Subject programme

1. Subject name / subject module: **Modern Control Theory**
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: **The Institute of Informatics and Mechatronics**
   - The person responsible for the subject: **Ocetkiewicz Tomasz, mgr 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

Teaching activities with the tutor																							Total
Form of classes / Mode of study		SOW	ECTS	Lecture	SOW	ECTS	...	SOW	ECTS	...	SOW	ECTS	...	SOW	ECTS	...	SOW	ECTS	...	SOW	ECTS	...	SOW	ECTS	ECTS
Full-time studies				22	41	2,5																	**2,5**
Part-time studies																							
Credit rigor	...			exam																			

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	**22**
Independent study of the subject	**29**
Preparation to the exam	**10**
Participation in an exam / graded assignment / final grading	**2**
Total student workload	**63**
ECTS credits	**2,5**
* Student's workload related to practical forms	**0**
Student's workload in classes requiring direct participation of academic teachers	**22**

7. Implementation notes: recommended duration (semesters), recommended admission requirements, relations between the forms of classes:

   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	**The student possesses sufficient knowledge of automation, electronics, and electrical engineering, necessary to understand the structure of control system and to apply this knowledge in practice through the use of appropriate methods, tools, and components to design and prototype a control system due to required task parameters.**	**Lecture**	**Expository methods**	**Exam**
K_W05	**The student knows and understands selected facts and phenomena in control systems, is able to explain the complex relationships between them, which constitute the advanced general knowledge in the field of automation, electronics, and electrical engineering, sufficient to prepare a control**			

	algorithm that meets all the design specifications.			
Skills				
K_U03	**The student has sufficient skills to plan and carry out experiments, including computer simulations of control systems, analyze data, and draw conclusions.**	**Lecture**	**Expository methods**	**Exam**
Social competence				
K_K02	**A student is ready to recognize knowledge in solving cognitive and practical problems and to consult experts in case of difficulties with solving the problem concerning control theory on their own.**	**Lecture**	**Expository methods**	**Exam**

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

0% - 60%	ndst	**81% - 90%**	db
61% - 70%	dst	**91% - 93%**	db+
71% - 80%	dst+	**94% - 100%**	bdb

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

(Lecture)

1) Control enginnering – revision: concept of a system; open-loop systems; closed-loop systems; time-omain analysis; design in frequency domain; design in the s-plane; system modelling; mathematical models of mechanical systems; mathematical models of thermal systems; mathematical models of electrical systems; mathematical models of fluid systems. 2) Digital control systems: sampling; the z-transform; stability in the z-plane; digital compensator design. 3) Design in state-space: the concept of state; controlability; observability; state variable feedback design; full-order state observer; reduced-order state obserer; controller examples. 4) Fuzzy logic contol systems: fuzzy set theory; fuzzy set operations; fuzzy relations; fuzzy logic control. 5) Application of neural network control systems to modelling, estimation and control. 6) Application of genetic algorithms to control systems design.

11. Required teaching aids

Lecture - multimedia projector

12. Literature:

a. Basic literature:

1. Stephen J. Dodds; Feedback Control; ISBN 978-1-4471-6675-7; Springer 2015

2. Magdi S. Mahmoud, Yuanqing Xia; Applied Control Systems Design; ISBN 978-1-4471-2879-3; Sprinder 2012

a. Supplementary literature:

1. Alexandru Forrai; Embedded Control System Design; ISBN 978-3-642-28595-0; Springer 2013

2. Tian Seng Ng; Real Time Control Engineering; ISBN 978-981-10-1509-0; Springer 2016

3. Stanko Strmčnik, Đani Juričić; Case Studies in Control; ISBN 978-1-4471-5176-0; Springer 2013

b. Internet sources:

1. Matlab Control System Designer - https://www.mathworks.com/help/control/ug/getting-started-with-the-control-system-designer.html

2. Control Loop Systems and Components - https://www.montalvo.com/article-library/control-loop-systems-explained/

3. Introduction to Control Systems - https://www.scilab.org/tutorials

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	Ocetkiewicz Tomasz, mgr inż.