

QUANT-410

Microwave engineering in physics

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Cursus	Sem.	Type
Ing.-phys	MA2, MA4	Opt.
Physicien	MA2, MA4	Opt.
Quantum Science and Engineering	MA2, MA4	Opt.

Language of teaching	English
Credits	4
Session	Summer
Semester	Spring
Exam	Oral
Workload	120h
Weeks	14
Hours	4 weekly
Lecture	2 weekly
Exercises	1 weekly
Project	1 weekly
Number of positions	

Summary

This course aims at teaching basic notions and tricks of microwave engineering to students with only an elementary knowledge of applied electromagnetism. Emphasis is made on topics that often arise in modern physics experiments, including quantum science and technology research.

Content

- Review of basic notions in electromagnetism
- Lumped element circuits, impedance, telegrapher's equation, impedance matching
- Transmission lines
- Introduction to network analysis
- Impedance transformers
- Resonators

- Power dividers and hybrid couplers

- Non-reciprocal devices
- Noise in linear and non-linear circuits
- Amplifiers
- Microwave systems and system noise temperature
- Radiometry

Keywords

Microwaves, low-noise measurements

Learning Prerequisites**Required courses**

Linear algebra, calculus, differential equations, electromagnetism

Important concepts to start the course

Working knowledge of complex numbers, calculus, and linear algebra; in-depth understanding of classical

Maxwell's equations.

Learning Outcomes

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

- Construct elementary microwaves-based measurement setups for table-top physics experiments
- Apply basic notions of electromagnetism to analyse microwave measurement setups

Teaching methods

Lectures and demonstration, simulation projects, possibility of in-lab projects

Expected student activities

Attending lectures, seminars, independent study, individual project study

Assessment methods

Oral final exam (project presentation)

Supervision

Office hours	Yes
Assistants	Yes

Resources

Bibliography

Course textbook: D. Pozar "Microwave engineering"
Course software: HFSS, Microwave Office

Moodle Link

- <https://go.epfl.ch/QUANT-410>