GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Analytical mechanics, PG_00064782		
Field of study	Mechatronics		
Date of commencement of studies	February 2027	Academic year of realisation of subject	2026/2027
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
Conducting unit	Division of Machine Design and Medical Engineering -> Institute of Mechanics and Machine Design -> Faculty of Mechanical Engineering and Ship Technology -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Edmund Wittbrodt	
	Teachers	prof. dr hab. inż. Edmund Wittbrodt mgr inż. Grzegorz Banaszek	

Lesson types

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
Number of study hours	30	4.0	16.0	50

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
[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

<table>
<tr><td>Subject contents</td><td>Course content – lecture

WYKŁAD

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).

ĆWICZENIA

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).</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>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.</td></tr>
<tr><td>Assessment methods and criteria</td><td><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>exercises</td><td>56.0%</td><td>50.0%</td></tr>
<tr><td>exam</td><td>56.0%</td><td>50.0%</td></tr>
</table></td></tr>
<tr><td>Recommended reading</td><td><table>
<tr><td>Basic literature</td><td>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)
2. Sawiak S., Wittbrodt E.: Mechanics. Selected issues. Theory and tasks. Publishing house Gdańsk University of Technology,, Gdańsk 2007
3. Awrejcewicz J.: Mechanics. WNT, Warszawa 2007</td></tr>
<tr><td>Supplementary literature</td><td>-</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
</table></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td>Calculate the reaction forces of the bearings of an unbalanced solid rotating with constant angular velocity

Calculate the speed of the chain sliding off a horizontal surface if the mass of the moving part varies

Calculation of the reaction of constraints using Lagrange equations of the first kind</td></tr>
<tr><td>Practical activites within the subject</td><td>Not applicable</td></tr>
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