



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Mechanics [S1MNT1>A-Mech]

### Course

Field of study

Mathematics of Modern Technologies

Year/Semester

2/3

Area of study (specialization)

–

Profile of study

general academic

Level of study

first-cycle

Course offered in

Polish

Form of study

full-time

Requirements

elective

### Number of hours

Lecture

30

Laboratory classes

0

Other

0

Tutorials

30

Projects/seminars

0

### Number of credit points

5,00

### Coordinators

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### Lecturers

### Prerequisites

A basic knowledge from the fields of mathematics, physics and mechanics. The ability to solve basic problems of mechanics. The ability to work alone, self-study and broaden the knowledge based on available literature.

### Course objective

Gaining a basic knowledge of mechanics within the scope specified in the study program. The ability to solve basic problems from the field of mechanics.

### Course-related learning outcomes

Knowledge:

- in-depth knowledge of three branches of classical mechanics, i.e., statics, kinematics and dynamics [K\_W06(P6S\_WG)].

Skills:

- solving of the problems of mechanics with analytical methods [K\_U07(P6S\_UW), K\_U08(P6S\_UW), K\_U16(P6S\_UO)];

- the use of acquired knowledge in modeling of mechanical problems [K\_U07(P6S\_UW), K\_U08(P6S\_UW), K\_U16(P6S\_UO)];
- acquiring information from literature, databases and other available sources of knowledge [K\_U08(P6S\_UW)];
- the ability to work individually and in a team. The ability to estimate the time needed for the implementation of the task ordered [K\_U16(P6S\_UO)];
- the ability to self-study, including to improve professional and social competences [K\_U07(P6S\_UW), K\_U08(P6S\_UW), K\_U16(P6S\_UO)].

Social competences:

- awareness of the limits of one's own knowledge and understanding the need for further education [K\_K01(P6S\_KK)];
- precise formulation of questions used to deepen one's own understanding of a given topic or finding missing elements of reasoning [K\_K02(P6S\_KK)];
- preparation to perform their social role as a graduate of a technical university, including providing the public with popular science content and identifying and resolving basic problems regarding the field of study and promoting mathematics as a basis for analytical reasoning and precise formulation of correct conclusions [K\_K05(P6S\_KR)].

### Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures:

Written exam verifying a knowledge and a proper understanding of the concepts of mechanics.

Tutorials:

Written exams verifying proper solving of the mechanical problems with analytical methods.

### Programme content

The subjects of the module includes an overview of the scope of classical mechanics, a characteristics of basic concepts and a discussion of issues that belong to three branches of mechanics, i.e., statics, kinematics and dynamics.

### Course topics

Lectures:

#### 1. Introduction

- Overview of the scope of classical mechanics.
- Introduction to kinematics and dynamics (statics and kinetics).
- Characteristics of basic concepts such as: models of real bodies (material point, perfectly rigid body), forces and types of forces depending on their nature and origin, a balance of forces.
- The principles of statics with examples.

#### 2. Statics

- A definition of a degree of freedom (numbers of degrees of freedom for a material point and a rigid body in a plane and a space), a concept of external and internal forces, constraints (classification and types) and supports.
- Introduction to systems of forces in a plane and in a space.
- Finding a resultant of forces.
- Varignon's theorem.
- The concept of a moment of a force about a point, a couple of forces and a moment of a couple.
- Equilibrium conditions and equations of a planar and a space force system.

#### 3. Kinematics

- Particle kinematics.
- Kinematic equations of motion and trajectory (path) of motion.
- Motion, velocity and acceleration of a particle in Cartesian and natural coordinate systems.
- Kinematics of a rigid body.
- Rotational motion.
- Planar motion.
- Velocity and acceleration of points of a rigid body.

- Composite motion of a material point.
  - Relative and absolute velocity and acceleration.
  - The Coriolis acceleration.
4. Dynamics
- Dynamics of a material point.
  - Newton's second law.
  - Equations of motion.
  - Simple and reverse problems of dynamics.
  - Work, power, potential of a force field.
  - The work-energy principle.
  - The principle of conservation of mechanical energy.
  - The momentum conservation principle.
  - The conservation of angular momentum.

Tutorials:

#### 1. Statics

- Convergent planar system of forces.
- Moments of a force. Parallel force system.
- Arbitrary plane system of forces.
- Convergent spatial force system.
- Arbitrary spatial force system.
- Spatial system of parallel forces. Gravity forces. Center of gravity.

#### 2. Kinematics

- Particle kinematics.
- Natural coordinate systems.
- Linear motion. Rotational motion.
- Planar motion.
- Composite motion.

#### 3. Dynamics

- Dynamics of a material point.
- Work, power and energy.
- Momentum and angular momentum of system of material points. Conservation principles.

## Teaching methods

Lectures:

Multimedia presentation illustrated with examples solved on the board.

Tutorials:

Solving of the mechanical problems analytically on the board, performing the tasks proposed by the lecturer.

## Bibliography

Basic:

1. J. Leyko. Mechanika ogólna. Część 1 i 2. Wydawnictwo naukowe PWN, Warszawa 2002.
2. J. Misiak. Mechanika techniczna. Statyka i wytrzymałość materiałów. Tom 1. Wydawnictwa Naukowo-Techniczne, Warszawa 2006.
3. J. Misiak. Mechanika techniczna. Kinematyka i dynamika. Tom 2. Wydawnictwa Naukowo-Techniczne, Warszawa 1999.
4. W. Biały. Metodyczny zbiór zadań z mechaniki. Wydawnictwa Naukowo-Techniczne, Warszawa 2004.

Additional:

1. J. Misiak. Zadania z mechaniki ogólnej. Część 1, 2 i 3. Wydawnictwa Naukowo-Techniczne, Warszawa 1994.
2. J. Nizioł. Metodyka rozwiązywania zadań z mechaniki, Wydawnictwa Naukowo-Techniczne, Warszawa 1978.
3. M.E. Niezgodziński, T. Niezgodziński. Zbiór zadań z mechaniki ogólnej, Wydawnictwo naukowe PWN, Warszawa 1997.

## Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,00
Classes requiring direct contact with the teacher	62	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	63	2,50