

ME-221

**Dynamical systems**

Sakar Selman

Cursus	Sem.	Type
Mechanical engineering	BA4	Obl.

Language of teaching	English
Credits	3
Session	Summer
Semester	Spring
Exam	Written
Workload	90h
Weeks	14
<b>Hours</b>	<b>3 weekly</b>
Courses	2 weekly
Exercises	1 weekly
<b>Number of positions</b>	

**Summary**

Provides the students with basic notions and tools for the analysis of dynamic systems. Shows them how to develop mathematical models of dynamic systems and perform analysis in time and frequency domains.

**Content**

- Dynamic behavior of physical systems with electrical, mechanical, electromechanical, fluid, and thermal components. Concept of process, system, and model.
- Linearization procedure. Convolution. State-space representation.
- Laplace transformation. Concept of transfer function. Poles and zeros.
- Transient and frequency response of linear dynamical systems. Bode and Nyquist plots.

**Keywords**

Mathematical modeling, transfer function, time and frequency domain analysis

**Learning Prerequisites****Required courses**

- Analysis I-III
- General Physics I and II

**Learning Outcomes**

By the end of the course, the student must be able to:

- Represent a physical process as a system with its inputs, outputs, and disturbances, A1
- Analyze a linear dynamical system (both time and frequency response), A3
- Represent a system by a transfer function and by a linear or nonlinear state-space model, A4
- Construct a linear model of a nonlinear system, A2

**Transversal skills**

- Manage priorities.

- Assess one's own level of skill acquisition, and plan their on-going learning goals.
- Access and evaluate appropriate sources of information.
- Use both general and domain specific IT resources and tools
- Plan and carry out activities in a way which makes optimal use of available time and other resources.

### Teaching methods

Lectures, written exercises, and computer-based exercises

### Expected student activities

- Participate to lectures and exercise sessions
- Assignments of about 2 hours per week

### Assessment methods

Written Exam

### Supervision

Office hours	No
Assistants	Yes
Forum	No

### Resources

#### Bibliography

- System Dynamics, 4th Edition by K. Ogata, Prentice Hall, 2004
- System Dynamics, 3rd Edition by W. Palm, McGraw-Hill College, 2013

#### Ressources en bibliothèque

- [System Dynamics / Palm](#)
- [System Dynamics / Ogata](#)

### Prerequisite for

- Control systems (ME-321)
- Mechanical vibrations (ME-332)
- Multivariable systems (ME-324)
- Measurement techniques (ME-301)
- Dynamical effects in mechanical design (ME-311)