Jordan University of Science and Technology  
Faculty of Medicine  
MD Program Curriculum

Course Title: Hematopoietic and Lymphoid System (HLS).  
Course Code: M272  
Credit Hours: 6 credits  
Calendar Description: 5 weeks/ Sem.2/ Year 2  
Teaching Approaches: Integrated System Course  
Course Coordinator: DR.ISMAIL MATALKA.  
Contact by department: Pathology Department phone(23700)

A. Course Description:
This course will cover the main features of the anatomy and function of the hematopoetic and lymphatic system. The basic classification of anemia's and neoplastic diseases and their relevant diagnostic methods and natural history will be discussed. All relevant Pharmacological, biochemical, microbiological, and public health aspects will be handled in relation to specific diseases.

B. General Objectives:
Upon completion of this course students should be able to:
1. Describe the constituents of blood, their origin and function.  
2. Discuss the structure and function of the lymphoreticular system.  
3. Describe the important aspects of hemoglobin genetics and abnormal hemoglobin synthesis.  
4. Understand the basic classification systems of anemias, their laboratory and clinical features, public health aspects, and their management.  
5. Understand epidemiological and social distribution of nutritional anemia in developing countries and in Jordan.  
6. Elaborate on main causes of nutritional anemia and its associated factors.  
7. Highlight preventive and therapeutic measures to combat nutritional anemia.  
8. Understand the classification of neoplastic diseases of hematopoietic cells, methods for their diagnosis and their natural history and general guidelines for their management.  
9. Describe the regulatory mechanisms of normal hemostasis, abnormalities that lead to bleeding disorders, pathologic aspects that cause thrombotic disorders and how are these conditions treated?  
10. Understand causes of toxaemia, its diagnosis, treatment and prevention.  
11. Describe the biochemical basis of porphoria

Methods of Instruction:
- Lectures.  
- Practical classes.  
- Small group discussions.  
- Self learning cases
## Specific objectives:

