COURSE UNIT DESCRIPTION

Course unit title	Code
KINESIOGENOMICS AND BIOLOGY OF HEALTHY AGING	

Annotation
The module focuses on the development and application of kinesiogenomics and biology of healthy aging in rehabilitation. Learning outcomes: students will know and understand the principles of kinesiogenomics and the theory of aging / longevity biology and research methodologies focused on ensuring the quality of life of people at all ages; will be able to analyze and critically evaluate the individual characteristics of the physical development, functional capacity and healthy aging, as well as pathological processes using theories of kinesiogenomics and other fields of science; will be able to apply research methodologies to solve complex rehabilitation problems, interpret the obtained data from an interdisciplinary point of view, analyze results, systematize and present conclusions, work independently and responsibly make decisions, organize and plan rehabilitation research, implement innovative ideas, improve professional knowledge and research results in practice.

Lecturer(s)	Department, Faculty
Coordinating: Valentina Ginevičienė, PhD, assoc. professor **Other:**	Faculty of Medicine Department of Rehabilitation, Physical and Sports Medicine Santariškių str. 2, Vilnius, LT–08661

Study cycle	Type of the course unit
Second	Required

Mode of delivery	Semester or period when it is delivered	Language of instruction
auditorium		Lithuanian, English

Requisites	
Prerequisites: basic knowledge of human anatomy and physiology, molecular biology and genetics at the undergraduate level.	**Co-requisites (if relevant):**

Number of ECTS credits allocated	Student's workload (total)	Contact hours	Individual work
5	133	64	69

Purpose of the course unit: programme competences to be developed
The aim is to provide theoretical knowledge in the field of kinesiogenomics and molecular biology of healthy aging, to acquaint with the development, principles, tasks, innovations and perspective of these fields of science; with projects and methods of molecular biology research on physical activity (related to movement and functional capacity at all ages), their diversity, achievements, problems and applications in rehabilitation; with the principles of bioethics, research' strategy and methodology, their planning and execution, data collection and analysis. To provide knowledge about the biological phenomena and analysis of human physical fitness and healthy aging at various levels (cells, tissues, organs, body systems; from gene to trait); on the mechanisms of human genome management, gene expression and implications for physical development, functional capacity, activity and health in old age; about the genetically determined activity of physiological functions under normal, exercise and pathology conditions, about the individual body's response to exercise and adaptation to unusual conditions. To develop the ability to critically evaluate the individual features of the human physical capacity and pathological processes using theories of kinesiogenomics and other fields of science; to apply research methodologies in solving complex rehabilitation problems, to interpret the obtained data from an interdisciplinary point of view, to analyse and systematize the results of study, and formulate conclusions; to work independently and make responsible decisions, to organize and plan rehabilitation research activities, to implement innovative ideas and improve professional activities, to apply theoretical knowledge and research results in practice.

Learning outcomes of the course unit	Teaching and learning methods	Assessment methods
A1, B1, E1 The student will know and be able to describe the theoretical principles, tasks and achievements of kinesiogenomics and molecular biology of healthy aging; the main mechanisms of human genome management and the principles of gene-induced physical health, functional capacity and adaptation to physical exercise and abnormal (pathological) conditions.	Lecture: demonstration, problem presentation, plenary discussion.	Observation of discussions and debates.
A1, B1, E1 Will be able to analyze the overall concept of kinesiology, genetic and molecular biology analysis of physical capacity, and understand the relationship of these fields of science with the technologies of -omics (phenomics, genomics, transcriptomics, metabolomics, proteomics).	Seminar: debate, presentation and discussion of independent tasks (essays); group work, group discussion, counseling.	Assessment of completed exercise tasks.
A1, B1, E1, C1, C2 Will be able to systematically evaluate the scientific knowledge and facts about the organization of the human body (from gene to trait) and individual characteristics, the risk of trauma and pathology, the application of gene therapy methods in rehabilitation.	Practice exercises: interpretation, solution and discussion of tasks; case analysis and presentation, situation modeling, group work.	Evaluation of the written work (essay) and observation of its presentation in the seminar.
A2, B1, C3, E1, E2 Will be able to describe and systematically evaluate molecular biology research of human physical activity related to physical performance, movement and functional capasity at all ages; will be able to plan the strategy and methodology of this research and to collect, analyze and interpret the obtained data in an interdisciplinary manner based on the principles of bioethics.	Self-study: analysis of scientific publications and genomic databases; preparation of a written essay.	Testing and examination: colloquia and exam.
A3, B1, B2, B3, C3, D1, E1, D1 Will be able to apply knowledge and research methodologies in solving complex rehabilitation problems, work independently and responsibly to make decisions, organize and plan rehabilitation research, implement innovative ideas and improve professional activities, apply theoretical knowledge and research results in practice.		

