



# Course Book

<p><b>Course Description</b></p>	<p>Hematopathology is one of the most important branch in the field of MLT. It is regarded as one of the major sections in any hospitals labs. In this course, the students will learn the fundamentals about hematology basics and tools related to the blood tests. The main idea of giving hematopathology is to make our students familiar with the elements exist within the blood especially the blood cells. The first lectures will provide students what is important about blood cell production and structure and function of RBC, then followed by some lectures about WBC structure, Classification and functions. Illustrating the main disease related to blood, such as anemia, leukaemia...etc are also included in the later lectures.</p> <p>It involves treating diseases that affect the production of blood and its components, such as blood cells, hemoglobin, blood proteins, bone marrow, platelets, blood vessels, spleen, and the mechanism of coagulation. Such diseases might include hemophilia, blood clots, other bleeding disorders and blood cancers such as leukemia, multiple myeloma, and lymphoma. The laboratory work that goes into the study of blood is frequently performed by a medical technologist or medical laboratory scientist. Many hematologists work as hematologist-oncologists, also providing medical treatment for all types of cancer</p>
<p><b>Course objectives</b></p>	<p>The objectives for practical classes of this course are to introduce the students to the field of hematology and engage the students in small laboratory experiments that they can accomplish in a small group. This program can utilize the concepts and skills learned to foster their career.</p>
<p><b>Student's obligation</b></p>	<p>1- Attendance at each laboratory is mandatory at Soran technical Institute campus, while attending MOODLE is mandatory for theory classes.                  2- Excessive absences can reduce a student's grade or deny credit for the course                  3- The students are required to set for 2 exams paper for theoretical part and 2 other exams papers for practical classes.                  4- Students are required to submit 2 assignments (one assignment) in each term.                  5- The monthly home work is one of the important duties to the students during the year. They are required to submit minimum 5 reports.                  6- Quizzes will be holds during the theory and practical classes, in every 3class's one test.</p>
<p><b>Required Learning Materials</b></p>	<p>Students are required to apply MOODLE program as the platform of electronic study. They need to use Laptop or mobile version. They need to use university G-suite account for accessing the course materials and assignments.</p>

<b>Evaluation</b>	<b>Task</b>		<b>Weight (Marks)</b>	<b>Due Week</b>	<b>Relevant Learning Outcome</b>
	Paper Review				
	Assignments	Homework	5		
		Class Activity	2		
		Report	10		
		Seminar			
		Essay			
		Project			
	Quiz		8		
	Lab.		10		
	Midterm Exam		25		
Final Exam		40			
Total		100			
<b>Specific learning outcome:</b>	<ol style="list-style-type: none"> <li>1) Apply principles of safety, quality assurance and quality control in hematology.</li> <li>2) Evaluate specimen acceptability.</li> <li>3) Demonstrate an understanding of the underlying processes in hematopoiesis and types of blood cells and their functions.</li> <li>4) Learn the most common medical terms in hematopathology.</li> <li>5) Reflect analytically on student's study learning styles in order to be able to identify and review additional literature to enhance learning.</li> <li>6) Compare and contrast hematology values under normal and abnormal conditions.</li> <li>7) Perform and explain principles and procedures of tests to include sources of error and clinical significance of results.</li> <li>8) Determine suitability of hematology specimens and dispose of them in the appropriate biohazard containers.</li> <li>9) Understanding hematological disorders and types of anemias</li> </ol>				
<b>Course References:</b>	<ol style="list-style-type: none"> <li>1) Hoffbrand A.V., Moss P.A.H., and Pettit J.E., (2006). Essential haematology. 5th ed. Blackwell publishing.</li> <li>2) Hoffman R., Shattil S.J., Furie B., Cohen H.J., Silberstein L.E., McGlave P., and Benz E.J., (2005). Hematology Basic principles and practice. 5th ed. Philadelphia: Elsevier Churchill Livingstone.</li> <li>3) Hillman R.S., Ault K.A. and Rinder H.M. (2005). Hematology in clinical practice. 4th ed. New York. McGraw-Hill.</li> <li>4) A. Victor Hoffbrand, Daniel Catovsky, Edward G. D. Tuddenham (2005) Postgraduate Haematology</li> </ol>				

- 5) Rodgers, Griffin P. Young, Neal S (2019). The Bethesda handbook of clinical hematology
- 6) Shauna C Anderson Young, Keila B. Poulsen (2013). Anderson's Atlas of Hematology

▪ **Useful references:**

- 1) Powers L.W. (1989). Diagnostic hematology clinical and technical principles. 1st ed. Mosby. USA.
- 2) Wallach J. (2007). Interpretation of Diagnostic Tests. Philadelphia. Lippincot Williams and Wilkins, a Wolters Kluwer business.
- 3) Lewis S.M., Bain B.J., and Bates I., (2006). Dacie and Lewis practical Hematology. 10th ed. Philadelphia. Elsevier Churchill Livingstone.

