Course Outline

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MLT 212</td>
<td>CLINICAL HEMATOLOGY</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hours:</th>
<th>Prerequisite:</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture 3/Lab 3</td>
<td>MLT 112 or permission of instructor</td>
<td>7A 2017</td>
</tr>
</tbody>
</table>

**Catalog description:**
Examines hematology and blood coagulation, including blood cell maturation, physiology, and morphology; hemostasis theory and procedures. Laboratory component develops skills used in the performance of hematology and coagulation lab analysis. *3 lecture/3 laboratory hours*

**Course Modified:** January 2017

**Required texts:**

<table>
<thead>
<tr>
<th>Title:</th>
<th>Author:</th>
<th>Publisher:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hematology in Practice 2nd edition</td>
<td>Betty Ciesla</td>
<td>F.A. Davis</td>
</tr>
<tr>
<td>Clinical Hematology Atlas</td>
<td>Carr, Rodak</td>
<td>Saunders</td>
</tr>
</tbody>
</table>

**Course Instructor:**
Brianna Lee  MLS(ASCP)
Office hours by appointment:
(269)240-5455
briannalugo123@gmail.com
leeb@faculty.mccc.edu
MCCC’s General Education Knowledge Goals and Core Competencies

MCCC General Education Knowledge Goals
Goal 1. Written and Oral Communication in English: Students will communicate effectively in both speech and writing.
Goal 2. Mathematics: Students will use appropriate mathematical and statistical concepts and operations to interpret data and to solve problems.
Goal 3. Science: Students will use the scientific method of inquiry, through the acquisition of scientific knowledge.
Goal 4. Technology or Information Literacy: Students will use computer systems or other appropriate forms of technology to achieve educational and personal goals.
Goal 8. Diversity and Global Perspective: Students will understand the importance of a global perspective and culturally diverse peoples.

Core Competencies
A. Communication: Students will communicate effectively in both speech and writing.
B. Critical Thinking and Problem-Solving: Students will use critical thinking and problem solving skills in analyzing information.
C. Ethical Reasoning and Action: Students will understand ethical issues and situations.
D. 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.
E. Computer Literacy: Students will use computers to access, analyze or present information, solve problems, and communicate with others.
F. Collaboration and Cooperation: Students will develop the interpersonal skills required for effective performance in group situations.
G. Intra-Cultural and Inter-Cultural Responsibility: Students will demonstrate an awareness of the responsibilities of intelligent citizenship in a diverse and pluralistic society, and will demonstrate cultural, global, and environmental awareness.

Units of study:

Week 1: Learning objectives (Chpt 1-4)
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. (G1, CC A, C, F, G)
2. Describe the components of quality assurance in the hematology laboratory. (G1, CC A, C)
3. Discuss the basic parts of the light microscope and the function and magnification of each objective. (G1,3,4, CC A)
4. Describe the organs involved in hematopoiesis throughout fetal and adult life. (G1,3, CC A)
5. Define factors affecting differentiation of the pluripotent stem cell. (G1,3, CC A)
6. Define the myeloid: erythroid ratio. (G1,3, CC A)
7. Understand the bone marrow collection procedure and the technologist’s role in bone marrow analysis. (G3)
8. List the components of a complete blood count. (G1,3)
9. Define and calculate red blood cell indices. (G1,2,3, CC A)
10. Recognize normal and critical values in an automated CBC. (G3, CC B)
11. Describe the clinical conditions that may produce polychromatophilic cells and elevate the reticulocyte count. (G1,3, CC A)
12. Define the morphologic classification of anemias. (G1,3, CC A)
13. Outline erythropoietic production from origin to maturation of red blood cells. (G3)
14. Describe immature red blood cells with regard to nucleus: cytoplasm ratio, cytoplasm color, nuclear structure and size. (G1,3, CC A)
15. Identify the metabolic pathways that provide energy for red blood cells. (G3)
16. Describe the composition of the red blood cell membrane. (G1,3, CC A)
17. Understand factors necessary for maintaining a normal red blood cell life span. (G3)
18. Define anisocytosis, poikilocytosis, microcytic and macrocytic. (G1,3, CC A)
19. Indicate clinical conditions in which variations in size and hemoglobin content are seen. (G1,3)
20. Identify the pathophysiology and the clinical conditions that may lead to target cells, spherocytes, ovalocytes and elliptocytes, sickle cells, and fragmented cells. (G3)
21. List the most common red blood cell inclusions and the disease states in which they are observed. (G3)
22. Describe hemoglobin structure and function of normal adult hemoglobin, Hgb A, Hgb A2 and Hgb F. (G1, CC A)
23. Relate the shift from fetal hemoglobin to adult hemoglobin. (G3, CC B)

