

## SYLLABUS OF A MODULE

Polish name of a module	<b>MECHANIKA ANALITYCZNA</b>
English name of a module	<b>ANALYTICAL MECHANICS</b>
ISCED classification - Code	0715
ISCED classification - Field of study	<i>Mechanics and metal trades</i>
Languages of instruction	<i>English</i>
Level of qualification:	<i>2 – MSc (EQF 7)</i>
Number of ECTS credit points	5
Examination:	<i>EW – exam written</i>

### Number of hours per semester:

Lecture	Tutorial	Laboratory	Seminar	Project	Others
30 E	30	0	0	0	0

## **MODULE DESCRIPTION**

### **MODULE OBJECTIVES**

- O1. Obtaining knowledge in the field of statics and dynamics of mechanical systems in terms of analytical mechanics
- O2. Acquiring skills in solving problems using Lagrange formalism

### **PRELIMINARY REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Knowledge of mathematical analysis and algebra.
2. Knowledge of the dynamics of mechanical systems.
3. Ability to calculate derivatives of complex functions.
4. Ability to perform basic operations on vectors and matrices.

### **LEARNING OUTCOMES**

- LO 1 – has theoretical knowledge in the field of analytical mechanics, knows the principle of virtual work, knows the d'Alembert principle, has theoretical knowledge in the formulation of second-order Lagrange equations
- LO 2 – is able to use the principle of virtual work for solving problems of statics, can solve problems using the d'Alembert principle and 2nd type Lagrange equations for a given mechanical system

## MODULE CONTENT

<b>Type of classes – LECTURES</b>	<b>Number of hours</b>
L1 - Introduction to analytical mechanics. Basic concepts.	2
L2 - Degrees of freedom. Constraints and their classification.	2
L3, 4 – Generalized coordinates, velocities and accelerations.	4
L5 - Examples of solutions in the field of kinematics.	2
L6 - Configuration space.	2
L7 - Generalized forces.	2
L8 - Kinetic energy and work.	2
L9 – Virtual displacements.	2
L10, 11 - Perfect constraints. Virtual work. The principle of virtual work.	4
L12 - D'Alembert's principle.	2
L13 - Lagrange equations of the second kind.	2
L14 - Equations of motion of holonomic systems with one and two degrees of freedom.	2
L15 - Examples of solutions in the field of dynamics.	2
<b>Type of classes – TUTORIALS</b>	<b>Number of hours</b>
T1, 2 - Determining the number of degrees of freedom of the system and the type of constraints. Derivation of equations of constraints.	4
T3, 4 - Determining the system configuration by selecting the appropriate set of generalized coordinates. Calculation of speed and acceleration of system elements as a function of generalized coordinates.	4
T5 - Determining the value of generalized forces acting on the system and the work performed by these forces.	2
T6, 7 - Calculation of the kinetic energy of the system as a function of generalized quantities.	4
T8 - Determining virtual displacements.	2
T9, 10 - Application of the principle of virtual work in the problems of statics.	4
T11, 12 - Application of d'Alembert's principle for determining differential equations of motion of material points.	4
T13-15 - The use of Lagrange equations to determine the differential equations of motion of a mechanical system with one or more degrees of freedom.	6

## TEACHING TOOLS

1. – lectures with the use of a blackboard and multimedia presentations
2. – tutorials - solving problems using blackboard and chalk

## WAYS OF ASSESSMENT ( F – FORMATIVE, S – SUMMATIVE

<b>F1.</b> – assessment of activity during classes
<b>F2.</b> – assessment of the ability to apply acquired knowledge in solving problems
<b>S1.</b> – assessment of the ability to independently solve given problems*
<b>S2.</b> – exam

\*) in order to receive a credit for the module, the student is obliged to attain a passing grade in achievement tests.

## STUDENT'S WORKLOAD

L.p.	Forms of activity	Average number of hours required for realization of activity
<b>1. Contact hours with teacher</b>		
1.1	Lectures	30
1.2	Tutorials	30
1.3	Laboratory	0
1.4	Seminar	0
1.5	Project	0
1.6	Consulting teacher during their duty hours	5
1.7	Examination	3
Total number of contact hours with teacher:		68
<b>2. Student's individual work</b>		
2.1	Preparation for tutorials and tests	30
2.2	Prereparation for laboratory exercises, writing reports on laboratories	0
2.3	Preparation of project	0
2.4	Preparation for final lecture assessment	0
2.5	Preparation for examination	10
2.6	Individual study of literature	17
Total number of hours of student's individual work:		57
Overall student's workload:		125
<b>Overall number of ECTS credits for the module</b>		5
Number of ECTS points that student receives in classes requiring teacher's supervision:		3
Number of ECTS credits acquired during practical classes including laboratory exercises and projects :		2

## BASIC AND SUPPLEMENTARY RESOURCE MATERIALS

1. L. Meirovitch: Analytical Methods in Vibrations, Macmillan Company New York 1967, reprinted by Pearson Education POD 1997
2. J. Tőrök: Analytical Mechanics, John Wiley & Sons, Inc., New York 2000

## MODULE COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)

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