MICRO-426

Laser fundamentals and applications for engineers

Moser Christophe

Cursus	Sem.	Type
Microengineering minor	H	Opt.
Microtechnics	MA1, MA3	Opt.
Photonics minor	H	Opt.

Language of teaching	English
Credits	3
Session	Winter
Semester	Fall
Exam	Written
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.

Assessment methods

The course grading is based on a final written exam which counts for 80% of the grade and two quizzes during the semester which count for 20% of the grade.

Supervision

Office hours	No
Assistant.e.s	Yes
Others	Chiara Bonati Leo Hsieh Mustafa Yildirim

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)

Moodle Link

- https://moodle.epfl.ch/course/view.php?idnumber=MICRO-426