Course description

1 General information

Course name	Introduction to automatics
Course code	M6-IA
Level of study (B.Sc, M.Sc., Ph.D.)	B.Sc.
ECTS	6
Course manager	Ph.D. Eng. Adam Slota, Char of Production Engineering
Course length	One (1) semester
Coordinator for international programs	erasmus@mech.pk.edu.pl

2 Prerequisites

 Knowledge of: complex numbers, linear ordinary differential equations, Laplace transform

2 Program Type	Lectures	Classes	Labs	Computer labs	Project	Seminar
Hours	30	15	15	0	15	0

3 Contents

Lectures		
No.		Hours
1	Classification of control systems: linear/nonlinear, time invariant/time varying, lumped/distributed parameters; signals. Structures of control systems	2
2	Transfer function and time responses: unit impulse, step and ramp. Transfer function for multidimensional systems.	4
3	Transfer function and time responses for first order and second order systems. Performance criteria for second order systems: rise time, settling time, overshoot.	4
4	Frequency response, Bode plots.	4
5	Block diagrams algebra.	3
6	Basic control actions: on-off control, proportional, integral and derivative.	3
7	Control systems with PID controllers, PID tuning	2
8	Stability of control systems, criteria of stability.	4
9	State space description of control systems.	4

Classes		
No.		Hours
1	Mathematical models of mechanical, electrical and electromechanical systems.	2
2	Transfer function, time responses and frequency responses of basic dynamic components.	2
3	Determination of representative transfer function for different structures of control systems.	3
4	Determination of frequency responses	2
5	Stability verification using stability criteria	2
6	Study of influence of PID components on control system behavior	2
7	Examples of state space equations	2

Labs		
No.		Hours
1	Plant parameters identification with the use of step response	2
2	Automatic control system of an inertial plant with the use of P controller	2
3	Automatic control system of an inertial plant with the use of PID controller	4

4	Frequency responses of a drive	3
5	Static accuracy of a drive in CNC machine	2
6	Dynamic accuracy of a drive in CNC machine	2
7	Examples of state space equations	

Computer Labs

No.		Hours
1	Introduction to Simulation and Control design with the use of LabVIEW	3
2	Analysis of steady state accuracy of control systems (static and astatic control systems)	4
3	Design of I-PD controller of robot arm drive with DC motor	4
4	Design of state feedback controller for Segway vehicle	4

3 Learning Outcomes (skills and knowledge):

- The student knows basic structures of control systems
- The student has knowledge about mathematical modelling of control system components
- The student is able to identify the type of system components based on its time response
- The student has knowledge about control system performance criteria
- The student is able to verify stability of a control system
- The student is able to find parameters of PID controller
- The student is able to find parameters of state feedback controller

4 Assessment policy (examination):

- A test with open tasks
- Homework and active participation in classes
- Reports form labs and computer labs
- Final grade is average from test and reports (all must be positive) plus 1 possible grade for active participation

5 Literature

1. K. Ogata “Modern control engineering”, Prentice Hall, New York, 1997.
2. Z. Bubnicki “Modern control theory” ; Springer-Verlag, Berlin : Springer, 2005
3. Rames C. Panda (Ed) “Introduction to PID Controllers - Theory, Tuning and Application to Frontier Areas” InTech 2012 , open access book available at https://www.intechopen.com/books/introduction-to-pid-controllers-theory-tuning-and-application-to-frontier-areas
4. T. Wescott “PID Without a PhD”, Wescott Design Services, available at http://www.wescottdesign.com/articles/pid/pidWithoutAPhd.pdf