



MERCER
COUNTY COMMUNITY COLLEGE

COURSE OUTLINE

Course Number	Course Title	Credits
MLT207	Clinical Immunohematology	4
Hours: Lecture/Lab/Other 3/3	Co- or Pre-requisite permission of program coordinator	Semester & Year Fall 2023

Catalog description:

Basic theory and concepts of antigen-antibody reactions as they pertain to blood cell transfusions. Blood group antigens and the genetics of their inheritance are examined along with principles of immunology. Methods are introduced for performing blood grouping, compatibility testing, and component selection. The laboratory component develops technical skills through hands-on experience in blood bank procedures.

General Education Category: **Not GenEd**

Course coordinator:

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Required texts & Other materials:

Required:

- i. **Textbook:** Basic & Applied Concepts of Blood Banking and Transfusion Practices by Howard P.R. (2021), 5th Edition, Elsevier Mosby ISBN-13: 9780323697392
- ii. Instructor-developed **Lab Manual** (purchase through the bookstore)
- iii. MediaLab Subscription (provided by program budget) <https://www.medialab.com/>

Needed Lab Materials:

- i. White lab coat- This must be a knee-length coat with a fitted wristband/cuff; it reduces the potential for splashes up the arm and fire hazards.
- ii. Gloves - latex or nitrile, not vinyl
- iii. Black or blue ink pen. (NO WORK IN PENCIL ACCEPTED)
- iv. Sharpie or other permanent marker, fine point, black or blue
- v. 3 ring binder w/Note pages:
 - √ Tabs or dividers are needed to identify and separate the following sections: Syllabus - including schedule and unit objectives, lecture PowerPoints, graded materials & other informative material.
 - √ Save all procedures, pre-labs, in-lab exercises, case studies and study questions.

Course Student Learning Outcomes (SLO):

Upon successful completion of this course, the student will be able to:

1. Exhibit knowledge of safety and quality control used in a blood bank laboratory (Supports ILG# 3,10; PLO# 2, 4)
2. Describe the function of the human immune system as it applies to the principles of immunology, serology and blood bank testing. (Supports ILG# 1,3,10,11; PLO# 1, 2)
3. Apply the biological concepts of genetics and immunology to antigen and antibody development in ABO, Rh, and other blood group systems. (Supports ILG# 2,3,11; PLO#1, 2)
4. Demonstrate knowledge and the application of principles of serological testing in pre-transfusion and compatibility testing and in the selection of component therapy as they relate to current blood bank practices. (Supports ILG# 3,11; PLO# 3, 6, 7)
5. Incorporate knowledge of Hemolytic Disease of the Fetus/Newborn in the evaluation of prenatal, maternal and cord blood testing as it applies to current blood bank practices. (Supports ILG# 3,11; PLO# 2,3,6)

6. Demonstrate competency in the performance and result evaluation of routine blood bank procedures. (Supports ILG# 3,10,11; PLO#2, 6, 7)
7. Research and give a classroom presentation on an assigned blood group system. Include information on genotype and phenotype frequencies and ethnic group diversities commonly associated with that system. (Supports ILG# 1,3,4,10,11; PLO#5)
8. Value working collaboratively using professional communication skills and behavioral attitudes while working with fellow students in the laboratory. (Supports ILG# 1,5; PLO#5)

Course-specific Institutional Learning Goals (ILG):

Institutional Learning Goal 1. Written and Oral Communication in English. Students will communicate effectively in both speech and writing.

Institutional Learning Goal 2. Mathematics. Students will use appropriate mathematical and statistical concepts and operations to interpret data and to solve problems.

Institutional Learning Goal 3. Science. Students will use the scientific method of inquiry, through the acquisition of scientific knowledge.

Institutional Learning Goal 4. Technology. Students will use computer systems or other appropriate forms of technology to achieve educational and personal goals.

Institutional Learning Goal 5. Social Science. Students will use social science theories and concepts to analyze human behavior and social and political institutions and to act as responsible citizens.

Institutional Learning Goal 9. Ethical Reasoning and Action. Students will understand ethical frameworks, issues, and situations.

Institutional Learning Goal 10. Information Literacy: Students will recognize when information is needed and have the knowledge and skills to locate, evaluate, and effectively use information for college level work.

