



Course Syllabus

MLAB 1415- HEMATOLOGY

Catalog Description: The study of blood cells in normal and abnormal conditions. Instruction in the theory and practical application of hematology procedures, including quality control, quality assurance, safety, manual and/or automated methods as well as blood cell maturation sequences, and normal and abnormal morphology with associated diseases.

Lecture hours = 4, Lab hours = 1

Prerequisites: Enrollment in this course and the Medical Laboratory Technology Program requires department head approval and successful completion of the admissions process. Students must be accepted into the MLT Program.

Semester Credit Hours: 4

Lecture Hours per Week: 4

Lab Hours per Week: 1

Contact Hours per Semester: 128

State Approval Code: 5110040000

Instructional Goals and Purposes: Hematology is the study of blood cells in normal and abnormal conditions. Students will be instructed in the theory and practical application of hematology procedures, including quality control, quality assurance, safety, manual and/or automated methods as well as blood cell maturation sequences, and normal and abnormal morphology with associated disease.

Learning Outcomes:

1. Apply principles of safety, quality assurance and quality control in Hematology.
2. Evaluate specimen acceptability.
3. Compare and contrast hematology values under normal and abnormal conditions.
4. Perform and explain principles and procedures of tests to include sources of error and clinical significance of results.
5. Evaluate normal and abnormal cell morphology with associated diseases.

Specific Course Objectives (includes SCANS):

After studying all materials and resources presented in the course, the student will be able to:

1. **Chapter 4- Hematopoiesis (1a-i., 1b-iv, 2c-i,ii)**
 - a. Define the terms hematopoiesis and extramedullary hematopoiesis.
 - b. Name the major anatomical sites of the hematopoietic system progressing from embryonic to adulthood.
 - c. Compare the developmental events of embryonic, hepatic, and early medullary phases of hematopoiesis.
 - d. Name the mature organs and tissues of the hematopoietic system.
 - e. Compare the anatomical location and functional differences between yellow and red marrow.

- f. Name the sites and cells found in primary and secondary lymphoid tissue.
 - g. Describe two conditions that can produce hepatosplenomegaly.
 - h. Describe the characteristics and functions of the spleen.
 - i. Compare the functions of lymph nodes.
 - j. Name the two functions of blood as a lymphoid tissue and effector organ.
 - k. Cellular elements of bone marrow.
 - l. Describe the functional characteristics of human stem cells.
 - m. Contrast the features of erythropoiesis, granulopoiesis, lymphopoiesis, and megakaryopoiesis.
 - n. Name three growth factors and associate each factor with target cells.
 - o. Name the cells in developmental order in maturation sequence of erythrocytes, thrombocytes, and the five leukocyte types.
 - p. Compare the cytoplasmic features of color, granulation, shape, quantity, vacuolization, and inclusions to cell maturity.
 - q. Name and describe the average percentage and cellular characteristics of the six mature leukocytes found in normal peripheral blood.
2. **Chapter 5- Erythrocytes: Erythropoiesis, Maturation, Membrane Characteristics, and Metabolic Activities**
(1a-i, 1b-iv, 2c-i,ii,iii)
- a. Name the sites of erythropoiesis from the early embryonic stage of development until fully established in adults.
 - b. Name the basic substances necessary for proper erythropoiesis.
 - c. Explain the normal condition that stimulates the production of erythropoietin.
 - d. List the maturational times for the various erythrocyte developmental phases.
 - e. Describe the major morphological features of each of the erythrocyte maturational stages.
 - f. Explain the events that occur during reticulocyte maturation.
 - g. Compare the terms secondary polycythemia and relative polycythemia.
 - h. Compare the morphological characteristics of defective erythrocyte maturation and megaloblastic maturation with normal developmental features.
 - i. Describe the general characteristics, including the physical properties, of the erythrocyte membrane.
3. **Chapter 6- Erythrocytes: Hemoglobin**
(1a-i, 2c-i,ii)
- a. Explain the genetic inheritance of hemoglobin.
 - b. Describe the chemical composition and configuration of normal adult hemoglobin molecule.
 - c. Explain the elimination and transport of carbon dioxide.
 - d. Explain the factors that regulate the synthesis of globin in hemoglobin production.
 - e. Specifically describe the outcomes of a deficiency in the production of globin.
 - f. Define the term porphyria and name three categories of classification of porphyrias.
 - g. Name the embryonic hemoglobins and describe their chemical composition and site of formation.
 - h. Explain the types of chains, developmental formation, and quantities of fetal hemoglobins.
 - i. Identify the types of chains, site of formation, and quantities of adult hemoglobin A and A2.
 - j. Name three variant forms of hemoglobin.
 - k. Describe the difference between normal hemoglobin and variant types of hemoglobin.
 - l. Name an example of an abnormal hemoglobin molecule.
 - m. Name at least four laboratory techniques for studying hemoglobin.
 - n. Name three major components of a disassembled hemoglobin molecule.
 - o. Explain the overall impact of intravascular destruction in normal erythrocyte physiology.
 - p. Name the three products of renal processing of filtered hemoglobin.
4. **Chapter 7- Erythrocytes: Morphology and Inclusions**
(1a-i, 1b-ii,iii,iv,v,vi)
- a. Name and describe the variations in the size of a mature erythrocyte.
 - b. Describe the artifacts that can cause a variation in size.
 - c. Correlate at least one clinical condition with each of the erythrocytic size variations: normocytosis, macrocytosis, and microcytosis.