Performance objectives:
Demonstrates safe laboratory practices (G3)
Accurately documents daily QC (G1, CC A)
Shows proficiency in the use and maintenance of the light microscope (G3,4)
Shows proficiency in making peripheral blood smears (G3)
Begins to recognize normal and abnormal RBC morphology (G3)

Week 2: Learning objectives (Chpt 5-6)
After completing this week, the student will be able to:
1. Describe red blood cell indices related to microcytic anemias. (G1,3, CC A)
2. Describe iron transport from ingestion to incorporation in hemoglobin. (G1,3, CC A)
3. Identify the laboratory tests used in the diagnosis of iron deficiency anemia. (G3)
4. Define the pathophysiology, diagnosis and clinical management of patients with hereditary hemochromatosis. (G1,3, CC A)
5. Describe the basic pathophysiologic defect in the thalassemia syndromes. (G1,3, CC A)
6. Correlate the morphologic changes in the red blood cell with the defect in the alpha and beta thalassemias. (G3, CC B)
7. Describe the criteria that define a macrocytic anemia as megaloblastic. (G1,3, CC A)
8. Compare and contrast the morphologic characteristics of megaloblasts and normoblasts in the bone marrow. (G1,3, CC A)
9. Describe the pathway of vitamin B12 and folic acid from ingestion through incorporation into the red blood cell. (G1,3, CC A)
10. Define pernicious anemia and its clinical and laboratory findings. (G1,3, CC A)
11. Describe laboratory tests used in the diagnosis of megaloblastic anemia. (G1,3, CC A)
12. Differentiate the anemias that are macrocytic but are not megaloblastic. (G3)

Performance objectives
Understand the principles used in automated RBC counts (G3,4)
Be able to define and calculate RBC indices (G1,2,3, CC A)
Show proficiency in performing a microhematocrit, sedimentation rate (ESR) and reticulocyte Count (G3)
Week 3: Learning objectives (Chpt 7-8)
After completing this week, the student will be able to:
1. Review the functions of the spleen as they relate to red blood cells (G3)
2. Describe the clinical findings in patients with hereditary spherocytosis. (G1,3, CC A)
3. Describe the osmotic fragility test and its clinical usefulness. (G1,3, CC A)
4. Identify the red blood cell membrane defects and peripheral smear findings in hereditary stomatocytosis, elliptocytosis, and pyropoikilocytosis. (G3)
5. Define the pathophysiology of the red blood cell biochemical disorders including glucose-6-phosphate dehydrogenase deficiency. (G1,3, CC A)
6. Describe Heinz bodies with respect to their appearance in supravital and Wright’s stain. (G1,3, CC A)
7. Define the defect in the rare membrane disorders of hereditary xerocytosis and Southeast Asian ovalocytosis. (G1,3, CC A)
8. Discuss the characteristics of aplastic anemia, paroxysmal nocturnal hemoglobinuria, paroxysmal cold hemoglobinuria, Fanconi’s anemia, and Diamond-Blackfan syndrome. (G1,3, CC A)
9. Identify the amino acid substitution in sickle cell disorders and Hgb C disease. (G3)
10. List the clinical and laboratory features of sickle cell anemia, sickle cell trait, Hgb C disease, Hgb C trait and Hgb SC disease. (G1,3,5)
11. Recognize normal and abnormal hemoglobin patterns on hemoglobin electrophoresis at pH 8.6 and 6.2. (G3, CC B)
12. Differentiate the clinical and laboratory features of other abnormal hemoglobins, such as Hgb E, Hgb OArab, Hgb DPunjab, and Hgb GPhila. (G3)
13. Calculate the white blood cell correction formula when nucleated red blood cells are noted in the peripheral smear. (G2,3)