▪ **Magazines and review (internet):**

- 1) The British Society for Haematology: <https://b-s-h.org.uk/>
- 2) The American Society of Hematology: <http://www.hematology.org/>
- 3) Blood Journal: [www.bloodjournal.org/](http://www.bloodjournal.org/)
- 4) Journal of Hematology: [thejh.org/](http://thejh.org/)
- 5) British Journal of Haematology: <https://onlinelibrary.wiley.com/journal/13652141>  
American Journal of Hematology - Wiley Online Library: <https://onlinelibrary.wiley.com/journal/10968652>

Course topics (Theory)	Week	Learning Outcome
Introduction to Hematology	Week 1	History of the science of hematology, Approach to hematology, Biohazard precautions and laboratory safety
Hematopoiesis	Week 2	Site of hematopoiesis, Hemopoietic stem and

		progenitor cell, Bone Marrow (BM) microenvironment, Stem cell division and differentiation
<b>Regulation of hematopoiesis and apoptosis</b>	Week 3	Growth factor receptors and signal transduction, Hematopoietic growth factors (HGFs), Role of growth factors in hemopoiesis
<b>Erythropoiesis</b>	Week 4	Red blood cell (RBC) production, Erythrocyte physiology and functions, Hemoglobin (Hb), Hb synthesis, structures and functions
<b>Metabolism of erythrocytes and erythrocyte disorders</b>	Week 5	Erythrocyte Lifecycle, Disorders of Erythrocytes, Red cell morphologic disorders and diseases associated with blood disorders
<b>Leukocytes , Leukopoiesis</b>	Week 6	White blood cell (leukocyte) production, Classification of leukocytes, Functions of leukocyte

<b>Lymphopoiesis</b>	Week 7	Lymphopoiesis (lymphocyte production), B lymphocyte and T lymphocyte maturation, activation and differentiation
<b>Megakaryopoiesis</b>	Week 8	Platelet production, structure and function, Primary hemostasis, Platelet adhesion and aggregation
<b>Megakaryopoiesis- Coagulation cascade</b>	Week 9	Secondary hemostasis, Coagulation cascade, Fibrinolysis
<b>Abnormalities of red blood cells: Anemia</b>	Week 10	Microcytic, normocytic and macrocytic anemias, Classification of anemia according to pathophysiologic characteristics: Microcytic Anemias
<b>Macrocytic anemias</b>	Week 11	Megaloblastic anemias: <ul style="list-style-type: none"> <li>• Folic acid deficiency</li> <li>• Vitamin b12 deficiency (pernicious anemia)</li> </ul> Laboratory diagnosis of anemia

<b>Genetic disorders of hemoglobin, Thalassemia</b>	Week 12	<ul style="list-style-type: none"> <li>Thalassemias α-Thalassemias β-Thalassemias</li> <li>Thalassemia intermedia</li> </ul> <p>Sickle cell anemia</p> <p>Laboratory investigation of thalassemia</p>
<b>Practical Topics</b>	Week	Learning Outcome
<b>Anticoagulants</b>	Week 1	<ol style="list-style-type: none"> <li>Learning hematology laboratory ethics and safety</li> <li>Blood handling, collection and sampling</li> <li>Learning of materials and tools are related to hematology lab such as glassware, reagents, chemicals, automated hematology analyzer, coagulometer, microscopes and</li> </ol>
Collection of blood from capillary		
Collection of blood from veins	Week 2	
Estimation of erythrocyte sedimentation rate (ESR)		
Packed cell volume	Week 3	
Hemoglobin measurement methods	Week 4	
Total leukocyte count, Differential leukocyte count	Week 5	
Total platelets count	Week 6	
Red blood cell indices (MCV, MCH, MCHC and RDW)	Week 7	
Blood film preparation	Week 8	
Normal and abnormal shapes of erythrocytes	Week 9	
Normal and abnormal shapes of leukocytes	Week 10	
Platelets indices (MPV, PCT, PDW and L-CPR)	Week 11	

Reticulocyte count	Week 12	<p>more</p> <p>4. Applying various techniques such as blood count (CBC) and manual measurements of white blood, red blood cells, platelets, and other blood parameters</p> <p>5. Blood smear preparation and analysis of blood morphology</p>
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### Examinations:

#### A-Theory

#### Q1/ Select the correct answer for the following multiple choice: (X Marks)

- which primarily produced in the liver stimulates the formation of platelets.  
a) Erythropoietin    b) TGF- $\beta$     c) M-CSF    **d) Thrombopoietin**
- The simplest method for detecting increased RBC production is -----  
a) Measure of the RBC survival    c) Ferrokinetics studies  
**b) Reticulocyte enumeration**    d) Bone marrow biopsy
- The five types of leukocytes found in normal peripheral blood are -----  
a) Lymphocytes, monocytes, neutrophils, basophils, and lymphoblast  
b) Lymphocytes, neutrophils, monocytes, myeloblasts, and eosinophils  
**c) Lymphocytes, neutrophils, monocytes, eosinophils and basophils**
- In high altitudes, the hemoglobin value is -----  
a) Lower    c) The same  
**b) Higher**    d) Not altered

