



## Subject card

|   |  |  |  |            |         |         |     |
|---|--|--|--|------------|---------|---------|-----|
| Subject name and code                       | Mechanics I, PG_00055378   |  |  |            |         |         |     |
| Field of study                              | Mechatronics   |  |  |            |         |         |     |
| Date of commencement of studies             | October 2022   | Academic year of realisation of subject  | 2022/2023  |            |         |         |     |
| Education level                             | first-cycle studies  | Subject group  | Obligatory subject group in the field of study<br>Subject group related to scientific research in the field of study |            |         |         |     |
| Mode of study                               | Full-time studies  | Mode of delivery   | at the university  |            |         |         |     |
| Year of study                               | 1  | Language of instruction  | Polish   |            |         |         |     |
| Semester of study                           | 2  | ECTS credits   | 6.0  |            |         |         |     |
| Learning profile                            | general academic profile   | Assessment form  | exam   |            |         |         |     |
| Conducting unit                             | Department of Mechanics and Mechatronics -> Faculty of Mechanical Engineering and Ship Technology  |  |  |            |         |         |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor   | prof. dr hab. inż. Marek Krawczuk  |  |            |         |         |     |
|   | Teachers   | dr inż. Paweł Załuski<br>mgr inż. Grzegorz Banaszek<br>prof. dr hab. inż. Marek Krawczuk |  |            |         |         |     |
| Lesson types and methods of instruction     | Lesson type  | Lecture  | Tutorial   | Laboratory | Project | Seminar | SUM |
|   | Number of study hours  | 45.0   | 30.0   | 0.0        | 0.0     | 0.0     | 75  |
|   | E-learning hours included: 0.0   |  |  |            |         |         |     |
|   | Mechanika, C, Mtr, sem. 02, letni 22/23, (PG_00055378) - Moodle ID: 29761<br><a href="https://enauczanie.pg.edu.pl/moodle/course/view.php?id=29761">https://enauczanie.pg.edu.pl/moodle/course/view.php?id=29761</a> |  |  |            |         |         |     |
| Learning activity and number of study hours | Learning activity  | Participation in didactic classes included in study plan                                 | Participation in consultation hours  | Self-study | SUM     |         |     |
|   | Number of study hours  | 75   | 5.0  | 70.0       | 150     |         |     |
| Subject objectives                          | Lectures and exercises in technical mechanics  |  |  |            |         |         |     |

| Learning outcomes | Course outcome  | Subject outcome   | Method of verification  |
|-------------------|---|---|---|
|                   | [K6_W04] has organized and theoretically supported knowledge in terms of general mechanics, strength of materials, theory of mechanisms and machine dynamics, fluid dynamics, hydraulics and pneumatics, machine construction and engineering graphics  | Student describes real systems using physical and mathematical models. Student recognizes meanings: ideal rigid body, dimension-less point, concentrated force.   | [SW1] Assessment of factual knowledge   |
|                   | [K6_U03] has self-learning skills   | Student defines substitute conditions of equilibrium.   | [SU1] Assessment of task fulfilment   |
|                   | [K6_U01] is able to acquire information from literature, databases and other, properly chosen sources, integrate these information, interpret them, draw conclusions and formulate opinions   | Student describes real systems using physical and mathematical models. Student recognizes meanings: ideal rigid body, dimension-less point, concentrated force. Student presents basic Newton's principles, primitive notions and axioms of mechanics. Student differentiates equilibrant forces; systems. Student characterizes the resultant force and the resultant momentum systems of forces. Student describes degrees of freedom, strengths and their reactions, and also statically determinate and indeterminate of systems. Student characterizes conditions of equilibrium of spatial force system, and particular systems: coplanar, concurrent, and parallel. Student defines substitute conditions of equilibrium. Student characterizes types of forces, and their sources, describes active and reactivity forces, as well as external and internal forces. Student characterizes gravity force and coordinates of the centre of gravity. Student describes friction forces, rolling resistance, and belt drive friction. Student characterizes forces in bars of truss. Student recognizes basic meanings of kinematics of point: position coordinates, velocity and acceleration. Student recognizes: vector, Cartesian, normal, and polar co-ordinates of point kinematics. Student characterizes parameters of kinematics of particular systems: linear track motion, circle and ellipse track motion, uniform and uniformly accelerated motion, harmonic motion, crank-shaft system motion | [SU1] Assessment of task fulfilment   |
|                   | [K6_W02] has a knowledge in term of physics that includes mechanics, thermodynamics, optics, electricity, magnetism, atomic physics, nuclear physics, solid state physics, including the knowledge necessary to understand basic phenomena occurring in mechatronic elements and systems and its surroundings | Student can apply mechanics fundamental principles to analyse phenomena happening in mechatronics systems   | [SW3] Assessment of knowledge contained in written work and projects<br>[SW1] Assessment of factual knowledge |

