, and interfering substances
  3. Test result interpretation
  4. Disease state correlation
- C. Heme Derivatives
  1. Biochemical theory and physiology
     a. Metabolic pathways
     b. Normal and abnormal states
     c. Physical and chemical properties
        1) Hemoglobin
        2) Bilirubin
        3) Urobilinogen
        4) Myoglobin
  2. Test procedures
     a. Principles
     b. Special precautions, specimen collection and processing, troubleshooting, and interfering substances
  3. Test result interpretation
  4. Disease state correlation

II. Proteins and Enzymes
- A. Enzymes
  1. Biochemical theory and physiology
     a. Metabolic pathways
     b. Normal and abnormal states

c. Physical and chemical properties
1) LD
2) CK
3) AST/ALT
4) GGT
5) Lipase
6) Amylase
7) Alkaline phosphatase
8) Angiotensin converting enzyme
2. Test procedures
a. Principles
b. Special precautions, specimen collection and processing, troubleshooting, and interfering substances
3. Test result interpretation
4. Disease state correlation

B. Proteins and Other Nitrogen-Containing Compounds
1. Biochemical theory and physiology
a. Metabolic pathways
b. Normal and abnormal states
c. Physical and chemical properties
1) Proteins
2) Amino acids
3) Urea
4) Uric acid
5) Creatinine
6) Ammonia
7) Tumor markers
8) Cardiac markers
2. Test procedures
a. Principles
b. Special precautions, specimen collection and processing, troubleshooting, and interfering substances
c. Clearances
3. Test result interpretation
4. Disease state correlation

III. Acid-Base, Blood Gases and Electrolytes
A. Acid-Base Determinations (Including Blood Gases)
1. Biochemical theory and physiology
a. Henderson-Hasselbach equation
b. pH and H+ ion concentration
c. CO2 and O2 transport
d. Normal and abnormal states
2. Test procedures
a. Analytical principles
b. Special precautions, specimen collection and processing, troubleshooting, and interfering substances
3. Test result interpretation
4. Disease state correlation

B. Electrolytes
1. Biochemical theory and physiology
a. Sodium, potassium, chloride, CO2, bicarbonate
b. Calcium, magnesium, phosphorus, iron, TIBC
c. Trace elements
d. Normal and abnormal states
2. Test procedures
a. Principles
b. Special precautions, specimen collection and processing, troubleshooting, and interfering substances

3. Calculations (osmolality, anion gap)
4. Test result interpretation
5. Disease state correlation

IV. Special Chemistry
- A. Endocrinology
  1. Biochemical theory and physiology
     a. Metabolic pathways
     b. Normal and abnormal states
     c. Mechanism of action
     d. Physical and chemical properties
        1) Steroid hormones (e.g., cortisol, estrogen, hCG)
        2) Peptide hormones (e.g., insulin, prolactin)
        3) Thyroid hormones
        4) Catecholamines
  2. Test procedures
     a. Principles
        1) Fluorescence
        2) Immunoassay
     b. Special precautions, specimen collection and processing, troubleshooting, and interfering subs
     c. Stimulation/suppression tests
  3. Test result interpretation
  4. Disease state correlation
- B. Vitamins and Nutrition
  1. Biochemical theory and physiology
     a. Metabolism and action
     b. Normal and abnormal states
     c. Properties
  2. Test procedures
     a. Principles
     b. Special precautions, specimen collection and processing, troubleshooting, and interfering subs
  3. Test result interpretation
  4. Disease state correlation
- C. Therapeutic Drug Monitoring
  1. Pharmacokinetics
     a. Therapeutic states
     b. Toxic states
     c. Metabolism and excretion
  2. Chemical and physical properties
     a. Aminoglycosides (e.g., gentamicin)
     b. Cardioactive (e.g., digoxin)
     c. Anticonvulsants (e.g., phenobarbital)
     d. Antidepressants (e.g., lithium)
     e. Immunosuppressants (e.g., tacrolimus)
  3. Test procedures
     a. Principles
        1) Immunoassay
     b. Special precautions, specimen collection and processing, troubleshooting, and interfering subs
  4. Test result interpretation
  5. Disease state correlation
- D. Toxicology
  1. Toxicokinetics
     a. Toxic effects, signs and symptoms
     b. Metabolism and excretion
  2. Chemical and physical properties

a. Alcohols
b. Heavy metals (e.g., lead)
c. Analgesics (e.g., acetaminophen)
d. Drugs of abuse

3. Test procedures
   a. Principles
      1) Immunoassay
      2) Enzymatic methods
   b. Special precautions, specimen collection and processing, troubleshooting, and interfering sub
4. Test result interpretation
5. Disease state correlation

Laboratory Operations

I. Quality Assessment/Troubleshooting

A. Pre-analytical, Analytical, Post-analytical (NAACLS requires these in all major area courses)
B. Quality Control
C. Point-of-care Testing (POCT)
D. Compliance
E. Regulation (e.g., proficiency testing, competency assessment, accreditation standards)

Course Number and Name: MLT 2424 Immunohematology

Description: This course includes collection, processing, storage, and utilization of blood components. It also includes the study of immunological principles and procedures for blood typing, cross matching, antibody detection, identification, and investigation of hemolytic disease of the fetus and newborn.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
4	2	4	90

Prerequisite: Immunology/ Serology (MLT 1413)

Student Learning Outcomes:

1. Relate principles of immunology to immunohematology.
   a. Correlate the immunologic response to the immunohematology theory. (ASCP Blood Banking III.A.1,2,3; III.B.1,2,3; III.C.1, III.C.2.a, b; III.D.1,2)
   b. State antigen and antibody characteristics with reactions in various media and temperatures. (ASCP Blood Banking III.C.1; III.C.2.a, b; V.A.1; V.A.2.a, b; V.A.4; V.C.1-15)

2. Describe the basic concepts of genetics.
   a. Apply basic concepts of genetics to various blood group systems. (ASCP Blood Banking II.A.1-3; II.B.1-13)
   b. Evaluate and interpret inheritance from results of blood bank procedures. (ASCP Blood Banking II.A.3; III.A.3; V.A.1; V.C.9)
   c. Determine statistical probability in inheritance of a given characteristic in an individual. (ASCP Blood Banking II.A.1-3; II.C.2)

3. Assess component utilization in transfusion therapy
   a. Explain techniques for collection, processing, storage, and shipment of blood components. (ASCP Blood Banking I.A.1-4; I.B.1-2; I.C.1-5; I.D.1-12; I.E) (ASCP Laboratory Operations I.B, D, E)
   b. Identify blood component of choice for transfusion therapy. (ASCP Blood Banking I.D.1-12; VI.A; VI.B; VI.E)
   c. Select pre-transfusion compatibility testing procedures required for component therapy. (ASCP Blood Banking V.A.1; V.A.2. a, b; V.A.3; V.E.1-3)
   d. Identify types of transfusion reactions and perform investigative testing. (ASCP Blood Banking IV.C.1-4; IV.D.2.a, b, c; V.A.1; V.A.2.a, b; V.A.4; V.E.1-3; VI.C.1-3) (ASCP Laboratory Operations I.A, B, D, E; II.A.1-5; IV.A)
   e. Assess and perform appropriate tests in investigation of transfusion reactions. (ASCP Blood Banking IV.C.2, 3; IV.D.2.b, c; V.A.1; V.A.2.a, b; V.A.3; V.A.4; V.E.3) (ASCP Laboratory Operations I.A, B, D, E; II.A.1-5; IV.A)
   f. Identify hemolytic disease of the fetus and newborn. (ASCP Blood Banking IV.C.1-4)

4. Perform basic procedures used in a blood bank laboratory.
   a. Assess patient condition to select required procedures for immunohematology. (ASCP Blood Banking I.A.1; IV.A.1; IV.A.2.a, b; IV.A.3, 4; VI.E)
   b. Perform and interpret routine pre-transfusion and compatibility patient testing. (ASCP Blood Banking V.A.1; V.A.2.a, b; V.A.3, 4; V.E.1-3) (ASCP Laboratory Operations I.A, B, D, E; II.A.1-5; IV.A)
   c. Understand the principles applied for recognition for differentiation of blood group antigens and antibodies. (ASCP Blood Banking II.B.1-13; II.C.1, 2; III.B.1-3; III.C.1; III.C.2.a, b; V.A.1; V.A.2.a, b; V.A.3)
   d. Apply the principles of immunohematology to the procedures used in the blood bank laboratory. (ASCP Blood Banking III.C.1; III.C.2.a, b; V.A.1; V.A.2.a, b; V.A.3)

