COURSE OUTLINE

Course Number	Course Title	Credits
MLT212	Clinical Hematology	**4**
Hours: Lecture/Lab/Other	**Co- or Pre-requisite**	**Semester & Year**
3/3	permission of program coordinator	**Fall 2023**

Catalog description:

Study of blood cells in bone marrow, peripheral blood, and body fluids. Normal and abnormal blood cell maturation, physiology, and morphology are examined along with coagulation, another branch of hematology, involving hemostasis (the stopping of blood flow). The laboratory component develops technical skills used to perform hematology and coagulation lab tests.

General Education Category:

Not GenEd

Course coordinator:

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Required texts & Other materials:

Required:

i. **Textbook:** Hematology in Practice by Betty Ciesla (2019), 3rd Edition, F.A. Davis Company, ISBN-13: 978-0-8036-6824-9
ii. **Atlas:** Clinical Hematology Atlas by Rodak and Carr, 6th Edition, Elsevier, ISBN-13: 978-0323711920
iii. Instructor-developed **Lab Manual** (purchase through the bookstore)
iv. 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 4. Pocket calculator
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. Apply principles of OSHA safety regulations for blood-borne pathogens, quality assurance and quality control in Hematology. (Supports ILG# 1,3,9; PLO#1, 2, 4)
2. Evaluate specimen acceptability of hematology specimens and dispose of them in the appropriate biohazard containers. (Supports ILG# 1,3,9; PLO# 2, 6)
3. Demonstrate an understanding of the components of human blood and characteristics, functions, and abnormalities and disease states of each. (Supports ILG# 1,3,9; PLO#3)
4. Compare and contrast hematology values under normal and abnormal conditions. (Supports ILG# 1,3,9,11; PLO# 2, 3, 6)
5. Demonstrate proficiency in the skills necessary to perform blood cell counts and evaluation of blood elements within stated limits of accuracy and assess the clinical significance of the results. (Supports ILG# 1,2,3,4,9,10,11; PLO# 2, 5, 6, 7)

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 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:

Basic Hematology Practices

Learning Objectives

Learning objectives (Chapters 1-4) **[Supports Course SLOs #1-2]**

The student should be able to:

After completing this week, the student will be able to:

1. Describe safe work practices, personal protective equipment and disposal of biologic hazards in the hematology lab.
2. Describe the components of quality assurance in the hematology laboratory.
3. Discuss the basic parts of the light microscope and the function and magnification of each objective.
4. Describe the organs involved in hematopoiesis throughout fetal and adult life.
5. Define factors affecting differentiation of the pluripotent stem cell.
6. Define the myeloid: erythroid ratio.
7. Understand the bone marrow collection procedure and the technologist's role in bone marrow analysis.
8. List the components of a complete blood count.
9. Define and calculate red blood cell indices.
10. Recognize normal and critical values in an automated CBC.
11. Describe the clinical conditions that may produce polychromatophilic cells and elevate the reticulocyte count.
12. Define the morphologic classification of anemias.
13. Outline erythropoietic production from origin to maturation of red blood cells.
14. Describe immature red blood cells with regard to nucleus: cytoplasm ratio, cytoplasm color, nuclear structure and size.

15. Identify the metabolic pathways that provide energy for red blood cells.
16. Describe the composition of the red blood cell membrane.
17. Understand factors necessary for maintaining a normal red blood cell life span.
18. Define anisocytosis, poikilocytosis, microcytic and macrocytic.
19. Indicate clinical conditions in which variations in size and hemoglobin content are seen.
20. Identify the pathophysiology and the clinical conditions that may lead to target cells, spherocytes, ovalocytes and elliptocytes, sickle cells, and fragmented cells.
21. List the most common red blood cell inclusions and the disease states in which they are observed.
22. Describe hemoglobin structure and function of normal adult hemoglobin, Hgb A, Hgb A2 and Hgb F.
23. Relate the shift from fetal hemoglobin to adult hemoglobin.

Psychomotor Performance Objectives:

1. Demonstrate safe laboratory practices.
2. Show proficiency in making peripheral blood smears.
3. Recognize and differentiate between normal and abnormal RBC morphology using staining techniques.

Week 2 Red Cell Disorders

Learning Objectives

Learning objectives (Chapters 5-8) **[Supports Course SLOs #3-4]**

The student learner should be able to:

1. Describe red blood cell indices related to microcytic anemias.
2. Describe iron transport from ingestion to incorporation in hemoglobin.
3. Identify the laboratory tests used in the diagnosis of iron deficiency anemia.
4. Define the pathophysiology, diagnosis and clinical management of patients with hereditary hemochromatosis.
5. Describe the basic pathophysiologic defect in the thalassemia syndromes.
6. Correlate the morphologic changes in the red blood cell with the defect in the alpha and beta thalassemias.
7. Describe the criteria that define a macrocytic anemia as megaloblastic.
8. Compare and contrast the morphologic characteristics of megaloblasts and normoblasts in the bone marrow.
9. Describe the pathway of vitamin B12 and folic acid from ingestion through incorporation into the red blood cell.
10. Define pernicious anemia and its clinical and laboratory findings.
11. Describe laboratory tests used in the diagnosis of megaloblastic anemia.
12. Differentiate the anemias that are macrocytic but are not megaloblastic.
13. Review the functions of the spleen as they relate to red blood cells
14. Describe the clinical findings in patients with hereditary spherocytosis.
15. Describe the osmotic fragility test and its clinical usefulness.
16. Identify the red blood cell membrane defects and peripheral smear findings in hereditary stomatocytosis, elliptocytosis, and poikilocytosis.
17. Define the pathophysiology of the red blood cell biochemical disorders including glucose- 6- phosphate dehydrogenase deficiency.
18. Describe Heinz bodies with respect to their appearance in supravital and Wright's stain.
19. Define the defect in the rare membrane disorders of hereditary xerocytosis and Southeast Asian ovalocytosis.
20. Discuss the characteristics of aplastic anemia, paroxysmal nocturnal hemoglobinuria, paroxysmal cold hemoglobinuria, Fanconi's anemia, and Diamond- Blackfan syndrome.
21. Identify the amino acid substitution in sickle cell disorders and Hgb C disease.
22. List the clinical and laboratory features of sickle cell anemia, sickle cell trait, Hgb C disease, Hgb C trait and Hgb SC disease.
23. Recognize normal and abnormal hemoglobin patterns on hemoglobin electrophoresis at pH8.6 and 6.2.
24. Differentiate the clinical and laboratory features of other abnormal hemoglobins, such as Hgb E, Hgb OArab, Hgb DPunjab, and Hgb GPhila.
25. Calculate the white blood cell correction formula when nucleated red blood cells are noted in the peripheral smear.

Psychomotor Performance Objectives:

1. Understand the principles used in automated RBC counts
2. Be able to define and calculate RBC indices
3. Show proficiency in performing a microhematocrit, sedimentation rate (ESR) and reticulocyte Count
4. Demonstrate proficiency in performing assays with the Sickle Cell test kit.
5. Describe the use of the Unopette system in hematology testing.
6. Show proficiency in using the Unopette system and hemocytometer in performing manual cell counts.

Week 3 White Cell Disorders

Learning Objectives

Learning objectives (Chapters 9-11) **[Supports Course SLOs #3-5]**

The student learner should be able to:

1. Describe leukopoiesis from immature forms to full maturation.
2. Identify morphologic features used in differentiating cells of the granulocytic series.
3. Describe features that differentiate the granules of the neutrophilic, eosinophilic, and basophilic cell lines.
4. Describe the lymphatic system and its relationship to lymphocyte production.
5. Identify conditions that cause a quantitative increase or decrease in a particular white blood cell line.
6. Identify conditions that lead to hyposegmentation or hypersegmentation of neutrophils.
7. Describe the effects of HIV on the CBC and the peripheral smear.
8. Describe the process of reactive lymphocytosis in infections with Epstein- Barr virus and cytomegalovirus.
9. Define white blood cell– related terms such as leukocytosis, left shift, leukemoid reaction and leukoerythroblastic reaction.
10. Describe briefly lipid storage diseases, such as Gaucher's disease, Niemann- Pick disease, and Tay- Sachs disease.
11. Compare and contrast acute versus chronic leukemia with respect to age of onset and presenting symptoms.
12. Describe acute leukemia with emphasis on symptoms, peripheral blood and bone marrow findings.
13. Classify acute leukemias according to the French- American- British (FAB) classification system.
14. Briefly describe the World Health Organization (WHO) classification for acute myeloid leukemias and related myeloid proliferations.
15. Describe how cytochemical staining can aid in the diagnosis of acute leukemias.
16. List the most pertinent CD markers for various acute leukemias.
17. Explain the WHO classification of acute lymphoblastic leukemia/lymphoma.
18. Describe acute lymphoblastic leukemia with emphasis on age of onset, symptoms at presentation, prognosis, and laboratory findings.
19. Demonstrate proficiency in using the Unopette system and hemocytometer in performing manual cell counts.

Psychomotor Performance Objectives:

1. Show proficiency in making peripheral smears for manual WBC differentials.
2. Be able to differentiate and count the various white blood cell lines.
3. Differentiate the different WBCs on a slide: segmented neutrophils (segs), band neutrophils(bands), lymphocytes (lymphs), monocytes (monos), basophils (basos), and eosinophils (eos).

Week 4 White Cell Disorders (Continued)-

Learning Objectives

Learning objectives (Chapters 12-14) **[Supports Course SLOs #3-5]**

The student learner should be able to:

1. Discuss the classification and pathogenesis of myeloproliferative disorders. ,
2. Understand the clinical features associated with chronic myeloproliferative disorders.
3. Demonstrate proficiency in making peripheral smears for manual WBC differentials.
4. Define the common features of the chronic lymphoproliferative disorders.
5. Describe the peripheral smear morphology of individuals with chronic lymphocytic leukemia.