- d. Define the term anisocytosis.
 - e. Explain the terms used when a mature RBC assumes an irregular shape.
 - f. Explain the chemical or physical reasons for a difference in cell shape.
 - g. Compare the chemical basis for difference in erythrocyte color on a stained blood smear.
 - h. Describe the alterations in color that can be seen in an erythrocyte.
 - i. Correlate at least one clinical condition with hypochromia and polychromatophilia.
 - j. Name and describe the appearance of inclusions that may be seen in a variety of abnormal conditions.
 - k. Explain the cellular or clinical basis of inclusions.
 - l. Identify in a smear and correlate at least on clinical condition with the following RBC inclusions: basophilic stippling, Cabot rings, Heinz bodies, hemoglobin C crystals, Howell-Jolly bodies, Pappenheimer bodies, and siderotic granules.
 - m. Name the clinical conditions associated with alterations in erythrocyte distribution on a blood smear.
 - n. Name and describe the morphology of malaria, Babesia, and leishmania parasites on a peripheral blood smear.
5. **Chapter 8- Leukocytes: The Granulocytic and Monocytic Series**
(1a-i,1b-ii,iii,iv,v,vi. 2c-i,ii,iii)
- a. Name the source of the cellular elements of the blood.
 - b. Name the three major categories of the cellular elements of the circulating blood.
 - c. List each types of immature neutrophil found in the proliferative compartment of the bone marrow along with the percentage of each.
 - d. List each type of neutrophil found in the maturation-storage compartment of the bone marrow along with the percentage of each.
 - e. Define the terms marginating and circulating pools.
 - f. Discuss the length of time the neutrophils, eosinophils, and basophils spend in each marginating and circulating pool.
 - g. Describe the nuclear and cytoplasmic characteristics of the neutrophils, eosinophils, and basophils throughout the maturation process.
 - h. Explain the appearance and etiology of the various morphological abnormalities encountered in mature granulocytes (i.e. inclusions, hypo- and hyper-segmented).
 - i. Define terms associated with an increase and decrease in granulocytes.
 - j. Explain the term: shift to the left.
 - k. Define the term leukocyte surface marker.
 - l. Name one technique for identifying cell surface markers.
 - m. Name the system for identification of cell surface markers.
 - n. Associate the various terms for macrophages depending on their anatomical site.
 - o. Compare the bone marrow maturation of the monocyte with that of neutrophils.
 - p. Describe the general functions of macrophages.
 - q. Describe the nuclear and cytoplasmic characteristics of the monocyte as it develops.
 - r. List the relative reference values for neutrophils, eosinophils, basophils and monocytes in normal peripheral blood.
 - s. State the (neutrophilic) granulocytic reference range.
 - t. State the normal relative reference range for monocytes.
 - u. Describe ethnic differences and daily fluctuation of granulocytes.
 - v. Describe the general function of monocytes.
6. **Chapter 9- Leukocytes: Lymphocytes and Plasma Cells**
(1a-i,1b-ii,iii,iv,v,vi. 2c-i,ii,iii)
- a. Briefly describe the role of lymphocytes and plasma cells in the body defense mechanism against disease.
 - b. Name and locate the two primary and three secondary lymphoid tissues.
 - c. Identify the anatomical sites populated by T cells and B cells.
 - d. Compare the length of the life span of the T and B lymphocytes in primary and secondary lymphoid tissues.
 - e. Explain the process and importance of lymphocyte recirculation.
 - f. Compare absolute and relative numbers in lymphocytes.

- g. Calculate the absolute value of a lymphocyte value.
- h. Cite the percentage of T and B cells found in the peripheral circulation of adults.
- i. Compare the major types, normal reference value percentages, and quantities of lymphocytes at different ages ranging from birth to adulthood.
- j. Define the terms leukocytosis and leukopenia. (1a-i.)
- k. Compare the characteristics, such as chromatin patterns, of the three major developmental stages of lymphocyte maturation.
 - l. Discuss the morphological abnormalities of specific variant (activated or reactive) lymphocytes.
- m. Differentiate the functions of the three major categories of lymphocytes.
- n. Describe the production of monoclonal antibodies.
- o. Briefly describe membrane marker development in T cells.
- p. Name four cytokines or chemokines produced by T cells and describe their function.
- q. Name several applications of lymphocyte subset testing.
- r. Describe the pathway of plasma cell development.
- s. Identify the maturational characteristic of plasma cell development.
- t. Describe the appearance and cytoplasmic contents of Russell's bodies, Mott cells, and flame cells.

7. Chapter 10- Basic Laboratory Assessment of Erythrocytes, Leukocytes, and Platelets (1a-i,iii,1b-ii,iii,iv,v,vi. 2c-i,ii,iii)

