COURSE DESCRIPTION CARD - SYLLABUS

Course name
Mechanics and mechatronics

Course

Field of study
Electrical Engineering
Year/Semester
2/3
Area of study (specialization)
-
Profile of study
practical
Level of study
First-cycle studies
Course offered in
Polish
Form of study
full-time
Requirements
compulsory

Number of hours

Lecture
15
Laboratory classes
Other (e.g. online)
Tutorials
Projects/seminars
15

Number of credit points

2

Lecturers

Responsible for the course/lecturer:
dr hab. inż. Grażyna Sypniewska-Kamińska
Responsible for the course/lecturer:

Prerequisites

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

Course objective

Cognizing and understanding the main concepts and laws of mechanics. Developing skills in modeling mechanical systems being parts of mechatronic systems and in solving problems related to the movement and the equilibrium of 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 simple static and kinematic problems and formulating dynamic problems of mechanical systems.

3. He knows and is able to explain the simplified models applied in engineering practice.

4. He has the knowledge of mechanics necessary to understand the basic physical phenomena occurring in mechatronic systems.

Skills

1. The student can formulate and solve the equilibrium equations. 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.

2. He can derive the equations of motion of the particle and formulate the appropriate initial conditions. He can also formulate the laws related to change of momentum and 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, and working in a group also stimulates the development of social skills.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

1. Lectures: Written test conducted at the last lecture. The test consists of 4 questions about theoretical issues and two practical tasks. The pass threshold equals 50% of the total points. A list of issues on the basis of which questions and tasks are developed is made available to students in the electronic form.

2. The project classes: Credit based on the total number of points gained during the semester. The pass threshold equals 50% of the total points. Points are awarded for:

- an effective participation at the classes - the level of advancement of the solution of the problem is assessed,

- the documentation of the project - the knowledge and the skills necessary for the implementation of a given project and the ability to clearly present the results of work are evaluated. The score is awarded to the team making the project,

- test of a practical nature conducted at the last classes.

Programme content

1. Lectures: Subject of mechatronics. Mechatronic devices. Basic knowledge in mechatronic systems. The role of mechanical systems in mechatronic systems.Basic knowledge in forces. The moment of the force about a point and an axis. Force systems – the couple of forces, the equivalence of force systems, the force-and-couple resultant of a system of forces, the resultant. Statics – the axioms of statics, the equilibrium conditions related to the spatial system of forces, the system of parallel forces, the concurrent system, and the plane system of forces. Supports and their reaction forces.Kinematics of a par-

ticle – the kinematic equations of motion, the motion path, the displacement of the point, the velocity and acceleration vectors. Description of the particle motion in the Cartesian coordinate system and in the natural coordinate system. Kinematics of a rigid body – the theorem about the projections of the velocity vectors of two points of a rigid body, the moving and the fixed reference system, the kinematic equations of motion of the rigid body, time derivatives of the unit vectors of the moving reference system, the angular velocity and angular acceleration vectors, the velocity and acceleration of any point of the rigid body. Translational, rotational and plane motion of the rigid body. Dynamics of a particle – the Newton laws of motion, direct and inverse problems of dynamics, the initial conditions and the initial value problems of dynamics. Dynamics of a mechanical system – free and constrained mechanical systems. The momentum and the angular momentum of a particle, particles system, and a rigid body. The relation between the momentum and the velocity of the mass centre. The relation between the angular momentum with respect to any point and with respect to the mass centre. The laws related to change of the momentum and the angular momentum for free and constrained mechanical systems.

2. The project classes: Principles of engineering calculations - accuracy of calculations, rounding rules in accordance with PN-70-N-02120. Application of the systems performing symbolic-numerical calculations (MatLab, Mathematica). Components and coordinates of the vector - the versor of the vector, determination of the vector in space by means of angles between the vector and the axes and planes of the Cartesian coordinate system.Kinematics of a particle - determination of the particle trajectory, velocity and acceleration of the particle in the Cartesian coordinate system and in the natural system of the trajectory (the Frenet frame). Structural analysis and kinematics of multibody systems in plane motion. Elements of mass geometry. The equilibrium equations for the spatial system of concurrent forces. Determination of the forces in the rods of spatial trusses. Uniaxial normal stress. The Hooke law. Allowable stresses. Strength criterion for uniaxial tensile or compressive stresses. The equilibrium equations for any spatial system of forces. The equilibrium equations for a system of rigid bodies under action of the plane forces system. The necessary and sufficient conditions for the geometrical invariance of the system. Determination of the reaction forces of and the forces at joints of the system.

Teaching methods

1. The lectures assisted by multimedial presentations and problem solving at the board. The students receive the lecture outline containing drawings, basic formulae and contents of the tasks (the outline is provided in the electronic form).

2. The project classes consists of four parts:

- a brief theoretical introduction,

- solving the exemplary problem by the teacher at the board,

- solving the project tasks in two-person teams. Each group solves a different problem. The lecturer consults the problems with the teams.

- an evaluation (by the lecturer) of the current achievements.

Bibliography

Basic

1. Leyko J., Mechanika ogólna, tom I i II, PWN, Warszawa 2013.

2. Osiński Z., Mechanika ogólna, PWN, Warszawa 2000.

3. Misiak J., Zadania z mechaniki ogólnej, część 1 i 2, WNT, Warszawa, 2012.

Additional

1.Taylor J.R., Mechanika klasyczna, t. 1 - 2, PWN, Warszawa 2012.

2. Misiak J., Mechanika techniczna, tom I i II, WNT, Warszawa, 1996.

3. Nizioł J., Metodyka rozwiązywania zadań z mechaniki, WNT, Warszawa, 2007.

Breakdown of average student's workload

	Hours	ECTS
Total workload	30	2
Classes requiring direct contact with the teacher	38	1,0
Student's own work (literature studies, preparation for project classes, participation in the consultations regarding the projects, project elaboration, preparation for test)[1]	22	1,0

[1] delete or add other activities as appropriate