

COURSE SYLLABUS

Polish name of a module	Mechanika I
English name of a module	Mechanics I
ISCED classification - Code	0715
ISCED classification - Field of study	<i>Mechanics and metal trades</i>
Languages of instruction	<i>English</i>
Level of qualification:	<i>1 – BSc (EQF 6)</i>
Number of ECTS credit points	<i>7 ECTS</i>
Examination:	<i>EW - exam written</i>
Available in semester:	<i>A-autumn only</i>

Total number of hours per semester:

Lecture	Tutorial	Laboratory	Seminar	Project	Other
30 E	30	0	0	0	0

COURSE DESCRIPTION

COURSE OBJECTIVE

- O1. Acquisition of theoretical knowledge in the field of general mechanics by students..
- O2. Development of students' ability to apply theoretical knowledge to problem-solving.
- O3. Enhancement of students' skills in analyzing obtained solutions.

PREREQUISITES IN TERMS OF KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of advanced mathematics (with particular emphasis on vector algebra) and basic knowledge of mathematical analysis.

2. Knowledge of physics, including an understanding of fundamental phenomena occurring in mechanics.
3. The ability to perform basic mathematical operations when solving problems.
4. The ability to use various sources of information, including online knowledge databases.
5. The ability to work both independently and in groups.

LEARNING OUTCOMES

LO 1 – The student has basic theoretical knowledge in general mechanics, including statics, kinematics, and dynamics of a particle..

LO 2 – The student is able to replace the effects of constraints with reaction forces for planar and three-dimensional force systems, formulate equilibrium equations for these systems, and determine the center of gravity for homogeneous bodies such as lines, surfaces, and solids.

LO 3 – The student is capable of determining the trajectory, velocity, and acceleration of a particle, formulating equations of motion based on a given kinematic diagram, and solving problems in particle dynamics using d'Alembert's principle, conservation of linear and angular momentum, and the equivalence of kinetic energy and work.

COURSE CONTENT

Course type – LECTURES	Number of hours
L1-4 – Introduction to mechanics. Scope of the subject. Newton's laws. Basic concepts and axioms of statics. Degrees of freedom. Constraints and reactions of constraints. Methods of implementing constraints. Force as a linear vector. Moment of force with respect to a point and a line.	4
L5-10 – Couple of forces. Reduction of a general spatial force system. Analytical equilibrium conditions for any spatial force system. Analytical	6

methods in statics of planar systems. Convergent, arbitrary, and complex planar systems	
L11-14 – Planar trusses. Determination of forces in truss members using the analytical method of node equilibrium. Sliding and rolling friction. Equilibrium of forces considering friction.	4
L15-18 – Three-dimensional systems of parallel forces. Methods for determining centers of gravity of lines, planar figures, and solids. Pappus-Guldinus theorem.	4
L19-24 – Kinematics of a particle. Mathematical description of particle motion. Trajectory, velocity, and acceleration of a particle. Selected cases of particle motion: rectilinear motion, simple harmonic motion, circular motion. Complex motion of a particle. Velocity and acceleration in complex motion.	6
L15-30 – Dynamics of a particle. Differential equations of particle motion. Concept of inertial force. d’Alembert’s principle. Linear and angular momentum of a particle. Principles of conservation of linear and angular momentum. Work and power. Potential and kinetic energy of a particle. Principles of energy conservation and the equivalence of kinetic energy and work.	6
SUM	30
Course type – TUTORIAL	Number of hours
T1-4 – Basic concepts of vector calculus. Projection of a vector in Cartesian coordinates. Addition and multiplication of vectors. Equilibrium of a convergent force system. Application of the theorem on the equilibrium of three forces.	4
T5-10 – Moment of force with respect to a point and an axis. Systems of parallel forces. Varignon’s theorem. Continuous load. Problems involving planar arbitrary force systems: determination of reactions in beams and frames. Equilibrium of planar, complex force systems	6

T11-14 – Planar trusses, application of the analytical method of node equilibrium. Equilibrium of planar force systems considering friction.	4
T15-18 – Equilibrium of arbitrary spatial force systems. Determination of the center of gravity for homogeneous bodies: lines, surfaces, and solids. Colloquium I.	4
T19-24 – Trajectory, velocity, and acceleration of a particle. Determination of equations of motion, trajectory, velocities, and accelerations for a given kinematic diagram. Complex motion of a particle. Coriolis acceleration.	6
T25-30 – Integration of differential equations of particle motion. d’Alembert’s principle. Principles of conservation of linear and angular momentum, mechanical energy, and the equivalence of kinetic energy and work. Colloquium II.	6
SUM	30

TEACHING TOOLS

1. Lectures using multimedia presentations.
2. Classroom exercises – examples of mechanics problems.
3. CUT e-learning platform and other tools for teaching on-line.

METHODS OF ASSESSMENT (F – FORMATIVE, P – SUMMATIVE)

F01 - Assessment of preparation for exercises
F02 - Assessment of the ability to apply acquired knowledge during lectures to solve mechanics problems
F03 - Assessment of activity during classes
P01 - Colloquium*
P02 - Written exam

*) a prerequisite for receiving credit is to receive positive grades on all of the above

listed items.

