Module Description

Ordinary Differential Equations and Dynamical Systems

General Information

Number of ECTS Credits

3

Abbreviation

FTP_OrdDiff

Version

14.10.2016

Responsible of module

Olivier Mermoud, BFH-TI

Language

	Lausanne	Bern	Zurich	Lugano/Manno
Instruction	☐ E ☑ F	☐ D ☐ E ☐ F	☐ D ☑ E	☑ E
Documentation	☐ E ☑ F	☐ D ☐ E ☐ F	☐ D ☑ E	☑ E
Examination	☐ E ☑ F	☐ D ☐ E ☐ F	☐ D ☑ E	☑ E

Module category

☑ Fundamental theoretical principles
☐ Technical/scientific specialization module
☐ Context module

Lessons

☑ 2 lecture periods and 1 tutorial period per week

Brief course description of module objectives and content

In this module, students learn which class of dynamical phenomena can be described with systems of ordinary differential equations. They learn to recognize the fundamental behavior patterns of these systems and also to develop simulation models for them.

Aims, content, methods

Learning objectives and acquired competencies

- Description of dynamical phenomena with differential equations
- Analysis of system behavior
- Knowledge of fundamental behavior patterns, understanding the connection with system structure
- Development and simulation of models for dynamical systems
- Knowledge of numerical methods for solving systems of differential equations

Contents of module with emphasis on teaching content

Topic 1: Modeling physical systems with differential equations, analysis of dynamical systems by way of example
Topic 2: Analytical and numerical methods
Topic 3: Systems of differential equations, state diagram, block diagrams
Topic 4: Trajectories, equilibria, linear stability analysis, eigenmodes, the example of linear, time-invariant (LTI) systems
Topic 5: Non-linear systems, bifurcation, chaos, discrete dynamical systems

Teaching and learning methods

Lecture units: lecture, working on and discussing short exercises
Tutorial units: working on and discussing set exercises
Private study: study of the literature, working on assignments and exercises

Prerequisites, previous knowledge, entrance competencies

Knowledge and abilities at the level of a completed Bachelor's degree in:
- Differential and integral calculus
- Ordinary differential equations
- Matrix calculus
- Complex numbers

Literature

[1] Differential Equations, An Introduction to Modern Methods and Applications, J. R. Brannan and W. E. Boyce,John Wiley and Sons, 2015
[2] Nonlinear Dynamics and Chaos, S.H. Strogatz, Westview press, 2014
[3] Differential Equations, Dynamical Systems, and an Introduction to Chaos, M. W. Hirsch, S. Smale, R. L. Devaney. Academic Press, 2012
[4] Differential Equations, A Dynamical Systems Approach, J.H. Hubbard, B.H. West, Springer,1997

Assessment

Certification requirements for final examinations (conditions for attestation)

Written module examination

Duration of exam :	120 minutes
Permissible aids:	- 1 formula book - summary on 5 A4 sheets (= 10 A4 pages) compiled by the student - a pocket calculator (with a CAS and graphics capability)