Subject programme

1. Subject name / subject module: **Energy Harvesting**
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				33	42	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	33
Preparation to laboratory classes	16
Preparation of homeworks	10
Independent study of the subject	16
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	33

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 in the field of automation, electronics and electrical engineering, necessary to understand at an advanced level the complex dependencies of energy harvesting systems and to apply this knowledge in practice through t**	**Laboratory work**	**Inquiry methods**	**Student learning activities**
Skills				
K_U08	**The student is able to plan and carry out experiments, including measurements and computer simulations, interpret the obtained results and draw conclusions - with particular emphasis on modern IT tools such as LabView or Matlab, typical for an engineer**	**Laboratory work**	**Inquiry methods**	**Student learning activities**

Subject programme

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(3,4,5)	arithmetic mean (5,3,4)* 50%	2
Activity druing classes	dst, db, bdb(3,4,5)	arithmetic mean (5,3,4)* 20%	0,8
Homeworks	dst, db, bdb(3,4,)	arithmetic mean (5,3,4) * 20%	0,8
Attendance	on 80% of all classes	80% * 5 -> 4 * 10%	0,4
Final result			4,0
Grade		4,0/5 = 80%	**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 energy harvesting: Power supply system for electronic devices, Energy vs power, Piezoelectric transducers., Thermo generators.

2. Solar cells, Fuel cells, Power management,

3. Energy storage: Battery basics, Battery chemistries, Battery specifications, Battery charging, Battery selection for application requirements., Ultracapacitors, Numerical simulation of an electrical energy storage system;

4. Application examples: Power sources for wireless sensor networks, Energy harvesting for ID tags, Battery-free wireless light switch, Energy harvesting for medical applications, Smart clothes.

11. 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.

12. Literature:

a. Basic literature:

1. Shashank PriyaDaniel J. Inman: "Energy Harvesting Technologies" Springer

2. Halil Berberoglu: "Photobiological Solar Energy Harvest" Submitted: February 11th 2011, Reviewed: September 13th 2011, Published: February 15th 2012

b. Supplementary literature:

1. Digital Transformation Monitor „Energy harvesting to power the rise ofthe Internet of Things" European Comission July 2017

2. Sorensen B.: Renewable energy conversion, transmission and storage. Elsevier, USA, 2007.

c. Internet sources:
https://www.nipslab.org/files/Wisepower_SummerSchool_MicroEnergy2017_building.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. Lecture	
2. Laboratory classes	Szychta Elżbieta, prof. dr hab. inż.
3. Training	
4. Project classes	
5. Workshop classes	
6. Simulation game	
7. Language classes	