



Department of -----Biology

College of ----- Science

University of ----- Salahaddin ....

Subject: ----- Haematology I.

Course Book ----- (3<sup>rd</sup> Year/ First semester)

Lecturer's name----- [Assist. Prof. Sarbaz I. Mohammed, PhD  
(Theory) + Darya M. Azeez (Practical)]

Academic Year: ----- 2023/2024



**11. Course objective:**

- **The goal of the clinical hematology is to facilitate mastery of the principles and practice of hematology needed by medical laboratory technician and medical laboratory science students to achieve board certification or licensure upon graduation. Clinical hematology has been classroom and laboratory (field tested) medical laboratory technician and medical laboratory technology**

**12. Student's obligation**

**Classroom polices:**

**1- Attendance:** You are strongly encouraged to attend class on a regular basis, as participation is important to your understanding of the material. This is your opportunity to ask questions. **You are responsible for obtaining any information you miss due to absence**

**2- Lateness:** Lateness to class is disruptive

**3-Talking:** During class, please refrain from side conversations. These can be disruptive to your fellow students and your professor

**13. Forms of teaching**

Course Book, white board and PowerPoint

**14. Assessment scheme**

Breakdown of overall assessment and examination

| Component   | Date | Percent |
|-------------|------|---------|
| Examination |      | 20 %    |
| Attendance  |      | 5 %     |
| Quiz        |      | 5%      |
| seminars    |      | 30%     |
| Total       |      | 60%     |

**15. Student learning outcome:**

After completion of this course, you will be able to:

- Define common terms used in clinical hematology & blood banking.
- Identify all the possible methods for preparation of blood analysis

- Different structure blood
- Identify basic classification of anemia
- Steps of blood banking

**16. Course Reading List and References:**

1. Turgeon M. L. (2018). Clinical Hematology Theory and Procedures. 6<sup>th</sup> edition. Philadelphia: Wolters Kluwer
2. Provan D., Trevor B., Inderjeet D., Johannes de vos. (2015) Oxford Handbook of Clinical Haematology. 4<sup>th</sup> edition. USA by Oxford University press.
3. Denise Harmening (2012). Modern Blood Banking & Transfusion Practices. 6th edition. F. A. Davis Company Philadelphia, PA.

**17. The Topics:**

**Lecturer's name**

- |   |                    |
|---|--------------------|
| 1- Haematology & history of haematology   | Week 1             |
| 2- Haemopoiesis   | Week 2             |
| 3- Erythropoiesis   | Week 3             |
| 4- Haemoglobins   | Week 4             |
| 5- Leukopoiesis   | Week 5             |
| 6- Leukocytosis   | Week 6             |
| 7- Haemostasis and its components   | Week 7             |
| 8- Platelets • Blood Vessel Wall • Coagulation System •<br>Coagulation Regulatory Mechanism • Fibrinolytic System •<br>Normal Haemostasis | Week 8             |
| 9- Anaemia  | Week 9             |
| 10- Iron-Deficiency Anemia  | Week 10            |
| 11- Haemolytic anemia (Thalassemia; Sickle cell anemia)   | Week 11            |
| 12- Examination 1   | Week 12            |
| 13- Polycythemia  | Week 13            |
| 14- Introduction to Acute Leukaemia (Lymphoblastic ALL &<br>myeloblastic Leukaemia AML)   | Week 14            |
| 15- Introduction to chronic Leukaemia (Lymphoblastic CLL &<br>myeloblastic Leukaemia CML )  | Week 15<br>Week 16 |
| 16- Bleeding disorders  |                    |
| 17- Examination 2   | Week 17            |

**18. Practical Topics (If there is any)**

In this section The lecturer shall write titles of all practical topics he/she is going to give during the term. This also includes a brief description of the objectives of each topic, date and time of the

Lecturer's name  
ex: (3-4 hrs)