5. Explain, perform, and interpret quality control in the blood bank laboratory.
   a. Identify and perform the daily quality assurance practices and safety practices used in the blood bank. (ASBP Blood Banking I.E; V.E.1-3)
   b. Identify sources of error and recommend corrective procedures. (ASCP Blood Banking V.E.1-3) (ASCP Laboratory Operations I.A, B, D, E)
   c. Assess physiologic and pathologic causes for discrepant test results. (ASCP Blood Banking IV.A.2.b; IV.B.1, 2; V.E.1-3) (ASCP Laboratory Operations I.A, B)
   d. Select and employ safe transfusion practices in the presence of unusual test results. (ASCP Blood Banking I.E; V.E.1-3; VI.E) (ASCP Laboratory Operations I.A, B, D, E)

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Blood Banking

I. Blood Products
- A. Donors
  6. Qualification
  7. Collection methods
  8. Adverse reactions
  9. Special donations (e.g., autologous)
- B. Processing
  1. Testing
  2. Labeling
- C. Storage
  1. Anticoagulants/additives
  2. Temperature requirements
  3. Transportation
  4. Properties of stored products
  5. Expiration
- D. Blood Components
  1. Red blood cells
  2. Cryoprecipitated AHF
  3. Platelets
  4. Plasma
  5. Granulocytes
  6. Leukocyte-reduced components
  7. Frozen/deglycerolized red blood cells
  8. Apheresis products 9. Fractionation products
  9. Whole blood
  10. Washed red blood cells
  11. Irradiated components
- E. Blood Component Quality Control

II. Blood Group Systems
- A. Genetics
  1. Basic
  2. Molecular
  3. Inheritance of blood groups
- B. B. Biochemistry/Antigens
  1. ABO
  2. Lewis
  3. Rh
  4. MNS
  5. P1PK/Globoside(P)
  6. Ii
  7. Kell
  8. Kidd
  9. Duffy
  10. Lutheran
  11. Antigens of high prevalence
  12. Antigens of low prevalence
  13. Platelet-specific
- C. Role of Blood Groups in Transfusion
  1. Immunogenicity

2. Antigen prevalence

III. Blood Group Immunology

A. Immune Response

1. Primary and secondary response
2. B and T cells, macrophages
3. Genetics

B. Immunoglobulins

1. Classes and subclasses
2. Structure
3. Biologic and physical properties

C. Antigen-Antibody Interactions

1. Principles
2. Testing
   a. Principles
   b. Methods

D. D. Complement

1. Classical and alternative pathway mechanisms
2. Biologic properties

IV. Physiology and Pathophysiology

A. Physiology of Blood

1. Circulation and blood volume
2. Composition and function of blood
   a. Normal function
   b. Abnormal physiology
3. Cell survival
4. Cell metabolism

B. B. Hemostasis and Coagulation

1. Coagulation factors and disorders
2. Platelet functions and disorders

C. Hemolytic Disease of the Fetus and Newborn

1. Pathophysiology
2. Detection
3. Treatment
4. Prevention

D. Anemias

1. Congenital and acquired
   a. Pathophysiology
   b. Detection
   c. Treatment
2. Immune hemolytic anemias: warm, cold, drug-induced
   a. Pathophysiology
   b. Detection
   c. Treatment

E. Transplantation

1. Solid organ
2. Hematopoietic progenitor cell (HPC)

V. Serologic And Molecular Testing

B. Routine Tests

1. Blood grouping tests
2. Compatibility tests
   a. Antibody detection
   b. Crossmatch
3. Antibody identification/clinical significance
4. Direct antiglobulin testing

C. Reagents

1. Antiglobulin sera
2. Blood grouping sera
3. Reagent red cells

D. Application of Special Tests and Reagents

3. Enzymes
4. Enhancement media
5. Lectins
6. Adsorptions
7. Elutions
8. Titrations
9. Cell separations
10. ELISA
11. Molecular techniques
12. Use of thiol reagents
13. Immunofluorescence
14. Solid phase
15. Column agglutination test
16. Chloroquine diphosphate
17. EDTA glycine-acid

E. Leukocyte/Platelet Testing

1. Cytotoxicity
2. Platelet testing

F. Quality Assurance

1. Blood samples
2. Reagents
3. Test procedures

VI. Transfusion Practice

A. Indications for Transfusion
B. Component Therapy
C. Adverse Effects of Transfusion

1. Immunologic reactions
2. Nonimmunologic reactions
3. Transfusion-transmitted diseases

D. Apheresis and Extracorporeal Circulation
E. Blood Administration and Patient Blood Management

Laboratory Operations

I. Quality Assessment/Troubleshooting

A. Preanalytical, Analytical, Postanalytical
B. Quality Control
C. Point-of-care Testing (POCT)
D. Compliance
E. Regulation (e.g., proficiency testing, competency assessment, accreditation standards)

II. Safety

A. Safety Programs and Practices

1. Prevention of infection with bloodborne pathogens
2. Use of personal protective equipment (PPE)
3. Safe work practices
4. Packaging and transportation of specimens and microorganisms
5. Safety data sheets (SDS) for chemicals and reagents

B. Emergency Procedures (e.g., needlesticks, splashes to mucous membranes, fire)

III. Laboratory Mathematics
    A. Concentration, Volume, and Dilutions
    B. Molarity, Normality
    C. Standard Curves
    D. Mean, Median, Mode, and Confidence Intervals
    E. Sensitivity, Specificity, and Predictive Value
IV. Manual/Automated Methodology and Instrumentation
    A. Basic Laboratory Equipment

Course Number and Name: MLT 2522 Pathogenic Microbiology I

Description: Basic skills, principles, and techniques for the staining, culturing, isolation, and identification of parasites, viruses, and fungi of medical importance are emphasized in this course. This course covers the morphology, physiology life cycles, and epidemiology of parasites with emphasis on human pathogenic parasites. Identification of the parasites, viruses, and fungi from human material is also included.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
2	1	2	45

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Describe the life cycle of medically important parasites. (Micro III. C. 1, 2)
    a. Describe the modes of infection for medically important parasites (Micro III. C. 1, 2)
    b. Recognize the diagnostic stages of medically important parasites. (Micro III. C. 1, 2)
2. Discuss isolation and identification techniques used in a clinical parasitology laboratory. (Micro III. C. 3-4) (Lab Operations I. A. B. C. D. E; II. A. 1-5, B.)
    a. Identify the various body fluids that might be examined for the presence of parasites. (Micro III. C. 1, 2)
    b. Describe the use of concentration techniques in parasitology. (Micro III. C. 3, 4)
    c. Describe the microscopic techniques used to identify medically important parasites. (Micro III. C. 3)
3. Identify medically important parasites. (Micro III. C. 1-4)
    a. Correlate test results with clinical conditions. (Micro III. C. 2- 4)
    b. Correlate other laboratory findings with results in the parasitology laboratory. (Micro III. C. 2, 3, 4)
4. Discuss transmission methods of disease and host susceptibility. (Micro III. C. 2)
    a. Describe the various ways that diseases are transmitted. (Micro III. C. 2)
    b. Identify conditions that lead to increased host susceptibility. (Micro III. C. 1-2)
    c. Identify a reportable disease. (Micro III. C. 2)
5. Identify organisms of medical importance, and correlate results with reading of plates, stain characteristics, biochemical studies, and molecular studies. (Micro I. C.1-2, D. 1,2,5; II. A. 1-8, B. 1-6, C. 1-5, D. 1-6, E. 1-5, F. 1-4, G. 1-4, H. 1-5, I. 1-4, J. 1-7, K. 1-4, L. 1-3; III. A. 1-3, B. 1-3, D. 1-5) (Lab Operations IV. K)
    a. Correlate laboratory test results with clinical conditions. (Micro II. A. 3-8, B. 2-6, C. 2-5, D. 2-6, E. 2-5, F. 2-4, G. 2-4, H. 2-5, I. 2-4, J. 1-7, K. 1-4, L. 2-3, M. 2-4; III. A. 2-3, B. 2-3, D. 2-5) (Lab Operations IV. K)
    b. Evaluate stain characteristics, colony morphology, and biological and differential tests for identification of pathogenic organisms including viruses and fungus. (Micro II. A. 3, 5, B. 2, 5, C. 3-4, D. 3-5, E. 2-4, F 1-3, G. 2-3, H. 2-4, I. 2-4, J. 1-7, K. 1-4, L. 3, M. 2; III.A. 3, B. 3, D. 3-5)
    c. Perform tests and recognize criteria for identification of pathogenic organisms including viruses and fungus. (Micro I. C. 1-2, D. 1,2,5; II. A. 2, 3, 5, 8, B. 2, 4-6, C. 3-5, D. 3-6, E. 2-5, F 1-4, G. 2-4, H. 2-5, I. 2-4, J. 1-7, K. 1-4, L. 3, M. 2, 4; III.A. 2-3, B. 2-3, D. 2-5) (Lab Operations IV. K)
6. Perform safety, quality control (QC), and infection control practices of the microbiology laboratory. (Micro I. A. 1-3, B. 1-7; II. M. 3; IV. A. B. C. D. E.) (Lab Operations I. A. B. C. D. E; II. A. 1-5, B.)
    a. Perform routine diagnostic microbiologic testing using aseptic techniques. (Micro I. A. 1-3, B. 1-7) (Lab Operations II A. 1-5, B)
    b. Explain and follow safety and standard precautions that are followed in and related to the microbiology laboratory. (Micro I. A. 1-3, B. 1-7) (Lab Operations I. A. B. C. D. E, II A. 1-5, B)
    c. Perform routine QC procedures. (Micro I. C. 1-2, D. 1-5, II. A. 3, B. 5, C. 4, D. 5, E. 4, F. 2-3, G. 3, H. 3-4, J. 2-7, K. 1-4, L. 3, M. 2; III. A. 3, B. 3, D. 3) (Lab Operations I. A. B. C. D. E; II. A. 1-5, B.)
7. Explain the principle and operation of automated instrumentation. Micro I. B. 5, C. 4, D. 5, E. 4, F. 2, H. 4, J. 5-7, K. 1-4, L. 3, III. B. 3, D. 3,5) (Lab Operations IV. K)
    a. List and discuss examples of automated instrumentation for a microbiology laboratory. (Micro I. B. 5, C. 4, D. 5, E. 4, F. 2, H. 4, J. 5-7, K. 1-4, L. 3, III. B. 3, D. 3,5) (Lab Operations IV. K)
8. Explain procedures used for collection of microbiology specimens from various body sites. (Micro I. A. 1-3, B. 1-3; II. A. 1, B. 1, C.1, D.1, E. 1, F. 1, G. 1, H. 1, I.1, L. 1, M.1; III. 1. 1, B. 1, D.1) (Lab Operations I. A, II. A. 1-5, B)

