COURSE UNIT (MODULE) DESCRIPTION

Course unit (module) title	Code
General Physics I (MECHANICS AND THERMODYNAMICS)	

Lecturer(s)	Department(s) where the course unit (module) is delivered
Coordinator: dr. J. Jurkevičius **Other(s):** dr. S. Balčiūnas	Faculty of Physics, Saulėtekio al. 3, NFTMC, LT-10257, Vilnius.

Study cycle	Type of the course unit (module)
First	Compulsory

Mode of delivery	Period when the course unit (module) is delivered	Language(s) of instruction
Auditorium	1 (Autumn) semester	Lithuanian/English

Requirements for students	
Prerequisites: None	**Additional requirements (if any):** None

Course (module) volume in credits	Total student's workload	Contact hours	Self-study hours
10	260	160	100

Purpose of the course unit (module): programme competences to be developed		
● By the end of the course of mechanics students are expected to be able to understand and analyze processes of kinematics and dynamics of particles and bodies, formulate problems and solve tasks. ● By the end of course of thermodynamics students are expected to be able to understand nature of heat exchange, to describe processes of heat mathematically, explain thermodynamic processes and to solve tasks.		
Learning outcomes of the course unit (module)	**Teaching and learning methods**	**Assessment methods**
Know and understand the physical laws of the mechanics and thermodynamics (1.1)	Lectures with visual demonstration	Tests, discussion, written exam
To be able to formulate and solve the problems of the mechanics and thermodynamics (1.2)	Seminars (solution of tasks)	Seminars, tests, written exam
Investigate practically the basic laws of the mechanics and thermodynamics (1.3, 3,4)	Consultation, laboratory work	Discussion

Content: breakdown of the topics	Contact hours							Self-study work: time and assignments	
	Lectures	Tutorials	Seminars	Exercises	Laboratory work	Internship/work	**Contact hours**	**Self-study hours**	**Assignments**
Mechanics									
1. Introduction. The object and aim of physical studies. Fundamental quantities. Dimensional analysis. Measurements.	1			1			**2**	**2**	
2. One-dimensional motion. Displacement, speed, velocity, acceleration. Motion diagrams, kinematic equations.	1			1			**2**	**2**	
3. Vectors and Scalars. Coordinate systems. Vector properties and operations.	1	1		1			**3**	**2**	
4. Two-dimensional motion. Kinematic vectors. Projectile motion. Circular motion. Tangential and normal acceleration.	1	1		1			**3**	**2**	
5. Laws of motion. Force. Newton's first law, inertial frames. Mass. Newton's second law. Gravity and weight. Newton's third law. Friction.	2	1		2			**5**	**3**	
6. Newton's laws in application. Circular motion. Motion in non-inertial frames. Euler method for dynamic problems.	2	1		2			**5**	**3**	
7. Work and kinetic energy. Work and force. Kinetic energy and work-kinetic energy theorem. Power.	1	1		1			**3**	**2**	
8. Potential energy and conservation of energy. Conservative and non-conservative forces. Energy diagrams.	1	1		1			**3**	**2**	Related problems and assignments (topically corresponding).
9. Momentum and collisions. Conservation of momentum. Elastic and non-elastic collisions. Center of mass. Motion of a particle system. Rocket motion.	2			2			**4**	**2**	
10. Rotation of a rigid body. Angular kinematics. Rotational energy. Moment of inertia. Torque. Work, power and energy of rotational motion.	2			2			**4**	**2**	
11. Rolling motion and angular momentum. Angular momentum of a particle and a system of particles. Conservation of angular momentum.	2			2			**4**	**2**	
12. Static equilibrium and elasticity. Condition for equilibrium. Deformation and elastic properties of solids.	2			2			**4**	**2**	
13. Oscillations. Harmonic oscillator, its energy. Pendulum. Circular description of a harmonic oscillator.	2	1		2			**5**	**3**	
14. Gravity. Newton's law of universal gravitation. Free fall acceleration and the force of gravity. Kepler's laws. Gravitational field and potential energy.	2	1		2			**5**	**3**	
15. Fluid mechanics. Pressure. Buoyancy. Fluid dynamics. Bernoulli equation. Dynamic lift.	2			2			**4**	**2**	