Institutional Learning Goal 11. Critical Thinking: Students will use critical thinking skills understand, analyze, or apply information or solve problems.

Program Learning Outcomes (PLO) for Medical Laboratory Technology

1. Integrate knowledge learned and experienced in the disciplines of general education, mathematics, science, and medical laboratory science;
2. Achieve entry-level career competencies of a medical laboratory technician by testing biological samples using current technology to generate accurate, quality-assured laboratory results used for health and disease evaluation;
3. Utilize critical-thinking skills to assess and problem- solve laboratory data for patient diagnoses;
4. Maintain familiarity with the profession's code of ethics and consistently act within those standards during interactions with fellow classmates and working professionals in the clinical setting;
5. Describe the importance of continuing education in lifelong learning and in obtaining and upholding professional credentialing;
6. Demonstrate academic and technical competence in the professional courses of the curriculum through college and applied clinical education experiences;
7. Take the national ASCP certification exam.

Units of study in detail – Unit Student Learning Outcomes:

Week 1 **History of Blood Banking**

Quality Assurance and Regulatory Requirements of the Blood Bank

Immunology Applications in Blood Bank and Genetic Principles in Blood Banking

ABO/RH BGS and Secretor Status

[Supports Course SLOs #1, 2, 3, 4]

Upon completion of this unit the student will be able to:

Learning objectives:

1. Explain how Safety Practices and Quality Control are implemented in the blood bank.
2. Define and list the elements of good manufacturing practices.
3. List the elements of and explain the importance of a well-written standard operating procedure (SOP).
4. Compare and contrast good record keeping with poor record keeping.
5. Compare and contrast innate and acquired immune systems.
6. Describe the molecular characteristics of antigens and antibodies and the attractive forces that bind them.

7. Explain the difference between a primary and secondary immune response. Define 'anamnestic' response.
8. Understand the principles of genetics as they apply to blood group antigens in immunohematology.
9. Explain how RBC, WBC and platelet antigens can elicit an immune response during a transfusion.
10. Define Landsteiner's rule.
11. Determine possible ABO genotypes and corresponding phenotypes.
12. Demonstrate knowledge of the genetics and antigen/antibody production as it pertains to the ABO Blood Group.
13. Describe the relationships among the ABO, H and Se genes.
14. Compare the A1 and A2 phenotypes with regard to serologic testing.
15. List ABO antigen and antibody discrepancies that can occur. Describe test methods for resolving these discrepancies.

Performance objectives:

1. Exercise safety practices during laboratory sessions.
2. Perform quality control procedures before beginning each laboratory assignment.
3. Correctly perform and interpret results of a forward and reverse blood type; interpret and record results using AABB standards.
4. Recognize and solve ABO discrepancies.

Week 2 RH Blood Group System and

PreTransfusion Testing

Blood Bank Automation

[Supports Course SLOs # 3, 4, 6]

Upon completion of this unit the student will be able to:

Learning objectives

Upon completion of this unit the student will be able to:

1. Compare and contrast theories of genetic inheritance for the Rh Blood group system.
2. Translate Fisher-Race and Weiner Rh blood group system terminology. Compare the Rosenfield and ISBT terminology in Rh labeling.
3. Describe the characteristics of Rh antibodies.
4. Explain testing method for the weak D antigen.
5. Compare and contrast a direct antiglobulin and indirect antiglobulin test.
6. State reasons why a patient may have a positive direct antiglobulin test.
7. Explain the use of automation in routine testing in blood bank laboratories.

Performance objectives

1. Correctly perform and interpret results of an IAT.
2. Perform an indirect antiglobulin test (IAT) for a weak D antigen.
3. Use mono- and polyspecific reagents and Coomb's check cells when appropriate.
4. Using the IAT, perform an antibody screen on a patient's plasma sample
5. Discuss and use critical-thinking skills to solve type and screen case studies.

