COURSE DESCRIPTION CARD - SYLLABUS

Course name
Aerial Robots Programming [S2AiR2-SIiB>PRL]

Course

Field of study
Automatic Control and Robotics

Year/Semester
1/2

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
0

Other
0

Tutorials
0

Projects/seminars
30

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

A student starting this subject should have the knowledge of automation and robotics provided for PRK (Polskie Ramy Kwalifikacji) level 6, in particular basic knowledge of computer science, embedded systems architecture and electronics. The student should know the basics of working with the Linux operating system and the ability to program in Python and/or C++. In addition, the student should manifest qualities in the field of social competence, including cognitive curiosity, understanding of the need to expand one's competence and readiness to cooperate as part of a team implementing a joint project.

Course objective

To provide students with knowledge of the architecture, tools and programming methods of UAV (Unmanned Aerial Vehicles) avionics systems. To familiarize students with the current standards and the flight controller systems used in practice. Discussion of selected tools and operating systems. Presentation of tools supporting the process of developing solutions based on autonomous unmanned systems.

Course-related learning outcomes

Knowledge:
1. has a structured and in-depth knowledge of modeling and system identification; [K2_W5].

2. has a structured and in-depth knowledge within selected areas of automation and robotics; [K2_W10]
3. has a structured and in-depth knowledge related to control systems and control and measurement systems. [K2_W11]

Skills:
1. has language skills in the field of automation and robotics in accordance with the requirements specified for level B2+ of the Common European Framework of Reference for Languages; [K2_U7]
2. is able to simulate and analyze the operation of complex automation and robotics systems, as well as plan and perform experimental verification; [K2_U9]
3. can integrate and program specialized robotic systems; [K2_U12]

Social competences:
1. is aware of the importance of and understands the non-technical aspects and consequences of engineering activities, including their impact on the environment and the related responsibility for decision-making; is ready to develop professional achievements; [K2_K2]
2. is aware of the responsibility for his/her own work and is ready to conform to the rules of teamwork and take responsibility for jointly implemented tasks; is able to lead a team, set goals and determine priorities leading to the implementation of the task; [K2_K3]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The knowledge acquired in the lecture is verified by a final examination in written or oral form. The exam is based on sets of questions given to students during the semester.
Project classes are evaluated on the basis of:
a) regular presentations of project progress;
b) the final report, prepared in the form of technical documentation;
c) practical presentation of the project activity, discussion of the project and the implementation made.

Programme content

During the lecture, students will learn the theory, methods and tools to develop software solutions for unmanned aerial vehicles.

Course topics

1. Hardware architecture of UAV avionics systems. The methods of implementing control and measurement functions. Overview of commonly used avionics systems.
2. Structure of on-board software and its main functions. Implementation of control and state estimation algorithms in avionics systems. Low-level integration of sensors and actuators.
3. Operating systems and tools in UAV avionics systems. Real-time mechanisms, methods of information exchange. The use of Linux and the ROS ecosystem in relation to unmanned aerial vehicles.
4. Communication protocols used in avionics systems. Interfaces for data exchange between system components. Communication and telemetry channels and tools related to ground control stations.
5. Tools supporting the programming of flying robots. Simulation and modeling environments. Motion tracking systems and their applications to UAVs. Selected programming environments, tools and programming interfaces.
Project classes consist of practical team projects using unmanned flying units. The class is carried out in two stages.The first stage involves the use of a simulation environment to validate the proposed solutions and understand the essence of the topic.The second stage involves testing on actual flying robots in a laboratory equipped with a motion tracking system.

Teaching methods

1. Lecture: multimedia presentation illustrated with examples. Demonstrations and presentations of practical solutions.
2 Project classes: programming projects using simulators and real MAV-class flying units, performed under the supervision of the instructor.

Bibliography

Basic:
1. Lecture and project materials provided by the instructor in electronic form.
2. Sadraey M., Design of Unmanned Aerial Systems, Wiley 2020
3. Valvanis K., Handbook of Unmanned Aerial Vehicles, Springer, 2015

Additional:
1. Documentation of selected libraries, tools and devices related to the programming of unmanned aerial vehicles.
2. Koubaa A., Robot Operating System (ROS) - The Complete Reference, Springer 2016

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