

VILNIUS UNIVERSITY DOCTORAL STUDIES COURSE UNIT DESCRIPTION

Scientific field(s), Direction(s) (codes)	Medical and Health Sciences (M 000): Medicine (M 001) Natural Sciences (N 000): Biochemistry (N 004); Biology (N 010)			
Faculty, Institute, Department/Clinic	Faculty of Medicine Institute of Biomedical Sciences Department of Physiology, biochemistry, microbiology and laboratory Medicine			
Subject name (ECTS credits, hours))	Laboratory hematology 9 credits (243 hours)			
Subject study method	Lectures	Seminars	Consultations	Individual work
ECTS credits	-	-	1	8
Method of subject assessment (evaluated on a 10-point scale)	<u>Presentation and evaluation of the report</u> : the report is presented on a targeted topic, which is coordinated with the coordinating lecturers (the doctoral student must analyze, review and present the latest scientific publications related to the relevant topic). <u>Report evaluation criteria</u> (minimum passing score – 5): a) relevance, novelty and correspondence of the presented material to the chosen topic (2 points); b) overall structure and scope of the report, clear presentation of knowledge, argumentation, conciseness and concreteness (2 points); c) summary, presentation and justification of conclusions (1 point); d) raising problematic issues, applying the reviewed knowledge in one's own presentation in the dissertation (3 points); e) organization of visual aids, ability to participate in discussion, question management, oratory skills (2 points).			
COURSE OBJECTIVE				
To provide in-depth theoretical and practical knowledge of laboratory hematology, including modern mechanisms of physiology and pathogenesis of hemopoiesis and hemostasis systems, their analytic technologies (spectrophotometry, turbidimetry, impedance, optical light scattering, flow cytometry, morphology and molecular biology methods) and the clinical significance of the most important parameters. To promote an interdisciplinary, holistic approach to patient health, relying on evidence-based laboratory medicine science data, in order to solve individual problems of different scientific directions and fields of relevant doctoral topics.				
MAIN TOPICS OF THE SUBJECT				
Morphology and hemopoiesis. Structure and functions of hematopoietic organs. Microenvironment and humoral factors affecting the growth and maturation of blood cells. Examination of peripheral blood. Hemoglobin concentration, hematocrit, erythrocyte count and their clinical significance. Erythrocyte indices. Reticulocyte examination and interpretation. ESR examination and its clinical significance. Total leukocyte count, differentiation and clinical significance. Examination and interpretation of platelets. Methods of smear staining and morphological examination. Pathological morphology of leukocytes in various diseases. Pathomorphology of erythrocytes and platelets. Cytological examination of bone marrow, including differential staining procedures. Examination and interpretation of megakaryocytes. Assessment of erythropoiesis. Assessment of granulopoiesis and monopoiesis. Assessment of thrombopoiesis. Lymphopoiesis, plasma cells. Bone marrow stromal cells and their morphology. Hemoglobinopathies. Defects in the structure of hemoglobin, thalassemia.				

Hemoglobin fractionation: agarose gel electrophoresis, high-performance liquid chromatography. Modern morphological classification of anemias. Iron metabolism. Microcytic-hypochromic anemias and their laboratory diagnostics. Vit.B12 and folic acid metabolism. Pathogenesis of macrocytosis. Megaloblastic anemias and their laboratory diagnostics. Morphological assessment of megaloblastic hematopoiesis. Normal and pathological destruction of erythrocytes. Laboratory diagnostics of hemolysis. Aplastic anemia and its laboratory diagnostics. Modern morphological-cytochemical-immunological-molecular diagnostics of acute leukemias. FAB, WHO classifications. Etiology, pathogenesis, classification, diagnostics of myelodysplastic syndromes. Chronic myelogenous leukemia and its laboratory diagnostics. Differentiation from leukemoid reaction. Chronic lymphocytic leukemia and its laboratory diagnostics. True polycythemia and its laboratory diagnostics. Laboratory diagnostics of myeloma diseases and paraproteinemias. Classification, etiology, diagnosis of Hodgkin's disease and non-Hodgkin's lymphoma. Methods and basic principles of bone marrow transplantation. The significance of stem cell (CD34+) counting in BMT.

Analytical hematology. Principles of operation of hematological analyzers: impedance, optical, etc. Principles of quality control in laboratory hematology. Cell analysis with a flow cytometer: viability analysis, marker expression studies on the cell surface and internal structures, cell cycle analysis, stem cell phenotyping, leukemia classification, paroxysmal nocturnal hemoglobinuria diagnostics, etc. Molecular biology methods in laboratory hematology: cytogenetics, fluorescence in situ hybridization, polymerase chain reaction, molecular microarray studies, DNA, RNA sequencing and comparative genome comparative hybridization studies.

