I. INTRODUCTION

A. THIS COURSE IS DESIGNED AS A COURSE IN CLINICAL IMMUNOHEMATOLOGY AND IMMUNOLOGY. Immunohematology is a study of blood antigens and antibodies, performance of routine blood banking procedures, including blood group and Rh typing, antibody screens, antibody identification, cross matching, elution, and absorption techniques. An introduction to the theory and application of basic immunology, including the immune response, principles of antigen-antibody reactions, and the principles of serological procedures will be included.

B. This course is designed to meet curriculum requirements for students in Medical Laboratory Technology, but may satisfy course requirements for other allied health disciplines.

C. This course is occupationally related and meets the curriculum requirements for Medical Laboratory Technology programs.

D. Prerequisite(s): MLAB 1201-Introduction to Clinical Laboratory Science
   MLAB 1211- Urinalysis and Body Fluids
   MLAB 1415- Hematology
   BIOL 2401/2402- A&P

II. LEARNING OUTCOMES

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

A. Demonstrate the use of relevant terminology in immunohematology.

B. Explain the structure and functions of the immune system.
C. List the various methods employed in detection of antigen-antibody reactions

D. Describe various blood group systems (ABO/Rh/others).

E. Relate disease manifestation and clinical correlation

F. Perform and evaluate the results of ABO, Rh, antibody screen, IAT, DAT, and crossmatch testing.

G. Describe hemolytic disease of the newborn

H. Describe collection, labeling, storage, and preparation of blood bank specimens.

I. Describe immunologic and genetic theory.

J. Compare principles of methods, including recognition and physiologic causes of problems or unexpected test results

K. Describe collection, handling, storage and preparation of immunology specimens.

L. Examine immunologic and physiologic theory of various immunology tests.

M. Compare principles of methods in immunology relate manifestation and clinical correlation in immunology.

N. Relate disease manifestation and correlation in immunology.

O. Describe the following immunology tests: RPR, VDRL, FTA-Abs, Mono test, Heterophile antibody, ASO, ANA, Hepatitis, Rubella, HIV, cold agglutinin, and CRP.

P. Recognize and use safety procedures required in the clinical laboratory. Describe quality control and quality assurance measures taken in a transfusion service or donor center setting. Perform reagent QC requirements and interpret QC results.

Q. Perform routine phlebotomy of Immunology and Immunohematology specimens.

R. Exhibit attitudes consistent with professionalism and concern for high quality health care by:
   1. Performing analysis with care, adhering strictly to written procedure
2. Demonstration flexibility by accepting and implementing approved changes to procedures
3. Attending scheduled lecture and lab regularly and punctually
4. Completing assigned tasks with minimal guidance
5. Maintains confidentiality of patient results
6. Seeks activities which further assists learning
7. Admits mistakes and takes steps to correct those repeats procedures when test results are in doubt
8. Responds appropriately to authority
9. Takes pride in role in laboratory medicine
10. Complies with stated dress code for laboratory exercises
11. Participating in continuing education activities

III. INSTRUCTIONAL MATERIALS

The instructional materials identified for this course are viewable through www.ctcd.edu/books.

IV. COURSE REQUIREMENTS

To receive transferable credit for this course, you must earn a grade of “C” or better.

A. You must keep up with the material on a day-to-day basis because the material is technical. In order to understand the material. It must be learned in a sequential order. You are expected to read all assigned materials and to bring text books to class and laboratory.

B. A good set of notes will be important. The majority of exam material will be taken from your notes and handouts; the rest will be taken from the text. All written assignments given by the instructor are to be completed and handed in as required

C. Students with a grade of 75 or less are expected to make an appointment with the instructor to discuss the reason for their low performance. Any material not understood by the student in lecture or lab can be discussed with the instructor privately. On the office door will be a list of office hours for conferences. Please try to make an appointment at your convenience.

D. Class attendance is mandatory. A student who is late for 15 minutes or more will be marked absent. A student who is late for less than 15
minutes late will be marked tardy. Two trades will count as an absence. Three absences results in loss of a letter grade for the course. Four absences will disqualify a student from the MLT program and the student will be required to meet with the program director for readmission.

V. EXAMINATIONS

A. Five lecture examinations, three laboratory examinations and a comprehensive final examination will be given. Examinations will include multiple choices, short answer, fill-in-the-blank, matching, and other test format styles as appropriate for the material covered. Lab exams can be both written and wet.

B. Makeup examinations will not be given. If you must miss an exam, you can use your final exam grade to replace your missed exam grade. Any additional missed exams would result in a “0” and cannot be made up.

C. Quizzes may be given at the discretion of the instructor.

D. Procedures outlined in this syllabus may be modified by the instructor.

VI. SEMESTER GRADE COMPUTATION

Lecture Examinations:

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<tr>
<th>Lecture</th>
<th>Points</th>
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<tbody>
<tr>
<td>Lecture 1</td>
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<td>Lecture 2</td>
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<td>Lecture 5</td>
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<tr>
<td>Comprehensive Final</td>
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TOTAL LECTURE POINTS 700 points

Laboratory Examinations:

<table>
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<tr>
<th>Laboratory</th>
<th>Points</th>
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<tr>
<td>Laboratory 1</td>
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<td>Laboratory 2</td>
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<td>Laboratory 3</td>
<td>100</td>
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<tr>
<td>Laboratory assignment points</td>
<td>100 points (50% lab ; 50%Professional)</td>
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TOTAL LAB POINTS 400 POINTS

Case studies, homework 50 Points

Total Possible Points: 1150

1035-1150 points = A
920-1034 points = B
862-919 points = C
690-861 points = D
< 690 points = F

**Professionalism Grade: 50 Points (This grade cannot be replaced by final)**
Grading for Professionalism Grade: Subtract 2 pts per tardy or absence, 1 pt for other infractions
Includes:
- Preparation for Class
- Completion of assignments (Homework assignments: Full credit at start of class, half points at end of day, 0 points after 1st day. See attendance below.)
- Attendance (Must bring a doctor’s note for each absence due to illness to accept assignments the following day)
- Tardies
- Unlawful Use of electronics (cell phones, etc)
- Observation (Team player, Participation, Stay on Task –minimal Distractions, cheating, plagiarism, talking)

Extra credit: Maximum of 3% of total grade. Extra credit for lecture portion only. Lab has lab participation points. No extra assignments without approval of professor for lecture. Again, must fit within 3% of total extra points.