STUDENT WORKLOAD

Ref No.	Form of activity	Average number of hours to complete the activity
1. Contact hours		
1.1	Lectures	30
1.2	Tutorials	30
1.3	Laboratories	0
1.4	Seminars	0
1.5	Project	0
1.6	Office hours	0
1.7	Exam	3
Total contact hours:		63
2. Self-study hours		
2.1	Preparation for tutorials and the final test	50
2.2	Laboratory preparation, laboratory report preparation	0
2.3	Project preparation	0
2.4	Preparation for the final lecture test	0
2.5	Exam preparation	32
2.6	Literature review	30
Total self-study hours:		112
Total student workload:		175
TOTAL NUMBER OF ECTS POINTS FOR THE COURSE		7

Number of ECTS points which a student obtains in classes requiring direct teacher participation:	2,4
Number of ECTS points that a student obtains in practical classes, including laboratory and project classes:	1,2

PRIMARY AND SUPPLEMENTARY RESOURCES

1. Skalmierski B., Mechanika, t. 1 i 2, Wydawnictwo Politechniki Częstochowskiej, 2002.
2. Misiak J., Mechanika techniczna, t.1 i 2, PWN, Warszawa 2019.
3. Leyko J., Mechanika ogólna, t. 1 i 2, PWN, Warszawa 2019.
4. Niezgodziński T., Mechanika ogólna, PWN, Warszawa 2019.
5. Buczkowski R., Banaszek A., Mechanika ogólna w ujęciu wektorowym i tensorowym. Statyka, przykłady i zadania. WNT, Warszawa 2018.
6. Beer F.P, Johnston E. R., Vector Mechanics for Engineers. McGraw-Hill Publishing Company, 2016.
7. Niezgodziński, M. Niezgodziński T., Zbiór zadań z mechaniki ogólnej, PWN Warszawa 2003.
8. Misiak J., Zadania z mechaniki ogólnej, część I, II i III, PWN, Warszawa 2017.
9. Nizioł J., Metodyka rozwiązywania zadań z mechaniki, WNT, Warszawa 2019
10. Leyko J., Szmelter J, Zbiór zadań z mechaniki ogólnej, t.1 i 2, PWN, Warszawa 1978.
11. Giergiel J., Głuch L., Łopata A., Zbiór zadań z mechaniki, metodyka rozwiązań, AGH, Kraków 2001.

COURSE COORDINATOR (NAME, SURNAME, DEPARTMENT, E-MAIL)

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MATRIX OF LEARNING OUTCOMES

Learning outcome	Reference of the given outcome to outcomes defined for the entire program (CLO)	Course objectives	Course content	Teaching tools	Method of assessment
LO 1	K_W01	O1	L1-30	1, 3	P2
LO 2	K_U01	O2, O3	T1-30	2, 3	F1-F3 P1, P2
LO 3	K_U01	O2, O3	T1-30	2, 3	F1-F3 P1, P2

FORMS OF ASSESSMENT– DETAILS*

Learning outcomes	Grade 2.0	Grade 3.0	Grade 4.0	Grade 5.0
LO 1	The student does not have basic theoretical knowledge in general mechanics – statics, kinematics, and dynamics of a material point.	The student has partial theoretical knowledge in general mechanics – statics, kinematics, and dynamics of a material point.	The student has a good command of theoretical knowledge in general mechanics – statics, kinematics, and dynamics of a material point.	The student has fully mastered theoretical knowledge in general mechanics – statics, kinematics, and dynamics of a material point.
LO 2	The student is unable to replace the effects of	The student can replace the effects of	The student can replace the effects of constraints with	The student can replace the effects of

	constraints with reaction forces for planar and spatial force systems, write equilibrium equations for these systems, or determine the center of gravity for homogeneous bodies: lines, surfaces, and solids.	constraints with reaction forces for planar force systems, write equilibrium equations for these systems, and determine the center of gravity of a homogeneous line and simple planar figures.	reaction forces for planar and spatial force systems, write equilibrium equations for these systems, and determine the center of gravity of any homogeneous line and planar figure.	constraints with reaction forces for planar and spatial force systems, including composite systems, write and solve equilibrium equations for these systems, and determine the center of gravity of any homogeneous line, planar figure, and solid.
LO 3	The student is unable to determine the trajectory, velocity, and acceleration of a material point, formulate equations of motion based on a given kinematic scheme, or solve problems in the dynamics	The student can determine the trajectory, velocity, and acceleration of a material point based on given equations of motion and solve problems in the dynamics of a material point using	The student can determine the trajectory, velocity, and acceleration of a material point based on given equations of motion, formulate equations of motion based on a given kinematic scheme, and solve problems in the dynamics of a material point	The student can determine the trajectory, velocity, and acceleration of a material point in both simple and compound motion, formulate equations of motion based on a given kinematic scheme, and

	of a material point using D'Alembert's principle, conservation of momentum and angular momentum, and the equality of kinetic energy and work.	D'Alembert's principle..	using D'Alembert's principle, conservation of momentum, and angular momentum.	solve problems in the dynamics of a material point using D'Alembert's principle, conservation of momentum and angular momentum, and the equality of kinetic energy and work.
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* A half grade of 3.5 is given if the student has achieved the learning outcomes for a grade of 3.0 but has not fully completed the learning outcomes for a grade of 4.0 .A half grade of 4.5 is given if the student has achieved the learning outcomes for a grade of 4.0, but the student has not fully completed the learning outcomes for a grade of 5.0.

OTHER USEFUL COURSE INFORMATION

1. Course topics, resources and literature are provided in classes, in the teacher's office, and in the USOS system.
2. Information on office hours is provided to students during the first class of a given course, and is also placed on website - www.wim.pcz.pl