Control Theory

Course ID: 322MI – Spring 2023

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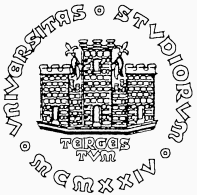

Course overview

Course administration

Lecturer and examiner

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Course home page

Moodle@UniTS: 322MI - CONTROL THEORY 2022

- slides
- complementary material
- Matlab code

Course credits

9 CFU

Examination

Examination

Final exam consisting of

- a written examination;
- a subsequent oral discussion.

The mark depends on both the written part and the oral discussion.
Usually, written examination and oral discussion are taking place during the same exam session.

Examination (cont.)

Written examination

It lasts 60 minutes and consists of a few (2 to 3) essay questions:

- numerical application problems;
- specific questions about theoretical aspects (theorems, properties, definitions).

Questions deal with any possible topic, discussed and analysed in the lectures.

Oral discussion

Oral questions deal with any possible topic, discussed and analysed in the lectures.
A short discussion about the written examination may also take place.

Exam sessions

Examination schedule

- 3 sessions in January-February
- 3 sessions in June-July
- 1 session in September

How to sign up for examinations

- To take the exam you must register (compulsory).
- To register, use the student career management system Esse3.
- Make sure not to miss the deadlines!

Prerequisites

Courses

The following courses are recommended (not mandatory) prerequisites:

- 034IN Fondamenti di Automatica (Fundamentals of Automatic Control);
- 267MI Sistemi Dinamici (Dynamical Systems).

Prerequisites (cont.)

Topics and tools

In any case, the following mathematical topics/tools must be known

- linear systems of equations;
- eigenvalue decomposition;
- positive definite matrices;
- derivatives;
- integrals;
- exponentials;
- complex numbers;
- differential and difference equations;
- Laplace and Z-transforms;
- linear programming.

References

Reference textbooks:

[1] Antsaklis, P. J. and Michel, A. N. (2006). *Linear Systems*.
Springer Science & Business Media

[2] Magni, L. and Scattolini, R. (2014). *Advanced and Multivariable Control*.
Pitagora Bologna

[3] Hespanha, J. P. (2018). *Linear systems theory*.
Princeton University Press

Lectures

Lect.	Content	Suggested readings
0	Course overview.	
1	Generalities: systems and models.	[1], ch. 1-2, [2], ch. 1, [3], ch. 1-7
2	Solutions to linear systems.	[1], ch. 1-2, [2], ch. 1, [3], ch. 1-7
3	Stability.	[1], ch. 1-2, [2], ch. 1, [3], ch. 8
4	Structural properties and special forms.	[1], ch. 3, [3], ch. 11, 12, 13, 15, 16
5	Realization.	[1], ch. 5, [3], ch. 17.
6	State feedback and output feedback.	[1], ch. 4, [2], ch. 6, [3] ch. 12, 14, 16
7	Optimal control.	[2], ch. 7-10, [3] ch. 21, 22, 23.
8	Optimization-based control.	[2], ch. 12.
9[1]	Robustness analysis with parametric uncertainty.	complementary material provided by the instructor.

[1] If possible.

Laboratory

Not a hands-on course

As the term “theory” suggests, this course is not a hands-on course. It provides the basic concepts and theoretical foundations. *The student is encouraged to experiment by himself with modeling, simulation and control using the preferred language/environment.*

Lab lectures

However, some lab lectures will take place. The lectures are based on Matlab.
Why?

- Matrices are fundamental in control theory and Matlab deals natively and simply with matrices;
- Matlab provides a powerful Control Systems Toolbox;
- Matlab is both a fast prototyping tool and a production tool thanks to the code generation capabilities;
- Matlab is rigorously tested and well documented;
- being familiar with Matlab is definitely a plus in one’s CV;
- University of Trieste provides a Campus-wide Matlab license to students, teachers and researchers.

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Course overview

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