MICRO-211 **Analog circuits and systems**

Enz Christian

Cursus	Sem.	Type
Microtechnics	BA4	Obl.

Language of teaching	English
Credits	4
Session	Summer
Semester	Spring
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Exercises	1 weekly
TP	1 weekly
Number of positions	

Summary

This course introduces the analysis and design of linear analog circuits based on operational amplifiers. A Laplace early approach is chosen to treat important concepts such as time and frequency responses, convolution, and filter design. The course is complemented with exercises and simulations.

Content

1. Introduction
2. Laplace transform
3. S-Domain circuit analysis
4. Network functions
5. Frequency response
6. Operational amplifiers (OPAMP) and operational transconductance amplifiers (OTA)
7. Feedback and stability
8. Active filters design

- RC-active filters
- OTA-C active filters
- Switched-capacitors filters

9. Signal generators
10. Nonlinear opamp circuits

Keywords

Linear circuits, operational amplifier, opamps, feedback, active filters

Learning Prerequisites

Required courses

• Electrotechnics I and II
• Electronics I

Important concepts to start the course

• Complex calculus
• Kirchhoff's laws for resistive circuits

- Phasors

Learning Outcomes

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

- Analyze analog circuits based on operational amplifiers
- Design simple circuits based on operational amplifiers
- Design analog active filters
- Verify the design by circuit simulation
- Develop simple analog systems

Transversal skills

- Continue to work through difficulties or initial failure to find optimal solutions.
- Demonstrate a capacity for creativity.
- Use both general and domain specific IT resources and tools

Teaching methods

Lectures with exercises and circuit simulations

Expected student activities

- Attend the lecture
- Complete the exercises
- Run simulation on LTspice

Assessment methods

- Mid-term on-line moodle MCQ
- Open-book written final exam in the form of an MCQ

Resources

Bibliography

Main reference:

1. R. E. Thomas, A. J. Rosa, G. J. Toussaint, The Analysis and Design of Linear Circuits, 9th Edition, Wiley, 2016, ISBN 978-1-119-23538-5.

Additional references:

Circuit theory:

1. C. A. Desoer, E. S. Kuh, Basic Circuit Theory, Mc Graw-Hill, 1969.
2. R. Boite and J. Neirynck, Théorie des réseaux de Kirchhoff, (TE volume IV), Presse Polytechniques et Universitaires Romandes, 1996.
3. W. H. Hayt, J. E. Kemmerly and S. M. Durbin, Engineering Circuit Analysis, 8th Edition, Mc Graw-Hill, 2012, ISBN 978-0-07-352957-8.
4. E. A. Guillemin, Introductory Circuit Theory, Wiley, 1953.

Opamps:

1. S. Franco, Design With Operational Amplifiers and Analog Integrated Circuits, 4th edition, Mc Graw-Hill,

2015.
2. J. M. Fiore, Operational Amplifiers & Linear Integrated Circuits: Theory and Application, available on line at www.mvcc.edu/jfiore

Laplace and Fourier transform:
1. A. Papoulis, The Fourier Integral and its Applications, Mc Graw-Hil, 1962.
2. R. N. Bracewell, The Fourier Transform and its Applications, 3rd edition, Mc Graw-Hill, 2000.

Ressources en bibliothèque

- Basic Circuit Theory / Desoer
- Design With Operational Amplifiers and Analog Integrated Circuits / Franco
- The Fourier Transform and its Applications, Bracewell
- The Fourier Integral and its Applications / Papoulis
- Operational Amplifiers & Linear Integrated Circuits: Theory and Application / Fiore
- The Analysis and Design of Linear Circuits/ Thomas
- Introductory Circuit Theory / Guillemin
- Engineering Circuit Analysis / Hayt
- Théorie des réseaux de Kirchhoff / Boite

Notes/Handbook

Copy of the slides in pdf format downloadable from the moodle site.

Moodle Link

- https://moodle.epfl.ch/course/view.php?id=16096#section-0

Videos

- https://tube.switch.ch/channels/d588db70