KHYBER MEDICAL UNIVERSITY

MODULE 2
BLOOD & IMMUNOLOGY
1ST YEAR BDS

Contents

Vision & Mission

Khyber Medical University (KMU) Vision:

Khyber Medical University will be the global leader in health sciences academics and research for efficient and compassionate health care.

Khyber Medical University (KMU) Mission:

Khyber Medical University aims to promote professional competence through learning and innovation for providing comprehensive quality health care to the nation.

Institute of Health Professions Education & Research (IHPER) Mission:

To produce leaders, innovators and researchers in health professions education who can apply global knowledge to resolve local issues.

Teaching Hours Allocation

Table 2: Hours allocation for different subjects

S. No	Subject	Hours
1	Anatomy	10
2.	Physiology	45
3.	Biochemistry	07
4.	Oral Biology	28
5.	Pathology	06
6.	Pharmacology	01
7.	Oral Medicine	02
9.	Community & Preventive dentistry	02
Total		**101**

Themes for Blood Module

SNO	Theme	Duration
1	Pallor and swelling	1 week
2	Fever (Infection and Immunity)	1.5 week
3	Excessive bleeding	1 week
4	Transfusion Reaction	0.5 week
Total		**4 weeks**

Learning Outcomes

Cognitive Domain

By the end of this module, first-year BDS students shall be able:

1. Describe the various cellular and non-cellular components of blood in relation to its Anatomy, Physiology & Biochemistry.
2. Describe the structure, synthesis, and degradation of Hemoglobin.
3. Describe the regulatory mechanisms of normal hemostasis and coagulation.
4. Describe the conditions associated with the dysfunction of cellular and non-cellular components of blood.
5. Describe the basic characteristics of the immune system.
6. Discuss the structure, functions, and biochemical aspects of the Lymphoreticular system.
7. Explain the principles and clinical significance of the ABO/RH blood grouping system.
8. Explain the pathophysiology of various bleeding disorders.
9. Identify the role of pharmacology in anemia and bleeding disorders.

Psychomotor Domain

Description of the psychomotor skills to be developed and the level of performance required:

By the end of the Blood Module, the student should be able to:

1. Perform practical work as instructed in an organized and safe manner
2. Record observations accurately.
3. Identify slides of the Lymph node, thymus, tonsils, and spleen under the microscope.
4. Identify the slide of Gut-associated lymphoid tissue.
5. Determine the percentage of formed blood elements.

6. Identify RBC and should be able to do its counting-on-counting chamber and to know normal values. And also classify Anemia morphologically.
7. Determine the Hemoglobin with the apparatus and have knowledge of normal and abnormal values.
8. Identify WBC morphology and its different types to count them on the counting chamber and know the normal values. Diagnostic importance of each WBC.
9. Identify Platelets and should be able to do its counting on the counting chamber and to know normal values. Its diagnostic importance in relation to bleeding disorders.
10. Perform bleeding time and clotting time, know normal values and their diagnostic importance in relation to bleeding disorders.
11. Perform Blood group typing and Rh factor.
12. Perform ESR and to know its normal value and prognostic importance.
13. Detect blood, bile pigments & bile salts in the given sample of urine.

Affective Domain

By the end of the Blood Module, the student should be able to.

1. Demonstrate ability to give and receive feedback and respect for self and peers.
2. Demonstrate empathy and care to patients.
3. Develop respect for the individuality and values of others - (including having respect for oneself), patients, colleagues, and other health professionals.
4. Organize and distribute tasks.
5. Exchange opinion & knowledge.
6. Develop communication skills and etiquette with a sense of responsibility.
7. Equip themselves with teamwork.
8. Regularly attend the classes.
9. Demonstrate good laboratory practices.

