



## Subject card

|   |   |  |   |                                     |                   |            |     |
|---|---|--|---|-------------------------------------|-------------------|------------|-----|
| Subject name and code                       | Modeling of converter electric drive systems, PG_00054496   |  |   |                                     |                   |            |     |
| Field of study                              | Electrical Engineering  |  |   |                                     |                   |            |     |
| Date of commencement of studies             | October 2021  |  | Academic year of realisation of subject |                                     | 2023/2024         |            |     |
| Education level                             | first-cycle studies   |  | Subject group                           |                                     |                   |            |     |
| Mode of study                               | Part-time studies   |  | Mode of delivery                        |                                     | at the university |            |     |
| Year of study                               | 3   |  | Language of instruction                 |                                     | Polish            |            |     |
| Semester of study                           | 6   |  | ECTS credits                            |                                     | 2.0               |            |     |
| Learning profile                            | general academic profile  |  | Assessment form                         |                                     | assessment        |            |     |
| Conducting unit                             | Department of Controlled Electric Drives -> Faculty of Electrical and Control Engineering   |  |   |                                     |                   |            |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor  |  | prof. dr hab. inż. Marcin Morawiec      |                                     |                   |            |     |
|   | Teachers  |  |   |                                     |                   |            |     |
| Lesson types and methods of instruction     | Lesson type   | Lecture  | Tutorial                                | Laboratory                          | Project           | Seminar    | SUM |
|   | Number of study hours   | 15.0   | 0.0                                     | 15.0                                | 0.0               | 0.0        | 30  |
|   | E-learning hours included: 0.0  |  |   |                                     |                   |            |     |
| Learning activity and number of study hours | Learning activity   | Participation in didactic classes included in study plan |   | Participation in consultation hours |                   | Self-study | SUM |
|   | Number of study hours   | 30   |   | 5.0                                 |                   | 15.0       | 50  |
| Subject objectives                          | The aim of the course is to introduce the modeling of basic converter systems supplying electric machines, renewable energy sources and cooperating with smart grids. |  |   |                                     |                   |            |     |

|                                 |  |   |   |
|---------------------------------|--|---|---|
| Learning outcomes               | Course outcome   | Subject outcome   | Method of verification  |
|                                 | K6_U05   | The student is able to comply with the rules of occupational health and safety  | [SU5] Assessment of ability to present the results of task<br>[SU2] Assessment of ability to analyse information<br>[SU1] Assessment of task fulfilment |
|                                 | K6_W11   | knows the principles of designing electrical installations and electric lighting, controlling electrical devices                                      | [SW2] Assessment of knowledge contained in presentation<br>[SW3] Assessment of knowledge contained in written work and projects                         |
|                                 | K6_W10   | knows the basics of processing, use and rational use of electricity, including the principles of electric traction                                    | [SW2] Assessment of knowledge contained in presentation<br>[SW1] Assessment of factual knowledge  |
|                                 | K6_K01   | The student knows the need for self-education.  | [SK4] Assessment of communication skills, including language correctness<br>[SK5] Assessment of ability to solve problems that arise in practice        |
|                                 | K6_K05   | The student knows the health and safety rules for the use of electrical devices   | [SK5] Assessment of ability to solve problems that arise in practice<br>[SK3] Assessment of ability to organize work                                    |
|                                 | K6_U10   | The student knows how to model the power electronics system.  | [SU4] Assessment of ability to use methods and tools<br>[SU1] Assessment of task fulfilment   |
|                                 | K6_U09   | The student is able to choose the electrical equipment for long-term load   | [SU2] Assessment of ability to analyse information<br>[SU4] Assessment of ability to use methods and tools<br>[SU1] Assessment of task fulfilment       |
|                                 | K6_W09   | The student knows the methods of management and transmission of electricity   | [SW1] Assessment of factual knowledge<br>[SW2] Assessment of knowledge contained in presentation  |
| Subject contents                | Transformation of multiphase systems into orthogonal systems. Spatial vector. Methods of generating the output voltage of a voltage inverter. Voltage inverter output current control systems. Structures of field-oriented control systems and direct torque control of an induction motor. Induction motor control according to the constant $U / f$ ratio. High-power drive systems with an induction motor. Double-sided machine regulation systems. Synchronous machine control systems. Permanent magnet motor control systems. Construction of motors with switched reluctance. Switching reluctance motor power systems. Start-stop and synchronous control of stepper motors. Principles of operation of regulators based on fuzzy logic. The use of neural networks and fuzzy logic in controlling drives. Modeling of converter systems: circuit breaker, H bridge, voltage inverter, current inverter. |   |   |
| Prerequisites and co-requisites | Basic of electric drive, electric machines.  |   |   |
| Assessment methods and criteria | Subject passing criteria   | Passing threshold   | Percentage of the final grade   |
|                                 | Laboratory exercises   | 60.0%   | 100.0%  |
| Recommended reading             | Basic literature   | R. Barlik, M. Nowak, Poradnik inżyniera energoelektronika, WNT 2003.<br><br>A. Dębowski, Automatyka. Napęd elektryczny, Wydawnictwo Naukowe PWN 2017. |   |
|                                 | Supplementary literature   | -   |   |
|                                 | eResources addresses   | Adresy na platformie eNauczanie:  |   |

|  |   |
|--|---|
| Example issues/<br>example questions/<br>tasks being completed | 1. Modeling of the DC chopper<br><br>2. Modeling of the H bridge<br><br>3. SVM for voltage and current inverter<br><br>4. Control of an induction motor supplied by a voltage source inverter<br><br>5. Modeling of a converter for photovoltaics system<br><br>6. MPPT algorithm |
| Work placement   | Not applicable  |