

Additive Manufacturing: Tools, Materials and Methods

Programme course

6 credits

Additiv tillverkning: verktyg, material och metoder

TFYA88

Valid from: 2021 Spring semester

Determined by

Board of Studies for Electrical Engineering,
Physics and Mathematics

Date determined

2020-09-29

Main field of study

Applied Physics, Physics

Course level

Second cycle

Advancement level

A1X

Course offered for

- Master's Programme in Biomedical Engineering
- Master's Programme in Physics and Nanoscience
- Master's Programme in Mechanical Engineering
- Master's Programme in Materials Science and Nanotechnology
- Master of Science in Design and Product Development
- Master of Science in Energy - Environment - Management
- Master of Science in Biomedical Engineering
- Master of Science in Mechanical Engineering
- Master of Science in Applied Physics and Electrical Engineering - International
- Master of Science in Applied Physics and Electrical Engineering
- Mechanical Engineering, M Sc in Engineering

Prerequisites

Thermodynamics at the level provided in a basic course in chemistry, physics, or materials science. Familiarity with material physics, as provided in a course such as modern physics, is beneficial but not required, as is familiarity with at least one CAD program. (CAD instruction will be offered as a brief supplemental course for those who lack training/experience.) Basic laboratory skills. This will be a relatively fast-paced course. Students who are unfamiliar with at least one of the pre-requisites (physics/chemistry/materials science or CAD) may struggle.

Intended learning outcomes

This course will provide a general understanding of additive manufacturing (3D-printing), and detailed understanding of:

- the physics and chemistry involved with the various printing methods, including the material requirements,
- the types of materials appropriate for various printing methods,
- various printing methods, their advantages and disadvantages,
- current and future applications of additive manufacturing.

After completing this course, students will be able to:

- describe several types of 3D printers, their mode of operation, and their strengths and limitations,
- determine which type of printer is most suitable for fabricating a part based on the requirements of the desired product (choice of material, tolerances, etc.), or whether 3D printing is at all a viable option,
- prepare 3D CAD models for creating printed devices (including editing for printer limitations, etc.), and
- confidently produce 3D-printed devices with at least two kinds of 3D printers (after hands-on work in the labs).

Course content

Material properties in the solid, liquid, and other (gel, glass) states. Phase-change processes and chemical reactions, including photo-initiated chemistry. Introduction to digital control of mechanical systems (stepper motors, etc.) Introduction to fluid mechanics, as applied to additive manufacturing. Introduction to surface science, as applied to additive manufacturing. Applications, strengths, and weaknesses of various forms of additive manufacturing including: Mechanical applications (prototypes, mechanical components), chemical and life-science applications (prosthetics, artificial organs, lab-on-a-chip devices, etc.). An introduction to 3D CAD. An introduction to planning/slicing software. Hands-on design, fabrication, and evaluation of fabricated parts.

Teaching and working methods

This course includes lectures, hands-on labs, a student-defined project and a field trip.

Examination

PRA2	Student project and presentation	U, G	2 credits
TEN1	Written examination	U, 3, 4, 5	3 credits
LAB1	Laboratory work	U, G	1 credits

Grades

Four-grade scale, LiU, U, 3, 4, 5

Other information

About teaching and examination language

The teaching language is presented in the Overview tab for each course. The examination language relates to the teaching language as follows:

- If teaching language is Swedish, the course as a whole or in large parts, is taught in Swedish. Please note that although teaching language is Swedish, parts of the course could be given in English. Examination language is Swedish.
- If teaching language is Swedish/English, the course as a whole will be taught in English if students without prior knowledge of the Swedish language participate. Examination language is Swedish or English (depending on teaching language).
- If teaching language is English, the course as a whole is taught in English. Examination language is English.

Other

The course is conducted in a manner where both men's and women's experience and knowledge are made visible and developed.

The planning and implementation of a course should correspond to the course syllabus. The course evaluation should therefore be conducted with the course syllabus as a starting point.

Department

Institutionen för fysik, kemi och biologi

Director of Studies or equivalent

Magnus Boman

Examiner

Nathaniel D Robinson

Education components

Preliminary scheduled hours: 40 h

Recommended self-study hours: 120 h

Course literature

Websites

Review articles and notes available for download (password protected) on the course homepage