UNIVERSITY OF LJUBLJANA
Faculty of Mechanical Engineering

# Additive Technology (6052-M) 5 ECTS

**Lecturer:** **E. Govekar, D. Klobčar**

Lectures: 30h | Tutorials: 14h | Labs: 16h | Project: 0h | Lang. :

## Objectives

Additive manufacturing (AM) is transforming manufacturing by enabling the fabrication of highly complex, customized components and shorter development cycles. To fully leverage these benefits, engineers must understand both AM processes and the complete digital-to-physical workflow. Metal AM, in particular, presents unique process, material, and quality challenges that directly affect part performance and cost. This course provides process physics and engineering foundations of metal AM needed to evaluate AM technologies, select appropriate processes, and support industrial implementation. The objectives of the course are to:

1. Introduce the capabilities and potential of metal AM
2. Explain the full AM production chain, from design and simulation to the final product.
3. Present the systems and processes used in metal additive manufacturing
4. Enable evaluation of cost-effective technologies and business opportunities for successful implementation

## Programme

**(1)** Introduction to additive manufacturing technologies (AM), **(2)** Basic physical principles of AM of metals, **(3)** Properties of materials for AM and incoming material quality control, **(4)** Physical basics of high density energy sources and defects in AM, **(5)** Product design specifics for AM, **(6)** Post-processing and final quality control, **(7)** DED-Arc system, process and characteristics, **(8)** DED -Arc path generation, process control and applications, **(9)** Basics of laser light metal interactions, **(10)** Metal droplet-based AM, **(11)** DED-LB/M wire systems, process and AM applications, **(12)** DED-LB/M powder systems, process and AM applications, **(13)** PBF-LB/M systems, process and AM applications, **(14)** Software for AM, **(15)** Laser based AM of multi and functionally graded materials

## Prerequisites

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

- Physics (high density energy source, heat transfer, phase changes)
- Materials (properties of metals)
- Manufacturing technologies 1 and 2 (metal material removal and joining processes, characteristics of cutting and joining processes)

## Learning outcomes

After attending this course, the student will be able to:

- Explain the principles, potential and limitations of additive manufacturing technologies
- Understand the complete AM production chain from digital design and simulation to final part realization
- Understand metal additive manufacturing systems, processes, and key quality considerations
- Evaluate AM process selection and cost-effectiveness for industrial

## Assessment

Short quiz after each lecture and two midterms (at the mid and end of the course).

## Literature


1. E. Govekar, A Jeromen Lecture Notes: Laser Based Additive Manufacturing Processes “
2 D. Klobčar, U. Trdan: Lecture notes for Additive technologies.
3. U. Trdan, D. Klobčar: Tutorial notes for Additive technologies.
4.Linkan Bian, Nima Shamsaei, and John M. Usher: Laser-Based Additive Manufacturing of Metal Parts: Modeling, Optimization, and Control of Mechanical Properties, 2018
5. O. Diegel, A. Nordin, D. Motte: A Practical Guide to Design for Additive Manufacturing, Springler series in Advanced Manufacturing, 2020