16. Waves. One-dimensional travelling wave. Superposition and interference. Speed of wave propagation. Reflection and transmission. Sinusoidal waves. Linear wave equation.	2			2			**4**	**2**	
17. Sound waves. Speed of sound. Periodic sound waves. Spherical and flat wavefront. Doppler effect. Standing waves, resonance, beats.	2			2			**4**	**2**	
Related laboratory assignments. During the semester 6 lab assignemnts ar due, 1 of which is a study of measurement uncertainties statistics, and 5 – related to randomly assigned topics.					16		**16**	**14**	Laboratory work in the mechanics lab.
Total (1/2):	**28**	**8**	**0**	**28**	**16**	**0**	**80**	**50**	
Termodinamika									
18. Temperature, heat exchange. The 0th law of thermodynamics, temperature measurement, heat capacity, heat conductivity.	6	1		6			13	8	Determination of latent heat of metals by cooling.
19. Heat and work, mechanical equivalent of heat. Heat and the 1st law of thermodynamics. Thermodynamic processes. Laws of ideal gases. Processes in ideal gases.	2	1		2	3		8	8	
20. Kinetic interpretation of heat energy. Kinetic interpretation of pressure and temperature of gases. Specific heat capacities of monoatomic and other gases. Law of equipartition of energy.	4	1		4	3		12	6	Measurement of viscosity and mean free path of molecules of air.
21 .Kinetic theory of real gases. Mean free path. Maxwelian distribution of molecular speeds. Brownian motion. Van der Waals equation. Critical parameters. Metastable phases. Joule–Thomson effect. Liquidification of gases. Low temperatures.	6	1		6	4		17	10	Measurement of viscosity and mean free path of molecules of air. Measurement of ratio of isochoric and isobaric specific heat capacities of a gas.
22 .Entropy and the 2nd law of thermodynamics. Reversible and irreversible processes. Carnot cycle. Heat engines and their efficiency.	2	1		2	2		7	4	Determination of molecular weight of vapour by Meyer apparatus. Measurement of specific heat conductivities of thermal insulators.
23. The 3rd law of thermodynamics. Entropy of reversible and irreversible processes.	5	2		5	4		16	8	Production and measurement of vacuum.
24. Thermodynamic potentials. Thermodynamic stability of systems.	3	1		3			7	6	Thermal expansion of solids.
Total	28	8		28	16		**80**	**50**	

Assessment strategy	**Weight,%**	**Deadline**	**Assessment criteria**
Exam (mechanics)	25	Session time	Exam (written and oral) answers, their correctness and accuracy. Examination is allowed after defending all of the laboratory work reports.
Colloquium results (mechanics)	10	Throughout entire semester	Written. Problem solutions and answers, answers to theoretical questions.
Laboratory report defense (mechanics)	15	Throughout entire semester	Oral defense of report with written report presented at the time. The quality of report, completion of tasks,

			explanations of results and ability to answer theoretical questions.
Exam (thermodynamics)	25	Session time	Exam (written) answers, their correctness and accuracy. Examination is allowed after defending all of the laboratory work reports.
Colloquium results (thermodynamics)	20	Throughout entire semester	Written. Problem solutions and answers, answers to theoretical questions.
Laboratory report defense (thermodynamics)	5	Throughout entire semester	Oral defense of report with written report presented at the time. The quality of report, completion of tasks, explanations of results and ability to answer theoretical questions.

Author	**Year of publication**	**Title**	**Issue of a periodical or volume of a publication**	**Publishing place and house or web link**
Compulsory reading				
Halliday D., Resnick R., Walker J.	2010	Fundamentals of Physics		Wiley
Matvejevas A.	1986	Molekulinė fizika		Vilnius: „Mokslas“
Optional reading				
Feynman, R.	1963	Lectures on Physics	Vol. 1	https://www.feynmanlectures.caltech.edu/
Artkan G.B., Greiffing D.F., Kelly D.C., Priest J.	1989	University Physics		N.Y., Academic Press
Wolfson R., Pasachoft J.M.	1987	Physics		Boston-Toronto-L-B corp.
Weidner R.T.	1989	Physics		Boston, Allyn and Bacon Inc.