a. Describe appropriate specimen containers for aseptic collection of microbiological specimens. (Micro I. A. 1-3, B. 1-3)
b. Explain the collection of specimens from various body sites. (Micro I. A. 1-3, B. 1-3; II. A. 1, B. 1, C.1, D.1, E. 1, F. 1, G. 1, H. 1, I.1, L. 1, M.1; III. 1. 1, B. 1, D.1) (Lab Operations I. A, II. A. 1-5, B)

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I. Preanalytic Procedures
- A. Specimen Collection and Transport
  1. Patient identification and specimen labeling
  2. Specimen collection
  3. Specimen transport systems and conditions for all organisms
- B. Specimen Processing
  1. Specimen prioritization and rejection criteria
  2. Biosafety cabinet and personal protective equipment
  3. Specimen preparation methods and applications
  4. Media
  5. Inoculation of media
  6. Incubation conditions (e.g., temperature, atmosphere, duration)
  7. Preparation methods for slides used for stains
- C. Stains: Procedure, Principle, and Interpretation
  1. Gram
  2. Acid-fast
- D. Stains: Procedure and Principle
  1. Modified acid-fast
  2. KOH and calcofluor-white
  3. Trichrome
  4. Giemsa
  5. Acridine orange

Ill. Analytic Procedures For Mycobacteriology, Virology, Parasitology, and Mycology
- A. Virology
  1. Specimen sources
  2. Major pathogens and disease states (e.g., etiology, epidemiology, transmission)
  3. Direct detection of pathogens
- B. Parasitology
  1. Specimen sources (e.g., stool, respiratory, blood, tissue)
  2. Major pathogens and disease states (e.g., etiology, epidemiology, transmission)
  3. Microscopic identification
  4. Direct and molecular detection
- C. Mycology
  1. Specimen sources
  2. Major pathogens and disease states (e.g., etiology, epidemiology, transmission)
  3. Yeast identification (e.g., biochemical, automated methods, MALDI-TOF MS)
  4. Microscopic identification of major pathogens
  5. Other identification methods

Laboratory Operations

I. Quality Assessment/Troubleshooting
- A. Preanalytical, Analytical, Postanalytical (NAACLS requires these in all major area courses)
- B. Quality Control
- C. Point-of-care Testing (POCT)
- D. Compliance
- E. Regulation (e.g., proficiency testing, competency assessment, accreditation standards)

II. Safety
- A. Safety Programs and Practices
  1. Prevention of infection with bloodborne pathogens
  2. Use of personal protective equipment (PPE)
  3. Safe work practices
  4. Packaging and transportation of specimens and microorganisms
  5. Safety data sheets (SDS) for chemicals and reagents
- B. Emergency Procedures (e.g., needlesticks, splashes to mucous membranes, fire)

IV. Manual/Automated Methodology and Instrumentation
- A. Basic Laboratory Equipment
- B. Automated Microbiology Processors

Course Number and Name: MLT 2614 Pathogenic Microbiology II

Description: Basic skills, principles, and techniques for the staining, culturing, isolation, and identification of microorganisms of medical importance are emphasized in this course. Included are techniques used in determining the sensitivity of pathogenic bacteria to different antibiotic and other drugs.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
4	2	4	90

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Discuss transmission methods of disease and host susceptibility. (Micro III. C. 2)
   a. Describe the various ways that diseases are transmitted. Micro III. C. 1-2)
   b Identify conditions that lead to increased host susceptibility.
   c. Identify a reportable disease. (Micro III. C. 2)
2. Identify organisms of medical importance, and correlate results with reading of plates, stain characteristics, biochemical studies, and molecular studies. (Micro I. C.1-2, D. 1,2,5; II. A. 1-8, B. 1-6, C. 1-5, D. 1-6, E. 1-5, F. 1-4, G. 1-4, H. 1-5, I. 1-4, J. 1-7, K. 1-4, L. 1-3; III. A. 1-3, B. 1-3, D. 1-5) (Lab Operations IV. K)
   a. Correlate laboratory test results with clinical conditions. (Micro II. A. 3-8, B. 2-6, C. 2-5, D. 2-6, E. 2-5, F. 2-4, G. 2-4, H. 2-5, I. 2-4, J. 1-7, K. 1-4, L. 2-3, M. 2-4; III. A. 2-3, B. 2-3, D. 2-5) (Lab Operations IV. K)
   b. Evaluate stain characteristics, colony morphology, and biological and differential tests for identification of pathogenic organisms including AFB. (Micro II. A. 3-8, B. 2-6, C. 2-5, D. 2-6, E. 2-5, F. 2-4, G. 2-4, H. 2-5, I. 2-4, J. 1-7, K. 1-4, L. 2-3, M. 2-4; III. A. 2-3, B. 2-3, D. 2-5) (Lab Operations IV. K)
   c. Perform tests and recognize criteria for identification of pathogenic organisms including AFB. (Micro I. C. 1-2, D. 1,2,5; II. A. 2, 3, 5, 8, B. 2, 4-6, C. 3-5, D. 3-6, E. 2-5, F 1-4, G. 2-4, H. 2-5, I. 2-4, J. 1-7, K. 1-4, L. 3, M. 2, 4; III.A. 2-3, B. 2-3, D. 2-5) (Lab Operations IV. K)
   d. Identify normal flora at various body sites. (Micro II. A. 1, 4, 8, B. 1, 6, C. 1, 2, 5, D. 1, 3, 6, E. 1, 2, 5, G. 1, 2, 4, H. 1, 2, 5, I. 1, 3
3. Perform susceptibility testing.
   a. Compare and contrast the various in-vitro methods for determining antimicrobial susceptibility. Micro II. A. 3, B. 5, D. 2, 5, E. 4, F. 2, G. 3, H. 3, J. 5, K. 1-4, M. 3;III. B. 3, D. 5
   b. Interpret results of in-vitro susceptibility tests as resistant, intermediate, and susceptible. (Micro I. K. 1-4; IV. A. B. C. D. E)
4. Perform safety, quality control (QC), and infection control practices of the microbiology laboratory. (Micro I. A. 1-3, B. 1-7; II. M. 3; IV. A. B. C. D. E.) (Lab Operations I. A. B. C. D. E; II. A. 1-5, B.)
   a. Perform routine diagnostic microbiologic testing using aseptic techniques. (Micro I. A. 1-3, B. 1-7) (Lab Operations II A. 1-5, B)
   b. Explain and follow safety and standard precautions that are followed in and related to the microbiology laboratory. (Micro I. A. 1-3, B. 1-7) (Lab Operations I. A. B. C. D. E, II A. 1-5, B)
   c. Perform routine QC procedures. (Micro I. C. 1-2, D. 1-5, II. A. 3, B. 5, C. 4, D. 5, E. 4, F. 2-3, G. 3, H. 3-4, J. 2-7, K. 1-4, L. 3, M. 2; III. A. 3, B. 3, D. 3) (Lab Operations I. A. B. C. D. E; II. A. 1-5, B.)
5. Explain the principle and operation of automated instrumentation. (Micro I. B. 5, C. 4, D. 5, E. 4, F. 2, H. 4, J. 5-7, K. 1-4, L. 3, III. B. 3, D. 3,5) (Lab Operations IV. K)

a. List and discuss examples of automated instrumentation for a microbiology laboratory. (Micro I. B. 5, C. 4, D. 5, E. 4, F. 2, H. 4, J. 5-7, K. 1-4, L. 3, III. B. 3, D. 3,5) (Lab Operations IV. K)

