COURSE DESCRIPTION CARD - SYLLABUS

Course name
Mechanics

Course

Field of study
Mechanical engineering
Area of study (specialization)

Level of study
Second-cycle studies
Form of study
part-time

Year/Semester
1/2
Profile of study
general academic
Course offered in
polish
Requirements
compulsory

Number of hours

Lecture
20
Tutorials
10

Laboratory classes

Projects/seminars

Other (e.g. online)

Number of credit points

5

Lecturers

Responsible for the course/lecturer:
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Instytut Mechaniki Stosowanej

Wydział Inżynierii Mechanicznej

ul. Jana Pawła II 24, 60-965 Poznań

Responsible for the course/lecturer:

Prerequisites

1. Basic knowledge of mechanics and mathematics corresponding to the core curriculum for the first-cycle studies.

2. The ability to solve elementary problems in the field of mechanics based on the acquired knowledge.

3. The ability to self-study including the skill for search the needed information from various sources.

4. The awareness of the necessity for continuous learning and improving the skills.

Course objective

1. Getting to know and understanding the main concepts and laws of analytical mechanics.

2. Developing the skills in modeling mechanical systems using analytical mechanics methods and effective solving of problems related to the equilibrium and the motion of complex mechanical systems.

Course-related learning outcomes

Knowledge

1. The student who completed the course can explain the basic concepts of analytical mechanics which concern the mechanical systems with the constraints.

2. The student knows the principle of virtual work, the Dirichlet principle and the Lagrange equations of the first and the second type, and can determine the conditions of their applicability.

3. The student has well-ordered and theretically-founded knowledge of analytical mechanics which allows him/her to determine the equilibrium states of mechanical systems using the principle of virtual work and the Dirichlet principle and also the motion of them using the Lagrange equations.

Skills

1. The student can determine the equilibrium states of complex mechanical systems employing the principle of virtual work.

2. Using the Dirichlet principle he can determine the equilibrium states of the mechanical system remaining under the action of the conservative forces and examine their stability.

3. Using the Lagrange equations of the second kind he can derive the motion equations for mechanical systems which have several degrees of freedom.

4. He knows how to derive the motion equations from the Lagrange equations of the first kind and he can apply this approach to the determining the reaction forces.

5. The student is able to formulate and explain the laws concerning the changes of kinetic energy of the mechanical system which remains under action of the non-stationary constraints. He can calculate the instanteneous power of the reaction forces resulting from these constraints.

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 can organise the processes of learning and self-education.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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

Tutorials: Two 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.

Programme content

Lectures: Free and constrained mechanical systems. The analytical form of the motion constraints. Classification of the constraints. Structural analysys of the complex mechanical systems. Determination of the number of the elementary constraints and degrees of freedom. The geometric bilateral constraints: the gradient of the constraints at a point, the constraints imposed on the velocity and the acceleration of the particles which are the repercussion of the geometric constraints. The possible (i.e. consistent with the motion constraints) positions, velocities and displacements of the particles. The virtual displacements. The ideal motion constraints. The generalised coordinates and velocities. The generalised forces. The principle of virtual work. The equilibrium conditions for the mechanical systems subjected to the conservative forces. The Dirichlet principle. The Lagrange equations of the second kind. The Lagrange equations of the second kind for the case of potential and conservative forces. The Lagrange equations of the first kind. The kinetic energy of the mechanical system as the function of the generalized velocities. The work-energy theorem for the systems which are subjected the non-stationary constraints. The resistance forces dependent linearly on the velocities. The Rayleigh dissipation function.

Tutorials: Determining of the kinetic energy of complex mechanical systems using the Koenig theorem. The principle of virtual work - determining of the reaction forces for pinned beams. The principle of virtual work - approach employing the generalised coordinates and generalised forces. The Dirichlet principle - determining of the equilibrium positions of the mechanical system remaining under the action of the conservative forces. Stability analysis of the equilibrium positions. The Lagrange equations of the second kind.

Teaching methods

Lectures: lecture supported by multimedia presentations, solving tasks at the blackboard; discussion.

Tutorials: problem solving, discussion.

The on-line course is available on the Moodle platform, which includes the presentations from lectures, solutions to tasks with broad comments, proposals for tasks for independent work and issues to help students prepare for the exam.

Bibliography

Basic

1. J. Grabski, J. Strzałko, B. Mianowski, Podstawy mechaniki analitycznej, Wydawnictwo Politechniki Łódzkiej, Łódź 2016.

2. J. R. Taylor, Mechanika klasyczna, t. 2, PWN, Warszawa, 2006.

3. Z. Gutowski, Mechanika analityczna, PWN.

Additional

1. W. Rubinowicz, W. Królikowski, Mechanika teoretyczna, PWN.

2. G.K. Susłow, Mechanika teoretyczna, PWN.

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	5,0
Classes requiring direct contact with the teacher	40	2,5
Student's own work (literature studies, preparation for tutorials, self-work consisting in solving tasks proposed, preparation for tests and for the exam) [1]	60	2,5

[1] delete or add other activities as appropriate