

ME-413

**Introduction to additive manufacturing**

Boillat Eric, Brugger Jürgen, Moser Christophe

Cursus	Sem.	Type
Mechanical engineering minor	H	Opt.
Mechanical engineering	MA1, MA3	Opt.
Microtechnics	MA1, MA3	Opt.

Language of teaching	English
Credits	3
Session	Winter
Semester	Fall
Exam	Written
Workload	90h
Weeks	14
<b>Hours</b>	<b>3 weekly</b>
Lecture	2 weekly
Practical work	1 weekly
<b>Number of positions</b>	

**Summary**

The state of the art in the domain of additive production processes (the part is built by material addition without use of a shape tool) will be presented. The main application/benefits/shortcomings of the common additive processes as well as technological and economical issues will be discussed.

**Content**

The course will describe the technico-economical environment of industry, that has led to the need for an improvement of performances.

The methods and techniques allowing a reduction of the design, prototyping and industrialization phases will be presented. We will then concentrate on the presentation of a particular method known as selective laser sintering (SLS). We will discuss its principles and its main limitations. We will then study the selective laser sintering process under two different aspects. At first, it will be used as an example to illustrate how it is possible to produce a part with a generative process directly from a CAD file. We will introduce different notions like CLI and SLI-files as well as filling strategies. Finally, we will study the fundamental physical phenomena involved in the SLS process.

The last point to be discussed will be the laser theory (wave length, power, intensity, beam radius, pulse length, repetition rate...). The laser is actually the energy source preferably used in the most efficient rapid manufacturing techniques.

In conclusion and after attending this course, the student will

- understand the rapidity and flexibility requirements related to the design and production of a product,
- know the main rapid prototyping and rapid manufacturing techniques,
- have a deep knowledge of a specific rapid tooling technique called selective laser sintering.

**Keywords**

Production processes, prototyping methods, rapid production methods, additive processes.

**Learning Prerequisites****Required courses**

None

### Recommended courses

Lecture on traditional production processes (like ME-212)

### Learning Outcomes

By the end of the course, the student must be able to:

- Choose suitable methods and tools for (a) the development of, (b) the modelling and simulation of, (c) the analysis of and (d) the choice of solution for an engineering problem in the mechanical engineering domain (product design, manufacturing process and system production), CP1
- Choose production tools and methods based on performance and cost requirements and needs, taking into consideration applicability limits and associated hypotheses, CP8
- Formulate the physical principles of production processes features and limits of production processes, CP12

### Teaching methods

Ex cathedra with examples and student presentation

### Expected student activities

Active participation to the ex-cathedra teaching.

Resolution of a collection of exercises.

Presentation of a small student project.

### Assessment methods

Written exam after the semester (50%) and student project during the semester (50%)

### Resources

#### Bibliography

Manufacturing Engineering and Technology / Kalpakjian  
Additive MANufacturing Technologies / Gibson, Rosen, Stucker

#### Ressources en bibliothèque

- [Manufacturing Engineering and Technology / Kalpakjian](#)
- [Additive Manufacturing Technologies / Gibson, Rosen, Stucker](#)

#### Moodle Link

- <https://go.epfl.ch/ME-413>