

ME-321

**Control systems + TP**

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| Cursus                   | Sem. | Type |
|--------------------------|------|------|
| Mechanical engineering   | BA5  | Obl. |
| Space technologies minor | H    | Opt. |

|                            |                 |
|----------------------------|-----------------|
| Language of teaching       | English         |
| Credits                    | 4               |
| Session                    | Winter          |
| Semester                   | Fall            |
| Exam                       | Written         |
| Workload                   | 120h            |
| Weeks                      | 14              |
| <b>Hours</b>               | <b>4 weekly</b> |
| Courses                    | 3 weekly        |
| TP                         | 1 weekly        |
| <b>Number of positions</b> |                 |

**Summary**

Provides the students with basic notions and tools for the analysis and control of dynamic systems. Shows them how to design controllers and analyze the performance of controlled systems.

**Content**

- Introduction to automatic control
- Closed-loop transfer functions
- Analysis of dynamic systems
- Design and analysis of PID controllers
- Loop shaping controller design
- State space analysis and control design
- Introduction to digital implementation

**Keywords**

Analysis and design of control systems, stability, PID control, loop shaping, state space control

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

- Real analysis
- Complex analysis
- Physics
- Signals and systems

**Important concepts to start the course**

- Represent a physical process as a system with its inputs, outputs and disturbances, A1
- Derive the dynamic equations for the system, A2
- Represent a linear system by a transfer function, A5

**Learning Outcomes**

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

- Analyze a linear dynamical system (both time and frequency responses), A4
- Design and analyse a discrete-time model for a dynamic system, A7
- Design a PID controller, A9
- Design a simple controller for a dynamic system, A10
- Assess / Evaluate the stability, performance and robustness of a closed-loop system, A14
- Define adequate control performance for dynamic systems, A15
- Propose several control solutions, formulate the trade-offs, choose the options, A16
- Design a state-space controller for a dynamic system, A10

### Transversal skills

- Communicate effectively with professionals from other disciplines.
- Set objectives and design an action plan to reach those objectives.
- Use both general and domain specific IT resources and tools
- Access and evaluate appropriate sources of information.

### Teaching methods

Lectures, written exercises, computer-based exercises and MOOC-based laboratory sessions

### Expected student activities

- Participate to lectures, exercises and laboratory sessions
- Homework of about 2 hours per week

### Assessment methods

Written exam

### Supervision

|              |  |
|--------------|--|
| Office hours | No   |
| Assistants   | Yes  |
| Forum        | No   |
| Others       | <ul style="list-style-type: none"> <li>• Supervised written exercise sessions</li> <li>• Supervised MOOC laboratory sessions</li> <li>• Supervised hands-on computer sessions</li> </ul> |

### Resources

#### Bibliography

Franklin, Powell and Emami-Naeini, "Feedback Control of Dynamic Systems, 7th Edition". Pearson publishing.

#### Ressources en bibliothèque

- [Feedback Control of Dynamic Systems / Powell](#)
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#### Notes/Handbook

Slides / notes available online.

**Moodle Link**

- <http://moodle.epfl.ch/course/view.php?id=13758>

**Prerequisite for**

- Multivariables Systems
- Advanced Control Systems
- Non-linear Control
- Model Predictive Control
- Identification of Dynamical Systems