Theme I: Pallor and Swelling			
Subject	**Topic**	**Hours**	**Learning objectives**
Physiology	Introduction to Blood	1 hour	1. Enumerate the composition & functions of blood. 2. Enlist the types of blood cells and their specific functions. 3. Enlist the components of plasma. 4. Differentiate between serum and plasma.
	Introduction to hematopoietic system	1 hour	5. Define Hematopoiesis and Classify hematopoietic stem cells. 6. Describe the genesis of blood cells.
	Red blood cells & Erythropoiesis	3 hours	7. Describe the structure, functions, life span and normal count of red blood cells. 8. Discuss the stages of RBC development (erythropoiesis) from pluripotent hematopoietic stem cells to a mature RBC. 9. Describe the factors regulating erythropoiesis. 10. Describe the role of Vitamin B12 and Folic acid in RBC maturation and the effects of their deficiency. 11. Classify and Discuss RBC indices and their clinical significance.
	Erythropoietin	1 hour	12. Describe source, control/regulation, and functions of Erythropoietin. 13. Explain the role of Erythropoietin in RBC production. 14. Describe the effects of high altitude and exercise on RBC production.
	Anemia and Polycythemia	2 hours	15. Classify the types of anemia on the basis of etiology and morphology 16. Interpret the type of anemia on the basis of red cell indices 17. Define and classify polycythemia 18. Differentiate between primary and secondary polycythemia

			19. Describe the effects of anemia & polycythemia on functions of circulatory system / human body
Biochemistry	Introduction of Porphyrins	1 hour	20. Define Porphyrins. 21. Describe Chemistry of Porphyrins. 22. Enlist the types, metabolic causes, and clinical presentation of different types of Porphyria's.
	Iron metabolism	1 hour	26. Describe the iron metabolism.
	Introduction to heme synthesis and degradation	1 hour	27. Define heme and describe its structure and functions. 28. Describe the biochemical features of the hemoglobin molecules. 29. Describe Heme Synthesis on cellular and molecular level. 30. Describe Heme Degradation. 31. Describe the Regulation of Heme Synthesis. 32. Describe the concept of Oxygen binding with hemoglobin.
	Hemoglobinop athies	3 hours	33. Define Hemoglobinopathies and enlist the variants of hemoglobin. 34. Describe causes of Hemoglobinopathies. 35. Describe two major categories of hemoglobinopathies. 36. Describe the amino acid substitution in sickle cell disease. 37. Define and Classify thalassemia's. 38. Explain the genetic defects in α and β thalassemia's. 39. Enlist the clinical features of α and β thalassemia's. 40. Discuss the role of vit B12 and Folic acid in prevention of anemia. 41. Describe abnormalities of iron metabolism.

Pathology	Anemias of diminished erythropoiesis and Hemolytic anemia's	2 hours	44. Define anemia. 45. List the factors for regulation of erythropoiesis. 46. Enlist the types of anemia.
			47. Define hemolytic anemia. 48. Enlist types of hemolytic anemia. 49. Discuss pathophysiology of hemolytic anemias.
Pharmacology	Drug treatment of anemia's	1 hour	50. Enlist the drugs used in the treatment of iron deficiency & Megaloblastic anemia. 51. Describe the pharmacological basis/ role of iron in iron deficiency anemia (hypochromic normocytic anemia). 52. Describe the pharmacological basis/ role of vitamin B12 and folic acid in megaloblastic anemia. 53. Describe the role of erythropoietin in the treatment of anemia (normochromic normocytic anemia).
Oral medicine	Oral manifestation of anemia	1 hour	54. Enlist oral manifestations of anemia. 55. Discuss various oral conditions associated with anemia.
Lab Work			
Physiology	RBC count	2 hours	56. Demonstrate the preparation of a blood sample using an appropriate dilution method for an accurate RBC count. 57. Operate a microscope and use a Neubar's chamber to accurately count red blood cells in a given sample. 58. Apply the formula for calculating the total number of red blood cells per microliter of blood based on the chamber grid and dilution factor. 56. Interpret and record the findings of the RBC count, identifying normal and abnormal values based on physiological reference ranges.
	Hemoglobin (Hb) determination	2 hours	57. Demonstrate the proper collection of a blood sample and its preparation for Hb estimation using Sahli's method.

