

**FS**UNIVERSITY OF LJUBLJANA
Faculty of Mechanical Engineering

Photonics and Laser Sources (6059-M)

5 ECTS**Lecturer:** R. Petkovšek, V. Agrež

Lectures: 30h

Tutorials: 10h

Labs: 20h

Project: 0h

Lang. :



Objectives

Lasers have become essential tools across modern engineering, from precision manufacturing and micro-processing to high-speed imaging and remote sensing. This course provides engineers with a practical foundation in laser technology, focusing on how to select the right laser for an application, how different laser systems work and how lasers are used to solve real engineering problems.

This course will cover:

- How to select lasers for specific applications based on wavelength, power, and mode of operation (pulse duration, continuous mode)
- The operating principles of different laser types and their key characteristics
- Ultrashort pulsed lasers and their interaction with matter
- Laser applications in micro-processing, illumination for imaging, and sensing

Programme

1. Introduction: Why lasers matter in modern engineering
2. Fundamentals of laser light: coherence, spectra, beam shape
3. How lasers work: gain media, optical cavities, and amplification
4. Laser types: solid-state, gas, semiconductor, and fiber lasers
5. Laser-matter interaction and material processing
6. Applications: illumination for imaging, micro-machining, and remote sensing
7. Laboratory tutorials: laser operation and application demonstrations

Prerequisites

In order to successfully achieve this course, the students must have:

- Basic mechanical engineering background
- Knowledge in experimental work

Learning outcomes

After attending this course, the student will:

- Be able to explain how different laser types operate and identify their key parameters
- Be able to select an appropriate laser source for a given engineering application
- Understand how laser parameters affect material processing and imaging performance
- Be able to design basic experimental setups using lasers
- Be equipped to evaluate technical literature and continue learning independently in photonics

Assessment

50% Theoretical exam, 50% Laboratory work

Literature

“Lasers : basics, advances and applications” - Springer, 2018 - H.J. Eichler, J. Eichler, O. Lux
“Photonics: Concepts, Technology and Applications” - Blackwell’s, 2019 - J. Landers
“Photonics, A Short course”- Springer, 2016 - V. Degiorgio, I. Christiani
“Fundamentals of photonics” - John Wiley and sons, Inc., 2019 - B. E. A. Saleh in M. C. Teich
“Applications of the Laser” - CRC Press, 2018 - L. Goldman