Laser fundamentals and applications for engineers

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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
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
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
Oral exam

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)