

# Lecture I-A - course description

General information	
Course name	Lecture I-A
Course ID	13.7-WF-FiAT-W-I-F- 18
Faculty	<a href="#">Faculty of Physics and Astronomy</a>
Field of study	Physics and Astronom
Education profile	academic
Level of studies	PhD studies
Beginning semester	winter term 2018/2019

Course information	
Semester	2
ECTS credits to win	3
Course type	obligatory
Teaching language	english
Author of syllabus	<ul style="list-style-type: none"><li>prof. dr hab. Andrzej Maciejewski</li></ul>

Classes forms					
The class form	Hours per semester (full-time)	Hours per week (full-time)	Hours per semester (part-time)	Hours per week (part-time)	Form of assignment
Lecture	30	2	-	-	Exam

## Aim of the course

The goal of the course is to acquaint the students with some of the selected methods of the dynamical systems that are described using ordinary differentia equations systems. The course will present basic notions of the theory of differential equations. Students will learn various types of equations and their solution methods. One of the most important goals will be to present the practical methods of the study of certain equation systems that appear in physics, astronomy and other applied sciences.

## Prerequisites

1. Knowledge of calculus and alegebra on the at the academic level for science or technical courses.
2. Knowledge of basic physics on the academic level.
3. Knowledge of theoretical mechanics.

## Scope

Ordinary differential equations:

- phase curves and integral curves , first integral, phase portrait
- types of equations
- linear differentia equations
- equilibrium points and their classification; normalization
- stability
- numerical integration methods
- Lapunov's exponents and deterministic chaos

Mechanics of material points and solids:

- Lanrange and Hamilton equations
- stability of equilibrium points in mechanicsl systems
- chaos in mechanical systems
- separatrix spliting amd Mielnikov method

## Teaching methods

Traditional lecture using multimedia presentations.

## Learning outcomes and methods of theirs verification

Outcome description	Outcome symbols	Methods of verification	The class form
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Outcome description	Outcome symbols	Methods of verification	The class form
Student is able to effectively use the mathematical apparatus for the description and modelling of physical phenomena.	<ul style="list-style-type: none"> <li>• <a href="#">SD_W03</a></li> <li>• <a href="#">SD_W05</a></li> </ul>	<ul style="list-style-type: none"> <li>• Exam</li> </ul>	<ul style="list-style-type: none"> <li>• Lecture</li> </ul>
Student has knowledge about the deterministic chaos phenomenon, understands the mechanisms of its appearance and the methods of its detection.	<ul style="list-style-type: none"> <li>• <a href="#">SD_W05</a></li> <li>• <a href="#">SD_W06</a></li> </ul>	<ul style="list-style-type: none"> <li>• Exam</li> </ul>	<ul style="list-style-type: none"> <li>• Lecture</li> </ul>
Student knows and understands the basics of modern Hamiltonian mechanics.	<ul style="list-style-type: none"> <li>• <a href="#">SD_W03</a></li> <li>• <a href="#">SD_W05</a></li> </ul>	<ul style="list-style-type: none"> <li>• Exam</li> </ul>	<ul style="list-style-type: none"> <li>• Lecture</li> </ul>
Student knows the basic notions and theorems of the ordinary differential equations.	<ul style="list-style-type: none"> <li>• <a href="#">SD_W05</a></li> <li>• <a href="#">SD_W06</a></li> </ul>	<ul style="list-style-type: none"> <li>• Exam</li> </ul>	<ul style="list-style-type: none"> <li>• Lecture</li> </ul>

## Assignment conditions

Written test.

Passing criterium – a positive grade from the test that involves questions/exercises of various degrees of difficulty.

## Recommended reading

[1] Perko, Lawrence. 2001. *Differential Equations and Dynamical Systems*. Vol. 7. Texts in Applied Mathematics. New York, NY: Springer New York.  
<http://link.springer.com/10.1007/978-1-4613-0003-8>.

[2] Walter, Wolfgang. 1998. *Ordinary Differential Equations*. Vol. 182. Graduate Texts in Mathematics. New York, NY: Springer New York. <http://link.springer.com/10.1007/978-1-4612-0601-9>.

[3]. Schuster, *Chaos deterministyczny*, PWN, Warszawa 1993.

[4] Florian, Scheck. *Mechanics: From Newton's Laws to Deterministic Chaos*. 3rd ed. New York, NY: Springer Verlag, 1999.

## Further reading

[1] W.I. Arnold, *Równania różniczkowe zwyczajne*, PWN 1975.

[2] W. I. Arnold, *Teoria Równań Różniczkowych*, PWN, 1983.

## Notes

Modified by dr Joanna Kalaga (last modification: 11-07-2018 13:07)

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