ENG-510

Space propulsion

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Cursus	Sem.	Type
Electrical and Electronical Engineering	MA2, MA4	Opt.
Space technologies minor	E	Opt.

Language of teaching	English
Credits	3
Session	Summer
Semester	Spring
Exam	Oral
Workload	90h
Weeks	14
Hours	**3 weekly**
Courses	2 weekly
Exercises	1 weekly
Number of positions	

Summary

The main objective of the course is to provide an overview about space propulsion systems like thermal propulsion systems, chemical propulsion systems and electrical propulsion systems. The secondary objective is to discuss all relevant equipment needed for propulsion systems .

Content

Introduction in Spacecrafts - Short highlights of spacecraft design including overview on subsystems.
Introduction in Propulsion Systems - Brief overview on all space propulsion systems and key aspects of space propulsion (Specific impulse, thrust, delta v)
Thermal Propulsion Systems - Basic description of cold gas propulsion systems, nuclear thermal propulsion systems and other thermal propulsion systems
Chemical Propulsion Systems - Basic description of solid, liquid and hybrid chemical propulsion systems and subsystems like pressurization systems (pump-fed and pressure-fed), feed systems, storages systems and engine systems / cycles
Electrical Propulsion Systems - Basic description of electro-thermal, electro-static and electro-magnetic propulsion systems
Propulsion System Components - Description of basic equipment needed for the different propulsion systems like pressure regulator, pressure vessels, tanks, valves, pumps
Future Aspects of Propulsion Systems - Introduction in future evolution of propulsion systems as well as overview of current investigations on new propulsion systems
Green Propulsion Systems - Basic description of green propulsion systems using Hydrogen Peroxide, Nitrous Oxide or similar
External Guest - Special lecture on propulsion by external guest speaker

Keywords

Space Propulsion, Thermal Propulsion, Chemical Propulsion, Electric Propulsion, Non-classical Propulsion Systems (e.g. tether, solar wind)

Learning Prerequisites

Required courses

None

Recommended courses

Space mission design and operations
Spacecraft design and system engineering

Learning Outcomes

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

- Analyze propulsion system requirements
- Plan a project in phases
- Coordinate tasks between different engineering disciplines
- Translate system requirements into subsystem requirements
- Justify propulsion system selection

Transversal skills

- Plan and carry out activities in a way which makes optimal use of available time and other resources.
- Communicate effectively, being understood, including across different languages and cultures.
- Identify the different roles that are involved in well-functioning teams and assume different roles, including leadership roles.
- Set objectives and design an action plan to reach those objectives.
- Respect relevant legal guidelines and ethical codes for the profession.
- Demonstrate a capacity for creativity.
- Access and evaluate appropriate sources of information.
- Make an oral presentation.

Teaching methods

Lecture every second week in English supported by excersises and project activity.

Expected student activities

Active participation in the course
Active participation in the exercise sessions (Various bi-weekly exercises leading to basic small thruster design for a liquid bi-propellant chemical propulsion system)
Active participation in the projet group (Design of a Water rocket in a group of 5 students leading to a launch event at the end of the course)

Assessment methods

Oral examination and excersise + project work evaluation.

Supervision

Office hours	Yes
Assistants	Yes
Forum	No
Others	Support by mail and / or telephone + video calls is ensured.

Resources

Virtual desktop infrastructure (VDI)

No

Bibliography

Space Propulsion Analysis and Design (Humble, Henry & Larson, Space Technology Series)
Rocket and Spacecraft Propulsion (Turner, Martin J. L., Springer)
Fundamentals of Electric Propulsion: Io and Hall Thrusters (Dan M. Goebel, I. Katz, Wiley)

Ressources en bibliothèque

- Fundamentals of Electric Propulsion: Io and Hall Thrusters (Dan M. Goebel, I. Katz)

- Space Propulsion Analysis and Design (Humble, Henry & Larson)
- Rocket and Spacecraft Propulsion (Turner, Martin J. L.)

Notes/Handbook

Notes will be delivered prior to each course

Moodle Link

- https://go.epfl.ch/ENG-510