#### Q2/ Choose the correct option to fill in the blanks: (X Marks)

(hematopoietic growth factors, leukopenia, leukemia, B lymphocytes, basophils, macrocytes, eosinophils, anisocytes, heme, signal transduction, microvasculature network, (1 alpha, 2 beta and 1 delta), (2 alpha and



2 beta), stromal cells)

1. -- **Heme** -- synthesis occurs largely in the mitochondria by a series of biochemical reactions.
2. CD20 is important surface marker on -- **B lymphocytes** --.
3. The smallest % of normal cells in a differential count is -- **basophils** --.
4. Red blood cells which are larger than 8.2 microns are called -- **macrocytes** --.

**Q3/ Identify whether the following statements are true or false: (X Marks)**

- 1) Apoptosis is important process for maintaining tissue homeostasis in hemopoiesis and lymphocyte development. **T**
- 2) Copper facilitates the synthesis of the globin portion of hemoglobin. **F**
- 3) Basophils comprised around 1% of all leukocytes and has a role in inflammation and allergic reaction. **T**
- 4) Diseases associated with microcytes include thalassemia minor and vitamin B12 deficiency. **F**

**Q4/ Match the questions in column A to the “appropriate” answers in column B: (X Marks)**

	A		B
1	RDW <b>1</b>	1	to measure of the variation in the volume of red blood cells
2	Heme degradation <b>3</b>	6	to measure the average mass of hemoglobin in each RBC
3	Anisocytosis <b>2</b>	5	abnormal variation in the shape of red blood cells
4	B lymphocyte <b>4</b>	3	Biliverdin
5		2	abnormal variation in the size of red blood cells
6		7	white cell count > 10,000/ $\mu$ L
7		4	acquired immune system

**Q5/ Answer the following questions: (X Marks)**

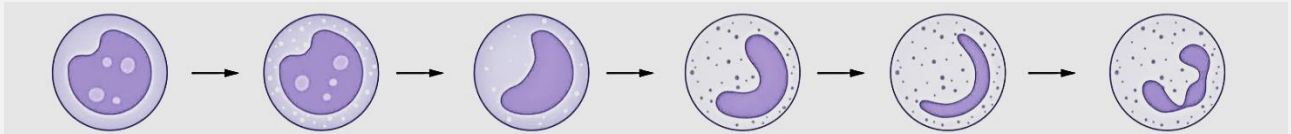
- 1) Enumerate the three major pathways contributed to signaling machinery in hematopoietic cells.

**Answer:**

- Janus associated kinase (JAK/STAT) pathway.
- The mitogen activated protein (MAP) kinase pathway.
- The phosphatidylinositol 3 (PI3) kinase pathway.

- 2) Label the following figure:

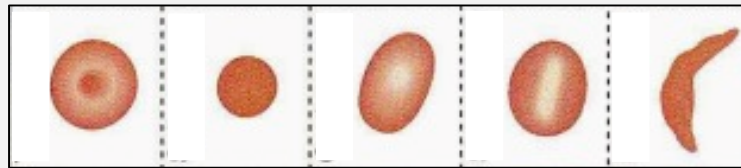
Drag each of the following terms into the appropriate places where indicating. (Metamyelocyte, Neutrophil, Myelocyte, Band neutrophil, Promyelocyte, Myeloblast)



**Answer:**

Myeloblast → Promyelocyte → Myelocyte → Metamyelocyte → Band neutrophil → Neutrophil

- 3) Identify the following figures (shape variations in red blood cells morphology):  
 Drag each of the following terms into the appropriate places.  
 (Spherocyte, Acanthocyte, Stomatocyte, Ovalocyte, Tear drop cell, Target cell, Sickle cell)



**Answer:** Target cell → Spherocyte → Ovalocyte → Stomatocyte → Sickle cell

## B- Practical Exam

### Written part

- Write the normal range of the following tests:
  - Packed cell volume
  - ESR
  - Reticulocyte count
- What are the requirements need in these tests:

- Hb electrophoresis.
  - Bleeding time.
3. How you can prepare:
- Hemolysate.
  - Sickling solution.

### ***Move part***

1. What is the type of this cell?
2. Name these apparatuses.

Which type of anemia you suggest if the patient has this blood film?

### **Extra notes:**

In this course theoretical part we will focus in some subjects such as; Hematological tests in general especially the important ones. In Assignments: Every lecture there is 10 min free for student to preview a seminar about a subject chosen by the lecturer previously planned and the purpose of this is to encourage the student to study as work team and encourage them to pass their fears on facing others for the future and consider as an activity for the students. 2- The best seminars will take into consideration and students will be rewarded.

### **External Evaluator**