### Lectures:

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<tr>
<th>#</th>
<th>Lecture Title</th>
<th>Lecture Objectives</th>
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| 1  | Introduction to Hematopoietic system (multidisciplinary)                      | 1. Understand the general outline of the module.  
2. Be familiar with the modalities of teaching throughout the course.  
3. Acknowledge the important relation between normal and abnormal structure and function.  
4. Appreciate the importance of basic sciences in clinical application. |
| 2  | Histology of formed blood elements-I (Anatomy)                               | 1. List blood components.  
2. Classify formed elements of blood.  
3. Discuss the scientific basis of the above classification.  
4. Describe the basic structure of erythrocytes and criteria of their identification.  
5. List the components of cellular granulocytes. |
2. Understand the functions of blood.  
4. Understand the principle of linear blood flow. |
| 4  | Metabolism of vitamin B12 and folic acid (Biochemistry)                       | 1. Describe the structure and biochemical importance of Vit B12  
2. Describe the structure and biochemical importance of folic acid |
| 5  | Physiological requirements for hematopoiesis process (Physiology)             | 1. Describe the food sources, requirement, absorption, distribution and excretion of iron, vitamin B12, and folic acid  
2. Describe the role of iron, vitamin B12, and folic acid in hematopoiesis  
3. Describe the clinical consequences of iron, vitamin B12, and folic acid deficiency |
| 6  | Hematopoiesis: Pre- & postnatal (Anatomy)                                     | 1. Name organs responsible for hematopoiesis in the fetus.  
2. List the developmental stages of hematopoiesis both prenatally and postnatally. |
| 7  | Erythropoiesis, Myelopoiesis & Thrombopoiesis (Anatomy)                       | 1. Outline the major steps of post-natal development of blood formed elements (erythropoiesis, granulopoiesis, monocytopoiesis and megakaryopoiesis.  
2. Identify characteristic features of these cells. |
| 8  | RBCs: Characteristics & functions (Physiology)                               | 1. Describe RBCs structure & its structure-function relationship.  
2. Understand the different functions of RBCs.  
3. Understand structure-function relationship of RBCs cell membrane like fluidity.  
4. Identify the physiological factors that affect RBCs count.  
5. Understand the life span of RBCs & its relationship to blood donation.  
6. Understand the principle of complete blood cell count (CBC). |
| 9  | WBCs: Characteristics & functions (Physiology)                               | 1. Recognize the different structural types of WBCs & their physiological functions.  
2. Define the life span & the physiological implication of that.  
3. Differentiate between marginating & circulating pools of WBCs  
4. Understand the principle behind the total, relative & absolute WBCs count.  
5. Understand how to apply this knowledge in clinical practice. |
| 10 | Hemoglobin (Hb): structure, function (Biochemistry) | 1. Describe the quaternary structure of hemoglobin, stress on quaternary structure  
2. Understand the different chains assembled in Hb.  
3. Understand the importance of iron and its form in heme.  
4. Understand how Hb is involved in O2 transport.  
5. Understand the factors that affect O2 binding affinity of Hb. |
|---|---|---|
| 11 | Introduction to Anemias: classification and strategies for diagnosis (Pathology) | 1. Name and describe the maturational sequence of erythroid cells in the bone marrow using the terms: proerythroblast, erythroblast, normoblast and reticulocyte.  
2. Discuss aplastic anemia with emphasis on its etiology, diagnostic criteria, clinical features and management.  
3. Classify myelophthisic anemias.  
4. Discuss the role of erythropoietin in hematopoiesis with emphasis on its site of production and target cells.  
5. Classify anemias according to pathophysiologic criteria.  
6. Classify anemias according to mean corpuscular volume (MCV) and give three examples of each type.  
7. Discuss the reticulocyte count, corrected reticulocyte count and diseases associated with high and low numbers. |
| 12+13 | Community health aspects of anemia (Comm. Med) | 1. Describe epidemiological and social distribution of nutritional anemias in developing countries.  
2. Distribution of nutritional anemias by population groups in Jordan.  
3. Describe the major nutritional risk factors in the determination of anemias.  
4. highlight preventive and therapeutic measures to combat nutritional anemia |
| 14 | Heme and porphyrin metabolism (Biochemistry) | 1. Understand the structure of heme and porphyrin.  
2. Understand the biosynthesis of heme and porphyrin  
3. Understand the degradation process of heme and porphyrin  
4. List substances produced by heme destruction and their fate in the body.  
5. Understand the basic abnormalities that may result in heme degradation. |
