GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00052287		
Field of study	Mathematics		
Date of commencement of studies	October 2022	Academic year of realisation of subject	2022/2023
Education level	second-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	1	Language of instruction	Polish
Semester of study	2	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Zakład Analizy Nieliniowej -> Instytut Matematyki Stosowanej -> Faculty of Applied Physics and Mathematics		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Robert Krawczyk	
	Teachers	dr inż. Robert Krawczyk dr Muhammad Riaz	

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	30.0	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

The aim of the course is to familiarize students with nonlinear systems of autonomous ordinary differential equations, and more specifically to introduce the study of the behavior of solutions of such systems based on the function f in the system x '= f (x). Does it have zeros and what types of equilibrium points are they for this system?

Learning outcomes

Course outcome	Subject outcome	Method of verification
K7_U09	The student is able to find the equilibrium points of a system of nonlinear equations, linearize a given system at equilibrium points, apply the Hartman-Grobman theorem and draw conclusions about the qualitative structure (stability) of the equilibrium points.	[SU3] Assessment of ability to use knowledge gained from the subject
K7_W04	The student knows the methods of solving ordinary differential equations and systems of linear differential equations.	[SW1] Assessment of factual knowledge
K7_K04	The student is able to decide what class is the function f in the equation x '= f (x). The student is able to formulate the Lipschitz condition.	[SK5] Assessment of ability to solve problems that arise in practice

Subject contents

ordinary differential equation, system of linear differential equations, system of nonlinear differential equations, stationary point of the system of differential equations, hyperbolic equilibrium point. The concept of a saddle, sink, source, center for a stationary point. Maximum lifetime of the solution. Stream and its domain. Stable and unstable variety. Hartman-Grobman theorem. Lapunov function. Basic bifurcations in differential equations.

Prerequisites and co-requisites

The student should know the basic concepts of the course of ordinary differential equations. Should be able to solve basic types of differential equations. He should be able to find a fundamental system for a system of linear differential equations.

Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	the test	50.0%	50.0%
	an activity	0.0%	20.0%
	the presentation	75.0%	30.0%
Recommended reading	Basic literature	1. J. Hale, H. Kocak, Dynamics and Bifurcations, Springer, 1991	
	Supplementary literature	1. J. Hale, H. Kocak, Dynamics and Bifurcations, Springer, 1991	
	eResources addresses	Adresy na platformie eNauczanie: Układy Nieliniowe - Moodle ID: 30967 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=30967	
Example issues/ example questions/ tasks being completed	1. Find the maximum lifetime of the problem solution x '= x ^ 2, x (0) = 1.2. Find the stationary points of the system x '= x-y ^ 2, y' = y-y ^ 2.3. Perform linearization of the system x '= x ^ 2-y ^ 2, y' = y ^ 3-1 at the points of equilibrium.4. Check if we can apply the Hartman-Grobman theorem in the system x '= f (x) at its points of equilibrium.5. Describe the bifurcation in the equation x '= a-x ^ 2. Sketch a diagram of the bifurcation		
Work placement	Not applicable		