Course unit title	Code
PATHOLOGY (for medical students)	**PAT02115**

Lecturer(s)	Department(s)
Coordinating: prof. dr. Arvydas Laurinavičius, seconded by: assoc. prof. Vaida Baltrūnienė (PP), lect. Vygantė Maskoliūnaitė (PA) **Others:** assoc. prof. Justinas Besusparis, prof. dr.Violeta Kvedarienė, assist. Tomas Baltrūnas, lect. Ugnius Mickys, assist. Julius Drachneris, lect. Artūras Barkus, lect. Aušra Garnelytė, assist. Augustinas Baušys, assist. Ieva Kažukauskienė, lect. Lina Barkienė	Vilnius university, Faculty of Medicine, Department of Pathology, Forensic Medicine and Pharmacology, M. K. Čiurlionio g. 21, Vilnius

Cycle	Level of the course unit	Type of the course unit
Cycle (integrated studies)		Compulsory
Mode of delivery	**Period of delivery**	**Language of instruction**
Blended-teaching methods: lectures (including virtual), seminars and practical works (including virtual), small group discussions, and providing feedback. Independent work using the specified databases and references.	4th semester	English and Lithuanian

Prerequisites and corequisites	
Prerequisites: A student must have completed the following courses: human anatomy, histology, physiology, biochemistry, genetics, microbiology, immunology.	**Corequisites (if any):** no

Number of ECTS credits allocated to the course unit	Total student's workload hours	Contact hours	Self-study hours
5 credits	132	66	66

Purpose of the course unit Programme competences to be developed		
To provide the students with principles of pathology, necessary for clinical medicine. Three main competences are to be developed: 1) understanding the causes and mechanisms of the diseases; 2) knowledge of special organ pathology; 3) skills of diagnostic and clinical judgement in relation to pathology features of a disease.		
Learning outcomes of the course unit	**Teaching and learning methods**	**Assessment methods**
Professional qualities: to act fairly and according to ethical obligations, apply good medical practice principles at work, be emphatic, to think critically and self-critically, be creative, take the initiative, to communicate with others	Lectures, seminars (including virtual), case studies, and small group discussions. Self-study.	Continuous assessment of theoretical knowledge and problem-solving skills
Professional activities: to make an assessment within the scope of one's competence and, if necessary, ask for help, to act in new situations and adapt to them, to act independently, to solve problems, to make judgements, to work with specialists of other fields.	Lectures, seminars (including virtual), case studies, and small group discussions. Self-study.	Continuous assessment of theoretical knowledge and problem-solving skills

To identify and assess pathology features and mechanisms of diseases; to understand the development of laboratory, biochemical, immunological, cytological and morphological alterations in diseased tissues of clinical importance; select relevant tests and interpret their results; evaluate diagnostic process and disease treatment on the basis of pathological knowledge. To understand disease mechanisms that give rise to clinical signs and symptoms. Formulate differential diagnosis based on the knowledge gained.	Lectures provide insights into essential knowledge on the topic and focus on principles of understanding pathology findings of clinical relevance. The lectures (including recordings) are available in digital format and can be viewed at the VU learning environment. During the seminars and practical works, a problem-based method is applied. The essence of this method is modeling disease diagnosis and treatment tactics. Based on this method, clinical situations (tasks) and pathology test results (pathology report) are analyzed.	Continuous assessment of theoretical knowledge and problem-solving skills: quiz in writing, solutions to didactic clinical situations. Main method of assessment Cumulative points (CP): **CP =10X%+40Y%+50Z% =100%** **X –** continuous assessment during seminars and practical tasks **Y –** interim control (test, colloquium) **Z –** final control (test, examination) The detailed assessment information is in the 5th-semester course unit description under the "Assessment Strategy" section
Application of evidence-based medical principles, skills and knowledge: to use scientifically-based evidence in practice, to search for the relevant literature, critically assess published medical literature	Lectures, seminars (including virtual), case studies, and small group discussions. Self-study.	Continuous assessment of theoretical knowledge and problem-solving skills
Efficient use of information and information technologies in medical practice: properly and completely keep and store medical documentation, use computers, search for sources of literature, store and update information	Lectures, seminars (including virtual), case studies, and small group discussions. Self-study.	Continuous assessment of theoretical knowledge and problem-solving skills
Ability to apply scientific principles, methods and knowledge in medical practice and research: to apply scientific principles, methods and knowledge in medical practice and research	Lectures, seminars (including virtual), case studies, and small group discussions. Self-study.	Continuous assessment of theoretical knowledge and problem-solvingskills

