

COURSE SYLLABUS

Course code	1080-BU200-ISA-0301
Course name	Theoretical Mechanics II
Course version	2026L
Level of education	first cycle programme
Form and mode of study	full-time study
Study profile	general academic profile
Field of study	Civil Engineering
Specialisation	-
Organizational unit	The Faculty of Civil Engineering
Implementing unit	The Faculty of Civil Engineering
Course unit	n/a
Course groups	-
Course status	Obligatory
Language of the course	English
Study stage code	BU000-S2-ISA-1080
Number of ECTS credits	3

Part I**01. Learning outcomes and the method of conducting classes**

Learning outcomes	see table "Learning outcomes"
Forms of classes and the number of hours in the semester	
tutorials	25,00 h
lectures	10,00 h

02. ECTS balance

Number of ECTS credits	3
------------------------	---

Course workload	Hours	ECTS
-----------------	-------	------

Total number of hours and ECTS credits for the course:

Hours and ECTS credits for courses involving direct participation of academic teachers	39	1,56
Hours and ECTS credits involving student's independent work	36	1,44
Total	75	3,00

Number of hours involving direct participation of academic teachers:

Hours connected with class participation	35
Other synchronous hours	4
Total	39

Number of hours involving student's independent work:

Hours for student's independent work	36
--------------------------------------	----

03. Course content

Part I	
Course content	Introduction. Kinematics. Concept of motion. Kinematics of a point. Rotational and translational motion of a rigid body. Plane motion, instantaneous center of velocity, instantaneous center of acceleration. Spherical motion of a rigid body. Motion of an arbitrary rigid system. Motion of a general system – constraints. Analysis of point motion in two reference frames (relative motion). Axiomatic foundations of classical Galilean–Newtonian dynamics – basic concepts (space, time, matter, force, physical motion) and postulates of dynamics (Newton's laws). Dynamics. 1) Vector and scalar Newtonian dynamics. Momentum, angular momentum, kinetic and mechanical energy of a point and of a system of particles. Work, power, potential and conservative forces. Centers of mass and moments of inertia of rigid bodies and systems of particles. Laws of variation of momentum and angular momentum. Collisions. Energy method. Inertial forces and kinetostatics method. 2) Analytical Lagrangian dynamics. d'Alembert's principle – virtual work. Lagrange's equations. Investigation of equilibrium position – stability of equilibrium. Vibrations – vibrations of a single-degree-of-freedom system.

Table: Learning outcomes	
Knowledge	
Outcomes code	W1
Description	Knows the basic concepts, assumptions and theorems (laws, principles) of classical Galilean–Newtonian–Lagrangian mechanics for a material point, a rigid body and a system composed of these elements, including constrained systems.
Related field-of-study learning outcomes	K1_W01, K1_W04
Skills	
Outcomes code	U1
Description	Can solve problems in kinematics and dynamics of a material point, a rigid body and systems of these elements using theorems, equations and methods of Newtonian dynamics as well as elements of Lagrangian dynamics.
Related field-of-study learning outcomes	K1_U01, K1_U05
Outcomes code	U2
Description	Can present problem formulations and solutions in the form of a report from independent work.
Related field-of-study learning outcomes	K1_U23
Social competence	
Outcomes code	K1
Description	Is ready to critically assess possessed knowledge and received content in the field of theoretical mechanics.
Related field-of-study learning outcomes	K1_K01

Part II	
04. Year and semester of studies	
Year	2026L
Semester	2
05. Course leader and course teachers	
Course leader	Magdalena Ataman
lectures	Magdalena Ataman
tutorials	Magdalena Ataman
06. Course objective	

Part II	
Course objective	Understanding of fundamental concepts and governing principles of Newtonian mechanics and Lagrangian mechanics. Skill in formulating the analytical description of the physical bodies, engineering structures being modeled as the constrained systems of particles and/or rigid bodies. Ability to solve the resulting equations of motion.
07. Teaching methods and techniques	
lectures	lecture with a blackboard
tutorials	solving problems
08. Methods of verifying learning outcomes	
Knowledge	
Outcomes code	W1
Description	Knows the basic concepts, assumptions and theorems (laws, principles) of classical Galilean–Newtonian–Lagrangian mechanics for a material point, a rigid body and a system composed of these elements, including constrained systems.
Verification methods	lectures: written examination lectures: oral examination tutorials: written test
Skills	
Outcomes code	U1
Description	Can solve problems in kinematics and dynamics of a material point, a rigid body and systems of these elements using theorems, equations and methods of Newtonian dynamics as well as elements of Lagrangian dynamics.
Verification methods	lectures: written examination lectures: oral examination tutorials: written test
Outcomes code	U2
Description	Can present problem formulations and solutions in the form of a report from independent work.
Verification methods	lectures: written examination lectures: oral examination tutorials: written test
Social competence	
Outcomes code	K1
Description	Is ready to critically assess possessed knowledge and received content in the field of theoretical mechanics.
Verification methods	lectures: written examination lectures: oral examination tutorials: written test
09. Required and recommended reading list	
Required reading	Gross D., Hauger W., Schröder J., Wall W.A., Govindjee S.: Engineering Mechanics 3, Dynamics, 2nd Edition, Springer, 2014. ISBN 978-3-642-53712-7 (eBook)
Recommended reading	Beer, Johnston: Vector mechanics for engineers: Statics & Dynamics, McGrawHill, 2004
10. Other information	
Other information	In according to the course regulations