Week 3 Other Blood Group Systems

Antibody Detection & Identification, Antigen Typing and Compatibility Testing

[Supports Course SLOs #6, 7, 8]

Upon completion of this unit the student will be able to:

Learning Objectives

Upon completion of this unit the student will be able to:

1. Identify the major antigens classified within other blood group systems.
2. List the frequencies of observed phenotypes in other blood group systems and associate the phenotypes with ethnic group diversity.
3. Classify and state the clinical relevance of the antibodies of other major blood group systems.
4. Define the term unexpected antibodies and state two reasons for their formation.
5. Discuss the purpose and the procedure for performing an antibody screen test.
6. Explain how patient information, including age, race, pregnancy history and medical diagnosis help in the process of antibody identification.
7. Describe the purpose of a red blood cell panel; define the term antigram as it relates to a red blood cell panel.

8. State the significance of the phase & strength of a reaction of an antibody in its identification.
9. Demonstrate knowledge of the "rule out" technique.
10. Explain the "rule of three" with regard to antibody identification.
11. Summarize the effects of dosage, temperature, pH, and enhancement techniques with potentiators in antibody identification.
12. Demonstrate knowledge of AABB standards used in compatibility testing.
13. Discuss the selection of compatible whole blood, packed cells, plasma and platelets for the various ABO blood groups.
14. Explain the difference between an Immediate Spin (IS) and a full Antiglobulin (IgG) crossmatch.
15. Explain the protocol for issuing uncrossmatched blood in an emergency release.

Performance objectives:

1. Perform type and screen procedures on blood samples.
2. Perform a direct antiglobulin (DAT) test on patient blood samples.
3. Solve antibody panel report sheets for single and multiple antibodies.
4. Perform antibody identification for single and multiple antibodies using screening cells and red blood cell panels
5. Perform antibody identification on blood samples for single and multiple antibodies using screening cells and red blood cell panels
6. Properly select compatible units for transfusions candidates.
7. Perform compatibility testing on samples of patient and donor blood.
8. Antigen type donor units or patient blood samples for specific blood group antigens.
9. Observe gel and solid phase automated methods for blood bank testing.

Week 4 Donor Selection and Phlebotomy

Testing of Donor Blood

Blood Components

[Supports Course SLOs #1, 2, 3, 4]

Upon completion of this unit the student will be able to:

Learning objectives:

1. Describe the "ideal" setting and personnel in a blood donation center.
2. State the differences between blood bank (transfusion service) and a blood center.
3. List and describe five agencies and/or governing bodies involved in the regulation of blood banks and blood centers.
4. Summarize the criteria for screening volunteer blood donors. Explain the registration process, health history review and the physical examination for potential donors.
5. Discuss autologous blood unit collection.
6. Define the terms 'directed donation', 'apheresis' and 'therapeutic phlebotomy'.
7. List the required tests performed on allogenic and autologous donor blood units.
8. Summarize the requirements for retention of donor records.
9. List the information which must appear on the label of each donor unit.
10. List the serological tests which must be confirmed by the transfusion service.
11. State the storage temperature and length of time which donor samples must be saved by the transfusion service
12. Describe the steps performed in preparing components from a unit of whole blood including packed RBCs, fresh frozen plasma (FFP), platelets and cryoprecipitate.
13. State the storage times & temperatures for the different blood products and components.
14. Explain the purpose for preparing leukocyte-reduced & irradiated red blood cells.
15. State requirements for administering of a unit of whole blood, packed cells, FFP, platelets or cryoprecipitate.

Performance Objectives:

1. Review donor qualifications and the questions asked of donors before donating blood components .
2. Evaluate the length of time for deferral for all unacceptable responses to the questions asked.
3. Perform a donor interview and physical exam.
4. Exercise safety practices during laboratory sessions.
5. Distinguish between blood bank components in the laboratory. Explain the storage requirements for each.
6. Reconfirm the blood type of donor units through the ABO/Rh testing procedures using quality-controlled blood bank reagents.

