EE-582

Lessons learned from the space exploration

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

Language of teaching	English
Credits	2
Session	Summer
Semester	Spring
Exam	During the semester
Workload	60h
Weeks	14
Hours	**2 weekly**
Lecture	2 weekly
Number of positions	

Summary

The main objective of the course is to present with different viewpoints, the lessons learned which lead to the choices and decisions in the space exploration and their consequences today and for the next decades to come. Several (past and present) examples are elaborated and discussed.

Content

1. Introduction – the first 15 years:
The history of the space conquest in the Cold-War context and the origin of the early Soviet successes, their working methodology, their way of doing and designing, the technological limits. The American political and technical reactions, the Moon race, the reasons for the first space disasters and the Soviet failure in the lunar competition. The end of the Apollo programme. The initial conception and design of manned space vehicles and their associated risks.
2. Soviet and American Low Earth Orbit manned occupancy:
The origin of the Soviet space stations programmes: Almaz, Salyut and Mir. The initial goals, the operational and human difficulties, the achieved results, the military hidden aspects. The US programmes: MOL, Skylab, the Space Shuttle Transportation System, its weakness and failures. The consequences of the end of the Cold-War on the Soviet/Russian and American activities. The start of the International Space Station programme and the new worldwide-cooperation between the different Partners.
3. The Launchers in the World:
Review and panorama of the launchers in the World with their associated technological choices: Soviet/Russian, American, Chinese, Japanese, and others. From Europa to Ariane, the national and European projects, the successes of Ariane 1 to 4, the evolution towards Ariane 5. How to deal with failures and operational difficulties. The introduction of a launchers' family with Vega and Soyuz in the CSG (European Spaceport). The evolution towards Ariane 6 and Vega-C.
4. The unmanned and future manned exploration programmes:
Review and panorama of the unmanned exploration missions towards Moon, Mars and Venus. The origin of the American manned exploration programme, the evolving Martian missions scenarios, the new space vehicles concepts and their recent evolutions. The Artemis programme. Return to the Moon in the next 5 years, with Mars missions as a goal. Strategies and roles of the main Space actors (USA, China, Russia, India, Japan and Europe). The "New Space".
5. The next 50 years:
What can be expected in the next decades with respect to Space tourism, the build-up of space colonies and the new visions for exploring, exploiting and colonising the solar system?
6. Perform a conceptual design assessment of a space project (see below).

Keywords

Cold-War, Sputnik, Luna, Vostok, Voskhod, Mercury, Gemini, Apollo, Soyuz, Salyut, Space Shuttle, Mir, ISS, Moon race, Space cooperation, Space barter, Artemis.
Launch service provider, recovery and re-use of space elements
Space tourism, Space resources exploitation.

Learning Prerequisites

Required courses

Recommended courses

Prof. Claude Nicollier's and Prof. Richard Muriel's classes.

Learning Outcomes

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

- Conduct a trade-off assessment of a space project conceptual design
- Assess / Evaluate competing space concepts
- Identify the different roles that are involved in well-functioning teams and assume different roles, including leadership

Teaching methods

Ex cathedra, in English or French.
Lecturing every second week at EPFL during the semester.

Expected student activities

- Active participation in the project groups
- Participation during the lectures

Assessment methods

During the semester, a short conceptual analysis of a Space project is requested. The students have to set-up and work in small, independent groups, to perform the work and defend it at the end of the semester. A System “trade-off” method, as applied in the frame of preliminary conceptual design phases (pre-Phase A), is introduced and shall be used in the evaluation process, with definition of evaluation criteria, their weighting and application to at least 3 system concepts proposals. A project follow-up and guidance is provided during the semester. A draft mid-term report is requested. The project final report and presentation close the activity at the end of the semester. Semester continuous evaluation through the project.

Supervision

Office hours	No
Assistants	No
Forum	No
Others	Available for each group to answer questions on the project conduct, the morning of the lecturing day.

Resources

Virtual desktop infrastructure (VDI)

No

Notes/Handbook

- Lectures' syllabus
- USB key with reference documents at the end of the course

Websites

- http://www.esa.int
- http://www.nasa.gov
- https://global.jaxa.jp
- https://cnes.fr/en

Videos

- https://www.esa.int/ESA_Multimedia/Videos/2013/07/Faces_of_ESA_Marc_Toussaint