Topics	**Contact work hours**							**Time and tasks of self-study**	
	Lectures	Consultations	Seminars	Practice	Laboratory work	Practical training	**Total contact hours**	**Self-study**	**Tasks**

IVth SEMESTER									
1. Introduction to pathophysiology. Environmental diseases PP			3				3	2	Prepare for the seminar. Read indicated literature. Review the provided video material. Be able to discuss the following topics. Define pathophysiology and its objectives, understand its connections with other sciences, and its significance for the clinic. Investigate the concepts of health and disease. Explore the general etiology and pathogenesis of diseases. The idea of a vicious circle in disease progression. Environmental diseases. The impact of climate change and air pollution. The health risks of metals lead, mercury, cadmium, and arsenic. Occupational exposures. Effects and detrimental effects of tobacco. Metabolism and harmful effects of alcohol. Injury caused by psychoactive substances.
2. Introduction to Pathology. Pathologic accumulations. Amyloidosis.	2		3				5	4	Prepare for the seminar. Read indicated literature. Review submitted visual materials. Be able to discuss the following topics. Role of pathology in clinical medicine. Tissue-based diagnosis, methods and principles. Amyloidosis, amyloid, detection, types. Dysproteinemias. Hyalinosis. Steatosis. Obesity. Cholesterol accumulations. Pathologic calcifications. Pigment accumulations. Hemosiderosis, local and systemic.
3. Injury of the cell and tissue. Hemodynamic disorders. Cell and tissue regeneration and adaptive changes.			3				3	5	Prepare for the seminar. Read indicated literature. Review submitted visual materials. Be able to discuss the following topics. Mechanism and causes of cellular injury. Reversible and irreversible cellular injury. Apoptosis. Necrosis. Types of necrosis, macroscopic and histology features. Outcomes of necrosis. Hyperemia, active and passive. Edema. Stasis. Infarction. Embolism. Thrombosis. Hemorrhage. Pathology of compensation and adaptation mechanisms. Hypertrophy. Hyperplasia. Regeneration. Atrophy. Epithelial / stromal interaction, architectural tissue rearrangements. Metaplasia. Dysplasia. Sclerosis.
4. Mechanisms of cell injury and cell death. PP	2		3				5	4	Prepare for the seminar. Read indicated literature. Review provided video material. Be able to discuss the following topics. Cell injury and adaptations. Causes and mechanisms of cell injury and death. Sequence of events in cell damage: reversible and irreversible cell injury. Cell death: apoptosis, necrosis, necroptosis, other pathways of cell death. Types of apoptosis, pro-apoptotic and anti-apoptotic proteins, diseases due to impaired regulation of apoptosis. The definition and mechanisms of autophagy. The common causes and mechanisms of cell injury and death: hypoxia, ischemia, endoplasmic reticulum stress, DNA damage, oxidative stress, etc. Ischemia-reperfusion injury. The role of mitochondrial dysfunction.
5. Inflammation. Immunopathology.	2		3				5	4	Prepare for the seminar. Read indicated literature. Review submitted visual materials. Be able to discuss the following topics. Biological significance of inflammation.

									Acute inflammation, mechanisms, morphology. Mediators of inflammation. Types of exudate. Outcomes of acute inflammation. Factors affecting healing. Chronic inflammation. Granuloma. Granulomatous diseases. Concept of immunopathology. Mechanisms of immune tissue injury (hypersensitivity reactions). Autoimmune disorders.
6. Pathophysiology of inflammation. Cellular and molecular basis of inflammatory mechanisms. PP	2		3				5	5	Prepare for the seminar. Read indicated literature. Review provided video material. Be able to discuss the following topics. Definition, causes and general features of inflammation. Pathophysiology of acute inflammation: local and systemic effects. Reactions of blood vessels, leukocyte recruitment, phagocytosis. Destruction of the pathogen, NET's. Leukocyte-mediated tissue injury. Mediators of inflammation: vasoactive amines, arachidonic acid metabolites, cytokines and chemokines, complement system, other mediators. Acute phase response. Pathogenesis of fever. The mechanisms of thermoregulation. Diagnostic tests and inflammatory markers. The course of inflammatory response; potential complications. Pathophysiology of chronic inflammation. Cells and mediators of chronic inflammation. The role of macrophages: classical and alternative activation.
7. Neoplasia. Principles of tumour pathology diagnosis	2		3				5	4	Prepare for the seminar. Read indicated literature. Review submitted visual materials. Be able to discuss the following topics. Definitions of neoplasia. Etiology and pathobiology of the tumours. Nomenclature of the tumors. Benign and malignant tumors. Premalignant lesions. Malignant transformation. Intratumour heterogeneity. Interaction between the host and the tumor. Anti-tumour immunity. Tumor microenvironment and progression. Predictive tissue pathology biomarkers.
8. Neoplasia. Molecular carcinogenesis. PP			3				3	5	Prepare for the seminar. Read indicated literature. Review provided video material. Be able to discuss the following topics.Molecular basis of cancer: role of genetic and epigenetic alterations. Genetic lesions in cancer. Mutations in proto-oncogenes, tumor suppressor genes, apoptosis regulating genes, and DNA repair genes. Carcinogenesis as a multistep process. Initiation and progression of the tumor. Cancer stem cells. The hallmarks of cancer: self-sufficiency in growth signals, insensitivity to growth-inhibitory signals, altered cellular metabolism (Warburg effect), evasion of apoptosis, limitless replicative potential, sustained angiogenesis, invasion and metastasis, evasion of immune surveillance, genomic instability, cancer-enabling inflammation. Local

