EPFL

MICRO-426   **Laser fundamentals and applications for engineers**

Moser Christophe

Cursus	Sem.	Type
Microtechnics	MA2, MA4	Obl.
Photonics minor	E	Opt.

Language of teaching	English
Credits	3
Session	Summer
Semester	Spring
Exam	Oral
Workload	90h
Weeks	14
Hours	**3 weekly**
Courses	2 weekly
Exercises	1 weekly
Number of positions	

Summary

The course will cover the fundamentals of lasers and focus on selected practical applications using lasers in engineering. The course is divided approximately as 1/3 theory and 2/3 covering selected applications.

Content

1. Introduction, history of the laser, overview market applications, basic laser operation I: dispersion, Lorentz model.
2. Basic laser operation II: Gain and resonators (spatial mode and longitudinal modes)
3. Laser systems I: most common solid state lasers and gas lasers
4. Detection of light: detector noise and laser Noise, AM, PM Noise.
5. Laser systems II: low and high power semi-conductor lasers, beam quality, beam combiners. Applications
6. Laser systems II: low and high power semi-conductor lasers, beam quality, beam combiners. Applications
7. Laser systems II: low and high power semi-conductor lasers, beam quality, beam combiners. Applications
8. Laser beam steering: theory, applications, printing
9. Laser systems III: Optical fibers and fiber lasers
10. Ultrafast lasers I: Femtosecond laser, modelocking. Two photon imaging, ablation.
11. Ultrafast lasers II: pulse characterization. Two photon 3D fabrication.
12. Non-linear frequency conversion I: frequency doubling. Applications
13. Non-linear frequency conversion I: Optical parametric amplification, OPA .
14. Lab tour

Learning Prerequisites

Important concepts to start the course

This course requires an understanding of introductory physics in wave theory (incl. complex numbers) and familiarity with Maxwell equations and electromagnetism.

Learning Outcomes

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

- Explain 1. Explain the basic working mechanism and characteristics of each lasers introduced. 2. Select a particular laser system adapted to an application.
- Select appropriately Select a particular laser system adapted to an application.

Supervision

Office hours	No
Assistants	Yes

Others	Chiara Bonati
	Ugur Tegin
	Babak Rahmani

Resources

Notes/Handbook

Polycopié (given as pdf) gathering selected topics of text books such as
Milonni, Eberly "Laser Physics" (Wiley Interscience)
Saleh, B. E. A., and M. C. Teich. Fundamentals of Photonics. New York, NY: John Wiley and Sons, 1991. ISBN: 0471839655.
Yariv, A. Optical Electronics in Modern Communications. 5th ed. New York, NY: Oxford University Press, 1997. ISBN: 0195106261.Amnon Yariv "Quantum Electronics" (Wiley)