<table>
<tr><td>Course code</td><td></td></tr>
<tr><td>Type and description</td><td>EC</td></tr>
<tr><td>ECTS credit</td><td>1</td></tr>
<tr><td>Course name</td><td>Bifurcation analysis of dynamical systems</td></tr>
<tr><td>Course name in Polish</td><td>Analiza bifurkacyjna układów dynamicznych</td></tr>
<tr><td>Language of instruction</td><td>English</td></tr>
<tr><td>Course level</td><td>8 PRK</td></tr>
<tr><td>Course coordinator</td><td>Przemysław Perlikowski</td></tr>
<tr><td>Course instructors</td><td>Przemysław Perlikowski</td></tr>
<tr><td>Delivery methods and course duration</td><td>
<table>
<tr><th></th><th>Lecture</th><th>Tutorials</th><th>Laboratory</th><th>Project</th><th>Seminar</th><th>Other</th><th>Total of teaching hours during semester</th></tr>
<tr><td>Contact hours</td><td>0</td><td>0</td><td>0</td><td>15</td><td>0</td><td>0</td><td>15</td></tr>
<tr><td>E-learning</td><td>No</td><td>No</td><td>No</td><td>No</td><td>No</td><td>No</td><td></td></tr>
<tr><td>Assessment criteria (weightage)</td><td>0,00</td><td>0,00</td><td>0,00</td><td>1,00</td><td>0,00</td><td>0,00</td><td></td></tr>
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<tr><td>Course objective</td><td>1. Enabling students to gain knowledge about bifurcation analysis of dynamical systems.

2. Enabling students to learn how to apply in practice method of continuation of steady state and periodic orbits.</td></tr>
<tr><td>Learning outcomes</td><td>After finishing the course student can:

1. Apply different methods of bifurcation analysis – effects W4, U4, K1

2. Choose appropriate analysis method depending on the type of dynamical system – effects W4, U4, K1

3. Create bifurcation diagrams and make their physical interpretation – effects W4, U4, K1</td></tr>
<tr><td>Assessment methods</td><td>Effects W4, U4, K1 – oral examination and presentation

The final grade consists of:

Activity during project classes - 40%

Analysis of dynamics of nonlinear system – 60%</td></tr>
<tr><td>Prerequisites</td><td>Master course in differential equations</td></tr>
<tr><td>Course content with delivery methods</td><td>1. Introductory information. Theorem on the existence and uniqueness of the solution of the differential equation, definitions of the dynamic system, phase space, critical points, linearization.

2. The definition of the attractor - the phenomenon of attraction in the phase space, the concepts of the attractor, the basin of attraction, the stability of the attractors.</td></tr>
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	3. Local bifurcations - examples of bifurcation of the critical point, classification of local bifurcations of the 1st type (linearization and eigenvalues) 4. Bifurcations of periodic orbits - definition of characteristic multipliers, doubling period bifurcation, Neimark-Sacker bifurcation and symmetry breaking bifurcation. 5. Path-following of steady states of nonlinear dynamical system 6. Frequency response curve of one degree of freedom system 7. Analysis of route to chaos via period doubling bifurcation 8. Analysis of symmetry breaking bifurcation 9. Analysis of real, nonlinear system with multiple degrees of freedom
Basic reference materials	1. Seydel R. Practical bifurcation and stability analysis. Vol. 5. Springer Science & Business Media, 2009. 2. Kapitaniak T., Wojewoda J.: Bifurkacje I Chaos, PWN, 2000. 3. E. J. Doedel, B. E. Oldeman, AUTO-07P: continuation and bifurcation software for ordinary differential equations, 2012
Other reference materials	Kuznetsov Y. A., Elements of applied bifurcation theory. Vol. 112. Springer Science & Business Media, 2013.
Average student workload outside classroom	10 h
Comments	
Last update	17 March 2023