**19. Examinations:****Q1/ Choose correct answer****(30 marks)**

- 1- The blood is fluid of life about ----- of human body weight  
(**a- 7-8%**      **b- 6-7%**      **c- 8-9%**      **d- 6-9%**)
- 2- Plasma is liquid portion of the blood, mainly consists of -----  
-----  
(**a- Organic , inorganic substances and H<sub>2</sub>O**      **b- Lipid, protein and H<sub>2</sub>O<sub>2</sub>**      **c- protein, sugar and blood cell**      **d- Organic , inorganic substances and protein**)
- 3- HSCs are capable of cell division to give rise to more stem cells is called-----(**a- Differentiation**      **b- Self-renewal**      **c- Pluripotent**      **d- stem cells**)
- 4- Stromal cells are the major source of growth factors except for -----  
(**a- erythropoietin**      **b- thrombopoietin**      **c- Interleukin-3**      **d- cytokines**)
- 5- Collectively, the progenitors, precursors, and adult red cells make up an organ termed the ----- (**a- erythron**      **b- spleen**      **c- blood cells**      **d- all of them**)
- 6- Although the erythropoietin response is primarily a function of the severity of ----- (**a- hypoxia,**      **b- erythroid marrow mass**      **c- inflammatory cytokines**      **d- all of them**)
- 7- Which red cells is not a biconcave disc? (**a. Anisocyte**      **b. Microcyte**      **c. Hypochromic red cells**      **d. Spherocyte**)
- 8- Red blood cells which are larger than 8.1 microns are called-----  
(**a. Anisocytes**      **b. Macrocytes**      **c. Microcytes**      **d. Normocytes**)
- 9- An iron protein complex which combines with oxygen and carbon dioxide is----- (**a. Deoxyhemoglobin**      **b. Hemoglobin**      **c. Hemosiderin**      **d. Oxyhemoglobin**)
- 10- The Bohr Effect is a physiological phenomenon, stating that hemoglobin's oxygen binding affinity is inversely related both to ---  
----- & ----- (**a- Alkalinity & CO<sub>2</sub>**      **b- Acidity & O<sub>2</sub>**      **c- acidity & CO<sub>2</sub>**      **d- Alkalinity & O<sub>2</sub>**)
- 11- Most antibodies are ----- globulins ( **a- α**      **b- β**      **c- γ**      **d- δ**)

- 12- Water act as----- for blood cells (**a-** Enzyme **b-** polar solvent **c-** polar solute **d-** cofactor)
- 13- In allergic conditions, we commonly find an increase of----- (**a.** Basophil **b.** Eosinophils **c.** Neutrophils **d.** Lymphocytes )
- 14- In which stage of erythrocytic maturation does Hgb formation begin? (**a.** Orthochromic normoblast **b.** Pronormoblast **c.** Basophilic normoblast **d.** Polychromatic normoblast)
- 15- life span of pronormoblast is ----- day (**a-** 1.3 **b-** 1.5 **c-** 2 **d-** 0.8)

**Q2/ True or False**

**(20 marks)**

- 1- The lower level of haemoglobin during pregnancy is due to by reduction of plasma volume
- 2- Poikilocytosis significant variation in size of red cells
- 3- Extravascular destruction of red cells by macrophages
- 4- Howell-Jolly bodies are small, spherically shaped DNA remnants
- 5- Heinz bodies are composed of denatured proteins, primarily hemoglobin
- 6- Hemoglobin H is composed of  $\gamma$ 4 tetramers
- 7- Natural killer cells are a type of granulocyte group
- 8- In Orthochromic normoblast, the nucleus appears as a dense blue-black sphere, is known as a pyknotic nucleus
- 9- Changes in the oxygen delivery to tissue are sensed by peritubular interstitial, fibroblast-like cells in the liver.
- 10- The rate of new RBC production varies according to the rate of RBC destruction and Tissue oxygen requirements.

**Q3/**

- 1- Explain morphological classification of anemia (15 marks)
- 2- Explain Biosynthesis of heme (20 marks)
- 3- Mention various hematopoietic organs during antenatal life (15marks)

**20. Extra notes:**

Here the lecturer shall write any note or comment that is not covered in this template and he/she wishes to enrich the course book with his/her valuable remarks.

## 21. Peer review

## پیداچوونہوی ھاوہل

This course book has to be reviewed and signed by a peer. The peer approves the contents of your course book by writing few sentences in this section.

*(A peer is person who has enough knowledge about the subject you are teaching, he/she has to be a professor, assistant professor, a lecturer or an expert in the field of your subject).*

نہم کورسبووکہ دہبیت لہ لایہن ھاوہلئیکئ نئکادیمیہوہ سہیر بکریٹ و ناوہرؤکی بابہتہکانئ کورسہکہ پھسند بکات و جہند ووشہیک بنووسئیت لہسہر شیاوی ناوہرؤکی کورسہکہ و واژووی لہسہر بکات.  
ھاوہل نئو کسہپہ کہ زانیاری ھبئیت لہسہر کورسہکہ و دہبیت پلہی زانستی لہ ماموستا کہمتر نہبئیت.

