Syllabus: Hematopoietic System (181501207)

Second Year–Second Semester–2022/2023

COURSE INFORMATION	
Course Name: Hematopoietic System **Semester:** Second (Spring) 2022/2023 **Department:** Pharmacology and Public Health **Faculty:** Medicine	**Course Code: 181501207** **Section:** Preclinical Modules **Core Curriculum**: MD program
Day(s) and Time(s): 8:00AM - 3:00PM Sunday-Thursday **(Teaching Period: 25.2.**20**24** – 13.3.20**24)** **Classroom:** ***Theoretical lectures:*** **Ibn Sina Complex 301, 302** ***Practical sessions:*** labs of anatomy, physiology, microbiology and pathology, Ibn Sina Complex	**Credit Hours:** 4 **Prerequisites**: NA

COURSE DESCRIPTION

The Hematopoietic Module is an intensive, multidisciplinary, integrated 4 credit-hour course designed to provide medical students with essential basic science and clinical framework for topics related to normal function and abnormalities of the blood and lymphatic systems. The course encompasses lecture-based and laboratory sessions in the anatomy, physiology, pathology, pharmacology, biochemistry, and community medicine of the blood. Students are expected to be familiar with main disorders that affect the blood and lymphatic systems and their corresponding therapy approaches.

DELIVERY METHODS

The course will be delivered through a combination of active, in-class and online, learning strategies. These will include:

- PowerPoint lectures and active classroom-based discussion
- Live online-delivered lectures
- Relevant papers and reading materials
- E-learning resources: e-reading assignments, virtual meetings, and practice quizzes through Microsoft Teams.

FACULTY INFORMATION

Course Coordinator	
Name	Tareq Saleh, MD, PhD
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REFERENCES AND LEARNING RESOURCES

* **Anatomy**:
- Grey's Anatomy for Students by Richard Drake, 4th edition.
- Principles of Human Anatomy by Gerard J Tortora and Mark Nilsen, 14th edition.
- Clinical Anatomy for Medical Students. By R.S. Snell, 5th edition.
- Before We Are Born, by K.L. Moore and T.V.N. Persaud, 10th edition.

* **Physiology**:
- Textbook of Medical Physiology by Gyton and Hall, latest edition.

* **Biochemistry**:
- Harper's Biochemistry by Robert K. Murray and Co., latest edition.

* **Pharmacology**:
- Lippincott's Illustrated Reviews: Pharmacology, 7th edition.

* **Pathology**:
- Basic Pathology by Kumar, Abbas and Aster, 10th edition.

* **Microbiology**:
- Medical microbiology. An introduction to infectious diseases. By Sheries. Latest edition.

TOPICS DETAILS/ STUDENT LEARNING OUTCOMES MATRIX *

Course Objectives	Course Student Learning Outcomes			Assessment Method
	TOPIC (SUBJECTS& NUMBER OF LECTURES/ SUBJECT)	SUBJECT	Intended Learning Outcomes	
A-Biomedical: 1. Describe the main components of blood, histology of bone marrow, lymph nodes and structure of spleen and their functions. 2. Understand the physiology of blood coagulation pathways and their contribution to thrombosis and bleeding disorders. 3. Identify abnormalities of red blood cells. 4. Understand the pathophysiology of anemia and its treatment. 5. Familiarize with the malignant and non-malignant disorders of white blood cells. 6. Identify different types of leukemia and lymphoma, their pathological classification, clinical presentation and treatment. 7. Identify the microbial agents and diagnostic tests related to blood. 8. Identify the public health issues associated with anemia and malaria.	***Topic 1: Structure and Function of Blood (11 lectures):** Anatomy: 2 Physiology: 6 Biochemistry: 3	Anatomy: 1. Anatomy and histology of blood (1) 2. Anatomy and histology of blood (2)	-Describe the composition of blood -Discuss the shape, size, color, structure, composition, number, and lifespan of erythrocytes. -Understand the structural-functional adaptation of erythrocytes. -Describe the shape, size, structure, and differential count of granular and agranular leukocytes. -Describe the histological features of neutrophils, eosinophils and basophils. -Describe the types of lymphocytes and their different basic functions. -Identify the light and electron microscopic features of monocytes. -Describe the count, size, shape and lifespan of platelets. -Describe the light and electron microscopic structure of platelets. -Describe the histology of the bone marrow and haemopoiesis	-Online quizzes. -Exams
		Physiology: 1. Blood Functions, Functions of plasma & RBCs characteristics. 2. RBCs functions and regulation of RBCs production 3. Blood Groups 4. Hemostasis and Blood Coagulation 5. Prevention of Blood Clotting and Lysis of Blood Clots 6. WBCs: Characteristics and functions	-Understand the functions of blood. -Describe the constituents of plasma and how they are attributed to the general function of the plasma. -State that RBCs are non-nucleated biconcave elastic discs, their number in peripheral blood. -Identify the sites of formation; discuss the normal percentage of reticulocytes of the whole circulating red blood cells and explain the causes of reticulocytosis. -How RBCs are regulated, the effect of hypoxia. -Describe the role of iron, vitamin B12, and folic acid and describe the effect of their deficiency. -Understand the basis of human blood typing into different blood groups. -Describe the ABO and Rh systems of blood grouping. -Apply the knowledge given in the blood grouping system in blood transfusion. -Describe the importance of cross-matching tests. -Identify the complications of incompatible blood transfusion.	

