UNIVERSITY OF LJUBLJANA
Faculty of Mechanical Engineering

Laser Processing Technology (6061-M) 5 ECTS

Lecturer: **M. Jezeršek, P. Gregorčič**

Lectures: 30h | Tutorials: 10h | Labs: 20h | Project: 0h | Lang. :

Objectives

The objectives of this course are to provide students with fundamental and advanced knowledge of modern laser processing technologies and to enable them to analyse, model, and optimise laser-based manufacturing processes. Through a combination of lectures, theoretical exercises, and laboratory work, students gain both theoretical understanding and practical experience with key laser processing techniques.
The objectives of this course are to:

- understand the physical principles of laser operation;
- understand the role of laser system components;
- understand the fundamental mechanisms of laser–matter interaction;
- understand the influence of laser and process parameters on processing efficiency and quality;
- acquire practical experience with selected laser processing techniques, including laser safety, engraving, drilling, welding, cutting, and ultrashort-pulse laser ablation of metals;
- acquire practical experience with basic methods for monitoring and control of laser processing processes.

Programme

1. Introduction – wider context of laser processing
2. Basics of lasers
3. Laser processing systems
4. Interaction between laser light and matter
5. Conversion of optical energy into thermal energy
6. Laser drilling – modelling with a Gaussian beam
7. Laser surface engineering
8. Laboratory work: laser safety, laser engraving, laser drilling, laser welding, laser cutting, and ablation of metals by ultrashort laser pulses

Prerequisites

In order to successfully attend this course, students are expected to have:

- Basic knowledge of optics and the physics of light
- Elementary mathematics (including basic calculus)
- Basic concepts of physics related to thermal properties of materials

Learning outcomes

After attending this course, the student will obtain the following knowledge and skills:

- thorough theoretical, methodological, and analytical knowledge with elements of a research work, forming a basis for demanding professional work in the field of laser processing and laser-based manufacturing technologies;
- the ability to plan, analyse, and manage laser processing tasks on the basis of creative problem solving, including the selection of appropriate laser systems and processing parameters, supported by practical laboratory training

Assessment

33% theory, 33% theoretical problem solving, 33% laboratory work

Literature

1. W.M. Steen, Laser Material Processing (4th Edition), Springer Verlag, 2010
2. E. Kannatey-Asibu, Principles of laser materials processing, John Wiley & Sons, 2009
3. J.F.Ready, Industrial Applications of Lasers, 2nd. ed., Academic Press, 1997
4. D. Schuoecker, High Power Lasers in Production Engineering, Imperial College Press, 1999.
5. M. Zupančič, P. Gregorčič, Laser Surface Engineering for Boiling Heat Transfer Applications, Springer International Publishing, 2021, pp. 245-303
6. P. Gregorčič, L. Hribar, Laser processing technology: theoretical exercises with solutions, Ljubljana, 2024.