



<b>STUDY GUIDE</b>	
<b>PROGRAM</b>	<b>MBBS</b>
<b>MODULE TITLE</b>	<b>Hematopoietic System-1</b>
<b>ACADEMIC YEAR</b>	<b>1<sup>st</sup> year MBBS-2026</b>
<b>INTRODUCTION</b>	<p>The hematopoietic system consists of the bone marrow and the cells it produces, including White Blood Cells (Leukocytes), Red Blood Cells (Erythrocytes), and Platelets (Thrombocytes). The Hematopoietic system-1 is the first system-based integrated module of the MBBS curriculum. It is an introduction to the hematology system with a review of some aspects of the essential Biochemistry, Physiology, Anatomy of blood and its components. The maximum load of content is from Physiology and Biochemistry. It is designed to provide students with not only knowledge about basics of Blood but also develop their ability to apply information to solve problems. This module is linked with Blood - 2 which will be conducted during 3rd year MBBS. At that time the emphasis will be on the details of how blood related diseases occur, how they can be treated and how common they are in the community.</p>
<b>RATIONALE</b>	<p>Conditions like nutritional deficiency anemia are rampant in Pakistan. It is commonly present in all age groups and both genders. Infectious conditions are also common in society. Hence knowledge of blood, immunity and inflammation is essential. This module provides the foundation knowledge to students to use the basic information in solving problems in a clinical context.</p>

## JINNAH SINDH MEDICAL

<b>OUTCOMES</b>	At the end of the module, the students will be able to solve common clinical problems related to Hematology by applying knowledge of the relevant Anatomy, Biochemistry and Physiology.
<b>DEPARTMENTS INVOLVED</b>	<ul style="list-style-type: none"> <li>• Anatomy,</li> <li>• Physiology,</li> <li>• Biochemistry</li> </ul>
<b>MODULE OBJECTIVES</b>	By the end of the module, the students will be able to:
<b>LECTURES</b>	<b>HISTOLOGY</b>
<b>ANATOMY</b>	<p><b>1. Immune system, Lymphoid tissue, lymph node and Thymus</b></p> <ul style="list-style-type: none"> <li>• List the components of immune system and lymphoid tissue</li> <li>• Differentiate between central lymphoid organs and peripheral lymphoid organs</li> <li>• Describe the structure of lymph nodes</li> <li>• Describe the structure and histological appearance of thymus</li> <li>• Discuss the clinical anatomy of lymphoid organs</li> </ul> <p><b>2. Histology of Spleen and Tonsils</b></p> <ul style="list-style-type: none"> <li>• Define the structure and location of tonsils and spleen</li> <li>• Describe histological features of tonsils and spleen</li> </ul>
<b>BIOCHEMISTRY</b>	<b>TOPIC - 1 HEMOGLOBIN</b> <p><b>1. Structure and types of Hemoglobin</b></p> <ul style="list-style-type: none"> <li>• Explain the structure of hemoglobin</li> <li>• Describe the types of hemoglobin</li> <li>• Discuss the biochemical function of hemoglobin</li> <li>• Discuss the clinical significance of hemoglobin</li> </ul> <p><b>2. Oxygen dissociation curves of Hemoglobin</b></p> <ul style="list-style-type: none"> <li>• Explain the biochemical basis of oxygen dissociation curve</li> <li>• Describe the oxygen dissociation curve for Hemoglobin</li> </ul>

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- Explain the oxygen dissociation curve for Myoglobin
- Describe the factors affecting binding of oxygen with hemoglobin
- Describe the allosteric effectors of Oxygen dissociation curve
- Explain transportation of oxygen and carbon dioxide through hemoglobin

### **3. Hemoglobin synthesis and Porphyrias**

- Explain the pathway of hemoglobin synthesis
- List the abnormalities of Hemoglobin synthesis
- Classify Porphyria
- Discuss Porphyria