Course content: breakdown of the topics	Contact hours							Individual work: time and assignments	
	Lectures	Tutorials	Seminars	Workshops	Laboratory work	Internship/work	**Contact hours, total**	**Individual work**	**Assignments**
1. Principles, tasks, development, most significant discoveries, achievements and projects in the fields of kinesiogenomics and biology of healthy aging.	2						**2**	**4**	Plenary debates and discussion
2. Complexity of molecular biology of physical activity and healthy aging, concept of holistic analysis (phenomics, genomics, transcriptomics, metabolomics, proteomics and the relationship between these types of science). Levels of human body organization (from gene to trait).	2		2	1			**5**	**5**	Analysis of scientific literature and genomic databases. Presentation of the chosen lecture subtopic. Debate.
3. Mechanisms of human genome management, gene expression and impact for health, physical	2		1	2			**5**	**5**	Analysis of scientific literature and genomic databases.

development, and functional capacity. Genotype - phenotype relationship. DNA markers.									Presentation of the chosen lecture subtopic. Debate.
4. Assessment of physical activity (movement and functional capacity) of all ages individuals using the theory and methodology of kinesiogenomics and molecular genetics.	1		2	1			**4**	**5**	Analysis of scientific literature. Presentation of the chosen lecture subtopic. Debate.
5. The main stages, principles and genetic control of human development. Influence of genetic and environmental factors on body formation in ontogenesis. Cellular and molecular - genetic features of aging.	1		2	1			**4**	**5**	Analysis of scientific literature. Presentation of the chosen lecture subtopic. Case analysis.
6. Kinesiogenomics. Individual response to exercise and adaptation to unusual conditions. Molecular adaptation of the nervous, muscular, respiratory, and cardiovascular systems to exercise. Metabolic adaptation and genes involved in metabolism.	2		1	2			**5**	**5**	Analysis of scientific literature. Presentation of the chosen lecture subtopic. Case analysis. Debate.
7. Application of genomics research in rehabilitation. Strategies and methodology of research on genetic factors that determine human health and physical capacity.	2		2	1			**5**	**5**	Analysis of scientific literature. Presentation of the chosen lecture subtopic. Case analysis.
8. Individualized research-based solution of rehabilitation and health problems of the elderly and / or people with long-term disabilities.	1		2	1			**4**	**5**	Analysis of scientific literature. Presentation of the chosen lecture subtopic. Debate.
9. Injuries and serious damage of health, symptoms, molecular mechanisms. The role of genetic factors in the risk of trauma and pathology.	1		2	1			**4**	**5**	Analysis of scientific literature. Presentation of the chosen lecture subtopic. Debate.
10. Kinesiogenomics and personalized medicine. Fundamentals of pharmacogenomics and nutrigenomics. Metabolism of drugs and supplements, genetic control.	2		2	1			**5**	**5**	Analysis of scientific literature. Presentation of the chosen lecture subtopic. Debate.
11. Influence of human epigenome and microbiome on health and physical performance. Mechanisms of epigenetic alterations.	1		2	1			**4**	**4**	Analysis of scientific literature. Presentation of the chosen lecture subtopic. Debate.
12. Behavioral genetics and human psychosocial development. Individual response in the context of lifestyle factors. Stressors and psychological stress. Genetic and epigenetic control.	2		2	1			**5**	**4**	Analysis of scientific literature. Presentation of the chosen lecture subtopic. Debate.
13. Genetic and lifestyle factors leading to metabolic syndrome and obesity. The influence of genetic factors on energy uptake, consumption and body composition. Importance of genetic research in the prevention of overweight and obesity.	1		2	1			**4**	**4**	Analysis of scientific literature. Presentation of the chosen lecture subtopic. Case analysis.
14. Application of gene therapy methods in rehabilitation. Gene therapy and other uses of molecular genetic techniques for therapy. Studies of model organisms in solving health care problems.	1		2	1			**4**	**4**	Analysis of scientific literature. Presentation of the chosen lecture subtopic. Case analysis.
15. Problems of biomedical ethics in human genome research.	1		2	1			**4**	**4**	Presentation of the chosen lecture subtopic. Debate.
Total	**22**		**28**	**14**			**64**	**69**	