6. Explain procedures used for collection of microbiologic specimens from various body sites. (Micro I. A. 1-3, B. 1-3; II. A. 1, B. 1, C.1, D.1, E. 1, F. 1, G. 1, H. 1, I.1, L. 1, M.1; III. 1. 1, B. 1, D.1) (Lab Operations I. A, II. A. 1-5, B)

a. Describe appropriate specimen containers for aseptic collection of microbiological specimens. (Micro I. A. 1-3, B. 1-3)

b. Explain the collection of specimens from various body sites. (Micro I. A. 1-3, B. 1-3; II. A. 1, B. 1, C.1, D.1, E. 1, F. 1, G. 1, H. 1, I.1, L. 1, M.1; III. 1. 1, B. 1, D.1) (Lab Operations I. A, II. A. 1-5, B)

ASCP©. Board of Certification
Medical Laboratory Technician, MLT and International Medical Laboratory Technician, MLT (ASCP©.)
I. Analytic Procedures for Bacteriology

A. Blood and Bone Marrow
1. Specimen sources (e.g., peripheral, intravenous catheters)
2. Continuous-monitoring systems
3. Rapid identification/resistance detection methods
4. Species comprising skin flora and clinical significance
5. Colony morphology and identification of major pathogens (e.g., Staphylococcus aureus, other Staphylococcus spp. including coagulase-negative staphylococci, beta hemolytic streptococci, Enterococcus spp., Candida spp., Streptococcus pneumoniae, Acinetobacter baumannii, Enterobacteriaceae, Pseudomonas spp.)
6. Common agents of endocarditis
7. Agents of bone marrow infection (e.g., Brucella spp., Salmonella spp.)
8. Organism pathogenicity (e.g., etiology, transmission, virulence mechanisms)

B. Cerebrospinal Fluid
1. Specimen sources (e.g., lumbar puncture, shunt, reservoir)
2. Colony morphology and identification of major pathogens associated with acute meningitis (e.g., Streptococcus pneumoniae, Haemophilus influenzae, Neisseria meningitidis, Escherichia coli, Listeria monocytogenes, Enterobacteriaceae, Staphylococcus aureus, beta-hemolytic streptococci)
3. Common agents of shunt infections (e.g., other Staphylococcus spp. including coagulase-negative staphylococci, Corynebacterium spp., Propionibacterium spp., Cutibacterium spp.)
4. Correlation with other laboratory results (e.g., glucose, protein, cell count)
5. Direct detection and molecular methods
6. Organism pathogenicity (e.g., etiology, transmission, virulence mechanisms)

C. Body Fluids from Normally Sterile Sites
1. Specimen sources (e.g., pleural, peritoneal, pericardial, vitreous and aqueous humor, synovial, amniotic)
2. Indigenous organisms associated with mucosal surfaces and skin
3. Colony morphology and identification of major pathogens (e.g., Streptococcus pneumoniae, Haemophilus influenzae, Neisseria spp., Escherichia coli, Listeria monocytogenes, Enterobacteriaceae, Staphylococcus aureus, beta-hemolytic streptococci, Enterococcus spp., Pseudomonas aeruginosa, Acinetobacter spp., Clostridium perfringens, Bacteroides fragilis group)
4. Molecular methods
5. Organism pathogenicity (e.g., etiology, transmission, virulence mechanisms)

D. Lower Respiratory
1. Specimen sources (e.g., sputum, endotracheal aspirate, bronchoalveolar lavage, bronchial wash, bronchial brush)
2. Significance of quantitative and semiquantitative reporting of results
3. Species comprising oral flora colony and Gram stain morphology
4. Colony morphology and identification of major pathogens
5. Direct detection and molecular methods (e.g., Streptococcus pyogenes, Bordetella pertussis)
6. Organism pathogenicity (e.g., etiology, transmission, virulence mechanisms)

E. Upper Respiratory
1. Specimen sources (e.g., throat, nasopharynx, middle ear, sinus)
2. Indigenous flora colony and Gram stain morphology
3. Colony morphology and identification of major pathogens
4. Direct detection and molecular methods (e.g., Streptococcus pyogenes, Bordetella pertussis)
5. Organism pathogenicity (e.g., etiology, transmission)

F. Gastrointestinal
1. Colony morphology and identification of major pathogens (e.g., Salmonella spp., Shigella spp., toxigenic Escherichia coli, Campylobacter spp., Vibrio spp., Yersinia enterocolitica, Aeromonas spp., Plesiomonas shigelloides)
2. Direct detection and molecular methods (e.g., Clostridioides difficile, Shiga toxin)
3. Serotyping of Escherichia coli, Salmonella spp., and Shigella spp.
4. Organism pathogenicity (e.g., etiology, transmission, virulence mechanisms) 5. Detection methods for Helicobacter pylori

G. Skin, Soft Tissue, and Bone
1. Specimen sources (e.g., wound, abscess, biopsy)
2. Indigenous flora colony and Gram stain morphology
3. Colony morphology and identification of major pathogens
4. Organism pathogenicity (e.g., etiology, transmission)

H. Genital Tract
1. Specimen sources (e.g., vaginal, cervical, urethral, endocervical)
2. Indigenous organisms colony and Gram stain morphology
3. Methods for detection of pathogens associated with vaginitis (e.g., Trichomonas vaginalis, Candida spp., bacterial vaginosis)
4. Culture and/or molecular detection (e.g., Neisseria gonorrhoeae, Chlamydia trachomatis, Streptococcus agalactiae, and Mycoplasma spp.)
5. Organism pathogenicity (e.g., etiology, transmission)

I. Urine
1. Specimen sources (e.g., mid-stream clean catch, catheterized, suprapubic, nephrostomy)
2. Colony morphology and identification of major urinary pathogens (e.g., Enterobacteriaceae, Enterococcus spp., Streptococcus agalactiae, Candida spp., Staphylococcus saprophyticus)
3. Correlation of colony counts with clinical significance
4. Correlation of culture with urinalysis results

J. Identification Methods (Theory, Interpretation, and Application)
1. Colony morphology
2. Rapid tests used for presumptive identification (e.g., coagulase, catalase, oxidase, indole, PYR)
3. Conventional biochemical identification (e.g., X and V factors, Neisseria carbohydrate utilization)
4. Commercial kits
5. Automated methods
6. MALDI-TOF MS
7. Multiplex molecular methods 8. Sequencing (e.g., 16S)

K. Antimicrobial Susceptibility Testing and Antibiotic Resistance
1. Method, theory, interpretation, and application
2. Phenotypic detection of resistance (e.g., beta-lactamase, ESBL, inducible clindamycin resistance, carbapenamases)
3. Mechanisms of action of major antibiotic classes
4. Detection of genetic determinants of resistance (e.g., mecA, vanA, blaKPC)
5. Intrinsic resistance patterns for common species

L. MRSA/MSSA, VRE, ESBL/CRE Screening
1. Specimen sources
2. Culture methods
3. Molecular methods

M. BSL-3 Pathogens and Select Agents (Bioterrorism)
1. Specimen sources (e.g., blood, sputum, tissue, lymph node)
2. Colony morphology and rapid tests used for presumptive identification (e.g., Bacillus anthracis, Yersinia pestis, Brucella spp., Francisella tularensis)
3. Role of regional laboratory and Laboratory Response Network
4. Organism pathogenicity (e.g., etiology, transmission, virulence mechanisms)