### **4. Hemoglobinopathies**

- Enumerate the Hemoglobinopathies
- Explain the biochemical, genetic, and clinical significance of Thalassemia
- Explain the biochemical, genetic, and clinical significance of Sickle cell anemia

## **TOPIC - 2 VITAMINS & MINERALS**

### **5. Iron metabolism**

- Discuss Iron metabolism in the body with its abnormalities
- Describe the biochemical functions, dietary sources, recommended daily intake and distribution of iron in the body
  - Explain the mechanism of absorption, transport, storage, and elimination of iron
- Discuss the clinical significance of Iron deficiency and Iron overload

### **6. Vitamin B12 & Folic acid**

- Discuss the factors regulating Erythropoiesis
- Discuss Vitamin B12 and Folic acid metabolism in the body

	<ul style="list-style-type: none"><li>• Describe the biochemical functions, dietary sources and</li></ul>
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	<p>recommended daily intake of Vitamin B12 and Folic acid</p> <ul style="list-style-type: none"><li>• Discuss the clinical significance of Vitamin B12 and Folic acid deficiency</li></ul> <p><b>7. Vitamins E &amp; K</b></p> <ul style="list-style-type: none"><li>• Discuss metabolism of Vitamin E &amp; Vitamin K in the body</li><li>• Describe the biochemical functions, dietary sources and recommended daily intake of Vitamins E &amp; K</li><li>• Discuss the clinical significance of Vitamin E &amp; Vitamin K deficiency</li></ul> <p><b>TOPIC - 3 PLASMA PROTEINS</b></p> <p><b>8. Plasma Proteins</b></p> <ul style="list-style-type: none"><li>• Explain the composition of plasma and plasma proteins</li><li>• Explain the difference between plasma and serum</li><li>• Discuss the separation techniques of plasma proteins</li><li>• Describe the individual plasma proteins and their biological functions</li><li>• Discuss the clinical abnormalities related to plasma proteins</li></ul> <p><b>9. Immunoglobulins</b></p> <ul style="list-style-type: none"><li>• Classify immunoglobulins</li><li>• Differentiate between immunoglobulins and antibodies</li><li>• Describe the chemical structure &amp; biochemical functions of immunoglobulins</li><li>• Discuss the clinical significance of immune deficiency diseases</li></ul>
<b>PHYSIOLOGY</b>	<p><b>1. Composition of blood &amp; its cellular components</b></p> <ul style="list-style-type: none"><li>• Enumerate the functions of the cellular components of blood</li><li>• State the normal values of RBCs, WBCs &amp; platelets</li><li>• Define hematocrit, normal values &amp; factors affecting hematocrit</li></ul> <p><b>2. Formation and development of RBCs (erythropoiesis)</b></p> <ul style="list-style-type: none"><li>• Discuss the different stages of RBCs formation</li><li>• List the factors that are necessary for erythropoiesis</li></ul>

- Discuss the significance of reticulocyte count
- Discuss the role of Erythropoietin

**3. Classification of anemia and significance of red cell indices**

- Describe the morphological & etiological classification of anemia
- Discuss the significance of red cell indices and their normal values

**4. Hemolytic anemias (Intracorpuscular and extracorpuscular causes)**

- Discuss the types of hemolytic anemias:
  - a) Hereditary spherocytosis
  - b) G6PD deficiency
  - c) Sickle cell anemia
  - d) Erythroblastosis fetalis

**5. Megaloblastic /Iron, B12, Folic acid deficiency anemia**

- Discuss the etiology & microscopic features of megaloblastic and iron deficiency anemia
- Differentiate between megaloblastic & pernicious anemia based on microscopic features and Red Cell Indices

**6. Blood groups ABO/RH system**

- Explain the ABO (classical) and Rh blood grouping systems & their inheritance pattern
- Define agglutinogen, agglutinin & agglutination
- List various Rh antigens & Rh immune response
- Name the transfusion reactions associated with mismatched blood transfusion