Performance objectives
Demonstrate proficiency in performing assays with the Sickle Cell test kit. (G3)
Describe the use of the Unopette system in hematology testing. (G1,3, CC A)
Show proficiency in using the Unopette system and hemocytometer in performing manul cell counts. (G3)

Week 4: Learning objectives (Chpt 9-11)
After completing this week, the student will be able to:
1. Describe leukopoiesis from immature forms to full maturation. (G1,3, CC A)
2. Name morphologic features used in differentiating cells of the granulocytic series. (G1,3, CC A)
3. Describe features that differentiate the granules of the neutrophilic, eosinophilic, and basophilic cell lines. (G1,3, CC A)
4. Describe the lymphatic system and its relationship to lymphocyte production. (G1,3, CC A)
5. Identify conditions that cause a quantitative increase or decrease in a particular white blood cell line. (G3)
6. Identify conditions that lead to hypossegmentation or hypersegmentation of neutrophils. (G3)
7. Describe the effects of HIV on the CBC and the peripheral smear. (G1,3, CC A)
8. Describe the process of reactive lymphocytosis in infections with Epstein-Barr virus and cytomegalovirus. (G1,3, CC A)
9. Define white blood cell-related terms such as leukocytosis, left shift, leukemoid reaction and leukoerythroblastic reaction. (G1,3, CC A)
10. Describe briefly lipid storage diseases, such as Gaucher’s disease, Niemann-Pick disease, and Tay-Sachs disease. (G1,3,5, CC A)
11. Compare and contrast acute versus chronic leukemia with respect to age of onset and presenting symptoms. (G1,3, CC A)
12. Describe acute leukemia with emphasis on symptoms, peripheral blood and bone marrow findings. (G1,3, CC A)
13. Classify acute leukemias according to the French-American-British (FAB) classification system. (G3)
14. Briefly describe the World Health Organization (WHO) classification for acute myeloid leukemias and related myeloid proliferations. (G1,3, CC A)
15. Describe how cytochemical staining can aid in the diagnosis of acute leukemias. (G1,3, CC A)
16. List the most pertinent CD markers for various acute leukemias. (G3)
17. Explain the WHO classification of acute lymphoblastic leukemia/lymphoma. (G1,3, CC A)
18. Describe acute lymphoblastic leukemia with emphasis on age of onset, symptoms at presentation, prognosis, and laboratory findings. (G1,3, CC A)

Performance objectives
Show proficiency in making peripheral smears for manual WBC differentials. (G3)
Be able to differentiate and count the various white blood cell lines. (G3)

Week 5: Learning objectives (Chpt 12-14)
After this week, the student will be able to:
1. Discuss the classification and pathogenesis of myeloproliferative disorders. (G1,3, CC A)
2. Understand the clinical features associated with chronic myeloproliferative disorders. (G3)
3. Define the common features of the chronic lymphoproliferative disorders. (G1,3, CC A)
4. Describe the peripheral smear morphology of individuals with chronic lymphocytic leukemia. (G1,3, CC A)
5. Describe features of hairy cell leukemia on peripheral smear and with cytochemical stains. (G1,3, CC A)
6. Define the clinical features of Sézary syndrome. (G1,3, CC A)
7. List the morphologic features of the plasma cell and the basic immunoglobulin unit. (G3)
8. List the laboratory criteria used to diagnose the monoclonal gammopathies. (G3)
9. Differentiate the clinical and laboratory features that distinguish multiple myeloma and Waldenström’s Macroglobulinemia. (G3, CC B)
10. List the CD markers used to differentiate B-cell and T-cell disorders. (G3)
11. Briefly describe how molecular diagnostics aids in the diagnosis of lymphoid malignancies. (G1,3,4, CC A)
12. Define the myelodysplastic syndromes and discuss the major cellular abnormalities of MDSs. (G1,3, CC A)
13. Classify MDSs according to the criteria of the World Health Organization. (G3)

Performance objectives
Understand and describe the principles of WBC automation and Flow cytometry. (G1,3,4,CC A)

