Subject programme

1. Subject name / subject module: **Modeling and simulation**
1. Lecture language: **English**
2. The location of the subject in study plans:
   - Area or areas of the studies: **Computer Engineering and Mechatronics**
   - Degree of the studies: **1st degree studies**
   - Field or fields (implementation of effects standard): **Mechatronics**
3. Supervision of subject implementation:
   - The Institute / Another unit: **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:
4. The number of hours and forms of teaching for individual study system and the evaluation method:

Teaching activities with the tutor																					
Mode of study	Form of classes																				Total
	...	SOW	ECTS	...	SOW	ECTS	Workshop	SOW	ECTS	...	SOW	ECTS	...	SOW	ECTS	...	SOW	ECTS	...	SOW	ECTS	ECTS
Full-time studies							32	43	3												3
Part-time studies																					
Credit rigor							Graded assignment														

5. 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 workshop	32
Preparation to workshops	32
Independent study of the subject	13
Participation in an exam / graded assignment	-
Total student workload (TSW)	75
ECTS credits	3
* Student's workload related to trainings	75
Student's workload in classes requiring direct participation of academic teachers	32

6. 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.
7. 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_W03	**A student possesses sufficient knowledge of mechanical engineering, necessary to model and simulate at an advanced level the complex relationships between components in mechatronic systems, the phenomena occurring there, and to apply this knowledge i**	**Workshop**	**Inquiry methods**	**Student learning activities**
K_W07	**A student possesses sufficient skills to select specific issues in the field of mechanical engineering and knows how to prepare a model of those issues.**			
Skills				
K_U09	**A student possesses sufficient skills to use analytical, simulation, and experimental methods to formulate and solve engineering tasks. A student is able to make decisions in the context of the quality and effectiveness of action and economic realiti**	**Workshop**	**Inquiry methods**	**Student learning activities**

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

0% - 50%	ndst	**80% - 86%**	db
51% - 70%	dst	**87% - 93%**	db+
71% - 79%	dst+	**94% - 100%**	bdb

Activity	Grades	Calculation	To Final
Laboratory tasks	dst, db, bdb, db (3,4,5,4)	arithmetic mean (3,4,5,4)	4,0
Final result			4,0
Grade		4,0/5 = 80%	**db (4,0)**

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

(Workshop)

Introduction to subject. The idea of modeling. The concept of model. Classification of models. Simulation of natural systems. The steps in modeling systems. Cybernetic model and its modifications. Physical model. Examples of physical models of selected systems. Mathematical model. The general form of a mathematical model. Classification of mathematical models. Examples of mathematical models of selected systems. Simulation model. The process of constructing the simulation model. Introduction to modeling your storage systems (Queue theory). Staging processes. The mathematical model of birth and death. The model solution. Markowski's models of mass support. The application of queue theory. In computer systems performance studies. M/M/1 and M/M/c Loss Models. M/M/1/L type maintenance system model with waiting (queue). M/M/1/N support system model with full-size ticket source. Mass service models with priority queue rules. Comparative analysis of the modeling methods of the systems presented.

10. Required teaching aids:

a. Lecture - multimedia projector.

b. Laboratory classes - specialist laboratory.

c. Exercises - a room adapted for conducting classes in the form of exercises / workshops, multimedia projector.

11. Literature:

a. Basic literature:

1. Hans-Joachim Bungartz, Stefan Zimmer, Martin Buchholz, Dirk Pflüger; Modeling and Simulation; ISBN 978-3-642-39524-6; Springer 2014

2. Mohamed Haddar, Fakher Chaari, Abdelmajid Benamara, Mnaouar Chouchane, Chafik Karra; Design and Modeling of Mechanical Systems—III; ISBN 978-3-319-66697-6; Springer 2018

3. Chapman S.; MATLAB Programming with Applications for Engineers; ISBN 978-0-495-66807-7; Cengage Learning 2013

b. Supplementary literature:

1. Aleksei Tepljakov; Fractional-order Modeling and Control of Dynamic Systems; ISBN 978-3-319-52950-9; Springer 2017

2. Jose Maria Giron-Sierra; Digital Signal Processing with Matlab Examples, Volume 1; ISBN 978-981-10-2534-1; Springer 2017

3. Jose Maria Giron-Sierra; Digital Signal Processing with Matlab Examples, Volume 2; ISBN 978-981-10-2537-2; Springer 2017

c. Internet sources:

1. Ogata Katsuhiko; Matlab for control engineers; ISBN 978-0-13-615077-0; Pearson Prentice Hall 2008

2. Scilab tutorial - www.scilab.org/tutorials

3. Matlab tutorial - www.mathworks.com/support/learn-with-matlab-tutorials.html

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

13. Teachers implementing particular forms of education:

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