**7. Polycythemia**

- Define the types of polycythemia

- Explain the effects of polycythemia on human body

**8. Hemostasis & role of Thrombocytes**

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	<ul style="list-style-type: none"><li>• Describe the events in Hemostasis</li><li>• Explain the mechanism of formation of platelet plug</li><li>• Describe the role of Prothrombin in blood coagulation and clot formation</li></ul>
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### **9. Clotting cascade & bleeding disorders**

- Explain intrinsic and extrinsic pathway for coagulation
- Enumerate the clotting factors
- Describe the role of clotting factors in coagulation

### **10. Fibrinolytic mechanisms**

- Explain the fibrinolytic mechanism and the role of plasmin in lysis of blood clots
- Discuss the role of fibrin & anti-thrombin III in anticoagulation

### **11. Hemorrhagic & thromboembolic conditions**

- Explain the following hemorrhagic and Thrombo-embolic conditions
  - a) Hemophilia
  - b) Thrombocytopenia
  - c) Disseminated Intravascular Coagulation
- Discuss the role of commonly used anticoagulants

### **12. Genesis and general characteristics of white blood cells**

- Describe the process of leukocyte genesis
- List the types of granulocytes and agranulocytes, their functions & normal values

### **13. Functions of WBCs, Monocytes macrophage cell system**

- Explain the significance of Reticuloendothelial system in body defense mechanism

	<ul style="list-style-type: none"><li>• List the various types of macrophages present in different tissues of body</li><li>• Discuss the role of passive immunity against infection</li></ul>
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**14. Types and functions of lymphocytes**

- List the types of lymphocytes and their sites of origin
- Discuss the functions of T and B lymphocytes
- Enumerate the types of T lymphocytes & their functions

**15. Immunity & its types (Innate)**

- Define immunity
- Classify immunity
- Describe the process of innate immunity

**16. Cell mediated Immunity**

- Define cell mediated immunity
- List the cells involved in this immunity type
- Describe the process of cell mediated immunity

**17. Humoral immunity**

- Define Humoral immunity
- List the cells involved in this immunity type
- Describe the process of humoral mediated immunity
- List the advantages of this type of immunity

**18. Passive immunity and immunization**

- Define passive immunity & immunization
- Differentiate between passive and active immunity
- Describe the process of immunization and its advantages
- Explain the Expanded Program on Immunization (EPI)

**19. Allergy and hypersensitivity**

- Discuss the types of hypersensitivity and allergic reactions including Urticaria, Anaphylaxis and Hay fever

	<ul style="list-style-type: none"><li>• Discuss the role of IgE antibodies in immunity</li></ul>
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<b>PRACTICALS</b>	<b>1. Histology of Lymph Nodes and Thymus</b>
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<b>ANATOMY</b>	<ul style="list-style-type: none"><li>• Briefly describe microscopic structure of lymphoid tissue</li><li>• Describe the structure and histological features of lymph nodes</li><li>• Describe the structure and histological features of thymus</li></ul> <p><b>2. Histology of Spleen &amp; Tonsils</b></p> <ul style="list-style-type: none"><li>• Describe the structure and location of tonsils and spleen</li><li>• Identify the histological features of tonsils and spleen</li></ul>
<b>BIOCHEMISTRY</b>	<p><b>1. Specimen collection</b></p> <ul style="list-style-type: none"><li>• Discuss the samples used for biochemical analysis</li><li>• Demonstrate the uses of the blood collection tubes</li><li>• Observe collection of blood specimen for biochemical analysis</li><li>• Separate plasma from a blood sample</li><li>• Separate serum from a blood sample</li><li>• Correlate the laboratory investigations with relevant clinical conditions</li></ul> <p><b>2. Spectrophotometry</b></p> <ul style="list-style-type: none"><li>• Explain the principle of Spectrophotometry</li><li>• Demonstrate the technique of Spectrophotometry</li><li>• Illustrate the parts of a Spectrophotometer</li><li>• Explain the significance of making blank solution</li><li>• Explain the significance of transmittance and optical density</li><li>• Calculate the concentration of the analyte in the sample</li><li>• Perform analysis of analyte in the sample by Spectrophotometry</li><li>• Correlate the laboratory investigations with relevant clinical conditions</li></ul> <p><b>3. Flame Photometry</b></p> <ul style="list-style-type: none"><li>• Explain the principle and technique of Flame Photometry</li></ul>
	<ul style="list-style-type: none"><li>• Explain the significance of using de-ionized water in Flame Photometry</li></ul>

