GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00056114		
Field of study	Mechatronics		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2025/2026
Education level	first-cycle studies	Subject group	
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	3	Language of instruction	Polish
Semester of study	6	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	prof. dr hab. inż. Krzysztof Kaliński	
	Teachers		

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	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	0.0	0.0	30

Subject objectives

Acquiring methods of modelling and simulation of dynamic phenomena in machine tools together with accompanying production processes.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W10] has knowledge about development trends in the field of engineering and technology sciences and scientific disciplines: Mechanical Engineering, Automation, Electronics, Electrical Engineering and Space Technologies, adequate for Mechatronics curse	Student analyse tool-workpiece vibration using selected models of cutting dynamics	[SW3] Assessment of knowledge contained in written work and projects
[K6_U05] is able to use properly chosen tools to compare design solutions of elements and mechatronics systems according to given application and economic criteria (e.g. power demand, speed, costs)	Student chooses optimal parameters of machining process according to a selected criteria.	[SU3] Assessment of ability to use knowledge gained from the subject
[K6_W08] knows and understands design and production processes of elements and simple mechatronic devices	Student identifies method for counteracting negative dynamical effects in machine tools	[SW3] Assessment of knowledge contained in written work and projects
[K6_U06] is able to identify and formulate specification of simple, practical engineering tasks, distinctive for mechatronics	Student solves problems of machine tool dynamics and milling processes on the basis of computer simulations	[SU4] Assessment of ability to use methods and tools

Subject contents

LECTURES. Introduction: Free vibration. Forced vibration. Self-excited vibration. Modelling methods in dynamics of machine tools and machining processes: Rigid finite element method. Mixed method of finite elements. Stationary systems and systems whose configuration changes with time. Dynamics of the machine tool main driving system: Steady and unsteady states. Transverse, torsion and transverse-torsion vibration. Dynamics of the machine tool carrying system: Rigid and flexible structures of machine tools. Flexibility of constructional and slideway joints. Dynamics of the feed drive: The stick-slip self-excited vibration. Dynamics of cutting process: Proportional model. Kudinov model. Tobias-Fishwick-Das model. Nosyrieva-Molinari model. Jemielniak model. Inner and outer modulation of the cutting zone thickness. Tool-workpiece relative vibration: Self-excited chatter vibration. Turning. Flat surface milling. Curved surface machining. Dynamic problems of the metal high speed machining: Flexible end milling of rigid details. Milling of flexible details. Methods of vibration surveillance in time and frequency domain.

Prerequisites and co-requisites	Knowledge on subject Mechanics. Knowledge in scope of the mechanical vibration problems. Knowledge and experience in subject Fundamentals of automatic control. Knowledge on subject Modern machine tools and production processes. Knowledge and experience in subject Programming of Computer Systems. Skills of defining and solving the problems of mechatronic design .
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
3 team projects	100.0%	100.0%

Recommended reading	Basic literature	1. Marchelek K.: Dynamics of machine tools (in Polish). 2nd edition. Warszawa: WNT 1991. 2. Tomków J.: Vibrostability of machine tools (in Polish). Warszawa: WNT 1997. 3. Jemielniak K.: Cutting machining (in Polish). Warszawa: Publishing Annexe of Warsaw University of Technology 1998. 4. Kaliński K.: Vibration surveillance of mechanical systems which are idealised discretely (in Polish). Series Monographs no 22. Gdańsk: The GUT Publishing House 2001. 5. Galewski M., Kaliński K.: Vibration surveillance at high speed slender milling with a use of changing spindle speed (in Polish). Gdańsk: The GUT Publishing House 2009. 6. Kaliński K. J.: A surveillance of dynamic processes in mechanical systems (in Polish). Gdańsk: The GUT Publishing House 2012.
	Supplementary literature	1. Bodnar A.: Diagnostics of self-excited vibration of a system machine tool cutting process (in Polish). Scientific Publications of Szczecin University of Technology 2006, No 595, Institute of Mechanical Production 18. 2. Powałka B.: Methodology of forming vibrostability of a system machine tool cutting process (in Polish). Scientific Publications of Szczecin University of Technology 2007, No 586, Institute of Mechanical Production 17. 3. Metal Cutting and High Speed Machining (red. Dudzinski D., Molinari A. Schulz H). New York: Kluwer Academic/Plenum Publishers 2001.
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed	1. Determination of natural frequencies and normal modes of discrete model of a machine tool. 2. Determination of a stability lobe in case of one-dimensional cutting process model. 3. Computer simulations of vibration during chosen machining processes.	
Work placement	Not applicable	