Subject programme

1. Subject name / subject module: **Digital Signal Processing**
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: **Grad Piotr, 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

Teaching activities with the tutor																							Total
Form of classes / Mode of study		SOW	ECTS	Laboratory work	SOW	ECTS	...	SOW	ECTS	...	SOW	ECTS	...	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 laboratory classes	**47**
Independent study of the subject	**51**
Participation in an exam / graded assignment / final grading	**2**
Total student workload	**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:

   Data Aquisition with Matlab

   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 principles of signal acquisition and conversion and to apply this knowledge in practice through the use of appropriate algorithms, tools, and methods.**	**Laboratory work**	**Inquiry methods**	**Student learning activities**
K_W05	**The student knows and understands selected facts and phenomena in a signal processing system and is able to explain the complex relationships between signal parameters.**			
Skills				

K_U03	The student has sufficient skills to plan and carry out experiments, including data acquisition, signal conditioning, and digital signal processing for smart sensors and systems, analyze data, and draw conclusions.	Laboratory work	Inquiry methods	Student learning activities

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

Activity	Grades	Calculation	To Final
Laboratory tasks	**Example: db; bdb; bdb; db (4; 5; 5; 4)**	**4 * 12.5% + 5 * 12.5% + 5 * 12.5% + 4 * 12.5% = 2.25**	**2.25**

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

(Laboratory work)

Introduction: complex numbers; the z-transform; sampling theorem; statistics,probability noise; ADC and DAC; convolution; properites of convolution; random signals. Matlab for digital signal processing: functions and variables; plotting data; multidimensional arrays; bitwise operators; vectorizing code; signal processing toolbox. Frequency analysis of signals: Fourier series; the Discrete Fourier Transform; application of the DFT; Fourier Transform properties; the Fast Fourier Transform; aliasing; buffering and windowing. Digital filters: filter basics; FIR and IIR filters; MA filters; windodow-sync filters; recursive filters; chebyshev filters; filters comparision.

11. Required teaching aids

Laboratory classes - specialist laboratory

12. Literature:

a. Basic literature:

1. Orhan Gazi; Understanding Digital Signal Processing; ISBN 978-981-10-4962-0; Springer 2018

2. Marcel J.M. Pelgrom; Analog-to-Digital Conversion; ISNB 978-1-4614-1371-4; Springer 2017

a. Supplementary literature:

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

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

4. Krzysztof Sozański; Digital Signal Processing in Power Electronics Control Circuits; ISBN 978-1-4471-7332-8; Springer 2017

b. Internet sources:

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

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

3. TI Principlesof DataAcquisitionand Conversion - https://www.ti.com/lit/an/sbaa051a/sbaa051a.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. Laboratory classes	Grad Piotr, dr inż.