



## Subject card

|   |  |  |                 |                                     |  |            |     |
|---|--|--|-----------------|-------------------------------------|--|------------|-----|
| Subject name and code                       | Measurements and Measurement Systems, PG_00042054  |  |                 |                                     |  |            |     |
| Field of study                              | Power Engineering  |  |                 |                                     |  |            |     |
| Date of commencement of studies             | October 2024   | Academic year of realisation of subject                  |                 |                                     | 2025/2026  |            |     |
| Education level                             | first-cycle studies  | Subject group  |                 |                                     | Obligatory subject group in the field of study<br>Subject group related to scientific research in the field of study |            |     |
| Mode of study                               | Full-time studies  | Mode of delivery   |                 |                                     | at the university  |            |     |
| Year of study                               | 2  | Language of instruction                                  |                 |                                     | English  |            |     |
| Semester of study                           | 4  | ECTS credits   |                 |                                     | 5.0  |            |     |
| Learning profile                            | general academic profile   | Assessment form  |                 |                                     | assessment   |            |     |
| Conducting unit                             | Department of Metrology and Information Systems -> Faculty of Electrical and Control Engineering   |  |                 |                                     |  |            |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor   |  |                 |                                     |  |            |     |
|   | Teachers   |  |                 |                                     |  |            |     |
| Lesson types and methods of instruction     | Lesson type  | Lecture  | Tutorial        | Laboratory                          | Project  | Seminar    | SUM |
|   | Number of study hours  | 30.0   | 0.0             | 30.0                                | 0.0  | 0.0        | 60  |
|   | 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  | 60   |                 | 10.0                                |  | 55.0       | 125 |
| Subject objectives                          | Familiarize students with issues related to metrology and measurement systems.   |  |                 |                                     |  |            |     |
| Learning outcomes                           | Course outcome   |  | Subject outcome |                                     | Method of verification   |            |     |
|   | [K6_U02] is able to apply the learned mathematical methods to the analysis and design of elements, systems and energy systems  |  |                 |                                     |  |            |     |
|   | [K6_W05] has structured knowledge in the field of electrical engineering and electronics, necessary to understand the basics of operation and selection of electrical machines, electricity transmission systems and power electronic devices  |  |                 |                                     |  |            |     |
| Subject contents                            | <p>LECTURE: Basic concepts of measurement. Measurement methods. The theory of measurement errors and uncertainty. Converters. The structure of measuring instruments. Analog and digital measuring instruments. Ways of extending the measuring ranges. Measurement bridges. Measurements of basic electrical quantities (voltage and current, resistance, inductance, capacity, frequency, phase shift, power and energy in single and three-phase circuits). Measurements of non-electrical quantities by electrical methods. Analog-to-digital converters of mechanical quantities. Electrical temperature measurements. Stress measurement. Measurement and diagnostic systems. Measurement software. Interfaces in measurement systems. Measurement data transmission methods: wired and wireless. Vision and infrared measurement systems. Virtual measuring instruments. The use of virtual instruments in the measurement and design of basic measurement systems.</p> <p>LABORATORY: Calibration of measuring devices. Measurements using an oscilloscope. Measurements of RLC elements parameters. Measurements of frequency and rotational speed. Measurement of earth resistance and short circuit loop impedance. Power measurement in three-phase circuits. Temperature measurement. Computer measuring systems.</p> |  |                 |                                     |  |            |     |
| Prerequisites and co-requisites             |  |  |                 |                                     |  |            |     |

| Assessment methods and criteria                                | Subject passing criteria   | Passing threshold   | Percentage of the final grade |
|--|--|---|-------------------------------|
|  | Entry tests nad reports- lab.  | 60.0%   | 50.0%                         |
|  | 28 / 5000 Wyniki tłumaczenia<br>Written test - lecture.  | 60.0%   | 20.0%                         |
|  | Homework and presentations - lecture.  | 60.0%   | 30.0%                         |
| Recommended reading  | Basic literature   | <p>1. Alan S Morris Reza Langari: Measurement and Instrumentation. Theory and Application. Elsevier, 2012. ISBN: 978-0-12-381960-4.</p> <p>2. Handbook of Measurements: Benchmarks for Systems Accuracy and Precision. CRC Press, 2015. PrintISBN: 978-1-4822-2522-8.</p> <p>3. Raghavendra, N.V.; Krishnamurthy, L.: Engineering Metrology and Measurements. Published by Oxford University Press, 2013. ISBN 9780198085492.</p> |                               |
|  | Supplementary literature   | <p>1. Parचाński J.: Miernictwo elektryczne i elektroniczne, WSiP, Warszawa, Wydanie ósme 2006.</p> <p>2. Chwaleba A., Poniński M., Siedlecki A.: Metrologia elektryczna, WNT, Warszawa 1979, 2003.</p> <p>3. Gawędzki W.: Pomiary elektryczne wielkości nieelektrycznych, Wydawnictwo AGH, Kraków, 2010.</p> <p>4. Czabanowski R.: Sensory i systemy pomiarowe, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław, 2010</p>   |                               |
|  | eResources addresses   | Adresy na platformie eNauczenie:  |                               |
| Example issues/<br>example questions/<br>tasks being completed | <p>1. Causes of errors: systematic, random and coarse. Ways to reduce these errors.</p> <p>2 How to estimate the measurement uncertainty as type A and type B?</p> <p>3. Derive the diagram and the method of balancing the Wheatstone bridge.</p> <p>4. Active and reactive power measurement systems in a three-phase, four-wire system.</p> <p>5. Systems for measuring active and reactive power in a three-phase three-wire system.</p> |   |                               |
| Work placement   | Not applicable   |   |                               |