COURSE DESCRIPTION CARD - SYLLABUS

Course name
Theoretical mechanics and mechanics of materials

Course

Field of study
Automatic control and robotics

Year/Semester
1/2

Area of study (specialization)
–

Profile of study
general academic

Level of study
First-cycle studies

Course offered in
english

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes

Other (e.g. online)

Tutorials
30

Projects/seminars

Number of credit points

5

Lecturers

Responsible for the course/lecturer:
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Responsible for the course/lecturer:

Prerequisites

The student beginning this course should:
– have basic knowledge of mathematics and physics,
– have the ability to solve problems based on the already possessed knowledge, and have the skill to search for specific information in certain sources,
– understand the necessity to broaden own knowledge,
– be self-reliant and persistent in completing tasks and problem solving.

Course objective

1) To make students familiar with the theoretical fundamentals of general mechanics and mechanics of materials.
2) To shape students' skills in the mathematical description and analysis of static equilibrium and motion

of mechanical systems.
3) To prepare students to design simple mechanical systems.

Course-related learning outcomes

Knowledge

1) The student has well-structured and theoretically-based knowledge on general mechanics (statics, kinematics, dynamics).
2) The student has basic knowledge on mechanics of materials and structures.
3) The student knows and understands the principles of modelling and analysis of mechanical systems.

Skills

1) The student can apply basic physical laws, principles and models to solve simple engineering problems.
2) The student can work individually and in a team, as well as can present results of the conducted calculations.
3) The student can conduct the calculations necessary in the design of simple mechanical systems, taking into account its material properties.

Social competences

1) The student understands the need for lifelong learning, and can organize the learning process, cooperate and work in teams.
2) The student is aware of the necessity of a professional approach to engineering problems, and the necessity of reliability and perseverance in completing tasks.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: a written exam consisting of 5 equally scored theoretical open-response questions. The list of topics that outline the exam content is sent to all students by using the university e-mail system.

Tutorials: two written tests related to (1) statics and mass geometry, and (2) kinematics, dynamics and mechanics of materials. Each test consists of 3 equally scored problems to solve.

Assessment rules: a grade given on the basis of the obtained scores; linear grading scale; the passing threshold is 50% of all points.

Programme content

Lecture:
1) Introduction to solid mechanics
Basic concepts (a particle, a rigid body, a concentrated force). Newton's laws. General mechanics (rigid body mechanics) vs. deformable body mechanics.
2) Statics
Vector algebra. Principles of statics. Moment of a force, a couple. Two- and three-dimensional systems of forces. Reduction of force systems, static equilibrium conditions. Free-body diagram. Types of supports, support reactions. Static analysis: trusses and multi-body systems.

3) Mass geometry
Mass center. Mass moments of inertia for simple and composite bodies. The parallel axis theorem.
4) Kinematics
Kinematics of a particle. Velocity and acceleration. Fixed and natural coordinate systems. Tangential and normal components of acceleration.
Translational and rotational motion of a rigid body. Planar motion of a rigid body.
5) Dynamics
Newton's second law of motion, the D'Alembert principle. Equations of motion for a particle, initial conditions.
Work. Kinetic and potential energy. Conservative forces. Principle of work and kinetic energy. Principle of conservation of mechanical energy.
Linear momentum and angular momentum. Principles of conservation of linear momentum and angular momentum.
6) Elements of mechanics of materials
Internal forces. Stress and strain. The essence of analysis and design in mechanics. Simple loading conditions. Axially loaded bars and bending of beams. Allowable stress, factor of safety, strength criteria.

Tutorials:
1) Statics
Static analysis: planar and spatial problems for plates and beams supported in different ways; planar multi-body systems; trusses.
2) Mass geometry
Determination of the mass center of a composite body. Calculation of axial moments of inertia for simple bodies by integration. Calculation of moments of inertia for composite bodies using the parallel axis theorem.
3) Kinematics
Determination of trajectory, position, velocity and acceleration of a particle on the basis of kinematic equations of motion. Kinematic analysis of planar mechanisms.
4) Dynamics
Integration of equations of motion for a particle under the action of different forces. Determination of displacement, velocity, time of travel, and forces by using the principles of conservation of energy, linear momentum and angular momentum.
5) Elements of mechanics of materials:
Strain and stress analysis of bar systems. Determination of the bending moment, shear force and bending stress for beams. Specifying the required dimensions of a system on the basis of strength criteria.

Teaching methods

Lecture: informational lecture, multimedia presentation, problem-based lecture.

Computer laboratory classes: problem-based method, project-based method, case study.

Bibliography

Basic

1) Beer F.P., Johnston E.R. Jr., Mazurek D.F., Cornwell P.J., Eisenberg E.R., Vector Mechanics for Engineers: Statics and Dynamics. McGraw-Hill, New York, 2010.
2) Hibbeler R.C., Engineering Mechanics: Statics. Pearson, 2013.
3) Hibbeler R.C., Engineering Mechanics: Dynamics. Pearson, 2016.
4) Beer F.P., Johnston E.R. Jr., DeWolf J.T., D.F. Mazurek, Mechanics of Materials. McGraw-Hill, New York, 2012.

Additional

1) Niezgodziński M.E., Niezgodziński T., Zbiór zadań z mechaniki ogólnej. PWN, Warszawa, 2008.
2) Niezgodziński M.E., Niezgodziński T., Zadania z wytrzymałości materiałów. PWN, Warszawa, 2016.
3) Pytel A., Kiusalaas J., Engineering Mechanics: Statics. Cengage Learning, 2010.
4) Pytel A., Kiusalaas J., Engineering Mechanics: Dynamics. Cengage Learning, 2010.
5) Pytel A., Kiusalaas J., Mechanics of Materials. Cengage Learning, 2012.

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5
Classes requiring direct contact with the teacher	60	2,5
Student's own work (literature studies, preparation for tutorials, preparation for the tests, preparation for the exam) [1]	65	2,5

[1] delete or add other activities as appropriate