**NOTE:** Plagiarism in any form will not be tolerated. A student who chooses to plagiarize will be given a zero on the assignment. A formal charge may be made to the College Disciplinary Board.

**Testing:** If professor elects to use testing center, tests will only be available on Tues-Thursday **only**. No exceptions. Tests will only be for same time period as the class. Class must meet during original scheduled class time for extra lectures and/or labs. Professor will take test on Monday, pick up tests on Friday to be able to grade by next class period.

**VII. NOTES AND ADDITIONAL INSTRUCTIONS FROM THE INSTRUCTOR**

**A. Course Withdrawal:** It is the student's responsibility to officially withdraw from a course if circumstances prevent attendance. Any student who desires to, or must, officially withdraw from a course after the first scheduled class meeting must file a Central Texas College Application for Withdrawal (CTC Form 59). The student must sign the withdrawal form. CTC Form 59 will be accepted at any time prior to Friday of the 12th week of classes during the 16-week fall and spring semesters. The deadline for sessions of other lengths is:

- **10-week**  
  Friday of the 8th week
- **8-week**  
  Friday of the 6th week

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5-week  Friday of the 4th week

The equivalent date (75% of the semester) will be used for sessions of other lengths. The specific last day to withdraw is published each semester in the Schedule Bulletin.
A student who officially withdraws will be awarded the grade of "W" provided the student's attendance and academic performance are satisfactory at the time of official withdrawal. Students must file a withdrawal application with the college before they may be considered for withdrawal. A student may not withdraw from a class for which the instructor has previously issued the student a grade of "F" or "FN" for nonattendance.

B. **Administrative Withdrawal:** An administrative withdrawal may be initiated when the student fails to meet College attendance requirements. The instructor will assign the appropriate grade on the CTC Form 59 for submission to the registrar.

C. **Incomplete Grade:** The College catalog states, "An incomplete grade may be given in those cases where the student has completed the majority of the course work but, because of personal illness, death in the immediate family, or military orders, the student is unable to complete the requirements for a course..." Prior approval from the instructor is required before the grade of "I" is recorded. A student who merely fails to show for the final examination will receive a zero for the final and an "F" for the course.

D. **Cellular Phones and Beepers:** Cellular phones and beepers will be turned off while the student is in the classroom or laboratory. No tolerance. If the phone goes off, the student will be asked to leave the class, and receive a zero for the day.

E. **American’s With Disabilities Act (ADA):** Disability Support Services provide services to students who have appropriate documentation of a disability. Students requiring accommodations for class are responsible for contacting the Office of Disability Support Services (DSS) located on the central campus. This service is available to all students, regardless of location. Explore the website at www.ctcd.edu/disability-support for further information. Reasonable accommodations will be given in accordance with the federal and state laws through the DSS office.

F. **Instructor Discretion:** The instructor reserves the right of final decision in course requirements.

G. **Civility:** Individuals are expected to be cognizant of what a constructive educational experience is and respectful of those participating in a learning environment. Failure to do so can result in disciplinary action up to and
VIII. Course Outline

A. Lesson one: Immunology/Introduction

1. Learning Outcomes: upon successful completion of this lesson, the student will be able to:

   - List and define the three overall functions of the immune system.
   - Define immunity and briefly describe the components of the immune system, including discussion of the origin and function of the monocyte-macrophage cell, B cell, T cells, and natural killer (NK) cells.
   - Define the following terms: reticuloendothelial system, T Lymphocytes, T cell receptors, MHC restriction; lymphokines; primary response; affinity; specificity; constant region; hypervariable region; prozone; post zone; hemolysis; direct antoglobulin test; antigen ;antigenic determinants; cross-reaction; autologous; humoral immunity; homeostasis; macrophage; B lymphocyte; clonal selection; anamnestic response; avidity; immunoglobulin; elution; equivalence; agglutination; sensitization; indirect antoglobulin test; immunogenicity; immunodominant; allogenic; cell-mediated immunity; apoptosis; antigen-presenting cell; antibody; epitope; avidity; lectin; isotope; chemotaxis; opsonization; interferon; hapten; allergen; hydrostatic forces; Van der Waals forces; immune complex; plasma cells; MAC; incubation phase; acute and convalescent phases.
   - Compare and contrast innate immunity and adaptive immunity as well as internal versus external defenses.
   - Define the term antigen and describe the common characteristics of antigen molecules that contribute to immunogenicity.
   - Discuss the role of the cellular immune response in delayed hypersensitivity and cell-mediated cytotoxicity (viral resistance and allograft rejection).
   - Discuss the mechanism of the humoral immune response versus cell-mediated response.
   - Relate role of granulocytes and mononuclear cells in origin of blood cells, process of phagocytosis, acute inflammation, inflammatory response and disorders associated with these.
   - Compare and contrast the characteristics of the primary antibody response with secondary (anamnestic) response, including time from antigen challenge to antibody production, antibody titer antibody class, and antibody affinity and avidity.
   - Discuss potential immunologic consequences of transfusion and pregnancy.
K. Describe the basic immunoglobulin structure, including the antigen-binding fragment. Be able to identify parts.

