

MICRO-423

**Optics laboratories I**

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Cursus	Sem.	Type
Electrical and Electronical Engineering	MA2, MA4	Opt.
Microtechnics	MA2, MA4	Opt.
Photonics minor	E	Opt.
Photonics		Opt.

Language of teaching	English
Credits	3
Withdrawal Session	Unauthorized Summer
Semester Exam	Spring During the semester
Workload	90h
Weeks	14
Hours	<b>3 weekly</b>
TP	3 weekly
Number of positions	
<b>It is not allowed to withdraw from this subject after the registration deadline.</b>	

**Summary**

This laboratory work allows students to deepen their understanding of optical instruments, optoelectronic devices and diagnostic methods. Students will be introduced in state of the art optical instruments and measurement principles.

**Content**

4 experiments on Fourier optics, optical fibers, lasers:

- Laser safety
- Optical fibers - Light injection, multi and single mode fibers
- Tunable diode laser – external cavity laser, MEMS grating
- Fourier Optics
- Solar cells characterisation
- Fabry Perot interferometry
- Digital holography
- Plasmonics and spectroscopy
- Fibre amplifier
- Microwave optics
- Diode pumped Nd :YAG laser - frequency doubling
- Photoelasticity
- Liquid crystal electrooptics
- Camera objective and imaging

**Keywords**

Optical instruments, optical measurement techniques, Diode laser, He-Ne laser, Fourier optics, waveguide and fiber optics, error analysis

**Learning Prerequisites**

**Required courses**

**Bachelor in**

- Microengineering, or
- Electrical and electronic engineering, or
- Physics.

### Recommended courses

MICRO-420: Advanced optics  
MICRO-421: Imaging optics  
MICRO-422: Lasers and optics of nanostructures  
MICRO-523: Optical radiation detection methods  
MICRO-321 Optical engineering I  
MICRO-321 Optical engineering II

### Important concepts to start the course

Basics of optics, programming with MATLAB or similar, matrix calculations, Fourier transformation, electromagnetic waves, refraction and reflection, polarization, basics of geometrical optics, semiconductor physics, laser physics.

### Learning Outcomes

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

- Apply principles of laser security
- Perform data analysis using excel and Matlab
- Assess / Evaluate the reliability of a measurement
- Perform an optical measurement
- Explain measurement results
- Estimate measurement errors

### Transversal skills

- Manage priorities.
- Communicate effectively, being understood, including across different languages and cultures.
- Use both general and domain specific IT resources and tools
- Continue to work through difficulties or initial failure to find optimal solutions.
- Demonstrate the capacity for critical thinking
- Take feedback (critique) and respond in an appropriate manner.

### Teaching methods

- Practical laboratory work in group (2 persons)
- 4 Experiments (2 afternoons each)

### Expected student activities

Individual activity

- Participation at all experiments
- Execution of practical work

- Keep a Laboratory note book

#### Group activity

- Scientific/technical report writing per experiment

### Assessment methods

Discussion of basic concepts during instruction (individual)

Evaluation of experimental work (individual)

Evaluation of written report (group)

Evaluation of laboratory notebook (individual)

### Supervision

Office hours	No
Assistants	Yes
Forum	No

### Resources

#### Bibliography

Fundamentals of photonics / B.E.A. Saleh, M. C. Teich, 2007

Integrated optics: theory and technology, vol. 33 / Hunsperger, 2009

An introduction to error analysis: the study of uncertainties in physical measurements, J. R. Taylor, University Science Books, 2nd ed., 1997

Fundamentals of optical waveguides / Katsunari Okamoto, 2006

#### Ressources en bibliothèque

- [Fundamentals of photonics / Saleh](#)
- [Fundamentals of optical waveguides / Okamoto](#)
- [Integrated optics: theory and technology / Hunsperger](#)

#### Notes/Handbook

Handout of course slides and documentation of individual experiments

#### Moodle Link

- <https://go.epfl.ch/MICRO-423>

### Prerequisite for

MICRO-425      **Optics laboratories II**