8-Correlate the basic biomedical knowledge to the clinical skills ***<u>B-Critical thinking skills:</u>*** 1-Observe, identify and predict health problems based on previous experience and make decisions based on evidence rather than opinion 2- Draw conclusions about the collected data (inference). 3- Maintain good communication habits, such as active listening and respect. 4-Improve problem-solving skills. 5-Demonstrate knowledge of resources and tools available to support lifelong learning			-Describe the major types and causes of anemia and polycythemia. -Define hemostasis and describe the three steps involved in hemostasis. -Understand the structure, function and life span of platelets. -Understand the interaction of platelets, blood vessels and plasma coagulation factors in hemostasis. -identify which coagulation factors are dependent on vitamin K and how vitamin K modifies these coagulation factors. -Describe the fibrinolytic system and understand its role during hemostasis. -Describe the mechanism of anticoagulants and correlate to the coagulation pathways and components. -Identify the pathophysiologic mechanisms of disease states caused by disturbed hemostasis. -Discuss how to recognize different WBCs types and describe their site of production, life span and function. -Differentiate between marginating and circulating pools of WBCs. -Understand the principle behind the total, relative and absolute WBCs count. -Describe the properties of phagocytic WBCs and physiological leukocytosis. -Describe the tissue macrophages and the reticulo-endothelial system.	
		<u>Biochemistry:</u> 1. Erythrocyte Metabolism (1) 2. Erythrocyte Metabolism (2) 3. Hemoglobin and Hemoglobinopathies	-Understand and illustrate the steps of the Embden-Meyerhof pathway, and how it helps regulate the reduction of methemoglobin back to hemoglobin. -Explain how the Embden-Meyerhof pathway relates to 2,3-DPG production. -Understand and describe the steps of the hexose monophosphate shunt. -Describe the HMP shunt function and explain on a biochemical basis how this shunt helps to protect red cells from oxidative stress. -Explain how G6PD deficiency causes favism. -List the normal hemoglobins found in fetal and adult blood. -Describe the genetics of sickle cell anemia and the precipitating factors by which hemoglobin S causes sickling. -Identify the different chromosomes responsible for alpha-globin and beta-globin synthesis. -Describe the basic genetic differences between alpha-thalassemia and beta-thalassemia. -Describe the genetic and hematologic differences between alpha-thalassemia	