Ill. Analytic Procedures for Mycobacteriology, Virology, Parasitology, And Mycology
1. Mycobacteriology and *Nocardia* spp.
2. Specimen sources (e.g., lower respiratory, blood, soft tissue)
3. Major pathogens and disease states (e.g., etiology, epidemiology, transmission)
4. Acid-fast reaction, colony morphology, and growth characteristics

LABORATORY OPERATIONS

I. Quality Assessment/Troubleshooting
    A. Preanalytical, Analytical, Postanalytical (NAACLS requires these in all major area courses)
    B. Quality Control
    C. Point-of-care Testing (POCT)
    D. Compliance
    E. Regulation (e.g., proficiency testing, competency assessment, accreditation standards)
II. Safety
    A. Safety Programs and Practices
        1. Prevention of infection with bloodborne pathogens
        2. Use of personal protective equipment (PPE)
        3. Safe work practices
        4. Packaging and transportation of specimens and microorganisms
        5. Safety data sheets (SDS) for chemicals and reagents
    B. Emergency Procedures (e.g., needlesticks, splashes to mucous membranes, fire)
IV. Manual/Automated Methodology and Instrumentation
    A. Basic Laboratory Equipment
    B. Automated Microbiology Processors

Course Number and Name: MLT 2711 Medical Laboratory Technology Seminar

Description: This course represents a synthesis of previous didactic, laboratory, and clinical experiences. It is designed to facilitate activities incorporated in student and professional organizations and to allow students to select and present a case study.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
1		2	30

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Demonstrate professionalism and team-building skills by participating in club activities and/or professional organizations.
   a. Attend scheduled club meetings and activities.
   b. Evaluate the financial needs of a club or organization.
2. Present and critique various case studies.
   a. Identify patient from laboratory or clinical experiences with an interesting diagnosis and a clinical course that includes medical laboratory work.
   b. Present case study to a peer audience.

Course Number and Name: MLT 2723 Certification Fundamentals for Medical Laboratory Technology

Description: This course is an in-depth study and review of material covered in the MLT curriculum. It is designed to prepare the student for the national certifying exams.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	3	0	45

Prerequisite: Completion of all didactic Medical Laboratory Technology courses

Student Learning Outcomes:

1. Correlate laboratory skills from areas with knowledge obtained from didactic and clinical experiences.
    a. Recognize and relate disease states with abnormal test results.
    b. Demonstrate acceptable proficiency in the cognitive level on all areas tested.
    c. Recognize color plate visuals and correlate with each area studied.
2. Compare student's pretesting results in each area with post-testing results.
    a. Recognize weak areas in knowledge and application.
    b. Diagnose strengths and weaknesses in each area by evaluating test results.
3. Practice computer constructed tests by using computer software.
    a. Develop computer skills to enable improved test taking strategies.
    b. Analyze the computer-aided testing results and formulate correct responses.
4. Correlate registry/certifying item descriptor list with curriculum content.
    a. Compare registry/certifying item descriptor list with the content of task areas tested.
    b. Construct test questions to correlate with item descriptor list.
    c. Recognize the three taxonomic levels and practice the utilization of each level.
5. Prepare for a certification exam.
    a. Complete a mock certification exam.
    b. Utilize test results to identify areas of knowledge that should be targeted for further study in preparation for a certification exam.

Course Number and Name: MLT 2914-6, MLT 2924-5, MLT 2934-5 Clinical Practice I, II, III

Description: This course includes clinical practice and didactic instruction in a clinical affiliate and/or comparable simulated environment. Areas covered are hematology, clinical chemistry, immunohematology, urinalysis, microbiology, coagulation, and serology.

Hour Breakdown:

Semester Credit Hours	Lecture	Clinical Practice	Contact Hours
4-6		12-18	180-270
4-5		12-15	180-225

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Process and collect specimens for testing and analysis.
    a. Determine the suitability of specimens submitted for standard laboratory testing.
    b. Use appropriate protective techniques in collection and processing of laboratory samples.
2. Perform analytical examinations on cellular products and body fluids.
    a. Analyze laboratory specimens according to the laboratory procedure manual.
    b. Apply basic scientific principles in learning new methodologies and techniques.
    c. Correlate laboratory findings with disease.
3. Recognize factors that affect testing procedures and results, and take action when predetermined limits are exceeded.
    a. Specify technical factors influencing test results.
    b. Assess physical and pathologic causes for variation in test results.
    c. Interpret laboratory data and follow established protocol when predetermined limits are exceeded.
    d. Discuss and observe data input, storage, and retrieval on a computer.
4. Participate in an established quality control program.
    a. Maintain and monitor an effective quality control program according to laboratory protocol.
    b. Interpret and evaluate quality control data to determine validity of patient test results.
    c. Explain corrective action according to laboratory protocol.
    d. Maintain preventive and corrective maintenance on laboratory equipment and instrumentation, including referral to an appropriate source for repairs and consultation.
5. Demonstrate professional conduct, communication, and interpersonal relations with laboratory personnel, patients, other health care professionals, as well as with the public.
    a. Interact and communicate with other laboratory and health care professionals to aid in patient care.
    b. Recognize the importance of continuing education as an ongoing process.
    c. Practice measures to protect confidentiality of patient test data.
6. Demonstrate technical processes sufficient to orient new employees.
    a. Communicate essential knowledge for job performance to new employees.
    b. Demonstrate laboratory procedures in order to orient new employees for skills required for the job.
    c. Practice using evaluation instruments to assess the performance of skills by new employees.

Laboratory Operations

I. Quality Assessment/Troubleshooting
   A. Preanalytical, Analytical, Postanalytical
   B. Quality Control
   C. Point-of-care Testing (POCT)
   D. Compliance
   E. Regulation (e.g., proficiency testing, competency assessment, accreditation standards)

II. Safety
   A. Safety Programs and Practices

1. Prevention of infection with bloodborne pathogens
2. Use of personal protective equipment (PPE)
3. Safe work practices
4. Packaging and transportation of specimens and microorganisms
5. Safety data sheets (SDS) for chemicals and reagents

B. Emergency Procedures (e.g., needlesticks, splashes to mucous membranes, fire)

III. Laboratory Mathematics

A. Concentration, Volume, and Dilutions
B. Molarity, Normality
C. Standard Curves
D. Mean, Median, Mode, and Confidence Intervals
E. Sensitivity, Specificity, and Predictive Value

IV. Manual/Automated Methodology and Instrumentation

A. Basic Laboratory Equipment
B. Spectrophotometry and Photometry
C. Mass Spectrometry
D. Osmometry
E. Electrophoresis
F. Electrochemistry
G. Fluorometry
H. Nephelometry
I. Flow Cytometry
J. Molecular Methods
K. Automated Microbiology Processors
L. Hematology Instrumentation

Course Number and Name: MLT 2943-4, MLT 2953-4, MLT 2963-4 MLT 2973-4 Clinical Practicum I, II, III, IV

Description: This course includes clinical practice and didactic instruction in a clinical affiliate and/or comparable simulated environment. Areas covered are hematology, clinical chemistry, immunohematology, urinalysis, microbiology, coagulation, and serology.

Hour Breakdown:

Semester Credit Hours	Lecture	Clinical Practice	Contact Hours
3-4	0	9-12	135-180

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Process and collect specimens for testing and analysis. Lab Operations I and II
    a. Determine the suitability of specimens submitted for standard laboratory testing.
    b. Use appropriate protective techniques in collection and processing of laboratory samples.
2. Perform analytical examinations on cellular products and body fluids. Lab Operations II and IV
    a. Analyze laboratory specimens according to the laboratory procedure manual.
    b. Apply basic scientific principles in learning new methodologies and techniques.
    c. Correlate laboratory findings with disease.
3. Recognize factors that affect testing procedures and results, and take action when predetermined limits are exceeded. Lab Operations I, II, III and IV
    a. Specify technical factors influencing test results.
    b. Assess physical and pathologic causes for variation in test results.
    c. Interpret laboratory data and follow established protocol when predetermined limits are exceeded.
    d. Discuss and observe data input, storage, and retrieval on a computer.
4. Participate in an established quality control program. Lab Operations I and III
    a. Maintain and monitor an effective quality control program according to laboratory protocol.
    b. Interpret and evaluate quality control data to determine validity of patient test results.
    c. Explain corrective action according to laboratory protocol.
    d. Maintain preventive and corrective maintenance on laboratory equipment and instrumentation, including referral to an appropriate source for repairs and consultation.
5. Demonstrate professional conduct, communication, and interpersonal relations with laboratory personnel, patients, other health care professionals, as well as with the public.
    a. Interact and communicate with other laboratory and health care professionals to aid in patient care.
    b. Recognize the importance of continuing education as an ongoing process.
    c. Practice measures to protect confidentiality of patient test data.
6. Demonstrate technical processes sufficient to orient new employees.
    a. Communicate essential knowledge for job performance to new employees.
    b. Demonstrate laboratory procedures in order to orient new employees for skills required for the job.
    c. Practice using evaluation instruments to assess the performance of skills by new employees.

