ME-413

Introduction to additive manufacturing

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Cursus	Sem.	Type
Materials Science and Engineering	MA1, MA3	Opt.
Mechanical engineering minor	H	Opt.
Mechanical engineering	MA1, MA3	Opt.
Microengineering minor	H	Opt.
Microtechnics	MA1, MA3	Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	Written
Workload	120h
Weeks	14
Hours	**3 weekly**
Courses	2 weekly
TP	1 weekly
Number of positions	

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 procuction 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-catrhedra teaching.

Resolution of a collection of exercices.

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

- Find the references at the Library

Moodle Link

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