			trait, hemoglobin H disease, and hydrops fetalis. -Describe the genetic and hematologic differences between beta–thalassemia minor and beta– thalassemia major. -Identify normal and abnormal hemoglobins by electrophoresis.	
	***Topic 2: Red Blood Cells Diseases and Treatment (lectures: 17)** Biochemistry: 1 Microbiology: 5 Community Medicine: 2 Pathology: 4 Pharmacology: 5	Biochemistry 1. Porphyria and hemolytic anemia	-Describe the reactions and rate-limiting steps implicated in heme synthesis -Describe the clinical consequences of the congenital deficiency of the enzymes involved in heme synthesis. -List and explain the intrinsic and extrinsic causes of hemolytic anemias. -List laboratory investigations that are used in the diagnosis of hemolytic anemias.	
		Microbiology 1. Epstein-Barr Virus (EBV) and parvovirus B19 2. Plasmodium and babesiosis 3. Trypanosomiasis, visceral leishmaniasis and filariasis 4. Salmonella typhi, enteric fever and brucellosis 5. Yersinia pestis, and plague; Q-Fever and other rickettsia	-Describe the virology, epidemiology, pathogenesis, clinical presentation, and management of Epstein-Barr virus -Describe the virology, epidemiology, pathogenesis, clinical presentation, and management of parvovirus B19. -Describe the morphology, life cycle, epidemiology, pathogenesis, immunity, clinical presentations, diagnosis, management, and prevention of malaria -Describe the general characteristics, epidemiology, pathogenesis, clinical presentation, and management of leishmania. -Describe the general characteristics, epidemiology, pathogenesis, clinical presentation, and management of filaria. -Describe the general characteristics, epidemiology, pathogenesis, clinical presentation, and management of trypanosoma. -Describe the general characteristics, epidemiology, pathogenesis, clinical presentation, laboratory diagnosis and management of salmonella -Describe the general characteristics, epidemiology, pathology and virulence, clinical presentation, laboratory diagnosis and treatment of brucella. -Describe the general characteristics, epidemiology, pathogenesis, clinical presentation, and management of Y. pestis.	

			-Describe the general characteristics, epidemiology, classification, pathogenesis, clinical presentation and management of Rickettsia.	
		<u>Community Medicine</u> 1. Blood-borne Infections (1) 2. Blood-borne Infections (2)	-Understand the definition of blood-born infections (BBI). -Discuss the epidemiological aspects, mode of transmission, and prevention of the most common BBIs including hepatitis B, hepatitis C, and HIV, AIDS. -Describe the risk of occupational exposure to blood. -Discuss the postexposure management of BBI. -Understand the epidemiological importance of malaria -Identify the types of malaria species. -Discuss the life cycle, transmission, presentation, diagnosis, and complications of malaria. -Familiarize with the epidemiology of malaria in Jordan.	
		<u>Pathology</u> 1,2,3. Anemia (microcystic, normocytic, and macrocytic anemias) 4. Bleeding and Coagulation disorders	- Understand the definition of anemia. - Discuss the classification of anemia according to the underlying mechanism or morphology (macrocytic, microcytic, and normocytic) - Understand the clinical presentation and approach for anemias - Start the discussion with microcytic anemias “iron def. anemia, AOCD and thalassemia) - Then, macrocytic anemia, “megaloblastic anemia.” - Discuss thalassemia and understand the major types, the underlying genetics and the different presentations. - Discuss the pathophysiology of sickle cell disease and the precipitating factors of sickling. - Understand the consequences of sickling, including a plastic crisis. -Discuss the mode of inheritance and pathogenesis of G6PD Understand paroxysmal nocturnal hemoglobinuria. -Discuss immune and non-immune mediated hemolytic anemia -Understand the types of immune-mediated hemolytic anemia, including A-Warm antibody type and B-Cold antibody type	