| Subject contents   | <b>Lectures/Tutorials</b><br><br>Modeling in mechanics: real system, physical and mathematical models, and also meanings of: ideal rigid body, dimension-less point, concentrated force. The basic Newtons principles, and primitive notions and axioms of mechanics. Equilibrant systems of forces. Resultant force of concurrent system of forces. Momentum of pair of forces. Resultant force and resultant momentum of spatial system of forces. Degrees of freedom, strains and their reaction forces. Statically determinate and in determinate systems. Conditions of equilibrium of system of forces, and particular systems: coplanar, concurrent, and parallel. Substitute conditions of equilibrium. Formulas of superposition, and independence of force acting. Forces, and their sources. Division of forces: reactive and active, external and internal. Gravity force and coordinates of centre of gravity. Friction forces, rolling resistance and belt drive friction. Analysis of forces in bars of truss. Basic meanings in kinematics of point: position coordinates, velocity, acceleration, and equations of motion. Description of motion of point in: vector, Cartesian, normal, and polar coordinates. Analysis of kinematics parameters of particular systems: linear track motion, circle and ellipse track motion, uniform and uniformly accelerated motion, harmonic motion, crank-shaft system motion. Kinematics of the rigid body. Basic definitions: angular coordinates, velocities and accelerations of the body, and linear velocity and acceleration of the point of the body. Dependency in-between velocities and accelerations of points of the body. Particular cases of the rigid body kinematics: transitional, rotational and coplanar motion. Description of coplanar motion as transitional and rotational motion superposition, and as rotational motion around contemporary center of velocity and center of acceleration. Analysis of kinematics parameters of planar and planetary toothed transmit boxes. Relative motion and Coriolis acceleration. Dynamics of inertial point in: Cartesian, polar, and normal coordinates. Particular cases of dynamics of point motion of: linear track motion, oblique projection motion, free motion in gravity field including resistance forces, harmonic motion, mathematical pendulum. Dynamics of the inertial points system. Dynamic analysis of the inertial point using principles of mechanics: d'Alembert, conservation of energy, conservation of momentum and impulse, conservation of moment of momentum. Inertia parameters of the rigid body: mass, coordinates of centre of mass, mass moments of inertia. Parameters of the principal moments of inertia and principal axes of inertia of the body. Differential equation of motion and dynamic principles in analysis of transitional, rotational and coplanar motion of the body. |                               |  |                          |   |                               |                          |  |       |                      |       |       |
|--|--|-------------------------------|--|--------------------------|---|-------------------------------|--------------------------|--|-------|----------------------|-------|-------|
| Prerequisites and co-requisites                          | Physics and mathematics on the secondary level school, including in particular: geometry, trigonometry, and also vector calculus.  |                               |  |                          |   |                               |                          |  |       |                      |       |       |
| Assessment methods and criteria                          | <table border="1"> <thead> <tr> <th data-bbox="456 920 794 952">Subject passing criteria</th> <th data-bbox="798 920 1136 952">Passing threshold</th> <th data-bbox="1139 920 1479 952">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="456 956 794 987">Practical exercise</td> <td data-bbox="798 956 1136 987">56.0%</td> <td data-bbox="1139 956 1479 987">50.0%</td> </tr> <tr> <td data-bbox="456 992 794 1023">Written exam</td> <td data-bbox="798 992 1136 1023">56.0%</td> <td data-bbox="1139 992 1479 1023">50.0%</td> </tr> </tbody> </table>   |                               |  | Subject passing criteria | Passing threshold   | Percentage of the final grade | Practical exercise       | 56.0%  | 50.0% | Written exam         | 56.0% | 50.0% |
| Subject passing criteria                                 | Passing threshold  | Percentage of the final grade |  |                          |   |                               |                          |  |       |                      |       |       |
| Practical exercise                                       | 56.0%  | 50.0%                         |  |                          |   |                               |                          |  |       |                      |       |       |
| Written exam   | 56.0%  | 50.0%                         |  |                          |   |                               |                          |  |       |                      |       |       |
| Recommended reading                                      | <table border="1"> <tr> <td data-bbox="456 1032 794 1081">Basic literature</td> <td colspan="2" data-bbox="798 1032 1479 1081">Wittbrodt E., Sawiak S.: Mechanika ogólna. Teoria i zadania. Wyd. PG, Gdańsk 2012</td> </tr> <tr> <td data-bbox="456 1086 794 1373">Supplementary literature</td> <td colspan="2" data-bbox="798 1086 1479 1373"> Osiński Z.: Mechanika ogólna. T. I i 2, PWN, Warszawa 1987<br/><br/> Nizioł J.: Metodyka rozwiązywania zadań z mechaniki. WNT, Warszawa 2002<br/><br/> Sawiak S., Wittbrodt E.: Mechanika. Wybrane zagadnienia. Teoria i zadania. Wyd. PG, Gdańsk 2007 </td> </tr> <tr> <td data-bbox="456 1377 794 1406">eResources addresses</td> <td colspan="2" data-bbox="798 1377 1479 1406"></td> </tr> </table>   |                               |  | Basic literature         | Wittbrodt E., Sawiak S.: Mechanika ogólna. Teoria i zadania. Wyd. PG, Gdańsk 2012 |                               | Supplementary literature | Osiński Z.: Mechanika ogólna. T. I i 2, PWN, Warszawa 1987<br><br>Nizioł J.: Metodyka rozwiązywania zadań z mechaniki. WNT, Warszawa 2002<br><br>Sawiak S., Wittbrodt E.: Mechanika. Wybrane zagadnienia. Teoria i zadania. Wyd. PG, Gdańsk 2007 |       | eResources addresses |       |       |
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| eResources addresses                                     |  |                               |  |                          |   |                               |                          |  |       |                      |       |       |
| Example issues/ example questions/ tasks being completed |  |                               |  |                          |   |                               |                          |  |       |                      |       |       |
| Work placement   | Not applicable   |                               |  |                          |   |                               |                          |  |       |                      |       |       |