- a. List the components of a complete blood count (CBC).
- b. Define abbreviations: RBC, WBC, Hgb, Hct, and retic.
- c. Calculate a manual RBC cell count when given the dilution and numbers of cells counted.
- d. Describe the principle of the cyanmethemoglobin assay for the determination of hemoglobin.
- e. Describe the measurement of microhematocrit.
- f. Compare RBC, hemoglobin, and hematocrit values using the rules of three.
- g. Define each of the erythrocyte indices: mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC).
- h. Apply the appropriate formulas and calculate the MCV, MCH, and MCHC when give the erythrocyte values.
 - i. Classify RBC morphology based on erythrocyte indices.
 - j. Compare the morphological appearances of reticulocytes stained with Wright stain and a supravital stain, such as new methylene blue.
- k. Give the normal value of the uncorrected reticulocyte count.
 - l. Define the terms shift or stress reticulocytes.
- m. Calculate a manual WBC cell count when given the dilution and numbers of cells counted.
- n. Name two conditions that can produce leukocytosis.
- o. Name two conditions that can produce leukocytopenia.
- p. Calculate an absolute cell count.
- q. Compare some reasons for eosinophilia and basophilia.
- r. Correct a total white blood cell count when nucleated red blood cells are present.
- s. Name a classic application of the leukocyte alkaline phosphatase (LAP) test.
- t. Explain the purpose of the erythrocyte sedimentation rate (sed rate).
- u. Discuss the classic history of the sed rate.
- v. Describe the appearance of a mature platelet in a platelet count preparation.
- w. Describe the manual calculation of platelet count.
- x. Describe the process of evaluating a peripheral blood film, including selection of the correct area and observations to be made at each magnifications.
- y. Define the terms anisocytosis and poikilocytosis.
- z. Define the terms rouleaux and agglutination.
- aa. Estimate WBC when give the number of cells observed per field and magnification of the objections.
- bb. Describe the value of comparing semiquantitative and quantitative leukocyte counts.
- cc. Explain the corrected leukocyte count.
- dd. Describe the manual calculation of platelet count.
- ee. Explain various sources of error in counting platelets.
- ff. Describe the appearance of a properly stained blood film.

8. Chapter 11- Classification and Laboratory Assessment of Anemias

(1a-i.1b-ii,iii,iv,v,vi. 2c-i,ii,iii)

- a. Define the laboratory measurements that define anemia.
- b. Define the term functional anemia.
- c. Name underlying disorders that can contribute to anemia.
- d. Explain the relationship of anemia as it relates to normal erythrocyte kinetics.
- e. State the causes of the clinical signs and symptoms of anemia.
- f. Briefly describe the usual complaints of an anemic patient.
- g. Describe the organization of anemias according to erythrocyte size and explain the limitations of such a system.
- h. Give examples of macrocytic anemias and pathological megaloblastic anemias.
- i. Briefly explain the characteristics of categories of anemias using a pathological basis.
- j. List the supplementary assays that may be of assistance in establishing a specific anemia diagnosis.

9. Chapter 12- Acute and Chronic Blood Loss Anemia and Anemias associated with Systemic Disorders.

(1a-i.2c-i,ii,iii)

- a. Describe the etiology and physiology of acute blood loss.
- b. Explain the significant hematological findings in acute blood loss
- c. Describe the etiology and physiology of chronic blood loss.
- d. Explain the significant hematological findings in chronic blood loss.

10. Chapter 13- Bone Marrow Failure Syndromes

(1a-i. 1b-i,ii,iv,v,vi. 2c-i,ii,iii)

- a. Describe the general characteristics of bone marrow syndromes.
- b. Name a variety of diagnoses associated with cytopenias with hypocellular bone marrow.
- c. Define pancytopenia.
- d. Describe the major characteristics of acquired aplastic anemia. Define the term iatrogenic.
- e. List three iatrogenic substances that can cause acquired aplastic anemia.
- f. Name 4 viral infections that have been associated with acquired aplastic anemia.
- g. Briefly describe how the immune process causes acquired aplastic anemia.
- h. Describe the clinical features of acquired aplastic anemia.
- i. Discuss the laboratory findings in acquired aplastic anemia (pertaining to ALL cells lines).
- j. Explain the impact of telomere on hematopoietic failure.
- k. Explain how the laboratory findings in acquired aplastic anemia manifest themselves after acute radiation exposure.
- l. Explain the clinical signs and symptoms of Fanconi anemia.
- m. Name one more treatment for Fanconi's anemia.
- n. Describe the laboratory features of familial aplastic anemia.
- o. Describe the characteristics of dyskeratosis congenital.
- p. Name three examples of pure red cell aplasia.
- q. Explain the laboratory findings in congenital dyserythropoietic anemia.
- r. Describe the characteristics of severe congenital neutropenia and cyclic neutropenia.
- s. Explain the characteristics of Shwachman-Diamond syndrome.
- t. Describe characteristics of congenital amegakaryocytic thrombocytopenia.
- u. Compare three types of congenital amegakaryocytic thrombocytopenia.

11. Chapter 14- Disorders of Iron Metabolism and Heme Synthesis.

(1a-i. 2c-i,ii,iii)

- a. Compare absolute iron deficiency with functional iron deficiency.
- b. Name an example of an absolute and functional deficiency anemia.
- c. Name an example of an iron accumulation condition and an iron loading anemia.
- d. Compare primary overload disorders to secondary iron overload disorders.
- e. Name conditions that can contribute to iron deficiency anemia IDA.
- f. Name three of the most common groups vulnerable to IDA.
- g. Describe the physiology of iron metabolism, including the iron needs of children and normal dietary sources.
- h. Describe laboratory findings of IDA.