			-Identify the causes of abnormal bleeding, including vascular disorders, thrombocytopenia, platelet function defects, and defective coagulation -Discuss the underlying etiologies of thrombocytopenia and describe both acute and chronic idiopathic thrombocytopenia -Describe the pathology of hemophilia A and B and von Willebrand disease -Discuss thrombotic thrombocytopenia purpura and microangiopathic hemolytic anemia -Define disseminated intravascular coagulopathy and it's clinical implications	
		Pharmacology 1. Drugs for the treatment of anemia (1) 2. Antiplatelets, anticoagulants and thrombolytics (1) 3. Antiplatelets, anticoagulants and thrombolytics (2) 4. Antiplatelets, anticoagulants and thrombolytics (3) 5. Chemotherapy for Malaria	-List the different approaches utilized for the treatment of anemia based on its classification. -Describe the main characteristics of iron preparations, their therapeutic indications, pharmacokinetics, and major adverse effects. -Describe the mechanism of action of folic acid and vitamin B12, their therapeutic indications and major adverse effects. -Understand the role of erythropoietin in the treatment of anemia, therapeutic guidelines, and major adverse effects. -List pharmacological therapy utilized for the treatment of neutropenia. -Describe the role of hydroxyurea in the treatment of sickle cell anemia, its mechanism of action and overall contribution to disease outcome. -Understand the roles of the endothelium, platelets, and coagulation pathway in the development of arterial and venous thrombosis. -Delineate the pharmacological targets of the platelet plug formation process, including platelet activation, adhesion, and aggregation. -Understand the mechanisms of action, therapeutic uses, therapeutic guidelines, and major adverse effects of platelet aggregation inhibitors. -List the hematological and non-hematological uses of aspirin -Understand the mechanisms of action, therapeutic uses, therapeutic guidelines, and major adverse effects of parenteral anticoagulants. -Understand the mechanisms of action, therapeutic uses, therapeutic guidelines, and major adverse effects of oral anticoagulants (direct and indirect agents). -Compare between heparins and warfarin in terms of mechanism of action, route of administration, onset, duration of action, drug interactions, teratogenic effects, and antidote.	

			-Describe mechanisms of action, therapeutic uses, therapeutic guidelines, and major adverse effects of thrombolytics. -Understand the different pharmacological approaches to treat bleeding -Understand the mechanism of action, pharmacokinetics, adverse effects, and clinical uses of antimalarial drugs -Describe the currently implemented guidelines for the treatment of complicated and uncomplicated malaria -Describe the drug regimens utilized for the prophylaxis against malaria	
	***Topic 3: White Blood Cells Diseases and Treatment (Lectures: 9)** Anatomy: 2 Pathology: 5 Pharmacology: 2	Anatomy 1. Anatomy and histology of the lymphatic system (1) 2. Anatomy and histology of the lymphatic system (2)	-Understand the major components and function of the lymphatic system -Describe the origin and composition of lymph -Describe the structure of lymphatic vessels, trunks, and ducts -Explain the anatomy of the thoracic duct and right lymphatic ducts -Describe the anatomy and histology of the thymus -Describe the structure, histology, and function of lymph nodes -Identify the anatomy, histology, and function of the spleen and tonsils	
		Pathology 1. Neoplastic proliferation of WBCs, Acute Leukemia (ALL+AML) 2. Myeloproliferative Neoplasms (MPN) and Myelodysplastic Syndromes (MDS) 3. Lymphoid neoplasms, non-Hodgkin lymphomas 4. NHL, Multiple myeloma, and related plasma cell disorders 5. Lymphoid neoplasms, Hodgkin lymphoma	- Define leukopenia and discuss the pathogenesis, clinical features, and morphology of neutropenia/agranulocytosis - Define leukocytosis and discuss the causes based on the specific type of white cells affected. - Discuss in detail infectious mononucleosis, including definition, cause, pathogenesis, clinical features, morphology, and diagnosis. - Discuss the classification of hematologic malignancies. - Discuss the definition, epidemiology, pathogenesis, clinical features, morphology, and prognosis of precursor B & T cell neoplasms (ALL). - Be familiar with the definition, incidence, pathogenesis, clinical features, and morphologic and immunophenotypic features of acute myeloid leukemia. - Discuss the WHO and FAB classifications of AML. - Talk about the clinical course and prognostic factors of AML. - Summarize the major differences between AML and ALL - Define myeloproliferative neoplasms and discuss their general features. - Discuss the pathogenesis, clinical features, differential diagnoses, laboratory findings, morphology, and clinical course of chronic myeloid leukemia (CML).	

