POZNAN UNIVERSITY OF TECHNOLOGY

EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)

COURSE DESCRIPTION CARD - SYLLABUS

Course name
Intelligent control systems [S2Inf1-IP>ISS]

Course

Field of study
Computing

Year/Semester
1/1

Area of study (specialization)
Internet of Things

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
15

Laboratory classes
30

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

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Lecturers

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Prerequisites

Student starting this course should have basic knowledge of basics of control engineering and embedded systems. She/He should have the skills to acquire knowledge from the indicated sources, to logical thinking, to drawing conclusions and to concise presentation of information. She/He should be honest, responsible, persistent, cognitive, creative, polite and respectful for other people.

Course objective

1. Providing students the basic knowledge in the field of classic and advanced control algorithms using elements of artificial intelligence.design. 2. Developing students" skills in solving simple problems related to the use of embedded systems in control systems and increasing the reliability of such systems. 3. Teaching students the skills of interdisciplinary teamwork, especially in the proces of project design and implementation.

Course-related learning outcomes

Knowledge:
1. the student has advanced and in-depth knowledge of the development and implementation of intelligent control algorithmshas.
2. the student has an ordered and theoretically founded general knowledge in the field of architecture of intelligent control systems.
3. the student has knowledge of development trends and the most important new achievements in the design and implementation of intelligent control systems.
4. the student knows the methods and tools of designing and implementing intelligent control systems.

Skills:
1. the student is able to obtain information from the literature (in the native language and english) in the field of intelligent control systems.
2. the student is able to plan and carry out experiments, including measurements and computer simulations of control systems, interpret the obtained results and draw conclusions.
3. the student is able - when formulating and solving engineering tasks - to integrate knowledge of computer science, automation and electronics.
4. the student is able to assess the usefulness and the possibility of using it tools for the design of intelligent control systems.
5. the student is able to critically assess the solution in the field of intelligent control systems and propose improvement of the control system.
6. the student is able to assess the usefulness of it tools for solving an engineering task in the field of intelligent control systems.
7. the student is able to solve an engineering task in the field of designing intelligent control algorithms using new methods.
8. the student is able - in accordance with the given specification, taking into account non-technical aspects - to develop, implement and verify an intelligent control system.
9. the student is able to cooperate in a team developing an advanced intelligent control system, assuming various roles.
10. the student is able to define directions of further learning in the field of intelligent control systems.

Social competences:
1. the student has advanced and in-depth knowledge of the development and implementation of intelligent control algorithms.
2. studnet understands that in computer science, knowledge and skills quickly become obsolete.
3. the student is able to plan and carry out experiments, including measurements and computer simulations of control systems, interpret the obtained results and draw conclusions.
4. the student understands the importance of using the latest knowledge in the field of computer science in solving research and practical problems.
5. the student has knowledge of development trends and the most important new achievements in the design and implementation of intelligent control systems.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Lectures:
a) formative evaluation - based on answers to questions concerning contents presented in previous lectures, b) evaluation summary - the knowledge and skills assessed in the written test (consisting of about 10-12 questions variously scored, covering the entire lecture content) . Passing threshold: 50% of scores. Examination issues, on the basis of which the questions are developed, will be sent to students by e-mail using the university"s e-mail system.
Laboratories :
a) formative evaluation - based on the quality of lab tasks execution;
b) evaluation summary - based on the assessment of student"s preparation for lab sessions, lab sessions execution and reports, as well as the quality of the project together with project report and its defense; the quality of team work will be also assessed.
It is possible to obtain additional scores for the active participation in classes, especially for discussing additional aspects of the program enabling ongoing improvement of the teaching process, the effectiveness of applying the acquired knowledge when solving a practical problem, comments related to the possible improvement of teaching method, indicating students" perceptual difficulties

Programme content

Basics of computer control systems: basic concepts, classification, direct and superior control systems, layered control structure (structure and structure of the automation channel, microcontrollers, PLC controllers). Introduction to intelligent control systems: intelligent measuring and actuating devices and intelligent control algorithms. Synthesis of discrete control systems: classical PID control algorithms. Theoretical basis of control in conditions of incomplete information about the object. Basics of fuzzy control - fuzzyfication, inference, defuzzyfication. Implementation of Mamdani and Takagi-Sugeno-Kang fuzzy regulators.
Basics of advanced control algorithms. Predictive control - MPC. The principle of operation of the predictive controller. Prediction of outputs with the model of step responses. DMC algorithm in the analytical and numerical version. Analytical and numerical version of the GPC algorithm. Predictive algorithms with models of state equations. Stability, tuning of predictive regulators. Non-linear predictive control - application of fuzzy TS models and neural models. On-line optimization and tuning of MPC regulators.

Teaching methods

1. Lecture: multimedia presentation illustrated with examples presented on the blackboard.
2. Laboratory exercises:
- multimedia presentation illustrated with examples presented on the blackboard and carrying out the tasks given by the teacher,
- practical exercises,
- team project presenting the application of acquired knowledge.

Bibliography

Basic
1. Rumatowski K., Podstawy automatyki cz.2, Układy dyskretne , Układy stochastyczne, Wyd. PP Poznań 2005
2. Kaczorek T., Dyskretne układy sterowania, WNT Warszawa 2000
3. Tatjewski P., Sterowanie zaawansowane obiektów przemysłowych. Struktury i algorytmy. Wydanie drugie zmienione, Wyd. Akademicka Oficyna Wydawnicza EXIT, Warszawa 2016
Additional
1. Nowak M., Urbaniak A., Application of predictive control algorithms for thermal comfort and energy saving in the classroom, [in:] Proceedings of 17th International Carpathian Control Conference ICCC'2016, Ivo Petras, Igor Podlubny, Jan Kocur (Eds.), ISBN: 978-1-4673-8605-0, IEEE Catalog Number: CFP1642L-USB, Tatranská Lomnica, Slovak Republic, May 29-June 1, 2016, (527-532) (DOI:10.1109/CarpathianCC.2016.7501154)

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	45	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	55	2,00