Subject programme

1. Subject name / subject module: **Modern Power Supply Systems**
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				45	55	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 work-load (full-time stud-ies/part-time studies)**
Participation in laboratory classes	**45**
Preparation to the laboratory classes	**20**
Independent study of the subject	**33**
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	**45**

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

   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_W02	**A student possesses sufficient knowledge of automation, electronics, and electrical engineering, necessary to understand the principles of operation of highly efficient power supplies and is able to apply this knowledge in practice through the use of appropriate design methods and simulation tools.**	**Laboratory work**	**Inquiry methods**	**Student learning activities**
K_W05	**A student knows and understands selected facts and phenomena in power electronics, is able to explain the complex relationships between them, which constitute the advanced general knowledge in the field of automation, electronics, and electrical engineering, sufficient to design, prototype, implement a highly efficient power supply.**			
Skills				

K_U02	A student is able to use information and communication technologies (ICT) to create documentation either of a power supply device or a power supply system.	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)

Systems:
Introduction to power semiconductors:
using thyristors and triacs;
thyristor and triac applications;
power MOSFETs;
high voltage bipolar transistors;
IGBTs.

Linear regulators:
power dissipation in linear regulators;
the low dropout regulator; packaging and thermal management;
PCB layout.

Switched mode power supplies:
using power semiconductors in switched mode topologies;
output rectification;
magnetics design;
resonant power supplies.

Design examples: buck converter;
boost converter;
SEPIC converter;
Cuk converter;
Zeta converter;
flyback converters;
forward converters;
half-bridge converter;
full-bridge converter.

Energy harvesting.
Rechargeable batteries in power supply systems.

11. Required teaching aids

Laboratory classes - specialist laboratory

12. Literature:

a. Basic literature:

1. Scherz P., Monk S.; Practical electronics for inventors; ISBN 978-1-25-958754-2; McGraw - Hill Education 2016

2. Branko L. Dokić, Branko Blanuša; Power Electronics Converters and Regulators; Springer 2015

a. Supplementary literature:

1. Van Breussegem T., Steyaert M.; CMOS Integrated Capacitive DC-DC Converters; ISBN 978-1-4614-4280-6; Springer 2013

2. Wen-Wei Chen, Jiann-Fuh Chen; Control Techniques for Power Converters with Integrated Circuit; ISBN 978-981-10-7004-4; Springer 2018

3. Carbone P., Sayfe Kiaei, Fang Xu; Design, Modeling and Testing of Data Converters; ISBN 978-3-642-39655-7; Springer 2014

b. Internet sources:

1. Texas Instruments; DC/DC switching regulators – Technical documents; https://www.ti.com/power-management/non-isolated-dc-dc-switching-regulators/technical-documents.html

2. Philips Semiconductors; Switched Mode Power Supplies; https://eclass.duth.gr/modules/document/file.php/TMA495/PHILIPS%20APPLICATIONS/PHILIPS%20SemiCond%20HB.pdf

3. Microchip; Switch Mode Power Supply (SMPS) Topologies; http://ww1.microchip.com/downloads/en/appnotes/01114a.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.