



## Subject card

Subject name and code	Space Mechanisms and Constructions, PG_00050014						
Field of study	Space and Satellite Technologies, Space and Satellite Technologies						
Date of commencement of studies	February 2023		Academic year of realisation of subject		2022/2023		
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		assessment		
Conducting unit	Department of Mechanics and Mechatronics -> Faculty of Mechanical Engineering and Ship Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Marek Chodnicki				
	Teachers		dr inż. Marek Chodnicki				
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
	Number of study hours	30		5.0		15.0	50
Subject objectives	The student becomes familiar with the literature on the theory of machines and mechanisms in space structures. The student becomes familiar with the most important sections of Theory of machines and mechanisms in space structures. Learns about the principles of Structural Analysis, Kinematics and Dynamics of planar mechanisms. The student uses vector and matrix methods to describe the geometry of mechanisms, knows the methods of kinematic analysis of spatial mechanisms and the Denavit-Hartenberg notation.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	K7_W03		The student has knowledge of the mechanisms		[SW1] Assessment of factual knowledge		
	K7_U13		The student recognizes the kinematic structures of mechanisms		[SU3] Assessment of ability to use knowledge gained from the subject [SU5] Assessment of ability to present the results of task		
	K7_W07		The student knows the life cycle of mechanical devices		[SW1] Assessment of factual knowledge		
	[K7_K03] Can analyse and implement assigned tasks while maintaining high technical standards. Is able to work and interact in a group, taking on different roles. Adheres to the principles of professional ethics and respects the diversity of views and cultures.		The student analyses and solves tasks on space mechanisms and constructions, working in workgroup. At the same time he/she provides high technical standards of the work.		[SK3] Assessment of ability to organize work		
	K7_U07		The student is able to estimate the cost of making the space mechanism		[SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools		

Subject contents	Familiarize students with the classification of the most important elements of mechanisms and machines, open kinematical chains, closed kinematic chains, classification of kinematical pairs and kinematic assemblies. Review of the most popular types of mechanisms. An introduction of the main concepts of structural analysis - structural equation of mobility of mechanisms, degrees of freedom, Assur structural groups, classes, orders and forms of the groups. Introduction to the selected methods used for determining the position, velocity and acceleration. Presentation of methods of dynamics of mechanisms - equations of kinetostatics, determination of forces present in kinematic pairs, differential equations of motion of mechanisms. Introduction to the free and forced vibration of discrete systems. To familiarize student with methods of vector and matrix description of kinematics of mechanisms, including the coordinates of constituting elements, coordinate systems, as well as the matrix notation. The analytical methods in kinematics of planar mechanisms, as well as the Denavit-Hartenberg notation for spatial mechanisms and manipulators are presented. The student become familiar with the methods of numerical determination of velocities and accelerations of selected points of planar and spatial mechanisms. Presentation of numerical methods for solving simple and inverse. The student become familiar with the numerical methods used in the dynamics of manipulators, especially the direct and inverse  problems of dynamics. Discussion of the energy balance of the machine to familiarize students with the calculation of mechanical efficiency of machines and self-locking conditions.		
Prerequisites and co-requisites	1) Mechanism theory and dynamics of machines I, including aspects of structural analysis, kinematics and dynamics of planar mechanisms, vibrations of systems with one degree of freedom and with many degrees of freedom without damping. 2) Mechanics including statics, kinematics, dynamics of mechanical systems. 3) Mathematics including algebra, matrix calculus, differential and integral calculus, linear differential equations.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Exercises	56.0%	60.0%
	Exam	56.0%	40.0%
Recommended reading	Basic literature	1. Morecki A., Knapczyk J., Kędzior K.: Teoria mechanizmów i manipulatorów WNT 2002  2. Olędzki A.: Podstawy teorii maszyn i mechanizmów. WNT 1978  3. Morecki A., Knapczyk J., Kędzior K.: Teoria mechanizmów i manipulatorów. Podstawy i przykłady zastosowań w praktyce. WNT, Warszawa 2001  4. Wawrzecki J.: Teoria maszyn i mechanizmów. Wyd Polit. Łódzkiej, Łódź 1994	
	Supplementary literature	1. Miller S.: Teoria maszyn i mechanizmów analiza układów kinematycznych; Oficyna Wydawnicza Politechniki Wrocławskiej; Wrocław 1996  2. Młynarski T., Listwan A., Pazderski E.: Zbiór zadań z teorii mechanizmów i maszyn do analizy kinematycznej mechanizmów; skrypt Politechniki Krakowskiej; Kraków 1992	
	eResources addresses	Adresy na platformie eNauczanie: Mechanizmy i konstrukcje kosmiczne, WC, TKiS, II st., sem. letni, (PG_000 - Moodle ID: 31140 <a href="https://enauzanie.pg.edu.pl/moodle/course/view.php?id=31140">https://enauzanie.pg.edu.pl/moodle/course/view.php?id=31140</a>	
Example issues/ example questions/ tasks being completed	Structural classification of mechanisms: groups, classes, orders, forms.  Direct and inverse problem of kinematics of the mechanism, trajectory planning problem  Methods of modeling of loads carried by rotating and prismatic kinematic pairs, known and searched parameters Introduce, define and comment the concept of the inertia reduced on the drive shaft, Homogeneous transformations: the idea and properties Denavit-Hartenberga coordinates: orientation of the axes		
Work placement	Not applicable		