GDAŃSK UNIVERSITY OF TECHNOLOGY

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 2021	Academic year of realisation of subject	2023/2024
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	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

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_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_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_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_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

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).

<table>
<tr><td>Prerequisites and co-requisites</td><td colspan="3">Ordinary differential equations. Partial differential equations.</td></tr>
<tr><td>Assessment methods and criteria</td><td colspan="3"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>a multimedia presentation</td><td>100.0%</td><td>50.0%</td></tr>
<tr><td>excercises for independent work</td><td>50.0%</td><td>50.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td colspan="2">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).</td></tr>
<tr><td>Supplementary literature</td><td colspan="2">1. Z. Kączkowski, Płyty. [Plates.] Obliczenia statyczne, Arkady, Warszawa, 1968 (in Polish).</td></tr>
<tr><td>eResources addresses</td><td colspan="2">Adresy na platformie eNauczanie:
Bifurkacje w równaniach mechaniki sprężystej 2023/24 - Moodle ID: 38226
https://enauczanie.pg.edu.pl/moodle/course/view.php?id=38226</td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="3">• 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.</td></tr>
<tr><td>Work placement</td><td colspan="3">Not applicable</td></tr>
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