- i. Define terms: transferrin, hemosiderin, ferritin, total iron-binding capacity (TIBC).
 - j. Explain the value of soluble transferrin receptors.
 - k. Describe the etiological basis of AOI.
 - l. Discuss the pathophysiology of AOI including the role of hepcidin.
 - m. Explain the cause of AOI.
 - n. Discuss the laboratory characteristics of AOI.
 - o. Compare the characteristics of iron deficiency anemia with AOI.
 - p. Classify sideroblastic anemias on a molecular basis.
 - q. Explain the laboratory characteristics of sideroblastic anemia.
 - r. Name a condition when globin synthesis is manifested.
- 12. Chapter 15- Macrocytic and Megaloblastic Anemias (1a-i, 2c-i,ii,iii)**
- a. Name at least three examples of conditions associate with non-megaloblastic macrocytosis.
 - b. Describe DNA synthesis differs in nonmegaloblastic macrocytosis from megaloblastosis.
 - c. Define the term megaloblastic anemia.
 - d. Name the two common causes and other less common causes of megaloblastic anemia.
 - e. Explain the cellular maturation abnormalities in the bone marrow in megaloblastic anemias.
 - f. Describe the body's requirement for vitamin B₁₂ and the physiologic role of B₁₂.
 - g. List 4 etiological causes of vitamin B₁₂ deficiency and describe two distinguishing clinical or laboratory characteristics for each.
 - h. Briefly describe the epidemiology of pernicious anemia.
 - i. Explain the etiology and pathophysiology, including the immune nature, of pernicious anemia.
 - j. Describe the clinical signs and symptoms of pernicious anemia.
 - k. Explain the usual management of and therapy for pernicious anemia.
 - l. List three etiological causes of folate or folic acid deficiency.
 - m. Briefly discuss the epidemiology of folate or folic acid deficiency.
 - n. Explain the physiology of folic acid deficiency.
 - o. Describe the body's requirements for folate and the physiological role of folate.
 - p. Describe the clinical signs and symptoms of folic acid deficiency.
 - q. Name the laboratory assays used to confirm folic acid deficiency and state the results associated with folic acid deficiency.
- 13. Chapter 16- Hemolytic Anemias (1a-i,1b-ii,iii,iv,v,vi)**
- a. Define the term hemolytic anemia.
 - b. Name at least three categories of intrinsic versus extrinsic hemolytic anemia.
 - c. Discuss the action of complement in producing hemolysis.
 - d. Name two categories of inherited hemolytic disorders.
 - e. Name and discuss the five types or varieties of membrane defects.
 - f. Name and briefly explain three categories of acquired hemolytic anemia.
 - g. Name four mechanisms of drug-induced hemolytic anemias.
 - h. Discuss immune mechanism related to acquired hemolytic anemia.
 - i. Compare various types of autoimmune hemolytic anemia (AIHA).
 - j. Describe hemolytic disease of the fetus and newborn as an example of isoimmune hemolytic anemia.
 - k. Name two medical conditions that can be the cause of hemolysis.
 - l. Characterized the etiology of paroxysmal nocturnal hemoglobinuria.
 - m. Explain the physiology of paroxysmal nocturnal hemoglobinuria.
 - n. Describe the clinical signs and symptoms, laboratory findings and treatment protocol of PNH.
 - o. Briefly describe the characteristics of cold agglutinin disease.
- 14. Chapter 17- Hemoglobinopathies and Thalassemias (1a-i,1b-ii,iii,iv,v,vi, 2c-i,ii,iii)**
- a. Describe the common denominator in hemoglobinopathies.
 - b. Name the three major categories to classify hemoglobin defects.
 - c. List the components and percentage of normal adult hemoglobin.
 - d. Compare the disease state and trait condition of a hemoglobinopathy.
 - e. Describe the etiology of Sick Cell Disease (SCD).

- f. Explain the epidemiology of Sickle Cell Disease (SCD).
 - g. Describe the clinical signs and symptoms of SCD.
 - h. Briefly explain the symptoms of SCD in children.
 - i. Describe the symptoms of SCD associated with pregnancy.
 - j. Discuss the clinical manifestations of SCD in adults.
 - k. Characterize the general signs and symptoms in the categories of pain, pulmonary complications, and stroke associated with SCD.
 - l. Identify globin chain defects causing SCD, hemoglobin D disease, and hemoglobin E disease.
 - m. Outline laboratory findings that are typical of SCD
 - n. Recognize and identify major clinical signs and symptoms and abnormal laboratory tests results including peripheral blood smear picture that are typically associated with homo and hetero conditions of HbS, HbC, HbD, and HbE and compound heterozygous conditions involving HbS and other variant hemoglobins.
 - o. Briefly describe the value of the techniques of hemoglobin electrophoresis and deoxyribonucleic acid (DNA) analysis.
 - p. Explain the process of prenatal diagnosis of SCD.
 - q. Delineate the general management of SCD.
 - r. Describe the conditions of sickle β -thalassemia, sickle-C (SC), and sickle cell trait.
 - s. Outline the laboratory findings in thalassemia.
 - t. Describe the general characteristics of Hb C disease, Hb SC disease, Hb D disease, Hb E disease, Hb H disease, methemoglobinemia, and unstable hemoglobins.
 - u. Describe the persistence of fetal hemoglobin.
15. **Chapter 18- Disorders of Granulocytes and Monocytes**
(1a-i,1b-ii,iii,iv,v,vi. 2c-i,ii,iii)
- a. Define the terms leukocytosis and leukocytopenia.
 - b. Explain quantitative neutrophil responses in normal and nonmalignant conditions.
 - c. List examples of general conditions that can cause leukocytosis.
 - d. Describe at least one representative condition in which an increase in neutrophils, eosinophils, basophils, or monocytes can be found.
 - e. List examples of common conditions that neutropenia.
 - f. List at least one representative condition in which a decrease in neutrophils, eosinophils, basophils, or monocytes can be found.
 - g. Identify nuclear alterations such as hypersegmentation, Pelger-Huet anomaly, pseudo-Pelger-Huet anomaly and pyknotic forms on stained blood films and digital images.
 - h. Describe the appearance of cells with the following cytoplasmic abnormalities: toxic granulation, Dohle bodies, *Ehrlichia*, and vacuoles.
 - i. Recognize cellular alteration on stained blood films and digital images of Cediak-Higashi syndrome, Alder-Reilly inclusions, and *Ehrlichia* are observed.
 - j. Recognize May-Hegglin anomaly on stained blood films and digital images.
 - k. Abnormalities of mature granulocytes in body fluids.
 - l. Describe the general characteristics of lysosomal storage disorders.
16. **Chapter 19- Disorders of Lymphocytes**
(1a-i,1b-v. 2c-i,ii,iii)
- a. State the normal relative value reference range for lymphocytes in an adult.
 - b. State the absolute number of lymphocytes using the total leukocyte count and the relative number of lymphocytes.
 - c. Explain the difference between absolute lymphocyte count and a relative lymphocyte count.
 - d. Name several disorders of lymphocytes frequently encounter in the hematology laboratory.
 - e. Describe why lymphocytosis occurs in infants and children up to 10 years of age.
 - f. Name at least three nonmalignant conditions associated with an absolute lymphocytosis.
 - g. Name at least three malignant conditions associated with lymphocytosis.
 - h. Describe the etiology, epidemiology, clinical signs and symptoms, and laboratory data for infectious mononucleosis.
 - i. Describe and recognize the appearance of lymphocytes associated with infectious mononucleosis.
 - j. Define and explain the term lymphocytopenia.