L. Describe, compare and contrast the structural and functional characteristics of the five immunoglobulin classes and any implications these may have in Immunohematology.

M. Identify forces that influence the building of antigen and antibodies.

N. Compare and contrast immunoglobulins IgM, IgA, IgE, and IgG antibodies.

O. Discuss the clinical significance of blood group antibodies.

P. Briefly describe the structure of the red cell membrane including implications for blood banking.

Q. Briefly describe the structure of the cell membrane, including implications for blood banking.

R. Discuss, define and differentiate the following methods and their principle used in the detection of antigen-antibody reaction in the clinical laboratory: agglutination, hemolysis, gel column technology, solid-phase adherence, precipitation, flocculation, and hemagglutination, complement fixation, RIA, molecular techniques, enzyme immunoassay, and fluorescent antibody and interpret the results.

S. Discuss in detail the two stages of the agglutination reaction and factors that can affect each phase.

T. Given a tube with red cell agglutination, grade the agglutination using the scheme provided in the chapter.

U. Discuss the significance of hemolysis in immunology testing.

V. Compare the direct and indirect antiglobulin test.

W. Distinguish complement pathways. Describe the mechanisms and consequences of complement activation, and its importance to blood banking.

X. Compare other types of nonspecific mediators of the immune system, including cytokines, interleukins, tumor necrosis factor, hematopoietic growth factors, and chemokines.

Y. Compare acute-phase reactant methods.

Z. Correlate infectious disease with immunology test used to diagnose them.

AA. Perform syphilis (RPR, VDRL, FTA, darkfield), infectious mononucleosis, RF, CRP, ASO, Strepzyme testing, Streptococcus pyogenes and interpret results, as well as be able to compare and contrast laboratory methodologies.

BB. Know etiology, epidemiology, signs and symptoms for each of the above tests.

CC. Compare different forms of lupus, epidemiology, signs and symptoms, diagnostic evaluation of ANA, and drugs associated with SLE.

DD. Exhibit sense of professionalism by:
   i. Performing analysis with care, adhering strictly to written procedures
   ii. Demonstrating flexibility by accepting and implementing
approved changes to procedures.

iii. Attending scheduled lab sessions regularly and punctually

iv. Completing assigned tasks with minimal guidance

v. Maintaining confidentiality of patient results

vi. Admitting mistakes and taking steps to correct them

vii. Repeating procedures when test results are in doubt

viii. Responding appropriately to authority

ix. Complying with stated dress code for laboratory exercises

EE. Demonstrate correct specimen handling.

FF. Perform clerical error correction procedure

GG. Demonstrate correct patient identification, specimen labeling and sample processing

HH. Perform quality Assurance on Laboratory storage units, including reagent storage temperatures and reagent use storage.

II. Describe functions and quality assurance of laboratory equipment: Serofuge, microscope, cell washer, incubators, refrigerators, thermometers.

JJ. Evaluate case studies.

2. Learning activities: methods of Teaching and Learning Students will taught using various learning methods and activities which includes lectures, demonstrations including hands on with practice sessions, case studies, projects, laboratory exercises, clinical experiences, Internet exercises, quizzes, exams, and recordings. All material covered by these methods maybe covered on Exams.

B. Lesson Two: Safety

1. Learning Outcomes: upon successful completion of this lesson, the student will be able to:

   A. Identify employee and employer responsibilities for safety
   B. List regulatory and accrediting agencies with safety standards and apply to workplace. Describe voluntary agencies and interpret their guidelines.
   C. Apply general safety practices to daily laboratory work
   D. Use safety labels to determine appropriate safety precautions
   E. Describe the practice of Standard Blood and Body Fluid Precautions
   F. Select the safety equipment appropriate for the prevention of infectious disease transmission, prevention of injury from chemicals.
   G. Define the elements of an infection control plan
   H. Identify tasks at higher risk for exposure to blood-borne pathogens
   I. Properly dispose of laboratory waste. Explain the process of properly segregating and disposing of various types of waste products generated in the clinical laboratory.
J. List the elements of a chemical hygiene plan.
K. Use a material safety data sheet to obtain chemical information
L. Define exposure limits
M. Interpret labels on chemical bottles
N. Outline actions in the case of a chemical spill or fire.
O. List the safety precautions necessary when using equipment, compressed gases, radioactive substances, and cryogenic liquids.
P. Identify the goals of accident reporting
Q. Discuss the occupational transmission of hepatitis B virus (HBV) and human immunodeficiency (HIV)
R. Describe and define the basic aspects of infection control policies, including the use of personal protective equipment or devices (gowns, gloves, goggles) and the purpose of standard Precautions.
S. Compare pre-exposure and post-exposure prophylactic measures for handling potential occupational transmission of certain pathogens (HBV, HCV, HIV).

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C. **Lesson Three: Quality Control; Quality Assurance; Quality Improvement; Peer Review**

1. **Learning Outcomes:** Upon successful completion of this lesson, the student will be able to:

A. Define and differentiate the following terms: Quality systems; Quality control; Quality assurance; continuous quality improvement; Utilization review
B. List the elements of a technical procedure according to the Clinical and laboratory standards Institute (formerly NCCLS) guidelines
C. Use a training checklist to document training, and evaluate competency.
D. Identify the requirements for calibration and testing laboratory instruments
E. Define, compare and contrast proficiency testing and competency testing.
F. List the requirements for testing laboratory reagents
G. Describe a method to document the lot number of reagents used.
H. List the minimum standards for quality control of blood components.
I. Describe a process for documenting non-conformances
J. Develop and indicator for quality monitoring of blood transfusion service activities
K. List the elements of, and explain the importance of a will-written standard
L. Define calibration, preventive maintenance, and quality control requirements; discuss the importance to each in reporting accurate results.