									and systemic effects of cancer. Cancer cachexia. Paraneoplastic syndromes.
9. Hypoxemia, hypoxia. Oxidative stress. PP	2		3				5	4	Prepare for the seminar. Read indicated literature. Review provided video material. Be able to discuss the following topics. Definition and classification of hypoxia: hypoxic, anemic, circulatory, histotoxic, and mixed hypoxia. The leading causes of hypoxemia: low oxygen pressure in inspired air, hypoventilation, and increaed alveolar-arterial gradient. Compensatory and adaptive mechanisms to hypoxia. The role of Hypoxia-inducible factor 1 (HIF-1). Pathological changes in various organs during chronic hypoxia. Accumulation of oxygen-derived free radicals: free radicals, reactive oxygen species (ROS). Ways of generation of free radicals. Pathologic effects of ROS: cell injury and death. Lipid peroxidation in membranes; oxidative modification of proteins, DNA lesions. Removal of free radicals. Primary, secondary, and tertiary antioxidants.
10. Pathophysiology of systemic blood flow. PP			3				3	4	Prepare for the seminar. Read indicated literature. Review provided video material. Be able to discuss the following topics.Types and causes of hypertension. The pathogenesis of essential hypertension: changes in blood vessel tone, increased vascular resistance, increased blood volume. Complications of hypertension. Heart failure. The concepts of cardiac output, preload, afterload, ejection fraction. Causes and pathogenesis of systolic and diastolic heart failure. Neurohumoral activation as one of the key mechanisms underlying the progression of heart failure. The role of increased sympathetic nervous system and RAAS activation, elevated production of ANP, BNP and cytokines. Pathophysiology and types of myocardial hypertrophy: eccentric and concentric. Causes and pathogenesis of acute and chronic heart failure. Pathophysiology-based heart failure treatment. The pathophysiology of primary and secondary pulmonary hypertension.
11. Pathophysiology of peripheral blood flow. Hemostasis and thrombosis. PP			3				3	4	Prepare for the seminar. Read indicated literature. Review provided video material. Be able to discuss the following topics. Hyperemia, congestion, ischemia. Factors influencing the severity of ischemia. Hemostasis and thrombosis. Arterial and venous thrombosis. Hypercoagulable states: acquired and inherited. Etiology and pathogenesis of pulmonary artery thromboembolism, systemic thromboembolism. The pathogenesis of Disseminated intravascular coagulation syndrome (DIC). Anticoagulative mechanisms. Bleeding disorders due to impairment in blood vessel function, lack of coagulation factors, and platelet pathology. Etiology, pathogenesis, and complications of aneurysms, aortic dissection.

