ME-416

# Fundamentals of computer aided manufacturing

Kyritsis Dimitrios

| Cursus | Sem. | Type |
|---|---|---|
| Mechanical engineering | MA1, MA3 | Opt. |
| Microtechnics | MA1, MA3 | Opt. |
| Mineur STAS Chine | H | Opt. |
| Robotics, Control and Intelligent Systems | | Opt. |
| Robotics | MA1, MA3 | Opt. |
| Systems Engineering minor | H | Opt. |

| | |
|---|---|
| Language of teaching | English |
| Credits | 5 |
| Withdrawal | Unauthorized |
| Session | Winter |
| Semester | Fall |
| Exam | During the semester |
| Workload | 150h |
| Weeks | 14 |
| **Hours** | **5 weekly** |
| Lecture | 3 weekly |
| Exercises | 2 weekly |
| **Number of positions** | |

**It is not allowed to withdraw from this subject after the registration deadline.**

## Summary

Students will be exposed to basic computer-aided manufacturing (CAM) modeling concepts, basic mathematical simulation, verification and optimization algorithms and methodologies and their applications. The students will practice their knowledge by doing projects with modern CAM software.

## Content

Introduction to CAM (computer aided manufacturing)
Machine tools (composition, performance and morphology)
Machining (cutting, tools, strategies, parameters, toolpaths, process plans)
CN Programming / Post-Processing
Process Planning
Process Planning Modeling and Optimization
The Pétri Net Process Planning Modeling Method
Toolpath generation (3 axis)
Machining cost estimation
CAM Projects (machining simulation and comparison with real machining)

## Keywords

Computer-aided manufacturing, toolpath generation, process planning

## Learning Prerequisites

### Important concepts to start the course

- Understand the basic notions of the geometry of curves and surfaces (length calculations, tangent vectors, curvatures)
- Understand the parametric representation of curves and surfaces
- Realize, analyze and criticize a surface and volumetric model of a part
- Basic notions of control theory
- Basic notions of a structured programming language
- Basic notions of machining

## Learning Outcomes

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

- Realize milling simulation model of a prismatic part
- Analyze a milling simulation model of a prismatic part
- Critique a milling simulation model of a prismatic part
- Estimate the cutting forces during milling
- Manipulate the interaction between the CAM and the CNC systems and the basic principles of a post-processor
- Model machining process plans
- Optimize machining process plans
- Model the machining costs of a prismatic machined part

## Transversal skills

- Assess progress against the plan, and adapt the plan as appropriate.
- Communicate effectively, being understood, including across different languages and cultures.
- Set objectives and design an action plan to reach those objectives.
- Plan and carry out activities in a way which makes optimal use of available time and other resources.
- Use a work methodology appropriate to the task.
- Use both general and domain specific IT resources and tools
- Evaluate one's own performance in the team, receive and respond appropriately to feedback.
- Identify the different roles that are involved in well-functioning teams and assume different roles, including leadership roles.

## Teaching methods

The course includes ex-cathedra lessons for the presentation of the theoretical notions of the course followed up by theoretical exercises and modeling practice on the computer in the form of projects.

## Expected student activities

The students will have to work on the assigned modeling problems on the computer in addition to the studying of the course material described in the documentation and presented in the classroom.
The students are organized in groups when performing their modeling assignments in form of projects.
The projects on the modeling problems require an average of 5 hours of workload per week

## Assessment methods

The students are graded by their reports on the modeling problems (80% of the grade). In addition to the project reports the students have to deliver a short presentation of their projects in the class at the end of semester (20% of the grade).

## Supervision

| | |
|---|---|
| Office hours | Yes |
| Assistants | Yes |
| Forum | Yes |
| Others | The students are supervised during their computer-aided exercise hours by a team of assistants including the responsible teacher.<br>The students can ask for more supervising assistance according to their needs outside the class hours. |

## Resources

### Bibliography

Course material is distributed during the course
The following references are related to the contents of the course:

- Sculptured Surface Machining, B.K. Choi and R.B. Jerard, Kluwer Academic Publishers, 1998, Chapters 1, 5 et 6, Kluwer Academic, 1998
- Manufacturing Design, Production, Automation and Integration, by Beno Benhabib Marcel Dekker, 2003
- Principles of Process Planning: A logical approach, by G. Halevi and R. Weil, Springer, 1995
- e-Design: Computer-Aided Engineering Design, by Kunag-Hua Chang, Elsevier, 2016

**Ressources en bibliothèque**

- Manufacturing Design, Production, Automation and Integration / Beno
- Principles of Process Planning: A logical approach / Halevi
- Sculptured Surface Machining / Choi
- e-Design: Computer-Aided Engineering Design / Chang