M. Define the terms accuracy, precision, reproducibility, and reliability.

N. Define true positive, true negative, false positive, and false negative.

O. Provide the equations for calculating percent sensitivity and percent specificity.

P. Define positive predictive value and negative predictive value.

Q. Explain the use of control specimens, and be able to troubleshoot controls out of the acceptable.

R. Define the term mean, median, mode, standard deviation, and reference range.

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D. **Lesson Four: Recording Keeping; Computers**

1. **Learning Outcomes:** Upon successful completion of this lesson, the student will be able to:

   A. Identify circumstances in which confidential patient information may be discussed or reported to a third party
   B. Define HIPPA guidelines
   C. List two records that must be maintained indefinitely
   D. List three records that should be maintained for at least 5 years
   E. Identify the resource for interpreting locally defined abbreviations
   F. List the items required to document the infusion of a blood component
   G. Identify the agency to be notified in the event of a transfusion related death
   H. Describe the method for correcting an original entry on a laboratory report
   I. List the documentation required when a computer system is used in a blood bank or transfusion services
   J. List two methods of preventing unauthorized access to a computer system
   K. Describe the purpose of a disaster recovery plan

2. **Learning activities:** methods of Teaching and Learning Students will taught using various learning methods and activities which includes lectures, demonstrations including hands on with practice sessions, case studies, projects, laboratory exercises, clinical experiences, Internet exercises, quizzes, exams, and recordings.
recordings. All material covered by these methods maybe covered on Exams.

E. Lesson Five: Immune Mediated Disease; Infectious Disease/Viral disease: Serology Methods and Auto Immune Diseases

1. Learning Outcomes: Upon successful completion of this lesson, the student will be able to:

   A. Describe important characteristics in the acquisition and development of infectious diseases
   B. Compare how the body develops immunity to bacterial, parasitic, fungal, viral, rickettsial, and mycoplasmal diseases
   C. Describe vaccine policy and the role and use of vaccines in public safety
   D. Identify at least three essential characteristic of a vaccines
   E. Based on immunologic principles, describe host response to vaccination
   F. Analyze the problems associated with AIDS vaccine development and use
   G. Describe the development and application of human papillomavirus vaccine.
   H. Describe the etiology, epidemiology, signs and symptoms, complications, diagnostic evaluation, treatment and prevention of: streptococcal infections, Lyme disease, ehrlichiosis, babesiosis, West Nile virus, infectious mononucleosis, including heterophil antibodies, EBV, RA
   I. Describe the etiology, epidemiology, sign, symptoms, diagnostic evaluation of primary, secondary, latent and late (tertiary) syphilis and congenital syphilis
   J. Discuss the principles and clinical applications of the rapid plasma regain card test, and the fluorescent treponemal antibody absorption test
   K. Describe the etiology, epidemiology, signs and symptoms and diagnostic evaluation of acquired and congenital toxoplasmosis infection
   L. Discuss and explain the etiology, epidemiology, signs, symptoms, serologic and diagnostic evaluation of acquired, latent and congenital cytomegalovirus (CMV) infection
   M. Identify and describe the characteristics of the various forms of primary infectious hepatitis and explain the serologic markers and diagnostic evaluation of hepatitis infection.
   N. Describe and compare the etiology, epidemiology, signs and symptoms of acquired and congenital rubella infection
   O. Explain the diagnostic evaluation of rubella, including hemagglutination inhibition and passive latex agglutination.
   P. Describe and explain the etiology, epidemiology, signs and symptoms including modes of transmission and viral characteristics of human immunodeficiency virus (HIV-1)
   Q. Describe the nature of autoimmune disorders

2. Learning activities: methods of Teaching and Learning Students will taught
using various learning methods and activities which includes lectures, demonstrations including hands on with practice sessions, case studies, projects, laboratory exercises, clinical experiences, Internet exercises, quizzes, exams, and recordings. All material covered by these methods may be covered on Exams.

F. **Lesson Six: Introduction to Immunohematology: Genetics and Immunology**

1. **Learning Outcomes**: Upon successful completion of this lesson, the student will be able to:

   A. Define the following: gene, allele locus, chromosome, homozygous, heterozygous, dominant, recessive, co-dominant, genotype, phenotype, antigen, antibody, IgG, IgM, dosage, in-vivo, and in-vitro. Define the following genetics terms: pedigree chart; incomplete dominance; genotype; diploid; mitosis; autosomal; linkage; blood group antigen; proteomics; single nucleotide polymorphism (SNP); polymerase chain reaction (PCR); point mutation, chimera, cluster of differentiation, autoantibody, alloantibody.

   B. Describe the major concepts of Mendelian genetics, including the following: Law of Independent Assortment

   C. Construct and interpret a pedigree chart using the symbols described in this chapter. Describe four patterns of inheritance

   D. Briefly describe linkage and give examples from blood group genetics

   E. Differentiate between direct and indirect exclusion in parentage testing

   F. Briefly describe what is meant by the term position effects and give one example from blood group genetics that illustrates this phenomenon. Explain the difference between cis and trans and their effect on gene interactions.