Week 6: Learning objectives(Chpt 15-17)
After completing this week, the student will be able to:
1. Explain the systems involved in hemostasis. (G1,3, CC A)
2. Describe the interaction of the vascular system and platelets as it relates to activation, adhesion, and vasoconstriction. (G1,3, CC A)
3. Identify the process involved in the coagulation cascade, from activation to stable clot formation. (G3)
4. Describe the role of platelets in hemostasis. (G1,3, CC A)
5. Define the difference between primary and secondary hemostasis. (G1,3, CC A)
6. Outline the intrinsic and extrinsic pathways, the factors involved in each, and their role in the coagulation system. (G3)
7. List the coagulation factors, their common names, and function. (G3)
8. Explain the interaction between prothrombin time, activated partial thromboplastin time, and factor assays. (G1,3, CC A)
9. Identify the relationship of the kinin and complement systems to coagulation. (G3)
10. Identify the inhibitors of the coagulation and the fibrinolytic systems and their role in hemostasis. (G3)
11. Identify the types of bleeding that are seen in platelet disorders. (G3)
12. List laboratory tests that are helpful in evaluating platelet disorders. (G3,4)
13. State how preanalytic variables may affect the platelet count. (G1,3, CC A)
14. Describe three characteristics of the qualitative platelet disorders von Willebrand’s disease, Bernard-Soulier syndrome, and Glanzmann's thrombasthenia. (G1,3, CC A)
15. Identify drugs that are implicated in immune thrombocytopenia. (G3)
16. Evaluate conditions that may cause thrombocytosis. (G3, CC B)
17. Compare and contrast acute versus chronic idiopathic thrombocytopenic purpura. (G1,3, CC A)
18. Define hemolytic uremic syndrome and thrombotic thrombocytopenic purpura in terms of pathophysiology and clinical features. (G1,3, CC A)
19. Describe platelet abnormalities caused by acquired defects—drug-induced, nonimmune, or vascular. (G1,3, CC A)
20. Outline the genetics, symptoms and lab tests used for individuals with hemophilia A and B. (G3)

Performance objectives

Perfomance objectives
Observe and perform routine coagulation tests (PT, PTT, Fibrinogen) using a fibrinometer. (G3,4)
Understand the necessity of Special studies in coagulation and the type of testing used. (G3,4)
Perform a D-dimer assay using the test kit. (G3)

Week 7: Learning objectives (Chpt 18-19)
After completing this week, the student will be able to:
1. Identify the components of the fibrinolytic system. (G3)
2. Describe plasmin in terms of activation and inhibition. (G1,3, CC A)
3. Differentiate the role of thrombin in the coagulation and fibrinolytic systems. (G3)
4. Outline the inherited disorders of fibrinogen. (G3)
5. Describe the laboratory tests for fibrinolytic disorders. (G1,3, CC A)
6. Define conditions that may precipitate disseminated intravascular coagulation (DIC) states. (G1,3, CC A)
7. Describe the laboratory testing and management of patients with DIC. (G1,3, CC A)
8. Define thrombophilia and thrombosis. (G1,3, CC A)
9. Describe antithrombin, protein C, and protein S with regard to properties, mode of action, factors affected, and complications associated with their deficiencies. (G1,3, CC A)
10. Describe heparin-induced thrombocytopenia with regard to the cause, patient’s clinical manifestations, and pathophysiology of the disease. (G1,3, CC A)
11. Discuss the laboratory tests and results used for the diagnosis of factor V Leiden and heparin induced thrombocytopenia. (G1,3,4, CC A)
12. List the types of anticoagulant drugs used for the treatment of thrombotic disorders. (G1, G3, CC A)
13. Discuss the laboratory test used for monitoring of heparin and Coumadin therapy. (G1,3, CC A)
14. Define the anti-factor Xa assay and its clinical application. (G1,3, CC A)

Performance objectives
WBC manual differential review: Continue to show proficiency in making and performing manual WBC differentials. (G3)

Laboratory – Exit Level Skill Competencies

1. Demonstrates proficiency in the enumeration of cellular elements. Given samples the student will perform replicate retic, platelet and cell count evaluations within +/- 10% proficiency of actual patient or QC results. (G2,3)
Given automated CBC reports and accompanying blood smears, the student will correlate results and evaluate blood smears to match patient results within a +/- 10% proficiency. (G3,4, CC B)

Perform differential smear evaluations on patients with normal and abnormal results. Students will reproduce results within +/- 10% proficiency of actual patient results. (G3)

Students will be able to recognize abnormal blood smears that require supervisory review. (G3)

2. Students will evaluate coagulation test results for PT and APTT tests. Students should meet a minimum 77% score on the evaluation of coagulation test results. (G3)

3. Student will be able to enumerate blood cells in fluid samples within a +/- 10% proficiency of patient results. (G3)

**Grading Policy:**

1. To receive a passing grade, students must earn a 77 or higher. A final grade of 77 or higher is required in each Medical Laboratory Technology course in order to progress to the next MLT course and to graduate. No make-up exams are to be given unless there are extenuating circumstances.

