Subject programme

1. Subject name / subject module: **Selected Methods of Control Systems Design**
2. Lecture language: **English**
3. The location of the subject in study plans:
   - Area or areas of the studies: **Computer Control Systems Engineering**
   - Degree of the studies: **2nd degree studies**
   - Field or fields (implementation of effects standard): **Mechatronics**
4. Supervision of subject implementation:
   - The Institute / Another unit: **Institute of Informatics and Mechatronics**
   - The person responsible for the subject: **Pólkowski Zdzisław, dr inż.**
   - People cooperating in the development of the programme of the subject:
5. The number of hours and forms of teaching for individual study system and the evaluation method:

Mode of study	Teaching activities with the tutor – Form of classes												Total
	...	SOW	ECTS	Laboratory work	SOW	ECTS	...	SOW	ECTS	...	SOW	ECTS	ECTS
Full-time studies				47	53	4							**4**
Part-time studies													
Credit rigor				Graded assigment									

6. Student workload – ECTS credits balance:
   1 ECTS credit corresponds to 25-30 hours of student work needed to achieve the expected learning outcomes including the student's own work

Activity (please specify relevant work for the subject)	**Hourly student workload (full-time studies/part-time studies)**
Participation in lectures	-
Participation in laboratory classes	47
Preparation to laboratory classes	30
Independent study of the subject	11
Preparation to a final test	10
Participation in an exam / graded assignment	2
Total student workload (TSW)	100
ECTS credits	4
* Student's workload related to practical forms	100
Student's workload in classes requiring direct participation of academic teachers	47

7. Implementation notes: recommended duration (semesters), recommended admission requirements, relations between the forms of classes:
   - Recommended admission requirements – none.
   - Recommended duration of the subject is taken from the course plan.
8. Specific learning outcomes – knowledge, skills and social competence:

Specific learning outcomes for the subject		Form	Teaching method	Methods for testing of (checking, assessing) learning outcomes
Outcome symbol	Outcome description			
Knowledge				
K_W02	**K_W02__Student has a structured and theoretically founded knowledge in the field of automation, electronics and electrical engineering, covering key issues and selected issues in the field of advanced detailed knowledge as well as practical application of this knowledge in mechatronics.**	**Laboratory work**	**Inquiry methods**	**Final test, Student learning activities**
K_W05	**K_W05__Student knows and understands to a greater extent selected facts and phenomena, explaining the complex relationships between them, which constitute advanced general knowledge in the field of automation, electronics and electrical engineering, sufficient to formulate and solve complex tasks related to mechatronics.**			
Skills				
K_U02	**K_U02__Student is able to use information and communication technologies (ICT) with particular emphasis on the development of project documentation**	**Laboratory work**	**Inquiry methods**	**Final test, Student learning activities**

	and the use of engineering graphics for the implementation of projects and tasks in the field of mechatronics.			

9. Assessment rules / criteria for each form of education and individual grades:

Activity	Grades	Calculation	To final
Final test	bdb (5)	5*30%	1,5
Attendance	on 75% of all classes	0,75*5 -> 3,5*20%	0,7
Exercise reports	dst, db, bdb, db, bdb (3,4,5,4,5)	arithmetic mean (3,4,5,4,5) * 50%	2,5
Final result			4,70

0 – 3.00	ndst	**4.01 – 4.50**	db
3.01 – 3.50	dst	**4.51 – 4.7**	db+
3.51 – 4.00	dst+	**4.71 – 5.0**	bdb

10. The learning contents with the form of the class activities on which they are carried out:

(Laboratory work)

1. PID control: feedback control; the 3 actions of PID control. structures of PID controllers; digital implementation; D filter design; anti-windup strategies; use of a feedforward action; tunning methods.

2. Introduction to adaptive control: real-time parameter estimation; self-tuning regulators; model-reference adaptive systems.

3. Optimal control systems design: the LQ regulator - continous, discrete; the LQ tracking problem - continous, discrete; the Kalman filter; LQG control system design; LQ H2-optimal control; H inf-optimal contol.

4. Robust control systems parametric robustness analysis; the basic perturbation model; the small gain theorem; stability robustness of feedback systems; structured singular value robustness analysis; combined performance and stability robustness; Internal Model Control.

11. Required teaching aids:

- Lecture - multimedia projector.
- Laboratory classes - specialist laboratory.

12. Literature:

a. Basic literature:

Dorf Richard C., Bishop Robert H., Modern control systems,Pearson Prentice Hall, Upper Saddle River, 2008,

b. Supplementary literature:

Nise Norman S., Control systems engineering, 5th ed., 2008, Hoboken

c. Internet sources:

https://eg4.nic.in/GOVPOLY/DFILES/EBOOKS/IR/ebookControlSystemDesign.pdf

13. Available educational materials divided into forms of class activities (Author's compilation of didactic materials, e-learning materials, etc.)

14. Teachers implementing particular forms of education:

Form of education	Name and surname
1. Lecture	
2. Laboratory classes	Pólkowski Zdzisław, dr inż.
3. Training	
4. Project classes	
5. Workshop classes	
6. Simulation game	
7. Language classes	