- k. Name major immune deficiencies associated with T cells or B cells.
17. **Chapter 20- Characteristics of Leukemias, Lymphomas, and Myelomas (1a-i.1b-ii,iii,iv,v,vi)**
- Define and differentiate the terms neoplasm and malignant.
 - Compare the characteristics of leukemia, lymphoma, and myeloma.
 - Define and compare acute and chronic leukemia.
 - Differentiate between acute and chronic myeloid (AML and CML) and lymphoid leukemias (ALL and CLL) based on clinical and hematologic findings.
 - List the traditional forms and the major types of leukemia
 - Compare the FAB and WHO staging systems for leukemia.
 - Compare the early treatment of leukemias and lymphomas with current therapy.
 - Name one genetic defect that is correlated with an increased incidence of leukemia.
 - Explain the significance of the discovery of the human T-cell leukemia virus (HTLV) family and describe associated disorders.
 - Describe the role of proto-oncogenes and oncogenes in leukemia and lymphomas.
 - Describe the variations in the incidence of leukemia in different ethnic and racial groups.
 - Correlate patient age to the overall incidence of various leukemias (hematopoietic neoplasm).
 - Describe the overall differences between the incidences of leukemia in female and male patients.
 - Explain the role of vaccines in treatment and/or prevention of leukemias.
18. **Chapter 21- Acute Leukemias (1a-i.1b-ii,iii,iv,v,vi. 2c-i,ii,iii)**
- Name three examples of conditions that are considered to be genetic lesions.
 - Describe the fundamental characteristics of blood and bone marrow cell in acute leukemias.
 - List and describe basic characteristics of classifications recognized by the FAB and WHO systems.
 - Discuss general prognostic factors and the importance of monitoring minimal residual disease on the survival of acute leukemia patients.
 - Discuss the concept of clonal heterogeneity in acute myeloid leukemia (AML).
 - Coordinate factors related to epidemiology and long-term survival of AML patients.
 - Discuss factors associated with the prognosis in AML.
 - Explain the importance of microRNAs.
 - Describe the utility of monoclonal antibodies in differentiating between various leukemias.
 - Explain the chromosomal alterations that may be observed in various AML.
 - Summarize and apply the diagnostic blood and bone marrow laboratory findings of each of the AML subgroups.
 - Discuss the purpose, advantages, and concerns related to allogeneic hematopoietic-cell transplantation.
 - Discuss the epidemiology of acute lymphoblastic leukemia (ALL) in the United State.
 - Summarize the pathogenesis of ALL.
 - Name and briefly describe the FAB classification of ALL.
 - Describe the clinical symptoms, laboratory findings, and special identification techniques in ALL.
 - Summarize treatment strategies and prognosis in ALL.
 - Name and describe five life-threatening emergencies.
 - Discuss future trends in the treatment of leukemia.
19. **Chapter 22- Lymphoid and Plasma Cell Neoplasms (1a-i.1b-v. 2c-i,ii,iii)**
- Compare the characteristics of leukemia and lymphoma.
 - Describe the types of specimens and methods of analysis used to study leukemia and lymphomas.
 - Name various categories with benign or malignant conditions that produce chronic lymphocytosis.
 - Describe the diagnostic features, including clinical symptoms and laboratory data, of chronic lymphocytic leukemia (CLL).

- e. Explain the usefulness of chromosome analysis and molecular analysis in the diagnosis and prognosis of CLL.
- f. Describe the features associated with aggressive forms of CLL.
- g. Explain the systems to stage disease and progress.
- h. Discuss the epidemiology, clinical signs and symptoms, laboratory characteristics and treatment of hairy cell leukemia (HCL).
- i. Describe laboratory findings seen in the variant form of HCL.
- j. Discuss the epidemiology, clinical signs and symptoms, laboratory characteristics, and prognosis of Sezary syndrome.
- k. Explain the general characteristics of a malignant lymphoma.
 - l. Name the factors known to be risk factors in the development of lymphoid neoplasms.
- m. Describe the two contemporary lymphoma classification systems, including how subtypes are classified.
- n. Identify the epidemiologic characteristics of lymphomas.
- o. Describe the laboratory analysis of lymphoid neoplasm.
- p. Explain the etiology, epidemiology, laboratory characteristics, and prognosis of Hodgkin disease.
- q. Name disorders based on the proliferation of plasma cells and abnormal production of immunoglobulins.
- r. Describe the general characteristics and laboratory data in multiple myeloma.