2. 

<table>
<thead>
<tr>
<th>Grade</th>
<th>Range</th>
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<tr>
<td>A</td>
<td>93-100%</td>
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<tr>
<td>A-</td>
<td>90-92</td>
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<tr>
<td>B+</td>
<td>87-89</td>
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<tr>
<td>B</td>
<td>83-86</td>
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<tr>
<td>B-</td>
<td>80-82</td>
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<tr>
<td>C+</td>
<td>77-79</td>
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<tr>
<td>C</td>
<td>70-76</td>
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<tr>
<td>D</td>
<td>60-69</td>
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<tr>
<td>F</td>
<td>0-59%</td>
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</tbody>
</table>

**Lecture**
- 2 Quizzes: 10%
- Midterm: 25%
- Final: 25%
  - Total: 60%

**Laboratory**
- Midterm: 20%
- Final: 20%
  - Total: 40%

**Academic Integrity Policy:**

Any student who (1) knowingly represents the work of others as his/her own, (2) uses or obtains unauthorized assistance in the execution of any academic work or (3) gives fraudulent assistance to another, is guilty of cheating. Violators will be penalized in accordance with established college policies and procedures.
**Support Services for Differing Abilities**

Mercer County Community College is committed to ensuring the full participation of all students in its programs. If you have a documented differing ability, or think that you may have differing ability that is protected under the ADA and section 504 of the Rehabilitation Act, please contact Arlene Stinson in LB 216 [stinsona@mccc.edu](mailto:stinsona@mccc.edu) for information regarding support services.

If you do not have a documented differing ability, other support services are available to all students on campus including the Learning Center located in LB 214.
# MLT 212: Clinical Hematology

## Lecture and Lab Schedule

Schedule is subject to change as deemed necessary.

<table>
<thead>
<tr>
<th>Date</th>
<th>Lab</th>
<th>Lecture</th>
<th>Assigned reading</th>
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</thead>
<tbody>
<tr>
<td>1 Jan 24</td>
<td>Sed rate</td>
<td>Chapters 1, 2</td>
<td>Chapters 1, 2</td>
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<tr>
<td></td>
<td>Micro hematocrit</td>
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<td>2 Jan 26</td>
<td>RBC morphology and CBC correlation</td>
<td>Chapters 3,4</td>
<td>Chapters 3,4</td>
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<tr>
<td>3 Jan 31</td>
<td>Smear and stain slides</td>
<td>Chapters 5,6</td>
<td>Chapters 5,6</td>
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<td>4 Feb 2</td>
<td>Retic stain</td>
<td>Chapters 6,7 Quiz</td>
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<td>Sickle dex</td>
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<tr>
<td>5 Feb 7</td>
<td>Normal diffs</td>
<td>Chapters 8,9</td>
<td>Chapters 8,9</td>
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<tr>
<td>6 Feb 9</td>
<td>Body fluids</td>
<td>Chapters 10,11</td>
<td>Chapters 10,11</td>
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<td>7 Feb 14</td>
<td><strong>Lab Midterm</strong></td>
<td><strong>Midterm CH 1-11</strong></td>
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<td>8 Feb 16</td>
<td>Normal differentials</td>
<td>Chapters 12,13</td>
<td>Chapters 12,13</td>
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<td>9 Feb 21</td>
<td>Abnormal differentials</td>
<td>Chapters 14, 15</td>
<td>Chapters 14,15</td>
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<td>10 Feb 23</td>
<td>D-dimer</td>
<td>Chapters 16,17 Quiz</td>
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<td>Continue Manual Differentials</td>
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<tr>
<td>11 Feb 28</td>
<td>Manual PT/PTT</td>
<td>Chapters 18, 19 Review</td>
<td>Chapters 18, 19</td>
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<td>12 March 2</td>
<td><strong>Final</strong></td>
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