Hemostasiology. Factors of primary hemostasis (platelet count, adhesion, activation and aggregation). Platelet function testing. Bleeding time. Von Willebrand factor testing, ADP-adrenaline, collagen, ristocetin, ADP and ATP effects on platelet aggregation. Serotonin determination. Spontaneous aggregation. Clot retraction. Coagulation factor III determination. Thrombasthenias (congenital adhesion, activation and aggregation disorders). Acquired platelet function disorders. Idiopathic thrombocytopenic purpura and its laboratory diagnostics. Thrombocytopenia and thrombocytosis. Factors of secondary hemostasis (coagulation proteins, intrinsic and extrinsic coagulation pathways, fibrin clot formation) and their regulatory systems (fibrinolysis, protein C, serine proteases, intrinsic coagulation pathway inhibitors). Characterization of normal and impaired coagulation functions using general tests (prothrombin time, thrombin time, activated partial thromboplastin time) and determination of individual coagulation factors. Use of chromogenic substrates for the determination of coagulation factors. Determination of circulating inhibitors. Immunological determination of coagulation factors and knowledge of coagulation abnormalities (factor deficiency, increased fibrinolytic activity), control and monitoring of thrombosis and disseminated intravascular coagulation. Action of anticoagulants, fibrinolytics and aggregation inhibitors. Prekallikrein, determination of high molecular weight kininogen, plasminogen, antiplasmin, plasminogen activators. Use of anticoagulants. Control of anticoagulant factors. Fibrinolysis test. Congenital (hemophilias, factor VII, X, V deficiencies), and acquired disorders, bleeding and thrombosis. Thrombophilias. Protein S, protein C, antithrombin, heparin cofactor II deficiency. Dysfibrinogenemia. Acquired (lupus anticoagulant, antiphospholipid syndrome, Trousseau syndrome) and congenital (factor V Leiden, prothrombin gene mutations, protein C resistance) thrombophilic disorders.

MAIN RECOMMENDED LITERATURE

1. John E. Hall, PhD and Michael E. Hall, MD, MSc. Guyton and Hall Textbook of Medical Physiology, 14th Edition, Elsevier, 2021.

2. Kenneth Kaushansky, Marshall A. Lichtman, Josef T. Prchal, Marcel M. Levi, Linda J. Burns, David C. Lynch. Williams Hematology, 10th Edition, Published McGrawHill: February 24, 2021.
3. Richard A. McPherson, MD, MSc and Matthew R. Pincus, MD, PhD. Henry's Clinical Diagnosis and Management by Laboratory Methods, 24th Edition, Elsevier, 2021.
4. A. Victor Hoffbrand, Paresh Vyas, Elias Campo, Torsten Haferlach, Keith Gomez. Color Atlas of Clinical Hematology: Molecular and Cellular Basis of Disease, 5th Edition, Willey Blackwell, 2019.
5. A. Victor Hoffbrand, Pratima Chowdary, Graham P. Collins, Justin Loke. Hoffbrand's Essential Hematology. 9th edition. Willey-Blackwell. 2024.
6. Editors: Robert T. Means, Jr.; George M. Rodgers, Bertil Glader, Daniel A. Arber, Frederick R. Appelbaum, Angela Dispenzieri, Todd A. Fehniger, Laura C. Michaelis, John P. Leonard. Wintrobe's Clinical Hematology. 15th edition, Walters Kluwer, 2024.
7. Anna Porwit Marie Christine Bene. Multiparameter Flow Cytometry in the Diagnosis of Hematologic Malignancies. Cambridge University Press, 2018.
8. Matuzevičienė R. Flow cytometry and its application in laboratory medicine. Vilnius, Peter's offset. 2013.
9. Internet sources:

<https://labtestsonline.org/>

<https://www.ncbi.nlm.nih.gov/pubmed/>

<https://www.islh.org/ISLH-Education/index.php>

<https://wiki.clinicalflow.com/cases>

<https://www.cytometry.org/web/education-public.php>

CONSULTING LECTURERS

1. Subject coordinator: Rėda Matuzevičienė (Assoc. Prof. PhD.).
2. Dovilė Karčiauskaitė (Prof. Habil PhD.).
3. Mantas Radzevičius (Asist. Ph.D.)

APPROVED:

By Council of Doctoral School of Medicine and Health Sciences at Vilnius University: 4th of June 2025

Chairperson of the Board: Prof. Janina Tutkuvienė