			58. Calculate the Hb concentration using the readings obtained and the provided formula or calibration chart. 59. Interpret the Hb concentration in relation to standard physiological ranges and identify deviations indicating anemia or polycythemia.
	Erythrocyte sedimentation rate (ESR)	2 hour	60. Demonstrate the correct procedure for collecting and preparing a blood sample for the estimation of ESR. 61. Set up a Westergren or Wintrobe tube accurately to measure ESR according to standard protocols. 62. Interpret the ESR results by comparing them with standard reference ranges and identify potential causes of abnormal values.

Theme –II Fever (Infection and Immunology)			
Subject	**Topic**	**Hour**	**Learning Objectives**
Anatomy	Histology of lymphoid tissues	4 hours	64. Describe the histological features and functions of lymph node. 65. Describe the histological features and functions of thymus. 66. Describe the histological features and functions of tonsils 67. escribe the histological features and functions of spleen.
Pathology	Inflammation	1 hour	68. Define inflammation. 69. Enlist the types of inflammation. Describe characteristics of inflammation (hallmark of inflammation).
	Abnormal Leukocyte counts/ Leukemia	2 hours	70. Define leukopenia and leukocytosis and Leukemia.

Physiology	White blood cells and its types	2 hours	71. Classify WBCs and Describe general characteristics of leukocytes (structure, functions & life-span). 72. Describe the stages of differentiation of white blood cells (leukopoiesis). 73. Describe the "Walling-Off Effects" of Inflammation. 74. Discuss neutrophils and macrophages responses during inflammation. 75. Discuss first, second, third and fourth line of defense cells. 76. Discuss the role of eosinophils in combating parasitic infections. 77. Discuss the role of basophils in allergic reactions.
	Reticuloendothelial (monocyte-macrophage) system	1 hour	78. Discuss the components of reticuloendothelial system (monocyte-macrophage system). 79. Describe the role of macrophage system in immunity in different body tissues (skin, lymph nodes, lungs, liver sinusoids, spleen and bone marrow).

Physiology	Introduction to Immunity	2 hours	80. Define and classify immunity: Innate & Acquired (adaptive). 81. Define antigen and pathogen. 82. Enlist different aspects of innate immunity. 83. List the substances and cells that participate in adaptive immunity. 84. Compare the characteristics innate and acquired immunity. 85. Classify acquired immunity: Active & Passive. 86. Compare the differences between active and passive acquired immunity.
	Humoral & Cell Mediated Immunity	2 hours	87. Describe and differentiate between humoral and cell mediated immunity. 88. Explain the role of antigen-presenting cells in the activation of T lymphocytes. 100. Classify T cells and discuss their specific immune functions.
	Complement System	2 hours	101. Describe the structural features of antibody. 102. Enlist different types of antibodies and specify their functions. 103. Discuss the direct action of antibodies on invading agents. 104. Explain the complement system of antibody action. 105. Compare classic and alternate pathways of complement activation. 106. Discuss the important effects of complement system.
	Allergy & Hypersensitivity	1 hour	107. Describe and classify the hypersensitivity reaction. 108. Compare the immediate and delayed hypersensitivity reactions. 109. List the diseases associated with hypersensitivity reactions
Biochemistry	Immunoglobulin's /Antibodies	1 hour	112. Define Immunoglobulins. 113. Describe the types of Immunoglobulins. 114. Describe Structure of Immunoglobulins. 115. Describe the mechanism of action of antibodies. 116. Explain biochemical role of each immunoglobulin in immunity.

Oral Biology	Dental Pulp	6 hours	117. Discuss anatomy of pulp including coronal and radicular pulp. 118. Describe the histology of pulp including cells, ground substance, fibers, blood and nerve supply and lymphatic drainage. 119. Identify microscopic zones of pulp with detailed theoretical and diagrammatic representation. 120. Describe functions of pulp. 121. Differentiation of pulp of primary and permanent dentition. 122. Discuss regressive changes of pulp (age changes). 123. Explain development of pulp. 124. Draw different microscopic zones of pulp with labelling. 125. Differentiate types and properties of pulpal sensory nerve fibers. 126. Interpret the number of root canals its configuration and position of apical foramen for endodontic procedures.
	Periodontal Ligament (PDL)	8 hours	129. Define Periodontal Ligament (PDL). 130. Explain in detail the development of principle fibers and cells of PDL. 131. Explain PDL homeostasis which helps to maintain the width of PDL. 132. Describe cells of PDL under headings of synthetic, resorptive, defense, progenitor cells and epithelial rest cells of Malassez. 133. Name markers of PDL and growth factors involved in normal biology. 134. Discuss the functions of PDL. 135. Discuss cell biology of PDL. 136. Enumerate the principal fibers of PDL with complete description of course and functions. 137. Describe composition of ground substance of PDL and its functions. 138. Describe synthetic cells and their individual function in detail. 139. Discuss clinical correlation of PDL with operative, surgical, and orthodontic procedures and conventional to latest treatment modalities for periodontal inflammatory diseases.

