ENG-411 **Concurrent engineering challenge**

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| Cursus | Sem. | Type |
|---|---|---|
| Space technologies minor | E | Opt. |

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|---|---|
| Language of teaching | English |
| Credits | 2 |
| Withdrawal | Unauthorized |
| Session | Summer |
| Semester | Spring |
| Exam | During the semester |
| Workload | 60h |
| Weeks | 14 |
| **Hours** | **4 weekly** |
| Courses | 2 weekly |
| TP | 2 weekly |
| **Number of positions** | **20** |

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

## Summary

The main objective of this course is to teach the students the fundamentals of concurrent engineering for space missions and systems. The course is built around a similar framework to that of the European Space Agency's (ESA) Concurrent Engineering Challenge.

## Content

**Please note that the following information shows the correct details of the class that differs from the heading information:**

**Course name: Concurrent Engineering of Space Missions**
**Language:** English
**Credits:** 2
**Semester:** Spring 2022/23
**Exam:** Oral
**Workload:** 60 h
**Weeks:** 2
**Lecture:** 8h total over 2 weeks
**Practical work:** 50h (40h/week long intensive workshop + 10 h debriefs and final presentation/exam)
**Number of positions:** max 20 students, min 8 students

**Content of the class**
Students will be split in two teams and design a space mission together in an intensive 2-week-long workshop, using the tools & process of Concurrent Engineering. During the course they will be at all times supported by experts from eSpace. This is a cooperative challenge, meaning teams will share progress at the end of every day. Course ends with a final presentation of the mission designed by each team. By the end of the course students shall become familiar with the foundation, benefits, and application of concurrent engineering practices when applied to solving complex engineering problems.

**Introduction**

- What is concurrent engineering?
- Introduction to common concurrent engineering practices and tools.
- Target mission design: mission overview, science objectives, and high-level requirements.

**Practical engineering of a space mission**

Primer on the space environment & spacecraft subsystems. Students form teams of 10 and are individually assigned to a given subsystem based on their competencies & interests. The involved disciplines include: structures & mechanisms, configuration, power, thermal, AOCS, propulsion, trajectory analysis, communication & data handling, and systems engineering.

**Concurrent & Systems Engineering techniques in action**
Real-time concurrent engineering processes, including: mission phases & modes definition, identification & resolution of key design trade-offs; design budgets; product tree; design iterations; preliminary subsystem design; trades between subsystems.

**Engineering teamwork**
Structured, intensive collaboration within and between engineering disciplines to rapidly design, in a realistic environment with tooling. Leadership & interpersonal skills, including presentations to peers & expert review, and their impact on design process success.

## Keywords

concurrent engineering, concept design, systems engineering, space exploration, space system, space environment, engineering teamwork

## Learning Prerequisites

### Required courses

Space mission design and operations (EE-585) Prof. Claude Nicollier **(already taken or be registered for it)**

### Recommended courses

- Spacecraft design and system engineering (EE-584) Prof. Bernard Foing
- Fundamentals in systems engineering (ENG-421) Prof. Olivier de Weck

### Important concepts to start the course

Some practical engineering team project experience.

## Learning Outcomes

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

- Perform concurrent engineering
- Coordinate with other students to design a coherent space mission
- Design a spacecraft sub system and understand its impact on system design
- Create a new mission in the frame of rapid, real time collaborative design
- Negotiate sub system tradeoffs and communicate key concerns to system levels

## Transversal skills

- Write a scientific or technical report.
- Access and evaluate appropriate sources of information.
- 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.
- Communicate effectively with professionals from other disciplines.
- Resolve conflicts in ways that are productive for the task and the people concerned.

## Teaching methods

Project-based learning

### Expected student activities

Design work during intensive workshop, final presentation & report.

### Assessment methods

Attendance
Engagement
Final report and presentation

### Supervision

| | |
|---|---|
| Office hours | Yes |
| Assistants | Yes |
| Forum | Yes |

### Resources

#### Virtual desktop infrastructure (VDI)

No

#### Bibliography

"Space Mission Analysis and Design", by W. Larson and J. Wertz

eSpace Concurrent Engineering Wiki

eSpace hosts students for Concurrent Engineering Challenge

#### Ressources en bibliothèque

- "Space Mission Analysis and Design", by W. Larson and J. Wertz

#### Websites

- http://comet.epfl.ch