Laboratory Operations

I. Quality Assessment/Troubleshooting
    A. Preanalytical, Analytical, Postanalytical
    B. Quality Control
    C. Point-of-care Testing (POCT)
    D. Compliance
    E. Regulation (e.g., proficiency testing, competency assessment, accreditation standards)

II. Safety

A. Safety Programs and Practices
    1. Prevention of infection with bloodborne pathogens
    2. Use of personal protective equipment (PPE)
    3. Safe work practices
    4. Packaging and transportation of specimens and microorganisms
    5. Safety data sheets (SDS) for chemicals and reagents
B. Emergency Procedures (e.g., needlesticks, splashes to mucous membranes, fire)

III. Laboratory Mathematics
A. Concentration, Volume, and Dilutions
B. Molarity, Normality
C. Standard Curves
D. Mean, Median, Mode, and Confidence Intervals
E. Sensitivity, Specificity, and Predictive Value

IV. Manual/Automated Methodology and Instrumentation
A. Basic Laboratory Equipment
B. Spectrophotometry and Photometry
C. Mass Spectrometry
D. Osmometry
E. Electrophoresis
F. Electrochemistry
G. Fluorometry
H. Nephelometry
I. Flow Cytometry
J. Molecular Methods
K. Automated Microbiology Processors
L. Hematology Instrumentation

Course Number and Name: PBT 1113 Phlebotomy

Description: This course is designed to provide practical instruction in the proper techniques used in collection, processing and handling of blood and body fluid specimens for laboratory analysis. The course includes basic medical terminology, medical ethics, basic anatomy and physiology, point-of-care testing, and laboratory operations.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Corequisite: Phlebotomy Practicum (PBT 1123)

Student Learning Outcomes:

1. Demonstrate knowledge of the health care delivery system and medical terminology.
    a. Identify the health care providers in hospitals and clinics and the phlebotomist's role as a member of this health care team.
    b. Describe the various hospital departments and their major functions in which the phlebotomist may interact in his/her role.
    c. Describe the organizational structure of the clinical laboratory department.
    d. Discuss the roles of the clinical laboratory personnel and their qualifications for these professional positions.
    e. List the types of laboratory procedures performed in the various sections of the clinical laboratory department.
    f. Describe how laboratory testing is used to assess body functions and disease.
    g. Use common medical terminology.
2. Demonstrate knowledge of infection control and safety.
    a. Identify policies and procedures for maintaining laboratory safety.
    b. Demonstrate accepted practices for infection control, isolation techniques, aseptic techniques and methods for disease prevention.
    c. Comply with federal, state, and locally mandated regulations regarding safety practices.
    d. Describe measures used to ensure patient safety in various patient settings, i.e., inpatient, outpatient, pediatrics, etc.
3. Demonstrate basic understanding of the anatomy and physiology of body systems and anatomic terminology in order to relate major areas of the clinical laboratory to general pathologic conditions associated with the body systems.
    a. Describe the basic functions of each of the main body systems, and demonstrate basic knowledge of the circulatory, urinary, and other body systems necessary to perform assigned specimen collection tasks.
    b. Identify the veins of the arms, hands, legs, and feet on which phlebotomy is performed.
    c. Explain the functions of the major constituents of blood; and differentiate between whole blood, serum, and plasma.
    d. Define hemostasis, and explain the basic process of coagulation and fibrinolysis.
    e. Discuss the properties of arterial blood, venous blood, and capillary blood.
4. Demonstrate understanding of the importance of specimen collection and specimen integrity in the delivery of patient care.
    a. Describe the legal and ethical importance of proper patient/sample identification.
    b. Describe the types of patient specimens that are analyzed in the clinical laboratory.
    c. Define the phlebotomist's role in collecting and/or transporting these specimens to the laboratory.
    d. List the general criteria for suitability of a specimen for analysis, and reasons for specimen rejection or recollection.
    e. Explain the importance of timed, fasting, and stat specimens, as related to specimen integrity and patient care.
5. Demonstrate knowledge of collection equipment, various types of additives used, special precautions necessary, and substances that can interfere in clinical analysis of blood constituents.
    a. Identify the various types of additives used in blood collection, and explain the reasons for their use.
    b. Identify the evacuated tube color codes associated with the additives.

c. Describe substances that can interfere in clinical analysis of blood constituents and ways in which the phlebotomist can help to avoid these occurrences.
d. List and select the types of equipment needed to collect blood by venipuncture and capillary.
e. Identify special precautions necessary during blood collections by venipuncture and capillary.

6. Follow standard operating procedures to collect specimens.
   a. Identify potential sites for venipuncture, capillary, and arterial punctures.
   b. Differentiate between sterile and antiseptic techniques.
   c. Describe and demonstrate the steps in the preparation of a puncture site.
   d. List the effect of tourniquet, hand squeezing, and heating pads on capillary puncture and venipuncture.
   e. Recognize proper needed insertion and withdrawal techniques including direction, angle, depth and aspiration, for venipuncture.
   f. Describe and perform correct procedure for capillary collection methods on infants and adults.
   g. Identify and describe limitations and precautions of alternate collection sites for arterial, capillary, and venipuncture.
   h. Identify and describe signs and symptoms of physical problems that may occur during blood collection.
   i. List the steps necessary to perform venipuncture, and /or capillary puncture in chronological order.
   j. Follow standard operating procedures to perform a competent/effective venipuncture on a patient.
   k. Follow standard operating procedures to perform a competent/effective capillary puncture on a patient
7. Demonstrate understanding of requisitioning, specimen transport, and specimen processing.
   a. Describe the standard operating procedure for a physician requesting a laboratory analysis for a patient.
   b. Discuss laboratory responsibility in responding to physician requests.
   c. Instruct patients in the proper collection and preparation for various samples, including sputum, urine, throat, and stools in order to instruct patients, process and handling of non-blood specimens.
   d. Explain methods for transporting and processing specimens for routine and special testing.
   e. Explain methods for processing and transporting blood specimens for testing at reference laboratories.
   f. Describe the potential clerical and technical errors that may occur during specimen processing.
   g. Identify and report potential pre-analytical errors that may occur during specimen collection, labeling, transporting, and processing.
   h. Describe and follow the criteria for specimens and test results that will be used as legal evidence, i.e., paternity testing, chain of custody, blood alcohol levels, etc.
8. Demonstrate understanding of Point-of-Care Testing and waived procedures using standard protocol and predetermined criteria for testing and quality assurance.
   a. Explain steps for the processing of the specimen and steps of testing for waived Point-of-Care Tests performed in the clinical laboratory
   b. Perform waived POCT in student laboratory.
9. Demonstrate understanding of quality assurance and quality control in phlebotomy.
   a. Describe the system for monitoring quality assurance in the collection of blood specimens.
   b. Identify policies and procedures used in the clinical laboratory to assure quality in the obtaining of blood specimens.
10. Communicate (verbally and nonverbally) effectively and appropriately in the workplace.
   a. Maintain confidentiality of privileged information on individuals.
   b. Value diversity in the workplace.
   c. Interact appropriately and professionally with other individuals.
   d. Discuss the major points of the American Hospital Associations' Patient's Bill of Rights or the Patient's Bill of Rights from the institution.
   e. Model professional appearance and appropriate behavior.
   f. Follow written and verbal instructions in carrying out testing procedures.
   g. Define the different terms used in the medicolegal aspect for phlebotomy and discuss policies and protocol designed to avoid medicolegal problems.
   h. List the causes of stress in the work environment and discuss the coping skills used to deal with stress in the work environment.
   i. Demonstrate ability to use computer information systems necessary to accomplish job functions.

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Medical Laboratory Technician, MLT and International Medical Laboratory Technician, MLT (ASCP©.)