Lab Work				
Histology		6 hours	140.	Identify and describe the microscopic anatomy of bone marrow and spleen under microscope.
			141.	Identify histological features of lymph nodes, spleen, thymus, and tonsils.
Physiology	WBC count	2 hours	142.	Demonstrate the preparation of a blood sample using the correct dilution technique for accurate WBC counting.
			143.	Use a Neubar's chamber to accurately count white blood cells under a microscope, ensuring proper focus and grid identification.
			144.	Apply the standard formula to calculate the total WBC count per microliter of blood based on the observed count and dilution factor.
			145.	Interpret WBC count results by comparing them to normal physiological reference ranges and identify abnormalities.
	DLC	2 hours	146.	Demonstrate the preparation of high quality peripheral blood smear suitable for differential leukocyte count analysis.
			147.	Apply the appropriate staining technique (e.g., Leishman or Wright's stain) to highlight the morphology of different types of leukocytes.
			148.	Identify and classify the different types of white blood cells (neutrophils, lymphocytes, monocytes, eosinophils, and basophils) based on their size, shape, and staining characteristics under a microscope.
			149.	Calculate the percentage of each type of leukocyte by systematically counting cells in various microscopic fields.
			150.	Interpret the results of the differential leukocyte count in relation to normal reference ranges and correlate deviations with pathological conditions, such as infections, allergies, or hematological disorders.

Theme –III Bleeding Gums			
Physiology	Hemostasis	1 hour	151. Describe the structure, function, life span and normal count of Platelets. 152. Define hemostasis. 153. Describe the role of platelets in hemostasis. 154. Outline the sequence of processes involved in hemostasis.
	Blood coagulation	1 hour	155. Enlist clotting factors and explain their role in blood coagulation. 156. Outline the sequence of processes during blood coagulation. 157. Describe with the help of a flow diagram the intrinsic and extrinsic pathways of coagulation cascade. 158. Discuss the role of calcium in coagulation.
	Anti-clotting mechanisms	1 hour	159. Discuss the prevention of blood clotting in normal vascular system. 160. Describe the lysis of blood clot. 161. Enlist anticoagulants and their mechanism of action: Heparin, coumarins (warfarin). 162. Describe the prevention of blood coagulation outside the body.
	Bleeding disorders	1 hour	163. Enlist bleeding disorders. i.e; decreased clotting factors, hemophilia, thrombocytopenia, thromboembolic conditions, disseminated intravascular coagulation (DIC). 159. Describe the bleeding disorders related to Vitamin K deficiency.
Oral Biology	Oral mucosa	6 hours	163. Define oral mucosa and classify on basis of function and histophysiology, into lining mucosa, masticatory mucosa, and specialized mucosa. 164. Describe structure of Oral epithelium, Basement membrane, Lamina Propria, Sub mucosa. 165. Describe functions of oral mucosa, compare with intestinal and skin mucosa.

			166. Enlist the histological differences between keratinized &non keratinized oral epithelium.
Lab Work			
Physiology	Platelet count	2 hours	166. Demonstrate the correct preparation of a blood sample using an appropriate anticoagulant and dilution method for platelet counting. 167. Use a Neubar's chamber under a microscope to accurately identify and count platelets in a diluted blood sample. 168. Apply standard formula to calculate platelet count per microliter of blood based on observed counts and dilution factors. 167. Interpret the platelet count results by comparing them with normal reference ranges and recognize deviations such as thrombocytopenia or thrombocytosis.
	Bleeding time	2 hours	169. Demonstrate the correct procedure for performing the bleeding time test using standardized methods, such as Ivy or Duke's method. 170. Measure and record the bleeding time accurately using a stopwatch and appropriate observation of blood cessation. 171. Interpret bleeding time results by comparing them with normal reference ranges and identify abnormalities such as prolonged bleeding time.

