

FACULTY OF ELECTRICAL  
ENGINEERING**SUBJECT CARD**

Name in Polish: **Przekształtniki energoelektroniczne w układach zasilania i sterowania 1**  
 Name in English: **Power converters in supply and control system 1**  
 Main field of study (if applicable): **Electrical Engineering**  
 Specialization (if applicable): **Industrial Electrical Engineering**  
 Level and form of studies: **2nd level, full-time**  
 Kind of subject: **obligatory**  
 Subject code: **ELR043211**  
 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):                                | 90          |         |            |         |         |
| Form of crediting:   | examination |         |            |         |         |
| For group of courses mark (X) final course:                                      |             |         |            |         |         |
| Number of ECTS points:   | 3           |         |            |         |         |
| including number of ECTS points for practical (P) classes:                       |             |         |            |         |         |
| including number of ECTS points for direct teacher-student contact (BK) classes: | 2.10        |         |            |         |         |

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. It has a basic knowledge of the principles of semiconductor devices and power electronic systems.
2. He knows the basic methods of mathematical description of power converter systems and their control systems.
3. Understands and is able to describe the basic physical processes occurring during the conversion of electrical energy by means of static converters.
4. Is able to be used to analyze the mathematical apparatus steady-state and transient in linear and nonlinear electric circuits which contain passive and active element.
5. He can effectively apply the knowledge in the field of automation for analysis of system operation control of power converters.
6. He understands the need for continuing education and professional skills developments.
7. It has a sense of responsibility for their own work.

**SUBJECT OBJECTIVES**

- C1. Acquaint the student with the topology power converters used in electrical equipment.  
 C2. To acquaint the student with the complex mathematical models of static converters used in supply systems.  
 C3. Acquisition of practical knowledge necessary for the construction of measuring systems used to study the characteristics of the converters.

**SUBJECT EDUCATIONAL EFFECTS***relating to knowledge:*

- PEK\_W01 It has a basic knowledge of the principles of operation of power converter in power supply systems AC and DC.  
 PEK\_W02 He understands the physical principles of electrical energy conversion in complex systems consisting of: the supply network, power converters and load of converters.  
 PEK\_W03 It has knowledge of the principles of magnetic components used in static converters.

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

- PEK\_K01 He understands the need for learning and improvement of qualifications.

| PROGRAMME CONTENT         |   |                  |
|---------------------------|---|------------------|
| Form of classes - lecture |   | Number of hours: |
| Lec 1                     | An Introduction. Basic supply DC and AC.  | 2                |
| Lec 2                     | Power Supply DC. Linear voltage regulator.  | 2                |
| Lec 3                     | Switching power supply DC - DC converters with pulse width modulation. Step-down and Step-up converters.                                | 2                |
| Lec 4                     | Switching regulators. Single-ended isolated flyback regulators. Single-ended isolated forward regulators.                               | 2                |
| Lec 5                     | Comparison of power switching supplies.   | 2                |
| Lec 6                     | AC supply converters. Basic topologies.   | 2                |
| Lec 7                     | AC converters with pulse width modulated.   | 2                |
| Lec 8                     | Power supplies input circuits: rectifiers, filters the input. Basis of design and choice of components for converters.                  | 2                |
| Lec 9                     | The magnetic elements switching power supplies. Filters and Reactors for inverters, transformers for pulse converters.                  | 2                |
| Lec 10                    | Resonant converters and quasi-resonant used in power systems. Basic topologies.   | 2                |
| Lec 11                    | Power factor correction circuits for rectifier.   | 2                |
| Lec 12                    | Automatic control of output signals of converters. Basic method of synthesis of closed control systems output parameters of converters. | 2                |
| Lec 13                    | EMI effects of power converters. Basic methods of reducing interference.  | 2                |
| Lec 14                    | The main fields of applications of power supplies.  | 2                |
| Lec 15                    | Mathematical modeling of converters.  | 2                |
| Total hours:              |   | <b>30</b>        |

| TEACHING TOOLS USED   |
|---|
| N1. Lecture using audio-visual presentation.<br>N2. Individual work, self-study.<br>N3. Consultation. |

| EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT                                   |  |  |
|---|--|--|
| Evaluation<br><i>F - forming (during semester)<br/>P - concluding (at semester end)</i> | Educational effect number                | Way of evaluating educational effect achievement |
| F1(w)   | PEK_W01<br>PEK_W02<br>PEK_W03<br>PEK_K01 | Written exam.                                    |
| F2(w)   | PEK_W01<br>PEK_W02<br>PEK_W03<br>PEK_K01 | Oral exam  |
| P(w)  | $P=0,4 \cdot F1 + 0,6 \cdot F2$          |  |

| PRIMARY AND SECONDARY LITERATURE   |
|--|
| <b>PRIMARY LITERATURE:</b><br>[1] Kaźmierkowski M.P., Matysik J.T.: Wprowadzenie do elektroniki i energoelektroniki. WPW., Warszawa 2005.<br>[2] O. Ferenczi: Zasilanie układów elektronicznych. Zasilacze impulsowe, WNT, Warszawa 1989<br>[3] Zasilanie układów elektronicznych: Zasilacze ze stabilizatorami o pracy ciągłej. Przetwornice DC-DC., WNT, Warszawa 1988.<br>[4] Borkowski A.: Zasilanie urządzeń elektronicznych, Warszawa, WKiŁ, 1990<br>[5] Muhammad Raschid.: Power Electronics Handbook, Third Edition, Butterworth-Heinemann, 2011.  |
| <b>SECONDARY LITERATURE:</b><br>[1] Barlik R., Nowak M.: Poradnik inżyniera energoelektronika. WNT, Warszawa 2013.<br>[2] Strzelecki R., Supronowicz H.: Współczynnik mocy w systemach zasilania prądu przemiennego i metody jego poprawy. Oficyna Wydawnicza Politechniki Warszawskiej. Warszawa 2000.<br>[3] Mikołajuk K.: Podstawy analizy obwodów energoelektronicznych. Warszawa, PWN 1998.<br>[4] Branko L. Dokic: Power Electronics: Converters and Regulators, Springer, 2015.<br>[5] Adrian Ioinovici: Power Electronics and Energy Conversion Systems: Fundamentals and Hard-switching Converters, Volume 1, Wiley 2013. |

| SUBJECT SUPERVISOR                            |
|---|
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT  
**ELR043211 - Power converters in supply and control system 1**  
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Electrical Engineering**  
AND SPECIALIZATION **Industrial Electrical Engineering**

| Subject educational effect | Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable) | Subject objectives       | Programme content  | Teaching tool number |
|----------------------------|---|--------------------------|--|----------------------|
| PEK_W01                    | S2ETP_W02   | C.1<br>C.2<br>C.3<br>C.4 | Lec1<br>Lec2<br>Lec3<br>Lec4<br>Lec5<br>Lec6<br>Lec7<br>Lec8<br>Lec9<br>Lec10<br>Lec11<br>Lec12<br>Lec13<br>Lec14<br>Lec15 | N.1<br>N.2<br>N.3    |
| PEK_W02                    | S2ETP_W02   | C.1<br>C.3<br>C.4        | Lec1<br>Lec2<br>Lec3<br>Lec4<br>Lec5<br>Lec6<br>Lec7<br>Lec8<br>Lec9<br>Lec10<br>Lec11<br>Lec12<br>Lec13<br>Lec14<br>Lec15 | N.1<br>N.2<br>N.3    |
| PEK_W03                    | S2ETP_W02   | C.1<br>C.2<br>C.3<br>C.4 | Lec5<br>Lec8<br>Lec9<br>Lec13<br>Lec15   | N.1<br>N.2           |
| PEK_K01                    | K2ETK_K01   | C.1<br>C.2<br>C.3<br>C.4 | Lec1<br>Lec2<br>Lec3<br>Lec4<br>Lec5<br>Lec6<br>Lec7<br>Lec8<br>Lec9<br>Lec10<br>Lec11<br>Lec12<br>Lec13<br>Lec14<br>Lec15 | N.1<br>N.2<br>N.3    |