Theory Lecturer's

Assist. Prof. Dr. Sarbaz I. Mohammed

Haematology/Biology department

College of Science





### **10. Course overview:**

Studding of this module is intended to:

In this course students will study fundamental concepts of hematology and the analysis of laboratory results and their clinical implications.

Understand the process of haemopoiesis and explain the function of the various blood constituents. Explain how certain disease processes may lead to a change in the numbers and morphology of blood cells.

Understanding the principles and efficiently performing, a range of routine laboratory tests including; full blood examination (including automated analysis and manual techniques for hemoglobin estimation, hematocrit, leucocyte counts, platelet and reticulocyte counts), and erythrocyte sedimentation rate (ESR).

Prepare, examine and report on stained peripheral blood smears (normal and abnormal) to include differential white cell count (DWCC) and assessment of morphology of blood cells. Understand the significance of the morphological changes in a peripheral blood smear and indicate further investigations useful in establishing a diagnosis of blood diseases.

Perform and understand the basis of certain laboratory tests used in the diagnosis and treatment of anemia, leukemia, and other blood disorders.

Understand normal and abnormal hemostasis, including the blood coagulation and fibrinolytic systems and the role of platelets. Perform relevant laboratory tests used in the diagnosis of patients with hemorrhagic disorders

Explain the inheritance, characteristics and nature of clinically important blood group antigens and antibodies. Understand the principles of, and perform various blood banking techniques including ABO, Rh grouping and compatibility testing.

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### **11.Course objective**

The course is especially planned for undergraduate students who intend to work in diagnostic laboratories. The goals of this module include:

1. Demonstrate proper procedures for the collection, safe handling, and analysis of biological specimens
2. Describe the principles of some of the most frequently used laboratory tests and their diagnostic significance.
3. Conduct a biomedical laboratory procedure and process, interpret and document the data obtained.
4. Apply appropriate problem-solving steps for determining instrument/methodology

problems, utilizing instrument manuals, laboratory procedure manuals, and information contained in package inserts

5. Evaluate laboratory test results to determine disease diagnosis.
6. Characterizing of different blood diseases (Anemia and Leukemia) bases on observation of blood cells under the microscope.

### 12. Student's obligation

- Students should attend all lectures and not miss any lecture time.
- Electronic devices: All cell phones are to be turned off at the beginning of class and put away.
- It is highly advised not to accumulate material until before the examination time. Cramming will definitely weaken the student's ability to understand and retain valuable information.

### 13. Forms of teaching

- Data Show Projector
- Blackboard
- Video
- The hard copy of the lectures will be given to the students

### 14. Assessment scheme

Breakdown of overall practical assessment and examination

#### Grading System:

- Semester exams: 20 %
- Weekly quizzes: 5%
- Activities and attendance 5%
- Assignment 5%
- Overall practical haematology marks 35 %

### 15. Student learning outcome:

At the end of the course students should be able to

- Demonstrate a working knowledge of the theories and techniques utilized in standard laboratory procedures performed in Hematology
- Differentiate various hematological procedures and the use of basic equipment required to working in Clinical Hematology Laboratory
- Evaluate test results with normal and abnormal physiologic circumstances
- Identify the various components of blood, their functions, and roles in various disease state

### 16. Course Reading List and References:

- 1- Colour Atlas of Haematology Practical Microscopic and Clinical Diagnosis by Harald Thöml, Heinz Diem, and Torsten Haferlach, 2nd revised edition, 2004, Thieme Stuttgart · New York.
- 2- Diagnostic Hematology by James A. Ker, 2009, Springer-Verlag London Limited.
- 3- Hematology, Basic Principles and Practice by Ronald Hoffman, Edward J. Benz, Sanford J. Shattil, Bruce Furie et al., Copyright © 2005, Elsevier Inc.