	Clotting time	2 hours	172. Demonstrate the correct procedure for performing the clotting time test using the capillary method or test tube method. 173. Accurately time the formation of a clot using a stopwatch, recording the clotting time for the given blood sample. 174. Interpret clotting time results by comparing them with normal reference values and recognize abnormal clotting time indicative of bleeding or clotting disorders. 175. Relate prolonged or shortened clotting times to specific clinical conditions such as hemophilia, liver disease, or vitamin K deficiency.
	PT & APTT tests	2 hours	176. Perform the PT and APTT tests accurately using a coagulation analyzer or manual method, following standard protocols. 177. Apply the appropriate reagents (e.g., thromboplastin for PT and partial thromboplastin with calcium for APTT) and ensure proper timing during the tests. 178. Calculate PT and APTT results and compare them with normal reference ranges to assess clotting function. 179. Interpret abnormal PT and APTT results to identify potential causes, such as vitamin K deficiency, liver disease, or coagulation factor deficiencies.
Oral Biology	PDL, pulp and oral mucosa in slides.	4 hours	180. Identify structures of PDL, pulp and oral mucosa in slides. 181. Identify the central and lateral incisors on models. 182. Draw the diagram of maxillary incisors. 183. Interpret the anatomical structure of maxillary incisors.

Theme –IV Cross Infection Prevention and Control in Dentistry			
Physiology	Blood grouping	1 hour	184. Describe different types of blood groups. 185. Describe and interpret the genotype phenotype relationships in blood groups. 186. Describe the role of agglutinogens (antigens) and agglutinins (antibodies) in blood grouping. 187. Describe the process of agglutination.
	Transfusion reactions	1 hour	188. Describe Rh blood type and Rh Antigens. 189. Discuss Rh immune response. 190. Classify and manifest the characteristics of transfusion reactions.
	Erythroblastosis fetalis	1 hour	191. Discuss the mechanism and clinical picture of erythroblastosis fetalis. 192. Describe the treatment options and preventive measures of erythroblastosis fetalis.
Pathology	Transfusion reaction and organ transplant	1 hour	200. Discuss transfusion reaction and organ transplant. 201. Explain the criteria for transplant, donor, recipient, role of immune system in transplant, different types of transplants.
Oral Medicine	Oral manifestations of blood disorders	1 hour	202. 203. Discuss leukemia & its oral presentation. 204. Discuss thrombocytopenia & its oral presentation. 205. Discuss leukocytic disorders (neutropenia, agranulocytosis & certain syndromes) & their oral presentation.

Community & Preventive Dentistry	Epidemiology of blood borne diseases	1 hour	206. Identify blood borne pathogens. 207. Discuss epidemiology of blood borne disease transmission. 208. Discuss routes of transmission. 209. Discuss best practices to perform safe blood transfusion. 210. Identify potential risks of exposures. 211. Enlist important safeguards against blood borne pathogens.
	Cross Infection Control/ Needle Prick Injury	1 hour	212. Enlist Causes of NPI. 213. Identify people at risk. 214. Discuss management of needle prick injury. 215. Discuss Prevention of NPI. 216. Discuss Importance of infection control practices while handling needles & sharp objects e.g., lancet.
Lab Work			
Physiology	Blood group	2 hours	217. Determine the O-A-B and Rh blood group in the given sample
Oral Bio & Tooth Morphology	Maxillary Central and Lateral Incisors	4 hours	218. Explain the morphology of labial, lingual, mesial, distal, and incisal, aspects of crown of maxillary central and lateral incisors. 219. Explain morphology of root of maxillary incisors. 220. Explain variations and anomalies associated with maxillary central and lateral incisors. 221. Explain variations and anomalies associated with maxillary central and lateral incisors. 222. Differentiate between maxillary central and lateral incisor.