| 15 | Globin genes and Molecular biology of globin synthesis & role of iron and heme (Biochemistry) | 1. Understand the organization of globin genes including beta and alpha gene families.  
2. Explain the regulation of globin biosynthesis by iron and other iron related transcription factors.  
3. Explain the regulation of globin biosynthesis by heme |
| 16 | Hemolytic anemias. (Pathology) | 1. Describe parameters used to detect hemolysis.  
2. Classify hemolytic anemias.  
3. Describe immune processes leading to hemolysis with reference to diseases associated with hemolysis. |
| 17 | Hemolytic anemias. (Pathology) | 1. Discuss the most frequent enzyme defects leading to hemolysis with emphasis on their clinical and laboratory findings.  
2. Identify: spherocyte, schistocyte, nucleated RBCs, Heinz bodies, elliptocyte and Howell-Jolly bodies.  
3. Describe the RBC membrane cytoskeleton with emphasis on hereditary spherocytosis |
| 18 | Hemoglobinopathies and hemoglobin electrophoresis (Biochemistry) | 1. Identify the structural abnormalities of alpha and beta thalassemia  
2. Identify the structural abnormalities of sickle cell anemia (Hbs), hemoglobin C disease (Hbc) and hemoglobin SC disease (Hbsc).  
3. Understand the principle behind hemoglobin electrophoresis as a diagnostic tool for hemoglobinopathies.  
4. Understand the molecular diagnostic techniques for hemoglobin disorders |
| 19 | Molecular Diagnostic Techniques Of Hemoglobin Disorders | 1. PCR-SSCP  
2. PCR-DGG  
3. PCR-HAPLOTYPES  
4. PCR-RFLP |
| 20 | Thalassemias and Hemoglobinopathies (Pathology) | 1. List the types of hemoglobin present in normal blood and what’s the percentage of each type?  
2. For thalassemia syndromes describe the following:  
   a. Basic genetic defect  
   b. Red cell morphology  
   c. Clinical manifestations and complications  
   d. Diagnostic procedures  
3. For sickle cell disease and trait describe the following:  
   a. Basic genetic defect  
   b. Red cell morphology  
   c. Clinical manifestations and complications  
   d. Diagnostic procedures |
| 21+22 | Drugs used in anemias I + II (Pharmacology) | 1. Describe the normal mechanism of regulation of iron in the body.  
2. List the major forms of iron used in the therapy of anemias.  
3. List the anemias for which iron supplementation is indicated and those for which it is contraindicated.  
4. Describe the acute and chronic toxicity of iron.  
5. Describe the role of B12 and folic acid in treatment of megaloblastic anemia and the hazards involved in the use of folic acid as a sole therapy of megaloblastic anemia.  
6. Describe the major bone marrow colony stimulating factors. |
| 23 | Physiology of blood coagulation (Physiology) | 1. Understand the process and stages (cascade) of blood coagulation and its significance.  
2. List and understand the role of factors involved in blood coagulation.  
3. Understand the role of serine proteases in the cascade of blood coagulation. |
| 24 | General overview of homeostatic process (Physiology) | 1. Understand the structure, function & life span of platelets.  
2. Understand the interaction of platelets, blood vessels and plasma coagulation factors in homeostasis.  
3. Understand the role of the liver in normal homeostasis. |
| 25 | Congenital Bleeding Disorders and DIC (Pathology) | 1. For each of von Willebrand disease, hemophilia A and hemophilia B, describe:  
   a. Heritance  
   b. Etiology  
   c. Clinical presentations  
   d. Laboratory findings  
   e. Treatment  
2. Understand the correct usage and significance of abnormalities of each of the following:  
   a. Prothrombin time (PT)  
   b. Partial thromboplastin time (PTT)  
   c. B-Thrombin time (TT)  
   d. Platelet count  
3. For disseminated intravascular coagulation (DIC), describe:  
   a. Etiology  
   b. Clinical presentations and complications  
   c. Laboratory findings  
   d. Histopathology of affected organs |
| 26 | Inherited disorders of platelets function Idiopathic thrombocytopenic purpura (ITP) and thrombotic thrombocytopenic purpura (TTP), (Pathology) | 1. List the surface glycoproteins of platelets and define their roles.  
2. Describe the pathogenesis and laboratory findings of Bernard-Solier disease and thrombasthenia.  
3. Describe the etiology, pathogenesis, clinical findings, laboratory results and patient management of adult and pediatric ITP.  
4. Identify the mechanism of neonatal and post transfusion thrombocytopenia.  
5. Describe the clinical findings and laboratory results of TTP. |
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| 27 | Hypercoagulable disorders (Pathology) | 1. Understand the basis for the antithrombotic role of normal endothelium.  
2. Describe the action of antithrombin III (ATIII), protein C, and protein S.  
3. Explain the pathogenesis of activated protein C (APC) resistance.  
4. Cite the most common conditions associated with primary (genetic) and acquired thrombosis. |