20. **Chapter 23- Myeloproliferative Neoplasms**
(1a-i,1b-ii,iii,iv,v,vi. 2c-i,ii,iii)

- a. Name the four diseases classified as myeloproliferative neoplasms (MPNs)
- b. Briefly describe the common abnormalities of hemostasis and coagulation in MPNs.
- c. Report the general prognostic features of MPNs.
- d. Criteria that indicate a transformation of an MPN into a blast crisis.
- e. Briefly explain general treatment approaches to MPNs.
- f. Name the subtypes of chronic myelogenous leukemia (CML)
- g. Describe the epidemiology of CML.
- h. Explain the pathophysiology of this leukemia.
 - i. Delineate the usefulness of the detection of genetic alterations in CML.
 - j. Compare the clinical signs and symptoms of this leukemia in the three phases of CML.
- k. Describe the cellular aspects of CML.
- l. Explain the use of leukocyte alkaline phosphatase (LAP) in the diagnosis of CML compared to a leukemoid reaction.
- m. Characterize modes of treatment and prognostic features in CML.
- n. State other names that might be used to refer to polycythemia rubra vera (PRV).
- o. Describe the etiology of polycythemia rubra vera (PRV).
- p. Name the most striking feature of PRV.
- q. Identify unique genetic abnormality in PRV.
- r. Describe the clinical signs and symptoms of PRV.
- s. List the criteria for establishing a diagnosis of PRV.
- t. Explain the factors that influence prognosis.
- u. Name the control and treatment methods in PRV.
- v. State the other name for primary myelofibrosis.
- w. Briefly describe the epidemiology of primary myelofibrosis.
- x. Name the predominate clinical manifestation in primary myelofibrosis.
- y. Describe the pathophysiology of primary myelofibrosis.
- z. Define and describe the consequences of dysmegakaryocytopoiesis.
- aa. Briefly characterize the genetic mutation profile of primary myelofibrosis.
- bb. Delineate the clinical signs and symptoms of primary myelofibrosis.
- cc. Name the cellular components of a leukoblastic peripheral blood picture.
- dd. Describe the life span prognosis in primary myelofibrosis.
- ee. Explain the treatment approach to primary myelofibrosis.
 - ff. List and describe the major criteria and other findings for the diagnosis of essential thrombocythemia.

- gg. Describe the epidemiology of essential thrombocythemia.
 - hh. Outline the major features of essential thrombocythemia.
 - ii. Describe the most common disorder in patients with essential thrombocytopenia.
 - jj. State the classic laboratory findings in essential thrombocythemia.
 - kk. Discuss platelet function findings in essential thrombocythemia.
 - ll. Compare the bone marrow architecture of essential thrombocythemia with other MPNs.
 - mm. Review the relationship between essential thrombocythemia and PRV.
 - nn. Report the treatment approach to essential thrombocythemia.
21. **Chapter 24- Myelodysplastic Syndromes and Myelodysplastic/Myeloproliferative Neoplasms (1a-i.1b-ii,iii,iv,v,vi. 2c-i,ii,iii)**
- a. Describe the comparative characteristics of the FAB and WHO classifications of myelodysplastic syndromes (MDSs) and myelodysplastic/myeloproliferative neoplasms (MDS/MPN).
 - b. Explain the causes or predisposing factors of primary or secondary MDSs.
 - c. Describe the age and gender distribution of MDSs.
 - d. Briefly describe the causes, types, and consequences of chromosomal abnormalities in MDSs.
 - e. List the incidence of chromosomal abnormalities.
 - f. Describe the relationship of cytogenetic findings to prognosis in MDSs.
 - g. Explain the clinical signs and symptoms of MDSs.
 - h. Itemize the cellular alternations, with an emphasis on the prominent features and additional hematological features in the four subgroups of MDS/MPN.
 - i. Compare the laboratory features of specific types of MDSs.
 - j. Distinguish between agranular blasts, granular blasts, and promyelocytes.
 - k. Calculate the percentage of myeloblasts in the bone marrow.
 - l. Describe the unique features and laboratory characteristics of chronic myelomonocytic leukemia (CMML).
 - m. Discuss factors that can affect prognosis in the MDSs, including FAB classification and karyotype.
22. **Lab #1:**
(1a-i.1b-ii,iii,iv,v,vi,2a-i.2b-i,ii,v,vi.2c-i,ii,iii.2e-i,ii,iii)
- a. Identify a normal red blood cell (RBC) on a stained slide. Describe (in words) the characteristics of a normal red blood cell.
 - b. Explain the FUNCTION of the red blood cell in the body.
 - c. Identify cells that are white blood cells (WBC) on a stained smear (not required to differentiate until next lab).
 - d. Identify normal platelets on a stained slide.⁵⁴ Understand the meanings and uses of the MCV, MCH, and MCHC on a Hematology analyzer report
 - e. Define normochromic and normocytic as it pertains to red blood cells.
 - f. Identify common RBC morphologies: hypochromia, polychromia, anisocytosis, poikilocytosis, acanthocytes, burr cells, sickle cells (drepanocytes), target cells, tear drop cells (dacryocytes), stomatocytes, schistocytes, microcytosis, macrocytosis.)
23. **Lab #2**
(1a-i.1b-ii,iii,iv,v,vi,2a-i.2b-i,ii,v,vi.2c-i,ii,iii.2e-i,ii,iii)
- a. Define lymphocytopenia.
 - b. List approximate the normal ranges for WBC, RBC, Hgb, Hct, Platelet.
 - c. Read a CBC printout/report and interpret results. Given the reference ranges, determine if the patient's results are high, low, or normal.
 - d. Identify RBCs, WBCs, and platelets on a slide.
 - e. Differentiate the different WBCs on a slide: segmented neutrophils (segs), band neutrophils (bands), lymphocytes (lymphs), monocytes (monos), basophils (basos), and eosinophils (eos).
 - f. Define leukocyte.
 - g. Be able to describe (in words) the appearance/characteristics of the different WBCs (seg, band, lymph, mono, baso, eo).
 - h. Define the requirements of a WBC differential.
 - i. Perform a WBC differential on unknown slides and match the instructor within a given margin of error.