7. Visit a community blood center to witness and participate in the blood collection and manufacturing process.

Week 5 Adverse Complications of Blood Transfusion (Transfusion Reactions)

Transfusion Therapy

[Supports Course SLOs #1, 2, 3, 4]

Upon completion of this unit the student will be able to:

Learning objectives:

1. State causes and list the signs and symptoms of the following transfusion-associated reactions.
 - a. Acute hemolytic reactions
 - b. Febrile non-hemolytic
 - c. Allergic reactions
 - d. Transfusion-related sepsis
 - e. Transfusion-related acute lung injury (TRALI)
 - f. Transfusion-associated circulatory overload (TACO)
2. Contrast immediate with delayed complications of transfusion.
3. List the signs and symptoms which should be looked for by the transfusionist which may indicate an acute hemolytic transfusion reaction (AHTR).
4. State the eight steps which must be performed by the transfusionist whenever a complication of transfusion occur which include patient and component focused steps.
5. State the four actions and test which must be performed by the transfusion service in the evaluation of the suspected AHTR.
6. Describe the tests which must be performed on the pre-transfusion and post-transfusion samples when the DAT is positive and/or hemolysis is present in the immediate post-transfusion specimen.
7. Differentiate the delayed hemolytic transfusion reaction due to a primary immune with that due to a secondary immune response, including: the time frame, antibody class involved, degree of hemolysis and results of serological tests.
8. State the reason for requiring blood samples for compatibility testing to be less than 72 hours old.
9. Describe the pathophysiology or acute blood loss and massive transfusion therapy.
10. List the four most frequently transfused blood components.
11. Explain the pathophysiology and transfusion needs of patients with sickle cell disease, thalassemia and autoimmune disease.
12. Discuss the transfusion requirements of oncology patients.
13. Present situations where a bone marrow transplant is required.
14. List the appropriate transfusion support for hemostasis disorders.
15. Describe the conditions which require therapeutic apheresis.
16. Discuss the transfusion requirements and administering of erythropoietin for patients with chronic renal disease.
17. List six solid organs that are routinely transplanted.
18. List two living donor tissue and cell allografts used for transplantation.
19. List two tissue allografts.
20. State the ABO compatibility requirements for:
 - a. Solid organs.
 - b. Progenitor cells or bone marrow.
21. State the role of the transfusion service in transplantation.
22. Define "human leukocyte antigen (HLA)" and where they are found.
23. State the importance of HLA antigens in transplantation medicine

Performance objectives

1. Perform testing on a blood sample from a patient who experienced a transfusion reaction by performing a direct antiglobulin test (DAT).
2. ABO type pre and post transfusion samples and confirm ABO typing of the donor unit.
3. Antibody test pre and post transfusion samples with the use of enhancement techniques.
4. Repeat crossmatch with pre and post transfusion samples using immediate spin and antiglobulin phase testing.
5. Inspect donor unit for bacterial contamination.

Week 6 Obstetrical Patients

[Supports Course SLOs #5, 6]

Upon completion of this unit the student will be able to:

Learning objectives

1. Summarize the etiology (causes) of Hemolytic Disease of the Fetus and Newborn (HDFN).
2. State which tests are performed on a mother's pre-natal blood sample.
3. List possible antibodies involved in HDFN.
4. Explain the fetal cell screen (Rosette test) procedure for fetal-maternal hemorrhage.
5. Summarize the principle and procedure of the Kleihauer-Betke stain for fetal-maternal hemorrhage.
6. Discuss the composition, prescription criteria, dosage and timing of administering of Rh immune globulin (RhIG).
7. List laboratory procedures that are performed on cord blood including the washing cord blood to remove Wharton's jelly.
8. List the criteria used to select compatible blood products for an exchange transfusion on a fetus/newborn.

Performance objectives

1. Perform maternal pre-natal testing, newborn cord blood testing, the qualitative rosette test and quantitative Kleihauer-Betke (KB) test.
2. Evaluate laboratory test results of maternal blood and the baby's cord blood to determine if an HDFN has occurred.
3. Evaluate lab test results of maternal blood to determine the need for administration of RhIG using.
4. Calculate the number of vials of Rh Immune Globulin that is needed to prevent a postpartum hemorrhage.

Week 7 Review and Presentation Week [Supports Course SLOs #1-8]

Upon completion of this unit the student will be able to:

1. Recall and apply concepts from Weeks 1-6 in order to solve case study examples.
2. Give a power point presentation of an assigned blood cell antigen group.

Evaluation of student learning:

1. Lecture

- a) Students will have weekly homework assignments through Blackboard LMS or via MediaLab Inc and must be completed to assess understanding of the theoretical concepts discussed in the lecture PowerPoints.
- b) Students will complete a weekly quiz, midterm and final assessment through Blackboard LMS or via MediaLab Inc.
- c) Students will contribute to a collaborative cell Blood Group System Presentation and present to the class.

