COURSE DESCRIPTION CARD - SYLLABUS

Course name
Spaceships and space technologies [S2AiR2-SIiB>SiTK]

Course

Field of study
Automatic Control and Robotics

Year/Semester
1/1

Area of study (specialization)
Intelligent and Unmanned Systems

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
30

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

dr inż. Dariusz Janiszewski
dariusz.janiszewski@put.poznan.pl

Lecturers

Prerequisites

A student starting this subject should have basic engineering level knowledge in the field of physics, astronomy, automation and robotics. He/she should also understand the necessity of broadening his/her competences and be ready to cooperate within a team realizing e.g. a team project.

Course objective

1. Providing students with basic knowledge in the field of space technologies focused on satellite technologies and research missions. Application examples include well-known civilian space mission projects. 2. Developing students' skills in solving design problems by analyzing past/ongoing missions and reconstructing the knowledge thus acquired. 3. Developing teamwork skills in students during the implementation of the final project in the laboratory.

Course-related learning outcomes

Knowledge:
The student knows and understands selected areas of mathematics to an in-depth level; has broadened and deepened knowledge necessary to formulate and solve complex tasks in the field of control theory, optimization, modeling, identification and signal processing; [K2_W1]

The student has structured and in-depth knowledge in the field of modeling and identification of systems; [K2_W5]
The student has structured and in-depth knowledge in selected areas of automation and robotics; [K2_W10]
The student has knowledge of development trends and the most important new achievements in the field of automation and robotics and related scientific disciplines; [K2_W12]

Skills:
The student is able to critically use literature information, databases and other sources in Polish and foreign languages; [K2_U1]
The student is able to designate models of simple systems and processes and use them for the purposes of analyzing and designing automation and robotics systems; [K2_U10]
The student is able to assess the usefulness and possibility of using new achievements (including techniques and technologies) in the field of automation and robotics; [K2_U16]4. is able to develop an algorithm to solve a complex and unconventional engineering task and a simple research problem and implement, test and run it in a selected programming environment for selected operating systems; [K2_U25].

Social competences:
The student is aware of the need for a professional approach to technical issues, thorough familiarization with the documentation and environmental conditions in which devices and their components can function; [K2_K4]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The knowledge acquired during the lecture is verified by an exam in the form of a defense of a set of laboratory reports. The exam consists of about 6 questions (mainly open), scored differently. Passing threshold: 50% of points. Exam topics are consistent with the syllabus and current news and are made available to students during the lecture.
The skills acquired during laboratory classes are verified on the basis of prepared reports on experiments and a laboratory diary.

Programme content

Space environment
Orbits and types of orbits
Satellite geometry
Spaceship structure
Phases and modes of missions and spacecraft launches
Space mission requirements
Transport methods from Earth to close orbits
Drive systems for artificial objects
Geometry of the satellite environment
Satellite components in orbit and cooperating components on the ground
Case study: Configuration and design of a satellite in low Earth orbit,
Open Problems: Control, Mechanics, Processing, Station power transmission,
During the lecture, students analyze real and emulated (simulated) issues related to the unit's scientific research, especially in the application of selected methods.
The laboratory program covers the following issues related to the design of subsystems and configuration of the LEO satellite in the field of electronic systems of instruments, propulsion systems, missions and experiments

Course topics

none

Teaching methods

1. Lecture: multimedia presentation, illustrated by examples given on the board.
2. Laboratory exercises: the execution of laboratory exercises, the study of prepared problems.

Bibliography

Basic:
Larson, Wiley, and James Wertz, eds. Space Mission Analysis and Design. Torrance, CA: Microcosm Press, 1999. ISBN: 9781881883104.
George Sebestyen, Steve Fujikawa, Nicholas Galassi, Alex Chuchra, Low Earth Orbit Satellite Design, Springer Cham, 2018, 978-3-319-68314-0
Eckart, Peter. The Lunar Base Handbook: An Introduction to Lunar Base Design, Development, and Operations. Columbus, OH: McGraw-Hill Companies, 2006. ISBN: 9780073294445.
James M Longuski , José J. Guzmán , John E. Prussing, Optimal Control with Aerospace Applications, Springer New York, NY, 2013 978-1-4614-8944-3
Miguel A. Aguirre, Introduction to Space Systems, Springer Science+Business Media New York 2013, 978-1-4614-3757-4

Additional:
Larson, Wiley, and Linda Pranke. Human Space Flight: Mission Analysis and Design. Columbus, OH: McGraw-Hill Companies, 1999. ISBN: 9780072368116.
Giancarlo Genta, Introduction to the Mechanics of Space Robots, Springer Dordrecht, 2012, 978-94-007-1795-4

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	60	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	40	1,50