   G. Identify antibody structure and classes of greatest significance to blood banking

   H. Describe factors affecting antigen-antibody reactions

   I. Calculate phenotypic frequencies and population genetics. Given the necessary data, calculate gene, genotype, and phenotype frequencies in the population. Given the frequency of blood group antigens in the population, calculate the number of units of blood that must be screened for a given transfusion

   J. Briefly define the term polymorphic and describe the impact of blood group polymorphisms on human blood group systems

   K. Discuss the usefulness of molecular techniques in expanding knowledge related to structure, genetics, and function of blood group-associated antigens

   L. Understand hematopoietic stem cells and cellular therapy

   M. Understand labeling techniques in immunoassay, homogeneous, heterogeneous, chemiluminescence, enzyme immunoassay (EIA),
Immunofluorescence

N. Identify and give example of the three phases of automated testing, nephelometry, analysis and implications of cryoglobulins

O. Define and describe technique electrophoresis, immunoelectrophoresis, immunofixation electrophoresis, capillary electrophoresis

P. Identify the fractions into which serum proteins can be divided by electrophoresis

Q. Define the terms hypersensitivity, allergy, sensitization and immunization

R. Identify and explain the three categories of antigens

S. Describe the etiology, immunologic activity, signs, symptoms, laboratory evaluation and treatment and compare the basic differences and give examples of I, II, III and IV hypersensitivity reactions

T. Discuss the acquisition and consequences of latex sensitivity

2. Learning activities: methods of Teaching and Learning Students will taught using various learning methods and activities which includes lectures, demonstrations including hands on with practice sessions, case studies, projects, laboratory exercises, clinical experiences, Internet exercises, quizzes, exams, and recordings. All material covered by these methods maybe covered on Exams.


1. Learning Outcomes: Upon successful completion of this lesson, the student will be able to:

   A. Briefly describe history of discovery of ABO blood groups
   B. Define the following terms: forward type, reverse type, Landsteiner’s Rule, secretor, subgroup, and discrepancy.
   C. Describe relationship between ABO antigens and antibodies for the ABO blood group (Landsteiner’s Rules), and what factors can affect red cell phenotyping.
   D. List the cells, body fluids and secretions where ABO antigens can be located. Identify correct ABO blood group and secretor status.
   E. Identify the frequencies of ABO blood types
   F. Explain the effect of age on demonstration of ABO type, and how compatibility testing is carried out for an infant younger than 4 months
   G. Predict ABO phenotypes & genotypes of children from various ABO parents
   H. Explain ABO genetic theory of A, B, and H antigens and the transferases responsible for each, and sugars associated with each.
   I. Describe relationship, difference among ABO, H and Se genes. Know plant lectin that will differentiate H antigen.
   J. Describe the ABO blood group system antibodies with regard to immunoglobulin class, clinical significance, and in vitro serologic
K. Describe the differences between A1 and A2 phenotypes, and which lectin is used to differentiate, and how to interpret results.

L. Describe the Bombay phenotype with regard to genetic pathway, serologic reaction and transfusion implication

M. Explain what is meant by “secretor status,” describe inheritance patterns and the effect of the ABO/H, Lewis, Se systems. What is a non-secretor?

N. Describe the inheritance, serologic characteristics and clinical frequencies and significance of the Lewis antigens and the products of the Le gene (anti-Le^a and anti-Le^b)

O. Define the terms universal donor and universal recipient as they apply to red blood cell and plasma products

P. Accomplish the following in regard to Lewis, P and I/i blood group systems:
   i. List major antigens and their frequencies
   ii. State clinical correlation between blood group and related disease state
   iii. Describe the major characteristics including inheritance patterns

Q. List the antigens of the P and Globoside blood group systems

R. Describe the serologic characteristics and clinical significance of the following P system antibodies: anti-P1, and anti-P and anti-P^k

S. Demonstrate basic blood banking techniques in:
   i. Preparing proper RBC suspension
   ii. Reading agglutination using viewer
   iii. Centrifuging test specimens
   iv. Resuspending cell buttons
   v. Standard technique-2 drops of antisera, 1 drop of cells

T. Perform record and interpret ABO forward and reverse testing

U. Recognize ABO testing reagents

2. **Learning activities:** methods of Teaching and Learning Students will taught using various learning methods and activities which includes lectures, demonstrations including hands on with practice sessions, case studies, projects, laboratory exercises, clinical experiences, Internet exercises, quizzes, exams, and recordings. All material covered by these methods maybe covered on Exams.

H. **Lesson Eight: Rh Blood Group System**

1. **Learning Outcomes:** Upon successful completion of this lesson, the student will be able to:

   A. Describe the biochemistry on Rh blood group antigen including the gene products and antigen structures to identify Rh antibodies. List the five major antigens of Rh system

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B. Explain how the d antigen was named Rh. Describe Rh system genetic theory and history of discovery of the D antigen
C. Compare the Fisher-Race and Wiener nomenclature, and how they translate from to the other. Be able to interpret results.
D. Describe weak D and list the genetic circumstances that cause this phenotype, and perform weak d testing and interpret results
E. Perform routine Rh and interpret results
F. Predict the Rh genotype given a phenotype
G. Describe the characteristics if the antibodies and their clinical significance with regard to transfusion and hemolytic disease of the fetus and newborn
H. Identify and resolve problems encountered in Rh testing
I. Determine the appropriate use of Rh control material based on reagent type. Recognize Rh and IAT testing reagents. Compare high protein and low protein Rh antisera
J. Indicate two reasons why Rh system is second only to the ABO system relative to its clinical significance
K. Select appropriate blood for transfusion to patients with Rh system antibodies
L. Given the anti-D testing results (including weak D on D-negative blood) form donor blood, determine whether the unit should be labeled D-positive or D-negative
M. Discuss four circumstances that could result in false-positive and false-negative Rh typing results
N. Describe the two genetic circumstances that give rise to the Rhnull phenotype and their clinical significance.