			- Discuss the genetic background, clinical features, laboratory findings, morphology, and clinical course of polycythemia vera and essential thrombocythemia. - Briefly discuss primary myelofibrosis. - Define myelodysplastic syndrome (MDS). - Discuss the pathogenesis, clinical features, WHO classification, and morphology of MDS - Discuss the normal lymph node morphology - Discuss acute non-specific lymphadenitis - Discuss chronic non-specific lymphadenitis by concentrating on the different morphologic patterns that occur. - Define lymphoid neoplasms and mention the WHO classification. - Be familiar with the definition, clinical, morphologic, and immunophenotypic features of low and intermediate grades peripheral B cell lymphomas, including CLL/SLL, follicular lymphoma, MALT lymphoma, and Mantle cell lymphoma. - Discuss diffuse large B cell lymphoma and be familiar with its clinical features, morphology, subtypes, and prognosis - Describe the clinical features, types, pathogenesis, morphologic features, and prognosis of Burkitt lymphoma. - Talk briefly about Hairy cell leukemia and T-cell lymphoma/leukemia - Define plasma cell neoplasms - Describe the spectrum of plasma cell dyscrasias - Discuss multiple myeloma, including the pathogenesis, clinical features, diagnosis, and morphologic and immunophenotypic features. - Briefly talk about Monoclonal Gammopathy of Undetermined Significance (MGUS). - Discuss the morphologic and clinical features of lymphoplasmacytic lymphoma -Discuss the general characteristics, classification, types, clinical features, morphologic features, immunophenotype, and prognosis of Hodgkin lymphoma. - Describe in detail the morphologic and clinical features of classical and non-classical Hodgkin lymphoma. - Be familiar with the staging system of Hodgkin and non-Hodgkin lymphoma.	
		Pharmacology 1. Immunosuppressants 2. Selected chemotherapy for the treatment of leukemia and lymphoma	-Understand the main steps involved the activation of T lymphocytes -Identify targetable molecular processes involved in immunosuppression -Understand the role of immunosuppressants in organ transplantation and the treatment of autoimmune diseases -List the major pharmacotherapies utilized for the induction of immunosuppression	

			-List the major pharmacotherapies utilized for the maintenance of immunosuppression -Understand the main differences between monoclonal and polyclonal antibodies -Understand the different phases of the treatment of leukemia -Understand the mechanisms of action, therapeutic uses, therapeutic guidelines, and major adverse effects of cytotoxic chemotherapy utilized for the treatment of hematological malignancies. -Understand the mechanisms of action, therapeutic uses, therapeutic guidelines, and major adverse effects of targeted therapies utilized for the treatment of hematological malignancies. -List the most frequently used chemotherapy regimens for the treatment of hematological malignancies.	
	<u>Practical Sessions:</u>	Anatomy Labs: 1. Anatomy and Histology of The Hematopoietic System	-Identify the morphological characteristics of neutrophils, eosinophils, basophils, lymphocytes and monocytes under light and electron microscope. -Identify the histological features of platelets under light and electron microscope. -Study the microscopic structure of bone marrow. -Identify the of different stages of hemopoiesis under light microscope -Identify the histological features of the thymus -Identify the histological characteristics of lymph nodes -Identify the gross anatomy of the spleen and palatine tonsils.	
		Physiology Labs: 1. RBCs: ESR, PCV; Blood Grouping; and Blood indices 2. Tests of Hemostasis: Clotting, Bleeding Time, capillary fragility and interpretation of lab results.	-Define Erythrocytes sedimentation Rate (ESR), Demonstrate its measurement using Westergren tube and identify the clinical significance -Demonstrate the PCV test using the microhematocrite. -Ask students to find their own blood group and the percentage of each blood group of the students attending the practical session. -Understand the blood indices of the CBC test. -Use the capillary method to determine the clotting time. -Determine the bleeding time by using the filter paper. -Apply Hess test to assess the capillary fragility -Learn how to interpret laboratory tests on coagulation profile.	

