SYLLABUS

Name: ***Automatic control systems (BioAIS-BF>SMs1ACp4O)***
Name in Polish:
Name in English: ***Automatic control systems***

Information on course:

Course offered by department: Faculty of Energy and Environmental Engineering
Course for department: Silesian University of Technology
Term: Summer semester 2021/2022
Cordinator of course edition: Dr hab. inż. Adam Gałuszka

Default type of course examination report:

ZAL

Language:

English

Course homepage:

https://platforma2.polsl.pl/rau1/course/view.php?id=518

Short description:

The objective of the lectures is to give basic control knowledge in the fields of analysis and design of linear control systems, continuous and discrete-time, single and multivariable. The objective of classes and laboratory exercises is to acquire some practice in control system analysis and design using advanced CAD environment, like MATLAB-SIMULINK

Description:

Lecture
1. Introduction to the course. Watt centrifugal governor Feedback Control Systems-basic notions, dynamic and static elements, block diagrams. Control system classification.
2. Models of physical systems. Differential equations, state space models, linearization, transfer function for single – and multivariable elements. State space versus transfer function description. Frequency responses: Nyquist, Bode plots.
3. Basic elements and their responses. Time and frequency responses of the basic elements: first order lag, second order, ideal integrator and differentiator, system with delay.
4. Dynamic system properties. Fundamental matrix derivation. Canonical form. Controllability – definition, conditions. Observability – definition conditions. Stability, Hurwitz criterion.
5. Feedback control systems. Closed-Loop system stability. Characteristic equation of the CL system. Applying of Hurwitz criterion. Nyquist criterion, derivation and calculation usage. Stability analysis using Bode plots. Stability of the systems with delay.
6. Quality of the control. Steady-state analysis – system of type 0 and type I. Account of nonlinearities.
7. Compensators and controllers. Lead, lag, lead-lag compensators. Recommendation for compensator choice. PID controller. Regulator implementations. Regulator parameters tuning. Ziegler-Nichols rules.

Class exercises:
1. Dynamic systems description
2. Frequency responses
3. Hurwitz stability criterion
4. Steady state analysis
5. Stability degree and resonance degree

Laboratory:
1. CAD of control systems – Matlab introduction
2. Stability of linear systems
3. Static accuracy
4. PID controllers

Bibliography:

Primary sources:
1. Gessing R.: Control Fundamentals, Wydawnictwo Politechniki Śl., Gliwice 2004.
2. Franklin G.F, J.D. Powell and Emani-Naeini: Feedback control of Dynamic Systems, (Third Edition) Addison-Wesley, 1994

Secondary sources:
1. Phillips CL., Harbor R.D.: Feedback Control Systems (Third Edition) Prentice Hall, 1996.
2. Goodwin G.C., Graebe S.F., Salgado M.E.: Control Systems Design, Prentice Hall, 2001

Learning outcomes:

Knowledge
Student knows and understands:
K1A_W08 problems of creating mathematical models of dynamic systems and processes based on differential equations and operator calculus along with their time, operator and frequency analysis
K1A_W15 problems of description, design and analysis of simple control and robotics systems, including the problems of stability and quality of control of control systems as well as construction, programming and control of robots
Skills
Student is able to:
K1A_U18 create a mathematical model of a simple dynamic control system, select the appropriate structure and types of controllers, select their parameters and evaluate the quality of control.
Social competences
Student is ready for:
K1A_K02 recognizing the importance of knowledge in solving cognitive and practical problems and consulting experts in the event of difficulties in solving the problem on their own.

Assessment methods and assessment criteria:

The credit points are awarded if a student meets the credit conditions for the exercise and laboratory classes.

Exercise classes
1. To get credit students write partial tests, lasting approximately 20 –30 minutes each,
2. The tests grading scale is: 0 – 5 points.
3. Results of all tests are taken into account to award the credit for the exercise classes.

Laboratory
1. The laboratory program includes five computer exercises performed in Matlab-Simulink environment.
2. During the laboratory, students work in groups.
3. Students are required to complete the program of each exercise and submit a report.
4. The time to prepare the report is one week from the date of the exercise.
5. In the report, students present models of the tested control systems, simulation results, the necessary calculations, as well as comments and conclusions.
6. Each report must be evaluated positively (the grade - min. 2.5 points in (0-5) scale). If the report is not accepted, it must be corrected in accordance with the tutor's instructions.
7. The final laboratory grade is a mean value of all exercise grades

Information on course edition:

Default type of course examination report:

ZAL

Bibliography:

missing bibliography in English

Details of classes and study groups

lecture (15 hours)

Study groups details

Group number 1

Class instructors:

Dr hab. inż. Adam Gałuszka

classes (15 hours)

Study groups details

Group number 1

Class instructors:

Dr hab. inż. Adam Gałuszka

laboratory classes (15 hours)

Study groups details

Group number 1

Class instructors:

Dr hab. inż. Adam Gałuszka
Dr hab. inż. Krzysztof Skrzypczyk

Element of course groups in various terms:

Course group description	First term	Last term
missing group description in English (BioAIS-BF>1(1))	2020/2021-L	

Course credits in various terms:

<without a specific program>

Type of credits	Number	First term	Last term
European Credit Transfer System (ECTS)	4	2020/2021-L	