2. Learning activities: methods of Teaching and Learning Students will be taught using various learning methods and activities which includes lectures, demonstrations including hands on with practice sessions, case studies, projects, laboratory exercises, clinical experiences, Internet exercises, quizzes, exams, and recordings. All material covered by these methods maybe covered on Exams.

I. Lesson Nine: Other Blood Group Systems

1. Learning Outcomes: Upon successful completion of this lesson, the student will be able to:

A. Accomplish the following in regard to other blood group systems:
   List major antigens and describe the biochemical characteristics of antigens within each blood group system
   i. Describe the genetic mechanism for antigen inheritance in each blood group system, as well as their immunogenicity
   ii. State clinical correlation between blood group and related disease state
iii. Calculate the frequencies of the observed phenotypes and the association of phenotypes with ethnic group diversity

iv. Describe the major characteristics, inheritance, structure, MNSs Kell, Duffy and Kidd systems, Lutheran and Xg

B. Distinguish between antibodies that show enhanced reactivity after treatment with enzymes and those that exhibit decreased reactivity

C. Identify which blood group systems exhibit dosage. Discuss the serologic characteristics of the antibodies and their clinical significance. Briefly discuss any special testing procedures useful in the investigation of the antibodies in the systems.

D. Briefly describe the relationship of the McLeod phenotype and chronic granulomatous disease, retinitis pigmentosa, and Duchenne muscular dystrophy

E. Briefly describe the relationship between the FY antigen system and the susceptibility to Plasmodium vivax infection.

F. Briefly describe the relationship between antibodies of the Kidd system and the incidence of delayed hemolytic transfusion reactions

G. Identify three high-incidence and low-incidence antigens that are not part of a known blood group system

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J. Lesson Ten: The HLA System

1. Learning Outcomes: Upon successful completion of this lesson, the student will be able to:

A. Define MHC and briefly describe the history and the inheritance patterns of the HLA system.

B. Explain clinical application of HLA antigens and leukocyte Antigens.

C. Briefly describe the physiologic process that takes place when an individual is exposed to a foreign antigen.

D. Discuss the functional differences and molecular structure and techniques to define both class I and class II molecules.

E. Given maternal and paternal haplotypes, determine the possible genotypes of offspring.

F. Describe the clinical significance of HLA crossmatch procedures.

G. List two HLA-disease associations.

H. Explain the etiology, epidemiology, signs and symptoms, manifestations, diagnosis, and prevention of graft-versus-host disease.

I. Briefly explain the mechanism of organ or tissue rejection.
J. Identify and explain some methods of immunosuppression.

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K. **Lesson Eleven:** Pretransfusion Testing: Compatibility Testing; Antibody Screen;

**IAT vs. DAT: Special Blood Bank Reagents**

1. **Learning Outcomes:** Upon successful completion of this lesson, the student will be able to:

   A. Explain purpose and use of antibody screen. Describe antiglobulin testing.
   
   B. Perform and interpret IAT using screening cells. Apply appropriate incubation times and temperatures. Understand composition of screening cells.
   
   C. Recognize common problems encountered with IAT and how to resolve them.
   
   D. Describe purpose of auto control, and interpret results.
   
   E. Compare the different crossmatch procedures, major and minor.
   
   F. Perform crossmatch. Understand purpose of IS crossmatch with a negative antibody screen.
   
   G. Resolve crossmatch incompatibilities, and limitations of crossmatches and how to interpret results.
   
   H. Discuss the principles in crossmatching autologous blood.
   
   I. Perform antigen testing of RBC’s with antisera.
   
   J. Differentiate IAT from DAT testing, and recognize common problems and how to resolve them.
   
   K. Describe content and uses for the following types of reagents in crossmatch and antibody identification: AHG (mono vs. poly specific), potentiators (albumin, LISS, PEG), reagent red cells (A1, A2, B, screening cells, panel cells, check cells), Fetal Bleed Screens, enzymes.
   
   L. Discuss the advantages, criteria and the limitations of the electronic (computer) crossmatch.
   
   M. Describe possible explanations for the following serologic reaction patterns: Positive antibody screen, or Positive crossmatch, with or without positive autocontrol.
   
   N. Understand specimen collection criteria, sample preservation, and labeling requirements for the crossmatch.

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L. **Lesson Twelve: Antibody Identification and ABO Discrepancies**

**Learning Outcomes:** Upon successful completion of this lesson, the student will be able to:

A. Define the following term: absorption vs. adsorption, antigram, dosage, eluate, sensitization neutralization, unexpected or alloantibody, rouleaux, warm antibodies, CAS, lectin, titer, gravida, para and interpret results to be able to complete testing.

B. Define atypical or unexpected antibodies and explain how they are formed. Discuss all immunization and situations that may stimulate it.

C. Describe the specimen, purpose, and limitations of antibody identification.

D. Explain why patient information regarding transfusion or pregnancy history, age, race and diagnosis helps in the process of antibody identification.

E. Outline the procedures used for antibody identification, including characteristics of reagents used in blood banking.

F. Interpret the results of antibody panel studies and suggest rule-out and confirmation procedures.

G. Define phase of reactions and its significance and correctly apply the use of enhancement media and alternative techniques.

H. Discuss how the reaction strength contributes to antibody resolution.

I. Explain the “rule of three” with regard to antibody identification.

J. List methods that can be used when working with a multiple-or-high frequency antibody or antibodies.

K. Explain the importance of a control when performing antibody neutralization.

L. Read an antigram and interpret results.

M. Explain the process of identifying the specificity of a cold autoantibody and techniques to avoid cold autoantibody reactivity.

