# GDAŃSK UNIVERSITY OF TECHNOLOGY

## Subject card

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| Subject name and code | Analytical mechanics, PG_00064782 |
| Field of study | Mechatronics |

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| Date of commencement of studies | February 2025 | Academic year of realisation of subject | 2024/2025 |
| Education level | second-cycle studies | Subject group | Obligatory subject group in the field of study |
| | | | 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 | 1 | ECTS credits | 2.0 |
| Learning profile | general academic profile | Assessment form | exam |

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| Conducting unit | Zakład Konstrukcji Maszyn i Inzynierii Medycznej -> Institute of Mechanics and Machine Design -> Faculty of Mechanical Engineering and Ship Technology |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr hab. inż. Wiktoria Wojnicz |
| | Teachers | |

| Lesson types and methods of instruction | Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
|---|---|---|---|---|---|---|---|
| | Number of study hours | 15.0 | 15.0 | 0.0 | 0.0 | 0.0 | 30 |
| | E-learning hours included: 0.0 | | | | | | |

| Learning activity and number of study hours | Learning activity | Participation in didactic classes included in study plan | Participation in consultation hours | Self-study | SUM |
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| | Number of study hours | 30 | 4.0 | 16.0 | 50 |

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| Subject objectives | Extension of knowledge acquired in general mechanics (statics, kinematics, dynamics). Introduction to kinematics and dynamics of spherical and arbitrary motion of a solid, a point in complex motion, collisions, dynamics of systems with variable mass, and fundamentals of analytical mechanics (general equation of dynamics, principle of prepared works, Lagrange's equations of the first and second kind). |

| Learning outcomes | Course outcome | Subject outcome | Method of verification |
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| | [K7_U15] evaluates the feasibility of advanced methods and tools for solving complex engineering tasks of a practical nature, characteristic of the field of study, and selects and applies appropriate methods and tools for this purpose | The student selects a method for describing and analyzing the dynamics for a given, complex problem of a mechatronic system | [SU4] Assessment of ability to use methods and tools |
| | [K7_W02] demonstrates structured and theory supported knowledge encompassing key issues in the field of Mechatronics, enabling modeling and analysis of stationary and non-stationary mechatronic systems, devices, and processes with continuous and discrete operation | The student demonstrates the ability to analyze phenomena related to the dynamics of solids in spatial motion as well as gyroscopic phenomena, collisions and variable mass. | [SW3] Assessment of knowledge contained in written work and projects |
| | [K7_U02] formulates and tests hypotheses concerning problems od stationary and non-stationary mechatronic systems/processes, as well as simple research problems | The student verifies the obtained analytical results with the results of experimental tests | [SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject |

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| Subject contents | **WYKŁAD**<br><br>Wstęp. Kinematyka punktu we współrzędnych krzywoliniowych i wektorowych oraz w ruchu złożonym (względnym) (1). Kinematyka ruchu kulistego bryły. Kąty Eulera. Precesja regularna (1). Prędkość i przyspieszenie obrotowe i doosiowe punktu bryły w ruchu kulistym. Kinematyka bryły w ruchu dowolnym (1). Dynamika bryły w ruchu kulistym i dowolnym. Kręt bryły (1). Energia kinetyczna, zasady dynamiki i równania dynamiki bryły w ruchu kulistym i dowolnym (1). Drgania własne i wymuszone układu o jednym i wielu stopniach swobody (2). Mechanika analityczna: współrzędne, więzy, stopnie swobody, współrzędne uogólnione, przemieszczenia uogólnione (1). Zasada prac przygotowanych (1). Zasada dAlemberta ogólne równanie dynamiki analitycznej (1). Równania Lagrange'a II rodzaju (2). Równania Lagrangea I rodzaju (1). Dynamika układu o zmiennej masie (1). Dynamika punktu w ruchu złożonym (1).<br><br>**ĆWICZENIA**<br><br>Obliczanie prędkości i przyspieszeń punktu bryły w ruchu płaskim: mechanizmy prętowe (1) i mechanizmy z kołami (1). Obliczanie prędkości i przyspieszeń punktu w ruchu złożonym (1). Obliczanie prędkości i przyspieszeń bryły w ruchu kulistym (1) oraz punktu bryły w ruchu kulistym (1). Drgania układów o 1 stopniu swobody (1). Kolokwium I (1). Drgania układów o wielu stopniach swobody (1). Rozwiązywanie przykładów przy wykorzystaniu zasady dAlemberta (1). Rozwiązywanie zadań za pomocą zasady prac przygotowanych (1). Rozwiązywanie zadań za pomocą równań Lagrangea II rodzaju (1) oraz równań Lagrangea I rodzaju (1). Obliczanie parametrów bryły o zmiennej masie (1) oraz punktu w ruchu złożonym (1). Kolokwium II (1). |
| Prerequisites and co-requisites | Knowledge of high school level physics and mathematics, including specifically: geometry and trigonometry, differential calculus, vector and matrix calculus, as well as knowledge of general statics, kinematics and dynamics. |

| Assessment methods and criteria | Subject passing criteria | Passing threshold | Percentage of the final grade |
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| | exercises | 56.0% | 50.0% |
| | exam | 56.0% | 50.0% |

| Recommended reading | Basic literature | 1. Wittbrodt E., Sawiak S.: General mechanics. Theory and tasks. University of Technology Publishing House Gdańska, Gdańsk 2020 (supplemented with the issue of vibrations of mechanical systems)<br>2. Sawiak S., Wittbrodt E.: Mechanics. Selected issues. Theory and tasks. Publishing house Gdańsk University of Technology,, Gdańsk 2007<br>3. Awrejcewicz J.: Mechanics. WNT, Warszawa 2007 |
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| | Supplementary literature | - |
| | eResources addresses | Adresy na platformie eNauczanie: |

| Example issues/ example questions/ tasks being completed | Calculate the reaction forces of the bearings of an unbalanced solid rotating with constant angular velocity<br><br>Calculate the speed of the chain sliding off a horizontal surface if the mass of the moving part varies<br><br>Calculation of the reaction of constraints using Lagrange equations of the first kind |
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| Work placement | Not applicable |

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