- 4- Dacie and Lewis Practical Haematology. 2017. BARBARA J. BAIN, IMELDA BATES.
- 5- Basic Medical Laboratory Techniques. 2007. Barbara H. Estridge, Anna P. Reynolds, Norma J. Walters. 5th edition
- 6- Hematology: Clinical Principles and Applications. 2007. Bernadette F. Rodak, George A. Fritsma, Kathryn Doig. 3ed edition. Elsevier Health Sciences

| <b>17. The Topics:</b>   | <b>Date</b> |
|--|-------------|
| <b>Week 1:</b> Introduction to basic concepts in practical haematology lab.    | 4/9/ 2023   |
| <b>Week 2:</b> Blood Specimen Collection.                                      | 11/9/2023   |
| <b>Week 3:</b> Haematocrit test  | 18/9/2023   |
| <b>Week 4:</b> Determination of Haemoglobin (Hb) concentration                 | 25/9/2023   |
| <b>Week 5:</b> Manual Red Blood Cell Counting.                                 | 2/10/2023   |
| <b>Week 6:</b> Erythrocyte sedimentation rate                                  | 9/10/2023   |
| <b>Week 7:</b> First exam  | 16/10/2023  |
| <b>Week 8:</b> Total white blood cell counting                                 | 23/10/2023  |
| <b>Week 9:</b> Preparation of the blood smear and differential Leukocyte count | 30/10/2023  |
| <b>Week 10:</b> anemia and RBC indices   | 6/11/2023   |
| <b>Week 11:</b> Forward and reverse blood grouping                             | 13/11/2023  |
| <b>Week 12:</b> Crossmatch   | 20/11/2023  |
| <b>Week 13:</b> Reticulocyte count   | 27/11/2023  |
| <b>Week 14:</b> Second exam  | 4/12/2023   |

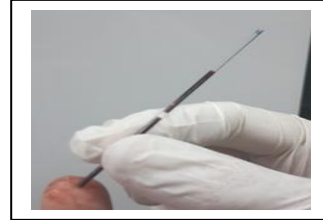
## 18. Examinations:

### Examples of Semester Examination

#### Practical Hematology exam

Q1/ Write briefly the aim of using the followings in hematological tests

1. Trisodium citrate in ESR
2. Turk's solution
3. Pottassium ferricyanide in Hb determination



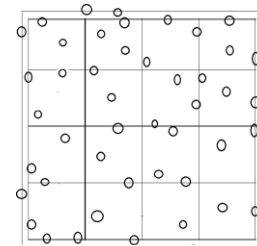
Q2/

A/ Write the name of this tube and mention the errors during this sample collection for estimation Htc

B/What are the suspected layers which are formed after centrifugation of this tube.

Q3 /

Count WBCs in this large square and calculate the number of WBC in 1  $\mu$ l of blood (if you know the sample is 10 times diluted) and explain the result?



Q4/ Explain why

- 1- The RBC pipette in some cases is used for WBC count instead of WBC pipette?
- 2- The error encountered in Hb estimation by SAHLI method may be up to 15 %? Mention two of sources error

Q5/

1. What are the differences between plasma and serum and how you can get both of them practically?
2. During blood sugar estimation blood collected in Oxalate or EDTA tubes mixed with sodium fluoride. Why?

Q6/

- 1- Why you are performing ESR? Write the principle of the test?
- 2- What are the stages of ESR?

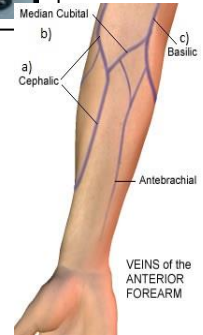
Q7/

How many platelet parameters are measured by coulter counter? What is the importance of the solution in manual PLT counting?

Q8

A/ Identify this test and briefly write the principle of it

B/ It's not true to divide PCV value by 3 for obtaining hemoglobin concentration in patients ? Why



Q9 A/ True or false

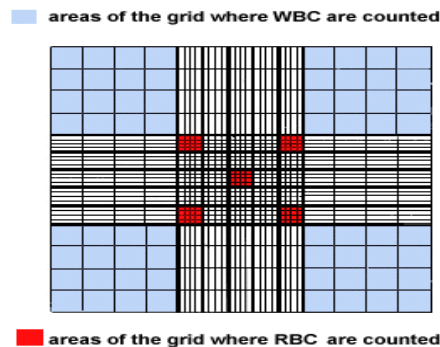
1. Polycythemia Vera is overproduction of RBC which is resulted from hypoxia?
2. Hayme's solution is used for diluting the blood during RBC counting

Q9 A/ Chose the correct answer

1. Which of the following vein is the first choice of vein puncture?  
A) Cephalic vein B) Median cubital vein C) Basilic vein
- 2- .....is an anticoagulant which prevent blood clotting by inhibiting thrombin activity  
a) Heparin, b) Sodium citrate, c) Salt-EDTA

Q10/

If the number of RBCs in 3 medium squares of hemomacutometer slide was 288 cell, calculate the number of RCB in 1 liter of blood?



Lecturer

Darya m. Azeez