COURSE DESCRIPTION CARD - SYLLABUS

Course name
Autonomous aerial robots [N2AiR1-ISAiR>PO2-RL]

Course

Field of study
Automatic Control and Robotics

Year/Semester
2/3

Area of study (specialization)
Intelligent Control and Robotic Systems

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
part-time

Requirements
elective

Number of hours

Lecture
10

Laboratory classes
20

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

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.

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, oral test. 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 OP from laboratory classes, determine (after rounding) the final mark OK computed as follows:
OK= OT*0.7 + OP*0.3. The result OK < 3.0 leads to a negative mark from the course.
In assessing learning outcomes, the following grades are assigned to percentage ranges:
Percentage Range / Verbal Grade / Letter Symbol / Numerical Grade
<90–100> Very Good A 5.0
<80–90) Good Plus B 4.5
<70–80) Good C 4.0
<60–70) Satisfactory Plus D 3.5
<50–60) Satisfactory E 3.0
<0–50) Unsatisfactory F 2.0
B) For laboratory 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 miniproject conducted as part in the second part of the course. The evaluation of the miniproject 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 module program covers issues related to the newest solutions in the field of unmanned aerial vehicles, modeling of their flight dynamics, as well as algorithms and methods for controlling and identifying parameters in the context of autonomous flights.

Course topics

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.
Laboratory classes closely correlate with the content presented in the lecture part. Examples of implementation based on Robot Operating System and/or MATLAB. In the second part of the 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) Laboratory classes: Excercises in a laboratory room, performed by teams of 2-3 students, in a form of programing-computing and simulation tasks of algorithms and methods for identification and control of UAVs flying autonomously.

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	3,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	45	2,00