1. Subject name / subject module: **Measurement systems**
2. Lecture language: **English**
3. **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**
4. Supervision of subject implementation:
   - The Institute / Another unit: **Institute of Informatics and Mechatronics**
   - The person responsible for the subject: **Szychta Leszek, prof. dr hab. 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																						
Mode of study	Form of classes																					Total
		SOW	ECTS	Laboratory work	SOW	ECTS	...	SOW	ECTS	...	SOW	ECTS	...	SOW	ECTS	...	SOW	ECTS	...	SOW	ECTS	ECTS
Full-time studies				38	50	3,5																**3,5**
Part-time studies																						
Credit rigor	...			Graded assignment																		

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	**38**
Preparing homeworks	**30**
Preparing reports	**18**
Participation in an exam / graded assignment / final grading	**2**
Total student workload (TSW)	**88**
ECTS credits	**3,5**
* Student's workload related to practical forms	**88**
Student's workload in classes requiring direct participation of academic teachers	**38**

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

   Circuit theory

   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_W01	**Student knows and understands at an advanced level the methods and theories explaining the complex dependencies in the measurement systems to formulate and solve tasks related to mechatronics**	**Laboratory work**	**inquiry methods**	**Laboratory tasks, reports with an emphasis on drawing conclusions.**
K_W05	**Student has basic knowledge of automation, electronics and electrical engineering, necessary to understand measurement systems of mechatronic systems and to apply this knowledge in practice**			
Skills				
K_U15	**Student is able to assess the suitability and choose the appropriate methods tools and materials to solve a simple measurement systems tasks in the field of Mechatronics.**	**Laboratory work**	**inquiry methods**	**Laboratory tasks, reports with an emphasis on drawing conclusions.**
K_U08	**Student is able to plan and carry out experiments, including measurements and**			

	computer simulations, interpret the obtained results and draw conclusions for measurement systems			

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

0% - 50%	ndst	**81% - 90%**	db
51% - 70%	dst	**91% - 93%**	db+
71% - 80%	dst+	**94% - 100%**	bdb

Activity	**Grades**	**Calculation**	**To Final**
Reports	**bdb(5)**	**5*50%**	**2,5**
Activity during classes	**Example: db, dst, bdb (4, 3, 5)**	**average (4+3+5)/3=4 4*20%=0,8**	**0,8**
Homeworks	**Example: ndst, db, dst (2, 4, 3)**	**average (2+4+3)/3=3 3*20%=0,6**	**0,6**
Attendance	**on 80% classes**	**0,8*5=4 -> 4*10%=0,4**	**0,4**
Final result			**4,3**

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

(Laboratory work)

1. Basic metrology - size and measurement, units, basic concepts;

2. Measurement systems - accuracy, error and measurement uncertainty;

3. Propagation of measurement uncertainty;

4. Measurement methods - classification and description;

5. Acquire and process signals. Measurement of electrical and mechanical size;

6. Co-ordinates metrology - selection of measuring instruments;

7. Optical measurement of geometrical quantities;

8. Monitoring the accuracy of measuring instruments;

11. Required teaching aids

Laboratory classes - specialist laboratory

12. Literature:

a. Basic literature:

1. Lu Guojun, Multimedia database management systems, Artech House, INC, 1999

2. Allan Morris, Measurement and Instrumentation Principles, BH, 2001

a. Supplementary literature:

John P. Bentley, Principles of Measurement Systems, Pearson Prentice Hall, 2005

b. Internet sources:

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	Szychta Leszek, prof. dr hab. inż.