COURSE DESCRIPTION CARD - SYLLABUS

Course name
Theoretical mechanics and mechanics of materials [S1AiR1E>MiWM]

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

Course offered in
English

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
0

Other
0

Tutorials
30

Projects/seminars
0

Number of credit points

5,00

Coordinators

dr inż. Paweł Fritzkowski
pawel.fritzkowski@put.poznan.pl

Lecturers

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:
"Knows and understands to an advanced extent - selected facts, objects and phenomena, as well as methods and theories related to them, explaining complex interrelationships between them, being basic general knowledge in the scope of selected branches of general physics covering: thermodynamics, electricity and magnetism, optics, photonics and acoustics, and rigid body physics;

this should include knowledge necessary to understand basic physical phenomena occurring in and around automation and robotics components and systems [K1_W2 (P6S_WG)]."
Has a structured and theoretically grounded general knowledge of general mechanics: statics, kinematics and dynamics, including the knowledge necessary to understand the principles of modelling and design of simple mechanical systems [K1_W3 (P6S_WG)].
Has basic knowledge of materials-science, strength and fatigue of materials, knows typical manufacturing technologies of machine components [K1_W4 (P6S_WG)].
Skills:
Be able to design simple mechanical components, electrical and electronic systems for various applications (taking into account material properties) [K1_U25 (P6S_UW)].
Social competences:
Is ready to critically assess his/her knowledge; understands the need for and knows the possibilities of continuous training - improving professional, personal and social competence, is able to inspire and organize the learning process of others [K1_K1 (P6S_KK)].

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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.

Course topics

none

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	120	5,00
Classes requiring direct contact with the teacher	60	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	60	2,50