| 28 | Drugs used in coagulation disorders I (Pharmacology) | 1. Compare the oral anticoagulants with heparin in terms of their pharmacokinetics, mechanisms, and toxicities.  
2. Describe types of anticoagulant drugs, their mechanisms of action, therapeutic uses, adverse effects, drug interaction with other drugs, and contraindications. |
| 29 | Drugs used in coagulation disorders II (Pharmacology) | 1. Describe types of antiplatelets drugs, their mechanisms of action, therapeutic uses, adverse effects, drug interaction with other drugs, and contraindications.  
2. Describe types of thrombolytic and antithrombotic drugs, their mechanisms of action, therapeutic uses, adverse effects, drug interaction with other drugs, and contraindications.  
3. Discuss the drugs used to treat disorders of excessive bleeding. |
| 30 | Lymph vascular, circulation and drainage and Lymphoid tissue I (Anatomy) | 1. Understand the origin and composition of lymph.  
2. Explain the circulation of lymph in the body.  
3. Describe the gross anatomy of the following lymphoid organs:  
   a. spleen, tonsils, thymus, lymph nodes and mucosa associated lymphoid tissue; i.e. (their shape, location, anatomical relations, blood and nerve supply). |
| 31 | Salmonella typhi, enteric fever and Brucella (Microbiology) | For each organism:  
1. Describe the morphology growth, virulence factor and structure.  
2. Explain pathogenesis and clinical manifestations  
3. Explain epidemiology of the disease.  
4. Be familiar with the laboratory diagnosis.  
5. Be familiar with treatment and prevention. |
| 32 | Lymphoid tissue II (Anatomy) | 1. Describe and understand the microscopic structure of lymphoid organs, spleen, tonsils, thymus, lymph nodes and mucosa associated lymphoid tissue. |
| 33 | Acute Leukemias I (Pathology) | 1. Understand the classification of acute leukemias with emphasis on the French American British (FAB) system.  
2. Define the term “blast”.  
3. Describe the normal phenotypic changes seen in differentiating B and T lymphocytes with reference to similar changes seen in Acute lymphoblastic leukemia. |
| 34 | Acute Leukemias II (Pathology) | 1. Describe the clinical presentations, complications and patient management of acute leukemias.  
2. Explain how the following tests are used in diagnosing acute leukemias:  
   i. Myeloperoxidase  
   ii. Non specific esterase  
   iii. TDT  
3. List six chromosomal abnormalities associated with acute leukemias. Identify the oncogenes associated with them and their effects on prognosis. |
| 35 | Plasmodium and Babesiosis (Microbiology) | Describe the following:  
1. Microbiological properties, classification and diseases.  
2. Microscopic differences between species, life cycle epidemiology, and pathophysiology.  
3. Clinical presentation, specimen collection, diagnosis, treatment, and prevention. |
| 36+37 | Lymph Node Enlargement and Non-Hodgkin Lymphomas (NHL) I & II (Pathology) | 1. Understand the general characteristics of NHL, with reference to pathogenesis, classification and procedures used to diagnose them.  
2. Describe the grading systems of NHL.  
3. Compare the histopathologic, immunologic and clinical features of NHL.  
4. List three chromosomal translocations associated with NHL; describe the oncogenes associated with them.  
5. Describe the morphology of:  
   a) small lymphocytes  
   b) small cleaved cells  
   c) mantle cells  
   d) immunoblasts  
   e) prolymphocytes  
   f) small non-cleaved cells  
   g) lymphoblasts |
| 38 | Hodgkin lymphoma (Pathology) | 1. Classify Hodgkin lymphoma  
2. Describe the morphology of Reed Sternberg cells and its variants  
3. Describe the staging system of Hodgkin lymphoma  
4. Understand the main clinical features and main lines of management of Hodgkin lymphoma  
5. List the histologic types Hodgkin disease; lymphoma, their clinical presentations, general guidelines for patient evaluation and management. |
| 39 | Yersinia pestis, plague, Q-Fever, and other rickettsia (Microbiology) | Describe the following:  
1. General microbiological properties, differences from other yersinia.  
2. Cultural techniques, epidemiology, pathophysiology.  
3. Clinical presentation, specimen collection for culture, treatment and prevention. |
| 40 | Biochemical basis of porphyria and jaundice in hemolytic anemia (biochemistry) | 1. List the enzymatic defects in the biosynthesis pathway that lead to porphyrias.  
2. Describe jaundice and bilirubin metabolic pathway defects.  
3. Understand bilirubin glucuronyl transferase enzyme and jaundice in newborns. |
| 41 | Trypanosomiasis, visceral leishmaniasis and filariasis (Microbiology) | For each of Trypanosomiasis, leishmaniasis and filariasis, describe the following:  
1. Microbiological properties.  
2. Classification and diseases.  
3. Microscopic differences between species.  
4. Life cycle epidemiology and specimen collection.  
5. Pathophysiology and clinical presentation.  
6. Diagnosis, treatment, and prevention. |
