



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 2023	Academic year of realisation of subject			2025/2026		
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	Zakład Układów Dynamicznych -> Instytut Matematyki Stosowanej -> Faculty of Applied Physics and Mathematics						
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. Joanna Janczewska					
	Teachers						
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						
	Adresy na platformie eNauczanie:						
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_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		
	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_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_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		
Subject contents	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. 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
	exercises for independent work	50.0%	50.0%
	a multimedia presentation	100.0%	50.0%
Recommended reading	Basic literature	<ol style="list-style-type: none"> 1. F. Bloom, D. Coffin, Handbook of Thin Plate Buckling and Postbuckling, Chapman and Hall/CRC, 2001. 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). 	
	Supplementary literature	1. Z. Kączkowski, Płyty. [Plates.] Obliczenia statyczne, Arkady, Warszawa, 1968 (in Polish).	
	eResources addresses		
Example issues/ example questions/ tasks being completed	<ul style="list-style-type: none"> • Derive the equation of von Karman type for an elastic beam. • Write von Karman equations for a circular/rectangular plate. • Formulate the definition of a bifurcation and a branching point. • Discuss the assumptions of the Crandall-Rabinowitz theorem. • Give a necessary condition on bifurcation. 		
Work placement	Not applicable		