24. **Lab #3**

(1a-i.1b-ii,iii,iv,v,vi,2a-i.2b-i,ii,v,vi.2c-i,ii,iii.2e-i,ii,iii)

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

Course Content:

A general description of lecture/discussion topics included in this course are listed in the Learning Objectives / Specific Course Objectives sections of this syllabus.

Students in all sections of this course will be required to do the following:

1. Lecture Assignments (20)
2. Lecture Quizzes (20)
3. Lecture Exams (3)
4. Lecture Final Exam
5. Pre-Lab Quizzes (6)
6. Lab Assignments – in lab class (6)
7. Post Lab Cases (4)
8. Lab Practicals (3)

Methods of Instruction/Course Format/Delivery:

This is a mainly online course so it will require a lot of outside proactive work by the student. The instructor will provide guidance as needed. The student will be evaluated by assignments and quizzes outside of the classroom. The student will be required to come to a Panola College testing Center to take all major examinations. Laboratories will take place on three pre-determined Saturdays during the semester and will be mandatory. During the laboratories the students will be evaluated by case studies, in-lab assignments, and lab practicals as assigned by the instructor.

Major Assignments / Assessments:

The following items will be assigned and assessed during the semester and used to calculate the student's final grade.

Assignments

1. Introductions discussion
2. Chapters 4-24 Assignments
3. Mitosis Quiz
4. Chapters 4-24 Quizzes
5. In-lab work- RBCs, WBCs, Differentials
6. Pre-lab quizzes
 - a. Safety
 - b. Microscope
 - c. Erythrocyte Identification
 - d. WBC Identification
 - e. WBC Abnormals
7. Post-Lab Cases 1-4

Assessment(s):

1. Proctored Exams #1, #2, #3
2. Final Exam
3. Lab Practicals 1, 2, 3

Course Grade:

The grading scale for this course is as follows:

- **Lecture-- 2/3 of Final Grade**
 - Major Exams-- 50%
 - Quizzes-- 15%
 - Homework Assignments-- 20%
 - Final Exam-- 15%
- **Laboratory— 1/3 of Final Grade**
 - Pre-Lab Quizzes-- 10%
 - Case Assignments-- 20%
 - In- Lab Assignments-- 20%
 - Practicals-- 50%

Texts, Materials, and Supplies:

- Turgeon, Mary Louise. (2017). *Clinical Hematology: Theory & Procedures 6th ed.* Baltimore: Lipincott Williams & Wilkins. ISBN 9781496332288
- Harmening, Denise and Finnegan, Kathleen (2014). *Heme Notes: A Pocket Atlas of Cell Morphology.* Philadelphia: F.A. Davis. ISBN 9780803619029
- White Lab Coat for lab (optional)

Required Readings:

- Course Textbooks
- All information given in Canvas

Recommended Readings:

- Medical Dictionary (reference)
- LabTestsOnline.org (reference)

Other:

- For current texts and materials, use the following link to access bookstore listings: <http://www.panolacollegestore.com>
- For testing services, use the following link: <http://www.panola.edu/elearning/testing.html>
- If any student in this class has special classroom or testing needs because of a physical learning or emotional condition, please contact the ADA Student Coordinator in Support Services located in the Administration Building or go to <http://www.panola.edu/student-success/disability-support-services/> for more information.
- Withdrawing from a course is the student's responsibility. Students who do not attend class and who do not withdraw will receive the grade earned for the course.
- Student Handbook, *The Pathfinder*: <http://www.panola.edu/student-success/documents/pathfinder.pdf>

More Information:

Laboratory Dress Code

The student will be expected to attend class clean and neatly dressed in long pants or scrubs and wear closed-toe shoes. A laboratory coat will must be worn snapped or buttoned up during all laboratory sessions. Hair that is shoulder length or longer must be worn up or securely tied back. Gloves must be worn when handling biological materials.

Behavioral Conduct

While a student is representing Panola College as a Medical Laboratory Technology student, they will be expected to conduct themselves in such a manner as to reflect favorably on themselves and on the Program. If a student acts in such a manner as to reflect immature judgment or disrespect for others, the student will be called before the MLT Department Chair for determination of their status in the Program. Inappropriate conduct is grounds discipline and may be cause for immediate probation or dismissal from the Program.

Academic Dishonesty

Under no circumstances shall a student submit work that is not their own. Copying answers for study questions, cheating on exams and/or submitting laboratory results which are not your own are expressly prohibited.