2. Lab

- a) Students will complete weekly quizzes (pre-lab and/or post-lab) and complete weekly homework assignments that pertain to the laboratory exercises.
- b) There will be written and hands-on practical assessments at the halfway point and at the end of the course to assess competency level.
- c) Students will work through case studies for patients with different etiologies and teach their fellow classmates.
- d) Laboratory Session Professional Performance- Students' professional performances will be evaluated during each of the laboratory sessions and weekly feedback will be given on how to improve. The grading scale for each of the categories below is that a student can score between 0-2 points (0= Unsatisfactory, 1=Satisfactory, 2=Exceeds Expectations).

i) PROFESSIONAL PERFORMANCE EVALUATION:

1. DEPENDABILITY

- The student arrives in the laboratory with adequate time to start lab session as scheduled. The student comes with appropriate manual and supplies, and wearing required laboratory attire. The student shows evidence of having reviewed the assigned topic before coming to the laboratory. The student completes assignments (lab reports, homework assignments, etc) on time.

2. ATTENTIVENESS

- The student is attentive to the instructor, takes complete notes and proceeds with laboratory work without repeated instructions. The student follows verbal and written instructions, asks pertinent questions when necessary, and seeks the instructor's assistance when needed. The student neither distracts others nor allows distractions to affect completion of laboratory exercises.

3. ORGANIZATION

- The student demonstrates the ability to organize work to be done within the available laboratory time. The student is able to perform multiple tasks without jeopardizing accuracy and precision.

4. INDEPENDENCE
 - The student demonstrates the ability to work independently by exercising independent judgement and thinking logically in using the protocols and instructions given. The student draws on previously gained information to solve problems without prompting from instructor. The student seeks activities to expand knowledge, ability and performance.
5. RECORD KEEPING
 - The student demonstrates the importance of proper record keeping by accurately and legibly labeling/recording laboratory work and reports (i.e. sample containers, reagents and worksheets).
6. MANAGEMENT AND ECONOMY
 - The student conserves reagents and supplies. The student maintains an adequate supply of common use items at their appropriate workstation. The student takes proper care of equipment
7. SAFETY
 - The student works in an orderly and safe manner, enabling others to safely work in the same general area. The student adheres to the guidelines of the Laboratory Safety Regulations (e.g. wearing eye protection, keeping long hair tied back, and properly storing hazardous materials).
8. INTERPERSONAL SKILLS
 - The student communicates in a professional, positive, tactful manner with peers and instructors. The student consistently shows common courtesy (e.e. restocks supplies) and contributes towards achieving an environment conducive to work and learning for self and others.
9. Composure
 - The student maintains composure and work quality under stressful conditions and adapts quickly to new situations. The student recognizes his/her own personal strengths and weaknesses and works positively within that framework. The student accepts evaluation of performance as constructive when offered by instructors and follows through with suggestions made.
10. INTEGRITY
 - The student accepts accountability for work performed. The student readily admits errors, follows procedures (including quality control) as written, and maintains confidentiality of patient results, if applicable. Student exhibits perseverance to obtain accurate results

Course Grading

A	93-100%	B-	80-82
A-	90-92	C+	77-79 <- minimum grade needed for total course grade
B+	87-89	C	70-76 <- minimum grade needed in Laboratory
B	83-86	D	60-69
F	0-59%		

Lecture (55% of total grade)

Presentation	5%
ABID Chart	5%
Assignments	20%
Quizzes	15%
Midterm	20%
Final	<u>35%</u>
100% x .55 = _____ Lecture Percentage	

Laboratory (40% of total grade)

Pre-Lab Quizzes	20%
Lab Assignments	10%
Lab Practicals (4)	25%

Written Midterm 20%
Written Final Exam 25%
100% x .40 = _____ Lab Percentage

Professionalism (Affective) 5% of totale grade

Attendance _____/800 points possible (100% for presence, 50% if tardy, & 0% if absent for each week)
Professionalism* _____/80 points
_____ /880 = x .05 = _____ **Affective Percentage**

_____ Final Total Grade= Lecture Percentage + Lab Percentage + Professionalism