



Subject card

Subject name and code	Bifurcation in the equations originating from the elasticity theory, PG_00021018						
Field of study	Mathematics						
Date of commencement of studies	October 2022		Academic year of realisation of subject		2024/2025		
Education level	first-cycle studies		Subject group		Optional subject group 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	3		Language of instruction		Polish		
Semester of study	6		ECTS credits		4.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Division of Dynamical Systems -> Institute of Applied Mathematics -> Faculty of Applied Physics and Mathematics						
Name and surname of lecturer (lecturers)	Subject supervisor		prof. dr hab. Joanna Janczewska				
	Teachers		prof. dr hab. Joanna Janczewska				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	30.0	0.0	0.0	0.0	60
	E-learning hours included: 0.0						
	Additional information: lecture and exercises; lecture method, talk method (pogadanka), exercise method, discussion method, project method						
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	60		5.0		35.0	100
Subject objectives	Applications of mathematics in the theory of elasticity.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	K6_K01		A student is able to search for information in literature, also in English, on the theory of bifurcation and its applications in mathematics, mechanics, and biology.		[SK3] Assessment of ability to organize work		
	K6_U09		A student is able to interpret the phenomenon of subcritical and postcritical bifurcation in tested models.		[SU4] Assessment of ability to use methods and tools		
	K6_K04		A student knows the equations of von Karman type for an elastic beam (4th order ODEs) and an elastic rectangular plate and an elastic circular plate (4th order PDEs).		[SK2] Assessment of progress of work		
	K6_U06		A student knows how to apply knowledge from mathematical analysis and ordinary differential equations to study a model of deformations of a rod.		[SU3] Assessment of ability to use knowledge gained from the subject		
	K6_U05		A student knows the notion of a bifurcation point and a branching point. A student can explain the phenomenon of subcritical and postcritical bifurcation. A student can give necessary conditions for bifurcation.		[SU1] Assessment of task fulfilment		

Subject contents	Selected topics in nonlinear analysis. The Kármán equations for an elastic beam (KE1). The Kármán equations for an elastic rectangular plate (KE2). The Kármán equations for an elastic circular plate (KE3). Boundary conditions. The Kármán equations (KE1) - (KE3) as an operator equation in Banach spaces. The linearization. The definition of a bifurcation point and a branching point. Subcritical bifurcation, postcritical bifurcation, transcritical bifurcation. Necessary conditions for the existence of bifurcation. The Crandall-Rabinowitz theorem. Bifurcation in the Kármán equations (KE1) - (KE3).		
Prerequisites and co-requisites	Ordinary differential equations. Partial differential equations.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	activity during classes	50.0%	20.0%
	test	50.0%	40.0%
	an oral presentation on a given topic	50.0%	40.0%
Recommended reading	Basic literature	1. F. Bloom, D. Coffin, Handbook of Thin Plate Buckling and Postbuckling, Chapman and Hall/CRC, 2001 (in English). 2. A. Borisovich, J. Dymkowska, Elementy Analizy Funkcjonalnej z Zastosowaniem w Mechanice Ciał Sprężystych [Functional Analysis with Applications in Elastic Mechanics], Politechnika Gdańska, Wydział Inżynierii Lądowej i Środowiska, skrypt dla słuchaczy Środowiskowego Studium Doktoranckiego Inżynierii Lądowej i Architektury Politechniki Gdańskiej, 2003 (in Polish). 3. Selected scientific articles on Karman equations	
	Supplementary literature	1. Z. Kączkowski, Płyty. [Plates.] Obliczenia statyczne, Arkady, Warszawa, 1968 (in Polish). 2. 2. I. Chueshov, I. Lasiecka, Von Karman Evolution Equations, Springer Monographs in Mathematics, Springer, 2010 (in English).	
	eResources addresses	Adresy na platformie eNauczanie: Bifurkacje w równaniach mechaniki sprężystej - Moodle ID: 44408 https://enauczenie.pg.edu.pl/moodle/course/view.php?id=44408	
Example issues/ example questions/ tasks being completed	1. Apply the Banach fixed point theorem to Euler's problem on the stability of an elastic rod. 2. Derive the equation of von Karman type for an elastic beam. 3. Write von Karman equations for a circular/rectangular plate. 4. Formulate the definition of a bifurcation and a branching point. 5. Discuss the assumptions of the Crandall-Rabinowitz theorem. 6. Give a necessary condition on bifurcation. 7. Give and discuss types of bifurcation.		
Work placement	Not applicable		

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