N. Describe the process and limitations of absorption techniques as they warm and cold autoantibodies.

O. Describe components appropriate for transfusion when alloantibodies or ABO discrepancies are present.

P. Perform enzyme treatment of reagent RBC’s and perform testing.

Q. Define the elution procedure and list methods and purpose of this test.

R. Recognize abnormal results of ABO typing & resolve commonly occurring discrepancies such as clerical, technical errors, subgroups,
recently transfused patient, weak/missing or unexpected antigens or antibodies or mixed populations of red cells, rouleaux.

S. Resolve case studies given patient history and test results with an ABO discrepancy, (Ex using saline to disperse rouleaux).
T. Choose the appropriate unit of blood to be transfused to a patient before typing problems can be resolved.
U. With a positive antibody panel, calculate the number of units needed to crossmatch based on the frequencies of blood group antigens.
V. Identify which antibodies exhibit dosage.

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M. **Lesson Thirteen: Donor Unit Processing and Blood Products**

1. **Learning Outcomes:** Upon successful completion of this lesson, the student will be able to:

   A. List and describe the regulating authorities in donor centers.
   B. Describe factors affecting the available blood supply, including proper techniques and requirements.
   C. Explain, list and describe donor screening procedures and requirements. Know rejection criteria for donors.
   D. Outline blood collection procedures, including selection of donor components based on ABO types, and criteria steps to continue blood collection.
   E. Discuss the major categories of screening question intended to protect the recipient.
   F. Describe the confidential self-exclusion procedure.
   G. List four possible donor reactions and solutions.
   H. Describe donor unit component preparation, processing, and purpose. Calculate cells/anti-coagulate ratio.
   I. Define possible donor reactions and solutions.
   J. Describe the various types of anticoagulants/preservatives used in blood donation and the expiration dates associated with each.
   K. List the various components that can be made from a unit of blood:
      1. Red blood cells (Irradiated, Whole Blood)
      2. Leukocyte poor RBC’s
      3. Washed RBC’s
      4. Frozen, deglycerolized RBC’s
      5. Platelet concentrates (LP, random, pheresis)
6. Fresh, frozen plasma
7. Cryoprecipitate
8. Granulocyte
12. List eligibility of donations based on each type of component.
13. Describe method of storage for each component, and what change can occur during storage of a red cell product.
14. Describe and contrast the use of each component, and expected outcomes as seen in repeat laboratory testing.
15. Describe shipping requirements for the various components.
16. Define the terms: autologous and directed donation, and who are the best candidates.
17. Outline the procedures for donor/patient care during the collection and processing of pheresis and autologous units.
18. Identify reasons for therapeutic phlebotomy.
19. Describe under what conditions the following test might be run on donor blood: cytomegalovirus (CMV) screening, special antigen typing and screening for sickle cell trait.

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N. **Lesson Fourteen:** Transfusion Practice, Component Therapy, Component preparation

1. **Learning Outcomes:** Upon successful completion of this lesson, the student will be able to:

   A. List the indications and contraindications for blood component therapies and the goals of transfusion
   B. For each of the following blood components, briefly describe the proper name, method(s) of preparation, storage temperature and limits, shelf life, labeling requirements for each component, composition, approximate volume, quality control standards, safety standards, clinical use and special considerations if any: Whole Blood; Red Blood Cells; Leukocytes Reduced RBC; Frozen RBC; Deglycerolized RBC; Fresh Frozen Plasma; Liquid Plasma; Cryoprecipitate; Granulocytes; Platelet.
   C. Describe component therapy in patient with complications such as DIC, liver disease, hemophilia, von Willabrand’s disease, chronic liver disease, congestive heart disease, hypovolemic shock, or Coumadin over administration.
   D. List the four major indications for the transfusion of blood or blood components/products. Define massive transfusion.
E. Given a patient’s scenario, select the appropriate red cell component and type, and defend that selection.

F. Given patient body weight, initial factor VIII level, and desired Factor VIII outcome, calculate the number of units of Factor VIII concentrates to administer.

G. Define storage lesion and the elements that change during blood storage.

H. Compare the anticoagulant and preservative solutions with regard to expiration and content. Compare and contrast the RBC anticoagulant/preservative solutions (ACD, CPD, CP2D, CDPS-1, AS), including historical and/or current applications, chemical ingredients, biochemical changes and shelf life.

I. Describe the steps, requirements in blood component collection and preparation.

J. Describe the quality control requirements for each component.

K. Given the blood volume, donor hemoglobin, calculate the volume necessary for direct transfusion to a neonate.

L. Know methodologies, requirements, etc. for infectious disease testing that must be performed on a unit of blood before transfusion.

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O. **Lesson Fifteen: Transfusion Reactions**

1. **Learning Outcomes:** Upon successful completion of this lesson, the student will be able to:

   A. Define transfusion reaction.

   B. Explain causes and risks associated with transfusion.

   C. Explain and differentiate between immediate and delayed hemolytic transfusion reactions.

   D. Explain the criteria used to evaluate whether or not a transfusion reaction had occurred.

   E. List the steps to be followed when a transfusion reaction is suspected. Compare and contrast acute and delayed immune mediated hemolytic transfusion reaction.

   F. Categorized the adverse complications of a transfusion such as DIC, renal failure, stroke, hemosiderosis, citrate toxicity, and post-transfusion purpura.