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	<ul style="list-style-type: none"><li>• Calculate the concentration of the analyte in the sample</li><li>• Demonstrate the use of Flame photometer Correlate the laboratory investigations with relevant clinical conditions</li></ul>
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### **4. Estimation of Plasma Proteins**

- Interpret the plasma protein levels in different diseases
- Estimate the plasma protein levels by Spectrophotometry using the Kit Method
  - Correlate the laboratory investigations with relevant clinical conditions

### **5. Electrophoresis**

- Explain the principle of electrophoresis
- Demonstrate the technique of electrophoresis
- Discuss the applications of electrophoresis
- Correlate the laboratory investigations with relevant clinical conditions

### **6. ELISA**

- Explain the principle of ELISA
- Demonstrate the technique of ELISA
- Discuss the applications of ELISA
- Correlate the laboratory investigations with relevant clinical conditions

## **PHYSIOLOGY**

### **1. Peripheral Blood Film**

- Explain the phlebotomy (venipuncture) procedure
- Discuss the procedure of blood sampling and its main constituents
- Describe Aseptic measures
- Explain the steps of formation of thin blood smear/film

### **2. Blood grouping & Cross matching**

	<ul style="list-style-type: none"><li>• Identify blood group by the use of antisera</li><li>• Mention different types of blood groups</li></ul>
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	<ul style="list-style-type: none"><li>• Describe ABO (classical) &amp; Rhesus blood grouping system</li><li>• Explain the causative mechanism of Erythroblastosis Fetalis</li><li>• Discuss the significance of Blood Grouping &amp; Cross Matching</li></ul> <p><b>3. Bleeding time and Clotting time</b></p> <ul style="list-style-type: none"><li>• Define bleeding time and its normal value</li><li>• Describe Duke's and Ivy's methods of measuring bleeding time</li><li>• List the conditions in which bleeding time is prolonged</li><li>• Define clotting time and its normal value</li><li>• Describe the Capillary tube and Modified Lee methods of measuring clotting time</li><li>• List the conditions in which clotting time is prolonged</li></ul> <p><b>4. Differential Leukocyte Count (DLC)</b></p> <ul style="list-style-type: none"><li>• List different types of WBCs and their normal values</li><li>• Discuss the composition of Leishman's stain &amp; its significance<ul style="list-style-type: none"><li>• Explain the methods of counting WBCs</li></ul></li></ul> <p><b>5. Erythrocyte Sedimentation Rate (ESR)</b></p> <ul style="list-style-type: none"><li>• Describe the mechanism of rouleaux formation</li><li>• Explain the methods of determination of ESR (Westergren's &amp; Wintrobe's method)</li><li>• State the normal value of ESR in males &amp; females, and its significance</li></ul>
<b>Interactive Session</b>	<b>Scenario Based</b> <ul style="list-style-type: none"><li>• Interpret the given CBC on the basis of red cell indices.</li></ul> <p style="text-align: right;">2 HOURS</p>
<b>CASE BASED LECTURE</b>	<b>Thalassemia</b> <ul style="list-style-type: none"><li>• Define thalassemia</li><li>• Discuss types of thalassemia (thalassemia major and minor)</li><li>• Explain the pathophysiology and development of signs and symptoms of Thalassemia in a given case scenario</li></ul>
<b>COURSE EVALUATION</b>	<ul style="list-style-type: none"><li>• The module will be evaluated through a feedback form posted on JSMU website</li></ul>

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