Subject programme

1. Subject name / subject module: **Embedded 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 Elżbieta, 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				32	43	3																3
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 lectures	-
Participation in laboratory classes	32
Preparation to laboratory classes	15
Preparation of homeworks	10
Independent study of the subject	6
Preparation of final project	10
Participation in an exam / graded assignment	2
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

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_W05	**The student has basic knowledge of electronics and electrical engineering, necessary to understand at an advanced level the complex dependencies of embedded systems and to apply this knowledge in practice through the use of appropriate methods, too**	**Laboratory work**	**Inquiry methods**	**Student learning activities**
K_W08	**The student knows and understands selected specific issues in the field of electronics and electrical engineering related to: embedded systems design and practical applications of this knowledge.**			
Skills				
K_U02	**The student can use his knowledge - formulate and solve problems and perform tasks typical for professional activities in the area of embedded systems.**	**Laboratory work**	**Inquiry methods**	**Student learning activities**
K_U14	**The student is able to see problems, imperfections in functioning or newly designed embedded systems, identify the problem and formulate a specification of simple solutions for perceived simple engineering problems.**			

K_U16	K_U16__The student is able to apply appropriate methods, techniques and tools - in accordance with the given specification - to design and implement a simple device, facility, system or process, typical for embedded systems.			

9. 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
Lab reports	dst, db, bdb (3,5,4)	arithmetic mean (5,3,4) * 50%	2
Attendance	on 80% of all classes	80% * 5 -> 4 * 10%	0,4
Final project	bdb (5)	5 * 30%	1,5
Homeworks	dst, db, bdb (3,5,4)	arithmetic mean (5,3,4) * 10%	0,4
Final result			4,3
Grade		4,3/5 = 86%	**Db (4.0)**

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

(Laboratory work)

1. Introduction to Embedded Systems;
2. Introduction to mbed and CooCox Platforms;
3. The ARM Cortex – M Processor Architecture;
4. ARM Cortex-M Programming;
5. Digital Outputs;
6. Digital Inputs;
7. Analog Inputs;
8. Timers. Input Capture. Output Compare. PWM;
9. Interrupts. Low Power Features;
10. Serial Communication;
11. Intefaces: CAN, HART, ModBus;
12. External Memories;
13. RTOS – Real Time Operating System

11. Required teaching aids:

Lecture - multimedia projector

Laboratory classes - specialist laboratory

12. Literature:

a. Basic literature:

1. Marwedel Peter:"Embedded system design : embedded systems foundations of cyber-physical systems and the internet of things" Springer, 2018

2. Li Qing, Yao Caroline: "Real-time concepts for embedded systems" 2003

b. Supplementary literature:

1. Evans Brian: Beginning Arduino Programming, Springer, 2012

2. Monk S.: Programming Arduino, Getting Started with Sketches 2012

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	Szychta Elżbieta, prof. dr hab. inż. Ocetkiewicz Tomasz, mgr inż.
3. Training	
4. Project classes	
5. Workshop classes	
6. Simulation game	
7. Language classes	