

EE-583

**Spacecraft avionics architectures**

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

Language of teaching	English
Credits	2
Session	Summer
Semester	Spring
Exam	Written
Workload	60h
Weeks	14
<b>Hours</b>	<b>2 weekly</b>
Courses	2 weekly
<b>Number of positions</b>	

**Remark**

pas donné en 2022-23

**Summary**

The course presents and analyses the different systems, architectures and components of spacecraft avionics (on board data handling and processing systems) controlling and commanding spacecraft and payloads (instruments). It will study typical bus structures (standard) used for S/C avionics.

**Content****Introduction**

Classification of spacecraft functions depending of mission profile and identification of requirements and functions of on board data handling systems

**Architecture**

Typical spacecraft structure, system and major subsystem, redundancy management, data flow, telematics, service module, payloads

**Space environment threats to electronics systems and mitigation technics**

On board electronics susceptibility to space radiation environment, radiation hardness, radiation mitigation techniques, HW and SW error detection and correction

**Components and subsystems**

On board microprocessors and microcontrollers, on board communication buses and interfaces, mass memories, attitude and orbit control subsystems, payloads data processing, telemetry and telecommands

**Standards and system modelisation**

Modelisation of flight avionics systems, spacecraft onboard interface services SOIS, Standard Space links protocols, standard data units, spacecraft synchronization time, buses and networks

[www.ecss.nl](http://www.ecss.nl)

**Cases studies**

examples of flight avionics on International Space Station ISS, Automated Transfer Vehicle ATV, ExoMars (Rover, Lander and Orbiter)

Avionics on CAN

**Exercices**

Implement simple avionics system components on an advanced design simulation and verification tool

<http://vector.com/>

**Keywords**

avionics

spacecraft telecommand/telemetry

intelligent distributed systems

spacecraft onboard interfaces services

space environment

spacecraft electronics,  
rad hard components  
on board processors and systems  
ECSS communication standards

### Learning Outcomes

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

- Classify space mission on avionics requirements
- Analyze spacecraft avionics requirements
- Design flight avionics systems
- Model a distributed intelligent system on CAN base
- Order different on board communication bus systems
- Recognize threads and requirements for on board electronics components
- Implement a simulated avionics components on design tool
- Assess / Evaluate flight avionics requirements

### Transversal skills

- 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.

### Teaching methods

Lecture with exercices in Space Center lab

### Expected student activities

exercice on CANoe implement some function of an flight avionics system , based on distributed intelligent system peer to peer communication system CAN.

### Resources

#### Notes/Handbook

Script handsout  
ECSS standards

#### Moodle Link

- <https://go.epfl.ch/EE-583>