6. Describe features of hairy cell leukemia on peripheral smear and with cytochemical stains.
7. Define the clinical features of Sézary syndrome.
8. List the morphologic features of the plasma cell and the basic immunoglobulin unit.
9. List the laboratory criteria used to diagnose the monoclonal gammopathies.
10. Differentiate the clinical and laboratory features that distinguish multiple myeloma and Waldenström's Macroglobulinemia.
11. List the CD markers used to differentiate B- cell and T- cell disorders.
12. Describe how molecular diagnostics aids in the diagnosis of lymphoid malignancies.
13. Define the myelodysplastic syndromes and discuss the major cellular abnormalities of MDSs.
14. Classify MDSs according to the criteria of the World Health Organization.

Psychomotor Performance Objectives*:*

1. Be able to describe (in words) the appearance/characteristics of the different WBCs (segs, bands, lymphs, monos, basos, eos).
2. Define the requirements of a WBC differential.
3. Perform a normal and abnormal WBC differentials on unknown slides and match the instructor within a given margin of error.
4. Understand and describe the principles of WBC automation and Flow Cytometry.

Week 5/6 Hemostasis and Disorders of Coagulation [Supports Course SLOs #3-4]

Learning Objectives

Learning objectives (Chapters 15-19)

The student learner should be able to:

1. Explain the systems involved in hemostasis.
2. Describe the interaction of the vascular system and platelets as it relates to activation, adhesion, and vasoconstriction.
3. Identify the process involved in the coagulation cascade, from activation to stable clot formation.
4. Describe the role of platelets in hemostasis.
5. Define the difference between primary and secondary hemostasis.
6. Outline the intrinsic and extrinsic pathways, the factors involved in each, and their role in the coagulation system.
7. List the coagulation factors, their common names, and function.
8. Explain the interaction between prothrombin time, activated partial thromboplastin time, and factor assays.
9. Identify the relationship of the kinin and complement systems to coagulation.
10. Identify the inhibitors of the coagulation and the fibrinolytic systems and their role in hemostasis.
11. Identify the types of bleeding that are seen in platelet disorders.
12. List laboratory tests that are helpful in evaluating platelet disorders.
13. State how preanalytic variables may affect the platelet count.
14. Describe three characteristics of the qualitative platelet disorders von Willebrand's disease, Bernard-Soulier syndrome, and Glanzmann' s thrombasthenia.
15. Identify drugs that are implicated in immune thrombocytopenia.
16. Evaluate conditions that may cause thrombocytosis.
17. Compare and contrast acute versus chronic idiopathic thrombocytopenic purpura.
18. Define hemolytic uremic syndrome and thrombotic thrombocytopenic purpura in terms of pathophysiology and clinical features.
19. Describe platelet abnormalities caused by acquired defects– drug- induced, nonimmune, or vascular.
20. Outline the genetics, symptoms and lab tests used for individuals with hemophilia A and B.
21. Identify the components of the fibrinolytic system.
22. Describe plasmin in terms of activation and inhibition.
23. Differentiate the role of thrombin in the coagulation and fibrinolytic systems.
24. Outline the inherited disorders of fibrinogen.
25. Describe the laboratory tests for fibrinolytic disorders.
26. Define conditions that may precipitate disseminated intravascular coagulation (DIC) states.
27. Describe the laboratory testing and management of patients with DIC.

28. Define thrombophilia and thrombosis.
29. Describe antithrombin, protein C, and protein S with regard to properties, mode of action, factors affected, and complications associated with their deficiencies.
30. Describe heparin- induced thrombocytopenia with regard to the cause, patient's clinical manifestations, and pathophysiology of the disease.
31. Discuss the laboratory tests and results used for the diagnosis of factor V Leiden and heparin induced thrombocytopenia.
32. List the types of anticoagulant drugs used for the treatment of thrombotic disorders.
33. Discuss the laboratory test used for monitoring of heparin and Coumadin therapy.
34. Define the anti– factor Xa assay and its clinical application.

Psychomotor Performance Objectives*:*

1. Independently read 3-5 slide differentials, matching the technologist within stated percentage.

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.

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 contribute to a collaborative cell atlas and present to the class.
d) Students will work through case studies for patients with different etiologies and teach their fellow classmates.
e) 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 is 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 PERFROMANCE 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 or 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

Assignment	20%
Quizzes	20%
Midterm	25%
Final	35%

100% x .65 = _____ Lecture Percentage

Laboratory

Pre-Lab Quizzes	20%
Cell Atlas/Case Study	10%
Lab Assignments	10%
Midterm	25%
Final Exam	35%

100% x .30 = _____ Lab Percentage

Professionalism (Affective)

Attendance	_____*/700 points possible (100% for presence, 50% if tardy, & 0% if absent for each week)*
*Professionalism**	_____*/70 points*
Microscope Checklist	_____*/70 points*

_____/840 = x .05 = _____ Affective Percentage

_____Final Total Grade= Lecture Percentage + Lab Percentage + Professionalism