| 42 | Chronic Lymphoproliferative disorders. Plasma cell tumors and monoclonal gammopathies (Pathology) | 1. Understand the clinical manifestations, laboratory findings and complications of chronic lymphocytic leukemia (CLL).  
2. Describe the morphologic and immunophenotypic characteristics of CLL cells.  
3. Describe the clinical manifestations and laboratory findings of:  
   a. Hairy cell leukemia  
   b. Large granular lymphatic disorders  
   c. Mycosis fungoides  
   d. Adult T-cell leukemia/lymphoma  
4. Understand the clinical manifestations, laboratory findings and complications of plasma cell tumors.  
5. Define:  
   a. Bence Jones proteins  
   b. Monoclonal spike  
   c. M proteins  
   d. Heavy chain disease.  
   e. Waldenstrom's macroglobulinemia. |
| 43 | Chronic Myeloproliferative and myelodisplastic syndromes (Pathology) | 1. Compare clinical and laboratory findings of:  
   a. Chronic myelogenous leukemia  
   b. Polycythemia  
   c. Essential thrombocythemia  
   d. Myelofibrosis with myeloid metaplasia  
2. Describe Philadelphia chromosome, its disease association and its significance.  
3. Understand the significance of the placenta like alkaline phosphatase (PLAP) score.  
4. Define the terms:  
   a. Leukoerythroblastosis  
   b. Leukemoid reaction  
   c. Dyserythropoiesis  
   d. Dysmyelopoiesis  
   e. Dysmegakaryopoiesis  
   f. Ringed sideroblasts  
   g. Myelofibrosis  
5. List different types of myelodysplastic syndromes. |
| 44 | Blood groups (Physiology) | 1. Understand the principles of ABH blood group system.  
2. Understand the principles of Rh blood group system.  
3. Understand the principles of the HLA system. |
| 45 | Blood transfusion and transplantation (Medicine) | 1. Apply the knowledge given in the blood grouping system in blood transfusion.  
2. Apply the knowledge given in the blood grouping system into organ transplantation.  
3. Understand how to use this knowledge in the clinical practice. |
| 46+47 | Anti-neoplastic drugs I & II (Pharmacology) | 1. Recognize the general principles of cancer therapy.  
2. Understand the three main lines of cancer therapy.  
4. Understand the terms: adjuvant therapy, growth fraction and cell cycle.  
5. Understand the mode of drug action either phase-specific or non-specific.  
6. Classify cytotoxic drugs and explain their mechanism of action.  
7. Recognize the major adverse effects of cytotoxic drugs.  
8. List the common drugs, which have an immunosuppressive effect. |
| 48 | Immunosuppressant Agents (Pharmacology) | 1. Classify the objectives of immunosuppressant drugs.  
2. Explain briefly their mechanism of actions and therapeutic uses.  
3. Recognize the major adverse effects of the immunosuppressant agents. |
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<thead>
<tr>
<th>Lab</th>
<th>Lab. Title</th>
<th>Objectives</th>
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<tbody>
<tr>
<td>1</td>
<td>Histology of blood smear and Histology of lymphoid tissue (Anatomy)</td>
<td>1. Review criteria for identifying neutrophils.  &lt;br&gt;2. Examine a blood smear under the light microscope applying the above criteria to decide which cell is a neutrophil.  &lt;br&gt;3. Repeat the same process above in identifying other blood cells: basophils, acidophils, lymphocytes, platelets and RBCs.  &lt;br&gt;4. Review criteria and distinguishing histological features for identifying a lymph node.  &lt;br&gt;5. Examine a cross section of lymph node under the light microscope applying the above criteria.  &lt;br&gt;6. Eat the same process above in identifying and examining cross sections of the spleen, thymus, tonsils and Mucosa Associated Lymphoid Tissues (MALT).</td>
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<tr>
<td>2</td>
<td>Histology of lymphoid tissue (Anatomy)</td>
<td>1. Review criteria and distinguishing histological features for identifying a lymph node.  &lt;br&gt;2. Examine a cross section of lymph node under the light microscope applying the above criteria.  &lt;br&gt;3. Repeat the same process above in identifying and examining cross sections of the spleen, thymus, tonsils and Mucosa Associated Lymphoid Tissues (MALT).</td>
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<td>3</td>
<td>RBCs &amp; WBCs count (Physiology)</td>
<td>1. Introduce the student to the hematology lab.  &lt;br&gt;2. Learn the basic techniques used in counting &amp; the clinical implication of this count.</td>
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<td>4</td>
<td>Hb, PCV, RBCs, WBCs, &amp; differential (Physiology)</td>
<td>1. Learn the basic techniques in doing Hb, PCV, &amp; RBCs  &lt;br&gt;2. Understand how to calculate RBCs values &amp; their clinical significance  &lt;br&gt;3. Learn the basic techniques of WBCs and differential count.  &lt;br&gt;4. Understand total leukocytic count, the differential leukocytic count &amp; their clinical significance.  &lt;br&gt;5. Learn how to calculate the relative leukocytic count &amp; its clinical significance.</td>
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Anemias and leulemias
(Pathology)