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G. Describe the immunobiology of in vivo red blood cell destruction features.
H. Describe and differentiate the major clinical features, causes of the following immune-mediated nonhemolytic transfusion reactions: febrile, urticarial, anaphylactic, transfusion-related acute lung injury, and anaphylactic, transfusion graft-versus-host disease, circulatory overload as well as appropriate blood product to use to avoid a transfusion reaction if possible.
I. Discuss the mechanism and clinical features of the bacterial contamination of blood products.
J. List the responsibilities of medical personnel performing the transfusion in the event of an adverse reaction.
K. Identify testing steps taken in the transfusion department on receipt of a patient sample post reaction and the proper documentation required.
L. Discuss component indicated for a patient who receives directed donations to prevent graft-versus-host transfusion reaction
M. Relate antibodies associated with delayed hemolytic transfusion reaction.

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P. Lesson Sixteen: Direct Antiglobulin Test/Autoimmune Hemolytic Anemia

1. Learning Outcomes: Upon successful completion of this lesson, the student will be able to:

1. Describe the possible causes of a positive DAT and be able to discuss next step to resolve. Briefly describe what information should be gathered before the initiation of a serologic investigation of a positive DAT.
2. Outline the procedure for evaluating a positive DAT results, and what DAT means.
3. Classify different manifestations of immune hemolysis according to the serological finding and the antibody specificities.
4. Describe various mechanisms of drug-induced immune hemolytic anemia.
5. Describe causes of and serological work up for AIHA
6. Describe the 4 categories of autoimmune hemolytic anemia’s
7. Describe proper cord blood specimen and handling
8. Perform cord blood testing, know specimen requirements, and know which of these tests should be performed on a cord blood.
9. State the approximate frequencies of the various types of immune hemolytic anemia and describe the usual serologic findings associated with each that is presence of IgG or C3 and reactivity of eluates.
10. Describe the common clinical and laboratory finding for autoimmune hemolytic anemia and describe the treatment strategies.
11. Discuss strategies for solving, and interpret serologic results for with warm autoimmune hemolytic anemia and cold agglutinin syndrome, including the resolution of ABO and Rh typing discrepancies and the detection and identification of alloantibodies, as well as the appropriate blood for transfusion if indicated.

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Q. **Lesson Seventeen: Hemolytic Disease of the Newborn/Rh Immune Globulin**

1. **Learning Outcomes:** Upon successful completion of this lesson, the student will be able to:

   A. Define and describe the basic process of HDN and the factors required for its development, as well as its characteristics.
   B. List three types of HDN based on antibody specificity.
   C. Briefly discuss other clinical conditions that can be associated with newborn hemolysis or jaundice.
   D. Define hydrops fetalis, kernicterus, icterus, para, and gravida.
   E. Explain the various tests and procedure employed to diagnose, identify, monitor and treat HDN.
   F. List two conditions associated with maternal immunization that can cause the destruction of other (non-red cell) lines in the fetus or newborn.
   G. Discuss the pathophysiology of HDN, differentiating between the disease course in utero and postpartum.
   H. Describe the routine prenatal testing necessary to diagnose, monitor and treat HDN.
   I. List which testing and patient information is critical to treatment of HDN once the disease has been detected.
   J. Describe the cordocentesis procedure.
   K. Describe the titration procedure and discuss variables that must be controlled to ensure the accuracy and reproducibility of the procedure.
   L. Interpret titer results and suggest clinical implications of the findings.
   M. Describe the amniocentesis.
   N. Discuss the producers used to analyze amniotic fluid for bilirubin and L/S ratios.
   O. Identify factors that can affect the accuracy of amniotic fluid analysis results.
   P. Describe the intrauterine transfusion procedures: intraperitoneal and
Q. When provided with the ABO and Rh group of the mother and the fetus and the identity of the maternal antibody (ies), select the appropriate blood for intrauterine transfusion.

R. Discuss AABB Standards with regard to the selection of blood for intrauterine transfusion and the advantages and disadvantages of doing an exchange.

S. Discuss the interpretation of cord blood hemoglobin and bilirubin levels in the early postpartum period.

T. Describe the exchange transfusion procedure and its purposes and goals.

U. Compare and contrast ABO-HDN with HDN associated with other blood group alloantibodies. Know requirements for prenatal workup.

V. Describe how Rh Immune Globulin works. Describe the use of RhIG in the prevention of HDN due to anti-D. Know criteria for candidacy for Rhogam injection.

W. Describe and interpret the procedures used to screen for fetal bleeds (rosette test-Liley method) to predict the severity of the disease, and be able to calculate the number of vials of RhIG needed.

X. Describe the principle of Kleihauer-Betke test, and given the fetal cell count per 1000 adult cells in a Kleihauer-Betke test, calculate the number of 300 ug doses of RhIG that should be administered to prevent maternal alloimmunization. Know time period when RhIG must be given during prenatal stage, as well as after delivery.

Y. Discuss factors that can cause false-positive results in the Kleinhauer-Betke stain.

Z. List the various blood group antibodies that can cause HDN.

AA. List example of antibodies that are not clinically significant in term of HDFN.

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R. **Lesson Eighteen: Transfusion of Select Patient Populations**

1. **Learning Outcomes:** Upon successful completion of this lesson, the student will be able to:

   A. Define massive transfusion and describe complications of this procedure.
   B. Describe the purpose of aphaeresis and therapeutic phlebotomy.
   C. Describe transfusion therapy for the neonate, and in the burn patients, liver patients, sickle cell disease, and oncology patients.
   D. Define the term hemorrhagic shock, and discuss options for fluid
replacement.

E. Discuss the physiologic consequences of hypothermia and strategies used to avoid it in massive transfusion.

F. Describe the AABB Standards for blood-warming devices.

G. Discuss the issues surrounding the emergency release of blood and components.

H. Define autologous transfusion and briefly state how it can be useful in the treatment of massive blood loss.

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