12. Endothelial dysfunction. Pathophysiology of atherosclerosis. PP	2		3				5	4	Prepare for the seminar. Read indicated literature. Review provided video material. Be able to discuss the following topics. Solve the provided test.The endothelium is an endocrine-paracrine organ regulating vascular homeostasis. Endothelial activation. Endothelial dysfunction: definition, causes, phenotype. Endothelial dysfunction and disease. The role of NO in vascular pathology. Vascular wall response to injury. Types of arteriosclerosis. The pathogenesis of atherosclerosis: the role of endothelial injury, inflammation, monocyte adhesion, lipid infiltration, smooth muscle cell proliferation, etc. Understanding the response-to-injury hypothesis Stable and unstable plaques. Vulnerability of atherosclerotic plaque. The consequences of atherosclerotic disease. Cardiovascular risk factors and their impact on atherosclerosis progression.
13. Heart pathology			3				3	4	Prepare for the seminar. Repeat normal histology of the cardiovascular system. Read indicated literature. Review submitted visual materials. Be able to discuss the following topics. Congenital heart defects: with shunt from left to right (open ductus arteriosus, atrial and ventricular septal defects); with shunt from right to left (transposition of main arteries, Fallot tetrad); obstructive (aortic coarctation, pulmonary venous atresia, common arterial trunk). Heart valve defects: degenerative; rheumatism and rheumatic heart disease, infectious endocarditis. Hypertensive heart disease. Ischemic heart disease; myocardial infarction, chronic coronary insufficiency.
14. Pulmonary pathology			3				3	4	Prepare for the seminar. Repeat normal histology of the respiratory system. Read indicated literature. Review submitted visual materials. Be able to discuss the following topics. Lung tumors, histological types. Interstitial pneumonia and pneumonitis (sarcoidosis, usual interstitial pneumonia, non-specific interstitial pneumonia, desquamative pneumonia). Adult respiratory distress syndrome. Bronchitis, chronic. Pulmonary tuberculosis. Bronchoectasis.
15. Leukaemias and lymphomas	2		3				3	4	Prepare for the seminar. Repeat normal histology of the lymph node. Read indicated literature. Review submitted visual materials. Be able to discuss the following topics. Enlarged lymph node: clinical and pathology algorithm of diagnosis. Histological patterns and differential diagnostics of reactive lymphadenopathy. Hodgkin's and non-Hodgkin's lymphomas in Lithuania and the

									World (WHO classification). Hodgkin's lymphoma. The most common B non-Hodgkin lymphomas: Diffuse large B cell lymphoma; B Follicular lymphoma; B mantle cell lymphoma; B small lymphocytic lymphoma/leukemia; B marginal zone lymphoma (extranodal).
16. Urological pathology			3				5	5	Prepare for the seminar. Repeat normal histology of the urinary tract. Read indicated literature. Review submitted visual materials. Be able to discuss the following topics. Urothelial tumors. Testicular tumors: germinogenic tumors: seminoma, yolk sack tumor, embrionic carcinoma, choriocarcinoma. Prostatic adenocarcinoma. Renal cell carcinoma: clear cell, papillary, chromophobe. Renal oncocytoma and papillary adenoma.
Colloquia		2							Prepare for colloquium.
Total hours	16		- 50				- **66**	66	

Assessment strategy	**Weight (%)**	**Assessment period**	**Assessment criteria**
X – continuous assessment of active participation during seminars and practical tasks **Y –** interim control (test, colloquium) Semester credits		During seminars During semester	Continuous assessment of active participation during seminars. Participation in the seminars is obligatory. During each seminar interactive questions are provided as open questions or MCQs. The questions have to be answered during the seminar in a particular time limit. In case of a positive response to the question 1 point is given, otherwise - zero points are gained. If one is late or forgets to answer the questions at the specified time, the questions will not be available later. A total of 4 interim assessment tests (colloquia) are carried out during the 4th and 5th semesters. 2 colloquia are delivered in the 4th semester, and the other two - during the 5th.The tests are aimed at knowledge evaluation obtained during the practical classes and by self-study. A percentage of correct answers is calculated. The tests are provided only once and at the appointed time. If a sound and documented reason (must be provided before the test to the pathology course administrator) prohibits a student from taking the test at the time appointed, 1

		At the end of the 4th semester	test during the course can be skipped without impacting the CP. In other cases, a missed test is estimated at zero score. The credits for the 4th semester are accomplished if a student has accumulated at least 80% of X score and collected a sum of at least 70 from the 2 Y tests taken. Students who fail to meet credit requirements can have a single retake. The retake involves a ten-question open-ended test without impacting the cumulative grade. Students scoring less than 5 points must repeat the fourth-semester course.

Author	**Year of publication**	**Title**	**No of periodical or vol. of publication**	**Publication place and publisher or Internet link**
Required reading				
Vinay Kumar Abul Abbas Jon Aster	2020	Robbins Pathology		Elsevier, 10th edition and other editions: https://www.clinicalkey.com/#!/browse/book/3-s2.0-C20160040871?indexOverride=GLOBAL
Recommended reading				
Copstead L-EC, Banasik JL.	2018	Pathophysiology,6/E		Saunders/Elsevier
Gary D. Hammer, Stephen J. McPhee	2020	Pathophysiology of Disease: An Introduction to Clinical Medicine, 8e		https://accessmedicine.mhmedical.com/book.aspx?bookID=2468
Stevens A, Lowe J, Scott I.	2009	Core Pathology,3/E,		Morsby/Elsevier
Recommended portals		http://www.proteinatlas.org/learn/dictionary/normal https://www.pathologyoutlines.com/ https://peir.path.uab.edu/wiki/IPLab		