Identify the morphologic abnormalities of peripheral blood and bone marrow in:

1. Iron deficiency anemia
2. Megaloblastic anemia
3. Thalassemias
4. Sickle cell anemia
5. Micoangiopathic hemolytic anemia
6. G6PD hemolytic anemia
7. Autoimmune hemolytic anemia
8. Hereditary spherocytosis
9. Identify:
10. Lymphoblasts
11. Myeloblasts
12. Promyelocytes
13. Prolymphocytes
14. Auer rods

Identify the diagnostic microscopic changes of:

1. Acute myeloid leukemia
2. Acute lymphoblastic leukemia
3. Chronic myelogenous leukemia
4. Chronic lymphocytic leukemia
5. Hairy cell leukemia

Lymph node enlargement and lymphomas (Pathology)

Identify the microscopic morphologic changes of:

1. Follicular hyperplasia
2. Follicular lymphomas
3. Mantle cell lymphoma
4. Small lymphocytic lymphoma
5. Large cell lymphoma
6. Hodgkin disease and its subtypes

Assessment:

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<th>EXAM FORMAT</th>
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<tr>
<td>FIRST EXAM</td>
<td>MCQ</td>
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<tr>
<td>LABORATORY EXAM</td>
<td>OSPE</td>
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<tr>
<td>FINAL EXAM</td>
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Recommended Text Books and Atlases:

* Anatomy:
  - Grant’s Atlas of Anatomy or any other reasonable colored Atlas of Human Anatomy.

* Physiology:

* Biochemistry:
  - Supplementary Departmental Handouts.
**Pharmacology:**
- Lippincott’s Illustarted Reviews: Pharmacology, Latest edition

**Pathology:**
- Kumar, Cotran and Robbins: Robbins Basic Pathology, Latest edition.
- Supplementary. Departmental handouts

**Microbiology:**

**Public Health (Community Medicine):**
- Department Handouts.

**Small Group Discussion Cases:**
1. Leukemia
2. Anemia

**Self Learning Cases:**
1. Stem Cell Transplantation
2. Bleeding Disorders

**Summary of the teaching activities in the HLS system 2010**

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<th>Department</th>
<th># of Lectures</th>
<th># of Practical</th>
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