A. Structure and Function of the Circulatory System
    1. Heart
    2. Arteries
    3. Veins
    4. Capillaries
B. Composition/Function of Blood
    1. Types of blood (venous, capillary, arterial)
    2. Plasma
    3. Serum
    4. Cellular elements (RBC, WBC, platelets)
C. Terminology

II. Specimen Collection (Venipuncture, Skin Puncture) (45 – 50%)
A. Review and Clarification of Orders
B. Patient Communication (pre and post collection)
C. Patient Identification
D. Patient Assessment/Preparation
E. Site Selection
F. Techniques
G. Common Tests
H. Order of Draw
    1. Venous
    2. Capillary
I. Complications and Considerations (e.g., fainting, edema, hematoma, IV, mastectomy)
J. Equipment (e.g., tubes/anticoagulants, needles, tourniquet, lancets, syringes, vein viewers)
K. Terminology

III. Specimen Handling, Transport, and Processing (15 – 20%)
A. Specimen Types/Suitability
    1. Routine specimens
    2. Unusual specimen types (e.g., trace metal elements)
    3. Newborn screening
    4. Chain-of-custody specimens
B. Accessioning
C. Labeling
D. Assess Specimen Quality (e.g., hemolysis, QNS, clotting, incorrect specimen type)
E. Transport and Storage
    1. Temperature
    2. Light
    3. Time
    4. Shipping
F. Equipment (e.g., centrifuge)
G. Terminology

IV. Waived and Point-of-Care Testing (POCT) (5 – 10%)
A. Urinalysis (e.g., dipstick)
B. Hemoglobin and Hematocrit
C. Coagulation (e.g., PT/INR)
D. Glucose
E. Kit Tests (e.g., Strep screen, rapid flu test, pregnancy test)
F. Performance/Operations
G. Terminology

V. Non-Blood Specimens (e.g., Urine, CSF, Breath, Stool, Nasal/Nasopharyngeal) (5 – 10%)
A. Physiology
B. Patient Preparation

C. Patient Collection
D. Processing and Handling
E. Terminology

VI. Non-Blood Specimens (e.g., Urine, CSF, Breath, Stool, Nasal/Nasopharyngeal) (5 – 10%)
A. Quality Control
1. Techniques
2. Equipment
B. Quality Improvement
C. Interpersonal Relations (e.g., age-specific communication, Americans with Disabilities Act)
D. Professional Ethics
E. Regulatory Applications (e.g., OSHA, CLSI, CDC, CLIA)
1. Safety
a. Patient
b. Personal (e.g., PPE, Standard Precautions)
c. Equipment
d. Laboratory/hospital (e.g., fire, chemical)
2. Infection control
a. Protective equipment (e.g., isolation)
b. Disposal of contaminated equipment
c. Hand hygiene.
3. Coding/billing
4. Patient confidentiality (e.g., HIPAA)
F. Terminology

Course Number and Name: PBT 1123 Phlebotomy Practicum

Description: This course provides a clinical practicum in an accredited laboratory affiliate. The practicum involves patient preparation, selection and preparation of puncture sites, collection of specimens, maintaining equipment, post-collection patient care and specimen processing. Requires a minimum performance of 100 successful unaided blood collections including venipuncture and skin punctures.

Hour Breakdown:

Semester Credit Hours	Lecture	Clinical Practice	Contact Hours
3		9	135

Corequisite: Phlebotomy (PBT 1113)

Student Learning Outcomes:

1. Perform infection control and safety.
    a. Perform accepted practices for infection control, isolation techniques, aseptic techniques and methods for disease prevention.
    b. Follow federal, state, and locally mandated regulations regarding safety practices.
2. Follow standard operating procedures to perform the collection of specimens.
    a. Perform proper specimen collection and maintain specimen integrity.
    b. Analyze requisitions and select the proper types of additives needed in blood collection.
    c. Recognize patient complications that require special blood collection techniques.
3. Interpret requisitions in order to collect and transport specimens according to laboratory protocol.
    a. Instruct patients in the proper collection and preservation for various samples.
    b. Transport and process specimens for routine and special testing.
4. Demonstrate quality assurance and quality control in phlebotomy.
    a. Identify and report potential pre-analytical errors that may occur during specimen collection, labeling, transporting, and processing.
    b. Perform quality control procedures.
    c. Record quality control results.
    d. Identify and report control results that do not meet pre-determined criteria.
5. Demonstrate medical ethics and professionalism.
    a. Maintain confidentiality of privileged information on individuals.
    b. Interact appropriately and professionally with other individuals.
    c. Model professional appearance and appropriate behavior.
    d. Demonstrate ability to use computer information systems necessary to accomplish job functions.

Appendix A: Recommended Tools and Equipment for Medical Laboratory Technician

CAPITALIZED ITEMS

1. Analyzer, Chemistry, Dry Slide (1 per program)
2. Analyzer, Chemistry, Wet Reagents (1 per program)
3. Analyzer Chemistry Ion Specific Electrode (1 per program)
4. Analyzer, Coagulation (1 per program)
5. Analyzer, Hematology (1 per program)
6. Analyzer, Urine Chemistry (1 per program)
7. Autoclave (1 per program)
8. Bath, Water (1 per 5 students)
9. Blood Bank Gel System (1 per program)
10. Cabinet, Biological Safety (1 per program)
11. Cabinet, Flammable (1 per program)
12. Centrifuge, Cell Washer (1 per lab)
13. Centrifuge, General Lab (2 per lab)
14. Centrifuge, Immunological (1 per student)
15. Centrifuge, Microhematocrit (1 per lab)
16. Chair, Blood Drawing (1 per lab)
17. Computer, CD ROM with Soundcard and DVD (1 per 3 students)
18. Counter, Differential Electronic (1 per student)
19. Fibrometers (1 per lab)
20. Freezer, small (1 per program)
21. Hood, Fume (1 per program)
22. Incubator, CO2 (1 per lab)
23. Incubator, Dri Bath (small, 1 per student; large, 1 per 4 students)
24. Incubator, General, table top model or stand-alone (1 per lab)
25. Microscopes, Binocular (1 per student)
26. Microscope, Dual Head (1 per lab)
27. Microscope, Fluorescent (1 per lab)
28. Microscope, Objectives, 40X (1 per student)
29. Microscope, Objectives, 100X (1 per student)
30. Microscope, Objectives, 50X (1 per student)
31. Microscope, Phase Contrast (1 per lab)
32. Microscope Trinocular (1 per lab)
33. Monitor, Cholesterol (1 per program)
34. Ovens, Drying (1 per program)
35. Printer (1 per 2 computers)
36. Refrigerator (commercial, 1 per lab; home, 2 per lab)
37. Refractometer (1 per 5 students)
38. Reader, Capillary Tube (1 per lab)
39. Rotator, Automatic with Timer (1 per lab)
40. System, Electrophoresis (1 per program)
41. Spectrophotometer (1 per 5 students)
42. Stainer, Slide (1 per lab)
43. System, Microbiology ID Sensitivity (manual, 1 per lab)
44. System, Water Purification (1 per program)
45. TV Monitor (1 per program)
46. VCR/DVD player (1 per program)
47. Video Monitor and Camera (1 per program)

NON-CAPITALIZED ITEMS

1. Arms (1 per 4 students)Blanket, Fire (1 per lab)
2. Box, Rh View (1 per 5 students)
3. Container, Hazardous Waste (small, 1 per 5 students; large, 2 per lab)
4. Counter, Hematologic (1 per student)
5. Counter, Differential Manual (1 per student)
6. Eye Wash Station (1 per lab)
7. Hot Plate with Stirrer (2 per lab)
8. Incinerator, Bacteriologic (1 per student)
9. Jar, Anaerobic system (2 per lab)
10. Microscope, Objectives, 4X (1 per student)
11. Microscope, Objectives, 10X (1 per student)
12. Mixer, Vortex (2 per program)
13. Monitor, Glucose (1 per program)
14. Pipets, Automatic (1 per 2 students)
15. Projector, Overhead (2 per program)
16. Rotator, Tube Rocker (1 per lab)
17. Safety Shower (1 per lab)
18. Scale, Balance (1 per lab)
19. Station, Hazardous Spill (1 per lab)
20. Viewers, Agglutination (1 per student)
21. Washer, Pipette (1 per lab)
22. Timers (1 per student)
23. Glassware, assorted set (1 set per student)
24. Hemacytometer (1 per student)
25. Stopwatches (1 per 2 students)
26. Thermometers (reference, 1 per lab; regular, 5 per lab)
27. Tray, Phlebotomy (1 per 4 students)
28. Fluid resistant lab stool (1 per student)

"Other equipment items can be added when deemed appropriate by the community college industry craft committee or by industry/business training requirements."

