

FACULTY OF ELECTRICAL
ENGINEERING**SUBJECT CARD**

Name in Polish: **Energoelektronika 1**
 Name in English: **Power electronics 1**
 Main field of study (if applicable): **Electrical Engineering**
 Specialization (if applicable):
 Level and form of studies: **1st level, full-time**
 Kind of subject: **obligatory**
 Subject code: **ELR052303**
 Group of courses: **NO**

| | Lecture | Classes | Laboratory | Project | Seminar |
|--|----------------------|---------|------------|---------|---------|
| Number of hours of organized classes in University (ZZU): | 30 | | | | |
| Number of hours of total student workload (CNPS): | 60 | | | | |
| Form of crediting: | crediting with grade | | | | |
| For group of courses mark (X) final course: | | | | | |
| Number of ECTS points: | 2 | | | | |
| including number of ECTS points for practical (P) classes : | | | | | |
| including number of ECTS points for direct teacher-student contact (BK) classes: | 1.40 | | | | |

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of the behavior of the basic elements of electrical circuits with various types of current and voltage stimulus
2. Knows the trigonometry functions, exponential, logarithmic, indefinite integrals functions of one variable, Fourier series, which are necessary to understand and describe the phenomena in power electronic circuits
3. Able to correctly apply the knowledge of calculus to analyze natural phenomena
4. Able to effectively use the acquired knowledge for the analysis of physical phenomena

SUBJECT OBJECTIVES

- C1. Familiarize students with the basic knowledge needed to understand the physical phenomena associated with nonlinear circuits
- C2. Familiarize students with the methods of energy conversion using power semiconductor devices
- C3. Familiarize students with the basic topology and characteristics of power electronic systems
- C4. Student awareness of the positives and negatives arising from the practical application of power electronics systems

SUBJECT LEARNING OUTCOMES*relating to knowledge:*

PEU_W01 It has a basic knowledge of electronics systems

PEU_W02 Basic knowledge of the impact for nonlinear circuits on the power AC network

*relating to skills:**relating to social competences:*

PEU_K01 Is aware about the importance and non-technical aspects of an control engineer activities

| PROGRAMME CONTENT | | |
|---------------------------|--|------------------|
| Form of classes - lecture | | Number of hours: |
| Lec 1 | Basic knowledge, introduction to the lecture, the program, requirements, credit. The types of power semiconductor devices (PPM). | 2 |
| Lec 2 | Static and dynamic parameters. PPM basic characteristics. General Power Semiconductor Switch Requirements. | 2 |
| Lec 3 | Parallel operation of thyristors and diodes. Semiconductor power devices - short circuits, overcurrent and overvoltage protections. | 2 |
| Lec 4 | 1-pulse controlled rectifier under R, RL load. Discussion of the phenomena. Energy oscillation. Free-wheel diode. 1-pulse inverter. | 2 |
| Lec 5 | 2- and 3-pulse controlled rectifiers. Switch Requirements. | 2 |
| Lec 6 | 6- and 12- pulse controlled rectifier. | 2 |
| Lec 7 | Transformer for static convertors. The transformation of distorted waveforms, typical kVA rating of converter- and system-side winding power transformer. Guidelines for selection. Typical electrical quantity in the environment of distorted waveforms. | 2 |
| Lec 8 | 1 - and 3-phase AC regulators. Basic systems. Regulators with typical load. Advantages and disadvantages of contactless AC regulators. | 2 |
| Lec 9 | Voltage-fed and current-fed inverters. The McMurray inverter. Series-Resonant inverters. Comparison of inverter techniques. | 2 |
| Lec 10 | Pulse Width Modulation. PWM inverter. Sinusoidal pulse-width-modulation. Methods of forming voltage curve. Generation of PWM Signals. Harmonics reducing. | 2 |
| Lec 11 | D.C. switching regulators. Step- down and step-up regulators. Buck-boost converters. | 2 |
| Lec 12 | Direct frequency converters. Cycloconverters. Basic systems. Advantages and disadvantages of direct frequency conversion. Direct multiplier frequencies convertor. | 2 |
| Lec 13 | Negative effects of the line commutated converters (LCC). Energy quality. Input power factor and harmonics. | 2 |
| Lec 14 | Active (APF) and passive (PPF) harmonic filters. Practical principles of selecting power electronic systems. | 2 |
| Lec 15 | Final test | 2 |
| Total hours: | | 30 |

| TEACHING TOOLS USED |
|------------------------------|
| N1. Lecture. |
| N2. Multimedia presentation. |

| EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT | | |
|---|-------------------------------|--|
| Evaluation <i>F - forming (during semester)</i> <i>P - concluding (at semester end)</i> | Educational effect number | Way of evaluating educational effect achievement |
| F1(w) | PEU_W01 PEU_W02 PEU_K01 | Final test |
| P(w) | P=F1 | |

| PRIMARY AND SECONDARY LITERATURE |
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| PRIMARY LITERATURE: [1] Tunia H., Winiarski B.: Podstawy energoelektroniki, WNT, Warszawa 1987; [2] Barlik R., Nowak M.: Technika tyrystorowa, WNT Warszawa 1997; [3] Borecki J., Stosur. M, Szkółka S.: Energoelektronika. Podstawy i wybrane zastosowania, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2008; [4] Piróg S.: Energoelektronika – negatywne oddziaływania układów energoelektronicznych na źródła energii i wybrane sposoby ich ograniczania, AGH Uczelniane Wydawnictwa Naukowo-Dydaktyczne, Kraków 1998; SECONDARY LITERATURE: [1] Piróg S.: Układy o komutacji sieciowej i o komutacji twardej, AGH Uczelniane Wydawnictwa Naukowo-Dydaktyczne, Kraków 2006; [2] Barlik R., Nowak M.: Poradnik inżyniera energoelektronika Tom 1 i 2, Wydawnictwo Naukowe PWN (WNT), Warszawa 2019; |

| SUBJECT SUPERVISOR |
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