COURSE DESCRIPTION CARD - SYLLABUS

Course name

Autonomous aerial robots

Course

Field of study	Year/Semester
Automatic Control and Robotics	1 / 2
Area of study (specialization)	Profile of study
Robots and autonomous systems	general academic
Level of study	Course offered in
Second-cycle studies	Polish
Form of study	Requirements
full-time	compulsory

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
15	0	0
Tutorials	Projects/seminars	
0	30	

Number of credit points

3

Lecturers

Responsible for the course/lecturer:

Wojciech Giernacki, Associate Professor

email: wojciech.giernacki@put.poznan.pl

phone: 665-2377

Faculty of Control, Robotics and Electrical Engineering

Piotrowo 3A Street, Poznań

Responsible for the course/lecturer:

Prerequisites

A student should know fundamentals on mobile robots, basics of control theory, modeling of control systems and methods for system identification. Moreover, he/she should have basic programming skills; should have skills to acquire knowledge from selected sources, skills in using basic information-communication tools, and should be ready to cooperate in a team.

Course objective

Extension of student's knowledge on control methods for autonomously flying robots; shaping the skills for cooperation in a small programing team in Robot Operating System and Matlab.

Course-related learning outcomes

Knowledge

1. Has an organized and in-depth knowledge of artificial intelligence methods and their application in automation and robotics systems-[K2_W5(P7S_WG)]

2. Has advanced detailed knowledge of the construction and use of advanced sensory systems-[K2_W9(P7S_WG)]

3. Has an organized and in-depth knowledge in the field of adaptive systems-[K2_W10(P7S_WG)]

4. Has an organized and in-depth knowledge within the selected robotics areas-[K2_W11(P7S_WG)]

Skills

1. Can design control systems for complex and unusual multidimensional systems; can consciously use standard functional blocks of automation systems and shape the dynamic properties of measuring tracks-[K2_U9(P7S_UW)]

2. Can analyses and interpret technical design documentation and use scientific literature related to a given problem, as well as perceive the possibility of using new techniques and technologies. Is able to perform tasks in an innovative way in unpredictable conditions-[K2_U10(P7S_UW)]

3. Can make a critical analysis of the operation of control systems and robotics systems; also has the ability to select automation systems with the use of microprocessor controllers-[K2_U19(P7S_UW)]

4. Is able to design control systems for complex and untypical multidimensional systems; is able to consciously use standard functional blocks of automation systems and shape dynamic properties of measurement paths-[K2_U27(P7S_UW)]]

Social competences

1. The graduate is aware of the need for a professional approach to technical issues, meticulous familiarization with the documentation and environmental conditions in which the equipment and its components can operate-[K2_K4(P7S_KR)]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

A) For lectures: Verification of the teaching results during an exam in the form of a final selection test written by students. The test includes 10-20 questions, every one with A,B,C answers, where one of them is correct and other two are false. A student earns 1 point for a question if he/she selects correct answer. No/wrong answer results on 0 point. A positive mark from the test needs earning more than a half of a maximal possible number of points. The result determines the mark OT which, together with a mark OL from laboratory classes, determine (after rounding) the final mark OK computed as follows: OK= OT*0.7 + OL*0.3. The result OK < 3.0 leads to a negative mark from the course.

B) For project classes: Verification of the teaching results is performed by ongoing control of students' state of knowledge, the status of assigned tasks, as well as the evaluation of the team project conducted as part in the second part of the course. The evaluation of the project includes the effects of its implementation, control of the correctness of the obtained results as well as the content and quality of the final report.

Programme content

The lectures cover the following topics: introduction to the lecture, historical overview, terminology and classification of unmanned aerial vehicles, introduction to modeling of the dynamics of multi-rotor flying robots, selected alternative models of the dynamics of flying robots, control architecture of multi-rotor UAVs together with the basic types of controllers used in flying robots, advanced systems of UAV position and orientation control, selected methods of numerical tuning of UAV controllers, algorithms of path planning and UAV collision avoidance.

Project classes closely correlate with the content presented in the lecture part. Examples of implementation based on Robot Operating System. In the second part of the 30-hour cycle of classes, each student team (2-3 people) selects and carries out one of the defined problem / task for controlling the unmanned aerial vehicle model.

Teaching methods

A) Lectures: Presentation of slides illustrated by additional examples provided and analyzed on a blackboard.

B) Project classes: Fifteen 2-hour excercises in a laboratory room. The first 7 classes are intended for the individual implementation of programming tasks in a simulation environment, dedicated, among others, to autonomous flights; the remaining 8 classes are the implementation of projects by teams of 2 or 3 persons, relating to the implementation of missions in a simulation and/or real environment.

Bibliography

Basic

1. Giernacki W., Drony i bezzałogowe statki powietrzne, Wydawnictwo Politechniki Poznańskiej, 2018.

2. Giernacki W., Roboty latające - laboratorium, Wydawnictwo Politechniki Poznańskiej, 2017.

Additional

1. Valavanis K., Handbook of unmanned aerial vehicles, Springer, 2015.

2. Bartkiewicz B. , Kruszewski P. , Szczepkowski M., Drony-teoria i praktyka, KaBe, 2016.

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,0
Classes requiring direct contact with the teacher	45	2,0
Student's own work (literature studies, preparation for laboratory classes, preparation for exam) [1]	30	1,0

[1] delete or add other activities as appropriate