# COURSE DESCRIPTION CARD - SYLLABUS

Course name
Mechaniccs [S1IBio1E>MECH]

## Course

Field of study
Biomedical Engineering

Year/Semester
1/2

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
English

Form of study
full-time

Requirements
compulsory

## Number of hours

Lecture
30

Laboratory classes
15

Other
0

Tutorials
15

Projects/seminars
0

## Number of credit points

4,00

## Coordinators

dr Tomasz Walczak
tomasz.walczak@put.poznan.pl

## Lecturers

## Prerequisites

The student starting the course should have a basic knowledge in mathematics and physics at the first cycle study level. He should have the ability to understand and interpret the acquired knowledge, and also to effective self-education and be ready to cooperate within a team.

## Course objective

Recognizing and understanding the main concepts and laws of mechanics. Developing skills in modeling of mechanical systems and in solving problems related to the movement and the equilibrium of the mechanical systems.

## Course-related learning outcomes

Knowledge:
1. The student who completed the course knows and is able to explain the main concepts in the area of engineering mechanics. He also knows the basic laws of mechanics and is able to write them using mathematical formulae and explain them in detail.
2. He has the knowledge in the field of engineering mechanics which allows for formulating and solving static and kinematic problems and formulating dynamic problems of mechanical systems.

Skills:
1. The student can formulate and solve the equilibrium equations.
2. He is able to make the structural analysis of simple multibody systems and determine the velocities and the accelerations of elements of these systems also.
3. He can derive the equations of motion of the particle, formulate the appropriate initial conditions and to solve the problem.
4. He can formulate the laws related to change of the momentum and the angular momentum for free and constrained mechanical systems.

Social competences:
1. The student understands the importance of knowledge in the modern world. He is also well aware that the rapid development of knowledge causes the need for lifelong learning.
2. He is able to think and act in a creative way.

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures: Exam in writing involving practical and theoretical issues. The exam tasks are rated on a point scale. 50% of the total points is needed to pass the exam.

Tutorials: Tests in written and assessment of the activity on classes. Both assessment components are rated on a point scale. To pass the classes the student needs at least 50% of total points.

Laboratory classes: assessment of self-solved problems using Mathematica program. Credit for a positive grade after obtaining at least 50% of the total points..

## Programme content

Lectures:
1. Introduction.
2. Vector Calculus.
3. Statics.
4. Geometry of masses.
5. Kinematics.
6. Dynamics.

Tutorials:
1. Geometry of masses.
2. Statics.
3. Kinematics.
4. Dynamics of material point.

Laboratory classes:
1. Introduction to the Matlab program.
2. Solving statics problems using Matlab.
3. Solving kinematics problems using Matlab.
4. Solving dynamics problems using Matlab.

## Course topics

Lectures:
1. Introduction.
2. Vector Calculus.
3. Statics:
- introduction to statics: force, degrees of freedom, constrains,
- systems of forces: parallel forces, concurrent forces, couple of forces,
- reduction of general coplanar system of forces,
- equilibrium equations,
- moment siły względem punktu, Varignon's theorem,

- equilibrium of general coplanar system of forces,
- system of connected rigid bodies,
- equilibrium conditions of any coplanar system of forces,
- 3D statics: equilibrium of general system of forces, moment of force about the axis, special cases of equilibrium equations,
- trusses: tensile and compressive forces, determinacy conditions for 2D and 3D trusses, methods for solving 2D trusses,
- static, kinetic and rolling friction.
4. Geometry of the masses: center of mass of a solid and a system of solids, moments of inertia.
5. Kinematics:
- kinematics of a particle: equations of motion, velocity, acceleration, natural coordinate system,
- kinematics of a rigid body: translational motion, rotational motion, planar motion.
6. Dynamics:
- dynamics of a particle - integration of Newton's equations,
- work, kinetic and potential energy, power, mechanical efficiency,
- momentum and angular momentum,
- conservation principles.

Tutorials:
1. Geometry of masses, static moments and the center of mass.
2. Statics: equations of equilibrium of general planar system of forces. Equilibrium of a system of connected bodies.
3. Kinematics of a particle - analysis of the motion of a point based on known kinematic equations of motion in the Cartesian coordinate system.
4. Dynamics of a particle - integration of Newton's equations.

Laboratory classes:
1. Introduction to the general principles of using Matlab – entering basic commands and calculations, explaining basic data structures and operations on them.
2. Basic principles and commands used when solving problems in mechanics using Matlab.
3. Solving statics problems, similar to those discussed in exercises, entering unknowns into the program, solving equations.
4. Result analysis – how to present results, e.g., in the form of a graph or table, data export.
5. Solving kinematics problems – introducing the issue, analyzing the results.
6. Solving dynamics problems – introducing the issues, analyzing the results.

## Teaching methods

Lectures: lecture supported by multimedia presentations, solving tasks on the blackboard. Presentations and issues that help students prepare for the exam are available online on the Moodle platform.
Tutorials: problem solving, discussion. A course supporting classes is available on the Moodle platform, containing solutions to tasks with broad comments and proposals for tasks for self learning.
Laboratory classes: solving problems with the use of Mathematica enabling the presentation of results in graphic form and the animation of motion. Discussion of results.

## Bibliography

Basic:
1. Z. Osiński, Mechanika ogólna, PWN.
2. J. Leyko, Mechanika ogólna t. 1-2, PWN.
3. M. Łunc, A. Szaniawski, Zarys mechaniki ogólnej, PWN.
4. Misiak J., Zadania z mechaniki ogólnej, WNT, Warszawa.

Additional:
1. J. R. Taylor, Mechanika klasyczna, t. 1 - 2, PWN.
2. W. Szcześniak, Mechanika klasyczna, analityczna i Mathematica w zadaniach i przykładach obliczeniowych, OWPW, Warszawa.

## Breakdown of average student's workload

| | Hours | ECTS |
|---|---|---|
| Total workload | 100 | 4,00 |
| 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) | 38 | 1,50 |