Assessment strategy	Weight %	Deadline	Assessment criteria

Assessment of seminars: written essay and its presentation.	15	During the semester	At the beginning of the semester, the student must choose one sub-topic of the lecture and present it in the seminar, prepare a written essay and an oral presentation using visual aids. The volume of the essay must be at least 10 pages; essays (.doc, .docx, or .pdf format) must be submitted two days before seminar. The presentation must be submitted together with the visual material (the duration of the presentation is 1 academic hour). During the assessment of the seminars (essay and its presentation) it is possible to collect 15% of the final grade - a maximum of 1.5 points in the ten-point grading system.
Practice exercises: solution and reporting of exercise tasks	5	At the end of the semester	During the assessment of the practice exercise, it is possible to collect 5% of the final grade - a maximum of 0.5 points in the ten-point grading system.
2 colloquia	40	During the semester	At each colloquium, 20% can be collected of the final assessment - a maximum of 2 points in the ten-point grading system. The colloquium questionnaire consists of 10 tasks, open-ended and closed-ended questions, each with a value of 0.2 points. If the student scores less than half of the possible colloquium score, the colloquium is considered unsuccessful and the student is required to retake the colloquium. The colloquium can be retake only once. Retraining of the colloquium yields 70% of the maximum colloquium estimate. Failure to pass the colloquiums may not be taken the exam.
Exam	40	Session	40% of the final grade can be collected during the exam - a maximum of 4 points in the ten-point grading system. The exam task consists of four open-ended (problematic) written questions, each with a value of 1 point. Maximum possible rating 4. The exam can be taken only after passing the colloquia, completing the parts of the seminars (essay and presenting the sub-topic of the lecture) and the practice exercises.

Author	Publishing year	Title	Issue of a periodical or volume of a publication; pages	Publishing house or internet site
Required reading				
Henning W.	2014	Molecular exercise physiology	1	Routledge
Korf BR, Irons MB.	2013	Human genetics and genomics	1	Wiley-Blackwell, A John Wiley & Sons, Ltd.
Barh D., Ahmetov I.	2019	Sports, Exercise, and Nutritional Genomics: Current Status and Future Directions.	1	e-book: https://www.elsevier.com/books/sports-exercise-and-nutritional-genomics/barh/978-0-12-816193-7
Giusti P.	2019	SECTION V Nutrigenetics, pharmacogenetics and metabolomics in sport and exercise.		DOI: 10.13140/RG.2.2.14497.15203
Recommended reading				
Posthumus M, Collins M.	2016	Genetics and Sports	1	Med Sport Sci. Basel, Karger (DOI: 10.1159/000445240)
Roth S.M.	2007	Genetics Primer for Exercise Science and Health	1	Human kinetics
Malzer D., et al.	2019	The genetics of human ageing		DOI: 10.1038/s41576-019-0183-6

Pagiatakis C., et al.	2021	Epigenetics of aging and disease: a brief overview		https://doi.org/10.1007/s40520-019-01430-0
Morris B.J., et al.	2019	Genetic and epigenetic regulation of human aging and longevity		https://doi.org/10.1016/j.bbadis.2018.08.039
Figueiredo V.C., et al.	2020	Genetic and Epigenetic Regulation of Skeletal Muscle Ribosome Biogenesis with Exercise.		https://www.biorxiv.org/content/10.1101/2020.12.14.422642v1.full
Maciejewska-Skrendo A., et al.	2020	Genetics of Muscle Stiffness, Muscle Elasticity and Explosive Strength.		DOI: https://doi.org/10.2478/hukin-2020-0027
Pickering C. and Kiely J.	2017	Understanding Personalized Training Responses: Can Genetic Assessment Help?		https://opensportssciencesjournal.com/contents/volumes/V10/TOSSJ-10-191/TOSSJ-10-191.pdf DOI:10.2174/1875399X01710010191