Course description

1 General information

Course name	General Mechanics
Course code	
Level of study (B.Sc, M.Sc., Ph.D.)	M. Sc.
ECTS	5
Course manager	PhD. Waldemar Łatas, Institute of Applied Mechanics
Course length	One (1) semester
Coordinator for international programs	erasmus@mech.pk.edu.pl

2 Prerequisites

- Basics of vector and matrix calculus. Basics of differential and integral calculus. Ordinary differential equations.

2 Program

Type	Lectures	Classes	Labs	Computer labs	Project	Seminar
Hours	30	30	0	0	0	0

3 Contents

Lectures		
No.		Hours
1	Repetition of the most important vector calculus operations. Objectives and scope of the classical mechanics. Basic concepts of mechanics. The moment of force with respect to the point and the line.	2
2	Reduction of the system of forces. Reduction invariants, a couple, a wrench, the central axis equation.	2
3	Kinematic constraints. Releasing from constraints, reactions of constraints. Balance of any flat and three-dimensional system of forces. The equilibrium equations.	2
4	Balance of systems including sliding and rolling friction forces.	2
5	Kinematics of point in Cartesian, natural and curvilinear coordinates.	2
6	Kinematics of a rigid body. Kinematics of rotational and flat motion.	2
7	Dynamics of a material point. Integration of differential equations of motion of a material point.	2
8	The momentum of a material point. The principle of change of the momentum. The angular momentum of a material point. The principle of change of the angular momentum.	2
9	The kinetic energy. The work of force. The principle of the kinetic energy change for a material point. The potential force. The principle of conservation of the mechanical energy for a material point.	2
10	Dynamics of the system of material points. The center of mass of the system of material points. The momentum of the system of material points – the principle of change. The angular momentum of the system of material points – the principle of change.	2
11	Kinetic energy of the system of material points – the Koenig's theorem. The principle of the kinetic energy change for the system of material points.	2
12	Geometry of masses. The center of mass. Tensor of inertia. The Steiner's theorem.	2
13	Dynamics of a rigid body. The momentum of a rigid body – the principle of change. The angular momentum of a rigid body – the principle of change.	2
14	The equation of rotational motion of the rigid body. Dynamic reactions in rotational motion. The equations of flat motion of the rigid body.	2
15	Kinetic energy of a rigid body – the Koenig's theorem. The principle of the kinetic energy change for a rigid body.	2

Classes		
No.		Hours
1	Determining the reactions of constraints in flat problems of statics. [STATICS]	3
2	Determining the reactions of constraints in three-dimensional problems of statics. [STATICS]	3
3	Determining the balance conditions of the flat systems including the friction forces. [STATICS]	3
4	Determining the course equation, calculating the velocity and acceleration vector components. Finding the tangential acceleration, normal acceleration and the radius of curvature. [POINT KINEMATICS]	3
5	Determination of the velocity and acceleration in the flat motion of a rigid body. [RIGID BODY KINEMATICS]	3
6	Integration of equations of motion for the free and constrained movement of a material point. [MATERIAL POINT DYNAMICS]	3
7	Equations of motion and equations of kinematic constraints for the system of material points. The use of the center of mass movement principle. [SYSTEM OF MATERIAL POINTS DYNAMICS]	3
8	Determination of the dynamic reactions in rotational motion of a rigid body. [RIGID BODY DYNAMICS]	2
9	Equations of motion and equations of kinematic constraints for the system of rigid bodies. [RIGID BODY DYNAMICS]	4
10	The use of the principles of conservation of momentum, angular momentum and energy in the problems of mechanics of the material point, the system of material points and the rigid bodies system.	3

3 Learning Outcomes (skills and knowledge):

- The ability to solve problems in statics.
- The ability to solve problems in point kinematics and kinematics of a rigid body.
- The ability to solve problems in the dynamics of a material point and the system of material points.
- The ability to solve problems in the dynamics of a rigid body.
- The ability to use the laws of conservation (of the momentum, angular momentum and energy) in mechanical problems.

4 Assessment policy (examination):

- Realization of the individual projects related to the processed particular mechanics issues.
- Passing the final test related to the processed mechanics issues.

5 Literature

1. "Classical Mechanics (3rd Edition)" (2001) by Herbert Goldstein, Charles P. Poole, John L. Safko.
2. "Mechanics, Third Edition: Volume 1 (Course of Theoretical Physics)" (1976) by L. D. Landau, E. M. Lifshitz.
3. "Classical Mechanics" (2002) by Walter Greiner.