**Nazwa przedmiotu:**

Dynamic Systems and Control

**Koordynator przedmiotu:**

Paweł D. Domański

**Status przedmiotu:**

Obowiązkowy

**Poziom kształcenia:**

Studia I stopnia

**Program:**

Computer Science

**Grupa przedmiotów:**

Technical Courses

**Kod przedmiotu:**

EDYCO

**Semestr nominalny:**

5 / rok ak. 2015/2016

**Liczba punktów ECTS:**

6

**Liczba godzin pracy studenta związanych z osiągnięciem efektów uczenia się:**

- lectures attendance: 15 x 2 h = 30 h;
- preparation to lectures (reviewing slides, notes and a textbook): 30 h;
- preparation to tests: 20 h
- laboratory attendance: 13 x 2.33 h = 30 h ;
- preparation to laboratories (learning exemplary lab tasks, reviewing slides, notes and a textbook): 40 h;
Total: 30 h + 30 h+ 20 h + 30 h+ 40 h = 150 h

**Liczba punktów ECTS na zajęciach wymagających bezpośredniego udziału nauczycieli akademickich:**

2

**Język prowadzenia zajęć:**

polski

**Liczba punktów ECTS, którą student uzyskuje w ramach zajęć o charakterze praktycznym:**

2

**Formy zajęć i ich wymiar w semestrze:**

|  |  |
| --- | --- |
| Wykład: | 30h |
| Ćwiczenia: | 15h |
| Laboratorium: | 15h |
| Projekt: | 0h |
| Lekcje komputerowe: | 0h |

**Wymagania wstępne:**

Required Prerequisites: EMANA, EDDE, EPHY1
Suggested Prerequisites: ECIRS

**Limit liczby studentów:**

120

**Cel przedmiotu:**

Teaching students basics of modeling and understanding dynamics of systems and basics of automatic control, in particular understanding of fundamental role of feedback.

**Treści kształcenia:**

The course is devoted to basics of automatic control, including modeling and understanding dynamics of systems. Main topics covered: logical control and PLC controller, structure of the feedback loop, building mathematical models of dynamic systems, linearization, analysis of dynamic systems in (continuous) time domain and in complex variable domain, transfer functions, static errors in feedback systems, Hurwitz stability criterion, Nyquist and Bode plots, Nyquist stability criterion, stability margins, linear compensator design in feedback loops, PID tuning rules, digital implementation of continuous-time control algorithms.
Introduction. Role and goals of automatic control. Basic control structures, fundamental role of feedback, examples. Logical open-loop control, continuous control, regulatory feedback control. An example of a decision support system. Brief history. (2)
Controllers, types of industrial feedback control. Industrial control hardware. Programmable logical controller (PLC): architecture, principle of operation. Basic structure of feedback control. Continuous control, on-off control, three-positions relay control, examples.(3)
Modeling of dynamical objects. Theoretical and empirical models, modeling by differential and difference equations, examples, role of identification. Equilibrium points, static characteristics, linearization of nonlinear models. (3)
Analysis of linear dynamic models in time domain. Impulse and step responses, convolution, general solution to linear dynamic state equations, stability of dynamic systems. (3)
Analysis of linear dynamic models in complex variable domain. Laplace transform, transfer function. Basic linear dynamic models. Transformation of block structures, transfer functions of structured systems. Hurwitz stability criterion. (3)
Static errors in feedback systems. Static errors for static (type zero) systems, influence of feedback on tracking accuracy and disturbance attenuation. Static errors in type I and type II feedback systems with integrators, influence of integration in the plant and in the controller. (3)
Analysis and correction of feedback systems in frequency domain. Nyquist plot, Bode plots, plots for basic linear dynamic systems. Nyquist stability criterion, amplitude and phase margins. Design of a servomechanism-type feedback system. (6)
PID control. Goals of process control. Structures and properties of PID controllers. Process modeling for PID control, PID tuning methods. Cascade and feedback-feedforward control structures. Model-based predictive control. (3)
Digital implementation of control algorithms. Design methods for control loops with digital controllers. Discrete (Z) transform. Emulation method, discretization of continuous algorithms. Discrete PID algorithm. Choice of sampling interval. (2)

**Metody oceny:**

Laboratory tasks, activity, homeworks, and tests.

**Egzamin:**

nie

**Literatura:**

1. G. Franklin, J. Powell, A. Emami-Naeini; Feedback Control of Dynamic Systems, Addison Wesley, (3rd ed., 1994).
2. U. Kręglewska, M.Ławryńczuk, P. Marusak.: Control, Laboratory exercises. Oficyna Wydawnicza PW, 2007.
3. K.Malinowski, P. Tatjewski: Podstawy Automatyki (In Polish, translation into English planned). Lecture notes available in ERES, 2011.

**Witryna www przedmiotu:**

https://studia.elka.pw.edu.pl/pl/11L

**Uwagi:**

The subject covers main issues associated with analysis of control systems enabling design (algorithm selection) od basic control systems.

## Efekty przedmiotowe

### Profil ogólnoakademicki - wiedza

**Efekt EDYCO\_W01:**

Knowledge to understand the notion of feedback, the basic structures and types of the automatic control, the rules and realization of the binary controls. The knowledge of the mathematical modeling fundamentals used in control, the analysis of the linear dynamical models in both time and complex variable domains, the form and characteristics of the base dynamical modules, frequency characteristics, the tracking accuracy, disturbance attenuation and stability assessment in the close loop systems, the design basics of digital control realization, the methods for the PID controller tuning.

Weryfikacja:

Lecture tests, introductory tests and final grading for the laboratory tasks.

**Powiązane efekty kierunkowe:** K\_W04, K\_W05

**Powiązane efekty obszarowe:** T1A\_W02, T1A\_W02

### Profil ogólnoakademicki - umiejętności

**Efekt EDYCO\_U01:**

Has the ability to program simple binary control tasks.

Weryfikacja:

Accomplished laboratory taks.

**Powiązane efekty kierunkowe:** K\_U08, K\_U09

**Powiązane efekty obszarowe:** T1A\_U08, T1A\_U09, T1A\_U08, T1A\_U09

**Efekt EDYCO\_U02:**

Has the ability to design proper simple process model, to implement algorithm and to tune PID parameters, and to find out digital controller realization.

Weryfikacja:

Laboratory tasks accomplished together with the lecture tests.

**Powiązane efekty kierunkowe:** K\_U08, K\_U09

**Powiązane efekty obszarowe:** T1A\_U08, T1A\_U09, T1A\_U08, T1A\_U09

**Efekt EDYCO \_U03:**

Has the ability to build simple dynamical models, to find out equilibrium points, perform linearization of nonlinear models, to evaluate transfer function, to analyze steady state errors, frequency characteristics and to design simple dynamical correction units satisfying typical control system design requirements.

Weryfikacja:

Lecture tests.

**Powiązane efekty kierunkowe:** K\_U07, K\_U08

**Powiązane efekty obszarowe:** T1A\_U07, T1A\_U08, T1A\_U09

### Profil ogólnoakademicki - kompetencje społeczne

**Efekt EDYCO\_K01:**

Has the team working skills.

Weryfikacja:

Realization and passing of the laboratory tasks.

**Powiązane efekty kierunkowe:** K\_K04

**Powiązane efekty obszarowe:** T1A\_K03, T1A\_K04