		Microbiology: 1. Blood Culture	-Define bacteremia and determine its causes, types, and clinical course. -Understand the indications, causes of contamination, approach to venipuncture, volume, number, and timing of blood culture. -Explain the steps implicated in the laboratory processing and interpretation of blood culture -Familiarize with case studies of bacteremia.	
		Pathology: 1. Pathology of non-Hodgkin Lymphoma 2. Neoplastic diseases of WBCs	-Briefly describe the architecture of normal lymph node. -Describe the gross and morphologic features of non-Hodgkin lymphoma types, the immunohistochemistry, and the flowcytometry. - Briefly discuss the gross and microscopic features of the normal lymph node. - Describe the morphologic features seen in acute leukemia and different chronic myeloid neoplasms. - Be familiar with the morphologic features seen in the different types of non-Hodgkin and Hodgkin lymphomas. - Describe the gross and microscopic features seen in plasma cell neoplasmS	

ACADEMIC SUPPORT

It is The Hashemite University policy to provide educational opportunities that ensure fair, appropriate, and reasonable accommodation to students who have disabilities that may affect their ability to participate in course activities or meet course requirements. Students with disabilities are encouraged to contact their Instructor to ensure that their individual needs are met. The University through its Special Need section will exert all efforts to accommodate for individual needs.

Special Needs Section: Student Services and Care Unit
Tel: 053903333 ext. 4132 / 4583 / 5023
Location: Deanship of Students Affairs
Email: **stydent@hu.edu.jo**

COURSE REGULATIONS

Participation

Class participation and attendance are important elements of every student's learning experience at The Hashemite University, and the student is expected to attend all classes. A student should not miss more than 15% of the classes during a semester. *Those exceeding this limit of 15% will receive a failing grade regardless of their performance*. It is a student's responsibility to monitor the frequency of their own absences. **Attendance record begins on**

the first day of class irrespective of the period allotted to drop/add and late registration. It is a student's responsibility to sign-in; failure to do so will result in a non-attendance being recorded.
In exceptional cases, the student, with the Instructor's prior permission, could be exempted from attending a class provided that the number of such occasions does not exceed the limit allowed by the University. The Instructor will determine the acceptability of an absence for being absent. A student who misses more than 25% of classes and has a valid excuse for being absent will be allowed to withdraw from the course.

Plagiarism

Plagiarism is considered a serious academic offense and can result in your work losing marks or being failed. HU expects its students to adopt and abide by the highest standards of conduct in their interaction with their professors, peers, and the wider University community. As such, a student is expected not to engage in behaviors that compromise his/her own integrity as well as that of the Hashemite University.

Plagiarism includes the following examples, and it applies to all student assignments or submitted work:

- **Use of the work, ideas, images or words of someone else without his/her permission or reference to them.**
- **Use of someone else's wording, name, phrase, sentence, paragraph or essay without using quotation marks.**
- **Misrepresentation of the sources that were used.**

The Instructor has the right to fail the coursework or deduct marks where plagiarism is detected.

Late or Missed exams:

In all cases of assessment, students who fail to attend an exam, on the scheduled date without prior permission, and/or are unable to provide an accepted medical note, will automatically receive a failure grade for this part of the assessment.

Student Complaints Policy
Students at The Hashemite University have the right to pursue complaints related to faculty, staff, and other students. The nature of the complaints may be either academic or non-academic. For more information about the policy and processes related to this policy, you may refer to the students' handbook.

COURSE ASSESSMENT

Course Calendar and Assessment

Students will be graded through the following means of assessment, and their final grade will be calculated from the forms of assessment as listed below, with their grade weighting considered.

Assessment	Grade	Material	Date
Exam 1	40%	TBD	TBD
Exam 2	20%	Practical Labs	TBD
Final Exam	40%	Inclusive	TBD

Description of Exams

Test questions will predominately come from the material presented in the lectures. The exam will consist of multiple-choice questions for the regular exams and short essay questions for makeup exams (for students with accepted excuses, only documented absences will be considered as per HU guidelines).

Grades are not negotiable and are awarded to the *MD program* according to the following criteria*:

Letter Grade	Description	Grade Points
A+	Excellent	4.00
A		3.75
A-		3.50
B+	Very Good	3.25
B		3.00
B-		2.75
C+	Good	2.50
C		2.25
C-		2.00
D+	Pass	1.75
D	Pass	1.50
F	Fail	0.00
I	Incomplete	-

WEEKLY LECTURE SCHEDULE AND CONTENT DISTRIBUTION

Provided separately