Recommended Instructional Aids

1. Presentation System (1 per lab)
2. Projector Screen (2 per program)
3. Projector Slide (1 per program)
4. Scanner, Regular and/or Kodachrome
5. Station, SDS Information (1 per program)
6. Interactive whiteboard (1 per program)
7. Document camera or digital visual presenter (1 per program)
8. Classroom response system (1 set per program)
9. Laptop/tablets
10. Smart TV
11. Laboratory software

SLIDE OR CD SETS:

1. Blood and Tissue Parasites
2. Body Fluids
3. Clinical Chemistry
4. Immunohematology
5. Immunology/Serology
6. Intestinal Parasites
7. Microbiology
8. MycologyNormal and Abnormal
9. Protozoa
10. Urinalysis/Sediment

“Other equipment items can be added when deemed appropriate by the community college industry craft committee or by industry/business training requirements.”

Appendix B: Recommended Tools and Equipment for Phlebotomy Technician

CAPITALIZED ITEMS

1. Centrifuge (1 per program)
2. Workstation, Phlebotomy (1 per 10 students)
3. Arm, Blood Drawing (1 per 3 students)

NON-CAPITALIZED ITEMS

1. Biohazard Containers (1 per workstation)
2. Phlebotomy Trays (1 per workstation)
3. Tube Racks (1 per workstation)

DISPOSABLES

1. Antiseptics
2. Adhesive Bandages
3. Tourniquets Gauze
4. Cotton Balls
5. Evacuated Tube Holders
6. Evacuated Tubes
7. Needles
8. Syringes
9. Winged Infusion Sets
10. Lancets
11. Biohazard Bags
12. Sharps Containers
13. Capillary Tubes
14. Micro-collection Tubes
15. Micro-collection Pipettes
16. Sealant Clay
17. Ammonia
18. Inhalants
19. Gloves
20. Goggles
21. Face Mask
22. Lab Coats, Fluid-resistant
23. Labeling Pens
24. Blood Culture Bottles
25. Disinfectants
26. Glass Slides

RECOMMENDED INSTRUCTIONAL AIDS

1. TV, Computer, Projector, Projector Screen or other course delivery technology
2. Table
3. AV Equipment
4. File with lock
5. Cabinet

Appendix C: Curriculum Definitions and Terms

- Course Name – A common name that will be used by all community colleges in reporting students

- Course Abbreviation – A common abbreviation that will be used by all community and junior colleges in reporting students

- Classification – Courses may be classified as the following:
    - Career Certificate Required Course – A required course for all students completing a career certificate.
    - Technical Certificate Required Course – A required course for all students completing a technical certificate.
    - Technical Elective – Elective courses that are available for colleges to offer to students.

- Description – A short narrative that includes the major purpose(s) of the course

- Prerequisites – A listing of any courses that must be taken prior to or on enrollment in the course

- Corequisites – A listing of courses that may be taken while enrolled in the course

- Student Learning Outcomes – A listing of the student outcomes (major concepts and performances) that will enable students to demonstrate mastery of these competencies

The following guidelines were used in developing the program(s) in this document and should be considered in compiling and revising course syllabi and daily lesson plans at the local level:

- The content of the courses in this document reflects approximately 75% of the time allocated to each course. The remaining 25% of each course should be developed at the local district level and may reflect the following:
    - Additional competencies and objectives within the course related to topics not found in the state framework, including activities related to specific needs of industries in the community college district
    - Activities that develop a higher level of mastery on the existing competencies and suggested objectives
    - Activities and instruction related to new technologies and concepts that were not prevalent at the time the current framework was developed or revised
    - Activities that include integration of academic and career–technical skills and course work, school-to-work transition activities, and articulation of secondary and postsecondary career–technical programs
    - Individualized learning activities, including work-site learning activities, to better prepare individuals in the courses for their chosen occupational areas

- Sequencing of the course within a program is left to the discretion of the local college. Naturally, foundation courses related to topics such as safety, tool and equipment usage, and other fundamental skills should be taught first. Other courses related to specific skill areas and related academics, however, may be sequenced to take advantage of seasonal and climatic conditions, resources located outside of the school, and other factors. Programs that offer an Associate of Applied Science Degree must include all of the required Career Certificate courses, Technical Certificate courses **AND** a minimum of 15 semester hours of General Education Core Courses. The courses in the General Education Core may be spaced out over the entire length of the program so that students complete some academic and Career Technical courses each semester. Each community college specifies the actual courses that are required to meet the General Education Core Requirements for the Associate of Applied Science Degree at their college.

- In order to provide flexibility within the districts, individual courses within a framework may be customized by doing the following:

    - Adding new student learning outcomes to complement the existing competencies and suggested objectives in the program framework
    - Revising or extending the student learning outcomes

Adjusting the semester credit hours of a course to be up 1 hour or down 1 hour (after informing the Mississippi Community College Board [MCCB] of the change)

Appendix D: Course Crosswalk

Course Crosswalk Medical Laboratory Technology CIP 51.1004 – Medical Laboratory Technology					
Note: Courses that have been added or changed in the 2017 curriculum are highlighted.					
Previous			**Existing**		
2011 MS Curriculum Framework			**2017 MS Curriculum Framework**		
Course Number	**Course Title**	**Hours**	**Course Number**	**Course Title**	**Hours**
MLT 1111	Fundamentals of Medical Laboratory Technology/Phlebotomy	1	MLT 1112	Fundamentals of Medical Laboratory Technology/Phlebotomy	2
MLT 1212	Urinalysis/ Body Fluids	2	MLT 1212	Urinalysis/ Body Fluids	2
MLT 1313	Hematology I	3	MLT 1313	Hematology I	3
MLT 1324	Hematology II	4	MLT 1324	Hematology II	4
MLT 1413	Immunology/ Serology	3	MLT 1413	Immunology/ Serology	3
MLT 1515	Clinical Chemistry	5	MLT 1515	Clinical Chemistry	5
MLT 1523	Principles of Organic and Biochemistry	3	MLT 1523	Principles of Organic and Biochemistry	3
MLT 2424	Immunohematology	4	MLT 2424	Immunohematology	4
MLT 2512	Parasitology	2			
			MLT 2522	Pathogenic Microbiology I	2
			MLT 2614	Pathogenic Microbiology II	4
MLT 2711	Medical Laboratory Technology Seminar	1	MLT 2711	Medical Laboratory Technology Seminar	1
MLT 2723	Certification Fundamentals for Medical Laboratory Technology	3	MLT 2723	Certification Fundamentals for Medical Laboratory Technology	3
MLT 2812	Clinical Instruct- mentation	2	MLT 2812	Clinical Instruct- mentation	2
MLT 2916	Clinical Practice I	6	MLT 2916	Clinical Practice I	6
MLT 2926	Clinical Practice II	6	MLT 2925	Clinical Practice II	5
MLT 2936	Clinical Practice III	6	MLT 2935	Clinical Practice III	5
			MLT 2944	Clinical Practicum I	4
			MLT 2954	Clinical Practicum II	4
			MLT 2964	Clinical Practicum III	4
			MLT 2974	Clinical Practicum IV	4

Course Crosswalk
Medical Laboratory Technology
CIP 51.1004 – Medical Laboratory Technology
CIP: 51.1009 – Phlebotomy Technician

Note: Courses that have been added or changed in the 2023 curriculum are highlighted.

Revised					
2023 MS Curriculum Framework					
Course Number	**Course Title**	**Hours**			
MLT 1112	Fundamentals of Medical Laboratory Technology/Phlebotomy	2			
MLT 1212	Urinalysis/ Body Fluids	2			
MLT 1313	Hematology I	3			
MLT 1324	Hematology II	4			
MLT 1413	Immunology/ Serology	3			
MLT 1515	Clinical Chemistry	5			
MLT 1532	MLT Chem I	2			
MLT 1543	MLT Chem II	3			
MLT 2424	Immunohematology	4			
MLT 2522	Pathogenic Microbiology I	2			
MLT 2614	Pathogenic Microbiology II	4			
MLT 2711	Medical Laboratory Technology Seminar	1			
MLT 2723	Certification Fundamentals for Medical Laboratory Technology	3			
MLT 2914-6	Clinical Practice I	4-6			
MLT 2924-5	Clinical Practice II	4-5			
MLT 2934-5	Clinical Practice III	4-5			
MLT 2943-4	Clinical Practicum I	3-4			
MLT 2953-4	Clinical Practicum II	3-4			
MLT 2963-4	Clinical Practicum III	3-4			
MLT 2973-4	Clinical Practicum IV	3-4			
PBT 1113	Phlebotomy	3			
PBT 1123	Phlebotomy Practicum	3			