Time Commitment

According to "Hints on How to Succeed in College Classes"

<http://tinyurl.com/3dqegz> you should budget your time per week for this four hour credit course as follows:

1. Reading assigned text 2 to 3 hours
2. Homework assignments 3 to 6 hours
3. Time for review and test preparation 3 hours
4. Total study time per week 8 to 12 hours PER WEEK

SCANS CRITERIA

1) **Foundation skills are defined in three areas: basic skills, thinking skills, and personal qualities.**

- a) **Basic Skills:** A worker must read, write, perform arithmetic and mathematical operations, listen, and speak effectively. These skills include:
 - i) Reading: locate, understand, and interpret written information in prose and in documents such as manuals, graphs, and schedules.
 - ii) Writing: communicate thoughts, ideas, information, and messages in writing, and create documents such as letters, directions, manuals, reports, graphs, and flow charts.
 - iii) Arithmetic and Mathematical Operations: perform basic computations and approach practical problems by choosing appropriately from a variety of mathematical techniques.
 - iv) Listening: receive, attend to, interpret, and respond to verbal messages and other cues.
 - v) Speaking: Organize ideas and communicate orally.
- b) **Thinking Skills:** A worker must think creatively, make decisions, solve problems, visualize, know how to learn, and reason effectively. These skills include:
 - i) Creative Thinking: generate new ideas.
 - ii) Decision Making: specify goals and constraints, generate alternatives, consider risks, and evaluate and choose the best alternative.
 - iii) Problem Solving: recognize problems and devise and implement plan of action.
 - iv) Visualize ("Seeing Things in the Mind's Eye"): organize and process symbols, pictures, graphs, objects, and other information.
 - v) Knowing How to Learn: use efficient learning techniques to acquire and apply new knowledge and skills.
 - vi) Reasoning: discover a rule or principle underlying the relationship between two or more objects and apply it when solving a problem.
- c) **Personal Qualities:** A worker must display responsibility, self-esteem, sociability, self-management, integrity, and honesty.
 - i) Responsibility: exert a high level of effort and persevere toward goal attainment.
 - ii) Self-Esteem: believe in one's own self-worth and maintain a positive view of oneself.
 - iii) Sociability: demonstrate understanding, friendliness, adaptability, empathy, and politeness in group settings.
 - iv) Self-Management: assess oneself accurately, set personal goals, monitor progress, and exhibit self-control.
 - v) Integrity and Honesty: choose ethical courses of action.

2) **Workplace competencies are defined in five areas: resources, interpersonal skills, information, systems, and technology.**

- a) **Resources:** A worker must identify, organize, plan, and allocate resources effectively.
 - i) Time: select goal-relevant activities, rank them, allocate time, and prepare and follow schedules.
 - ii) Money: Use or prepare budgets, make forecasts, keep records, and make adjustments to meet objectives.
 - iii) Material and Facilities: Acquire, store, allocate, and use materials or space efficiently. Examples: construct a decision time line chart; use computer software to plan a project; prepare a budget; conduct a cost/benefits analysis; design an RFP process; write a job description; develop a staffing plan.
- b) **Interpersonal Skills:** A worker must work with others effectively.
 - i) Participate as a Member of a Team: contribute to group effort.
 - ii) Teach Others New Skills.
 - iii) Serve Clients/Customers: work to satisfy customer's expectations.

- iv) **Exercise Leadership:** communicate ideas to justify position, persuade and convince others, responsibly challenge existing procedures and policies.
- v) **Negotiate:** work toward agreements involving exchange of resources, resolve divergent interests.
- vi) **Work with Diversity:** work well with men and women from diverse backgrounds.

Examples: collaborate with a group member to solve a problem; work through a group conflict situation, train a colleague; deal with a dissatisfied customer in person; select and use appropriate leadership styles; use effective delegation techniques; conduct an individual or team negotiation; demonstrate an understanding of how people from different cultural backgrounds might behave in various situations.

c) **Information:** A worker must be able to acquire and use information.

- i) **Acquire and Evaluate Information.**
- ii) **Organize and Maintain Information.**
- iii) **Interpret and Communicate Information.**
- iv) **Use Computers to Process Information.**

Examples: research and collect data from various sources; develop a form to collect data; develop an inventory record-keeping system; produce a report using graphics; make an oral presentation using various media; use on-line computer data bases to research a report; use a computer spreadsheet to develop a budget.

d) **Systems:** A worker must understand complex interrelationships.

- i) **Understand Systems:** know how social, organizational, and technological systems work and operate effectively with them.
- ii) **Monitor and Correct Performance:** distinguish trends, predict impacts on system operations, diagnose deviations in systems' performance and correct malfunctions.
- iii) **Improve or Design Systems:** suggest modifications to existing systems and develop new or alternative systems to improve performance.

Examples: draw and interpret an organizational chart; develop a monitoring process; choose a situation needing improvement, break it down, examine it, propose an improvement, and implement it.

e) **Technology:** A worker must be able to work with a variety of technologies.

- i) **Select Technology:** choose procedures, tools or equipment including computers and related technologies.
- ii) **Apply Technologies to Task:** understand overall intent and proper procedures for setup and operation of equipment.
- iii) **Maintain and Troubleshoot Equipment:** Prevent, identify, or solve problems with equipment, including computers and other technologies.

Examples: read equipment descriptions and technical specifications to select equipment to meet needs; set up and assemble appropriate equipment from instructions; read and follow directions for troubleshooting and repairing equipment.