

## Subject card

|                                             |                                                                       |                                                          |                                         |                                     |                                                |            |     |
|---------------------------------------------|-----------------------------------------------------------------------|----------------------------------------------------------|-----------------------------------------|-------------------------------------|------------------------------------------------|------------|-----|
| Subject name and code                       | Fundamentals of electrical engineering - lecture, PG_00131458         |                                                          |                                         |                                     |                                                |            |     |
| Field of study                              | Marine Hydrography                                                    |                                                          |                                         |                                     |                                                |            |     |
| Date of commencement of studies             | October 2025                                                          |                                                          | Academic year of realisation of subject |                                     | 2025/2026                                      |            |     |
| Education level                             | Bachelor's studies                                                    |                                                          | Subject group                           |                                     | Obligatory subject group in the field of study |            |     |
| Mode of study                               | full-time studies                                                     |                                                          | Mode of delivery                        |                                     | at the university                              |            |     |
| Year of study                               | 1                                                                     |                                                          | Language of instruction                 |                                     | Polish                                         |            |     |
| Semester of study                           | 2                                                                     |                                                          | ECTS credits                            |                                     | 1.0                                            |            |     |
| Learning profile                            | practical                                                             |                                                          | Assessment form                         |                                     |                                                |            |     |
| Conducting unit                             |                                                                       |                                                          |                                         |                                     |                                                |            |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor                                                    |                                                          | dr inż. Piotr Bekier                    |                                     |                                                |            |     |
|                                             | Teachers                                                              |                                                          |                                         |                                     |                                                |            |     |
| Lesson types                                | Lesson type                                                           | Lecture                                                  | Tutorial                                | Laboratory                          | Project                                        | Seminar    | SUM |
|                                             | Number of study hours                                                 | 12.0                                                     | 0.0                                     | 0.0                                 | 0.0                                            | 0.0        | 12  |
|                                             | 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                                                 | 12                                                       |                                         | 1.0                                 |                                                | 12.0       | 25  |
| Subject objectives                          | ransfer of knowledge in the field of basic electrical engineering.    |                                                          |                                         |                                     |                                                |            |     |
|                                             | Mastering the fundamental principles of operating electrical devices. |                                                          |                                         |                                     |                                                |            |     |

| Learning outcomes | Course outcome                                                                                                                                                                                                                                                                                         | Subject outcome                                                                                                                                                                                                                                           | Method of verification            |
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|                   | [HML3-W01] selected facts, phenomena and processes, as well as methods and theories concerning them, explaining the complex relationships between them, constituting basic general knowledge in the field of scientific disciplines forming the theoretical foundations specific to the field of study | Knows:<br><br>fundamental laws and relationships in electrical engineering phenomena related to electrical devices                                                                                                                                        | [SW4] test/exam - oral or written |
|                   | [HML3-W03] directions of development and the latest discoveries in the field of scientific disciplines forming the theoretical basis appropriate to the field of study                                                                                                                                 | Knows:<br><br>basic laws and relationships in electrical engineering methodology for measuring electrical quantities in direct current (DC) and alternating current (AC) systems similarities and differences between various types of electrical devices | [SW4] test/exam - oral or written |
|                   | [HML3-U01] plan and conduct experiments, including computer simulations, interpret the results obtained and draw conclusions                                                                                                                                                                           | Is able to:<br><br>analyze a simple electrical circuit                                                                                                                                                                                                    | [SU4] test/exam - oral or written |
|                   | [HML3-U11] use navigation devices, means of technical observation and communication as well as measuring instruments, as well as apply in practice various techniques of measurement and observation in the field of professional activity related to the field of study                               | Is able to:<br><br>work with electrical devices                                                                                                                                                                                                           | [SU4] test/exam - oral or written |
|                   | [HML3-W12] basic processes taking place in the life cycle of devices, facilities and technical systems                                                                                                                                                                                                 | Knows:<br><br>phenomena related to electrical devices methodology for measuring electrical quantities in direct current (DC) and alternating current (AC) systems similarities and differences between various types of electrical devices                | [SW4] test/exam - oral or written |

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| Subject contents                | <p>Key Concepts in Electric, Magnetic, and Electromagnetic Field Theory</p> <p><b>Electric Field Theory</b></p> <ul style="list-style-type: none"> <li>• <b>Electric Field and Charge:</b> <ul style="list-style-type: none"> <li>• Electric field as a region of space influenced by electric charges.</li> <li>• Definition of <b>electric charge</b> and its role in creating an electric field.</li> </ul> </li> <li>• <b>Field Intensity and Lines of Force:</b> <ul style="list-style-type: none"> <li>• Field intensity as a measure of the force experienced by a charge in an electric field.</li> <li>• <b>Lines of force</b> representing the direction and strength of the field.</li> <li>• <b>Electric flux</b> as the measure of the total electric field passing through a surface.</li> </ul> </li> <li>• <b>Fundamental Laws:</b> <ul style="list-style-type: none"> <li>• <b>Coulombs Law:</b> Describes the force between two point charges.</li> <li>• <b>Gausss Law:</b> Relates the electric flux through a closed surface to the enclosed charge.</li> </ul> </li> </ul> <p><b>Magnetic Field Theory</b></p> <ul style="list-style-type: none"> <li>• <b>Potential and Electric Voltage:</b> <ul style="list-style-type: none"> <li>• Concept of electric potential as work needed to move a charge in an electric field.</li> <li>• Relationship between potential difference (voltage) and the electric field.</li> </ul> </li> <li>• <b>Magnetic Field and Forces:</b> <ul style="list-style-type: none"> <li>• Definition of <b>magnetic field</b> as the space influenced by moving charges or magnets.</li> <li>• <b>Magnetic force</b> acting on charged particles in motion or on a current-carrying conductor.</li> </ul> </li> <li>• <b>Lines of Magnetic Force:</b> <ul style="list-style-type: none"> <li>• Magnetic field lines representing the direction and intensity of the field.</li> <li>• Determination of field direction using the right-hand rule.</li> </ul> </li> <li>• <b>Motion of Charged Particles in Magnetic Fields:</b> <ul style="list-style-type: none"> <li>• Interaction of charged particles with the magnetic field, resulting in circular or spiral trajectories.</li> </ul> </li> </ul> <p><b>Magnetic Field Interaction with Current:</b></p> <ul style="list-style-type: none"> <li>• <b>Amperes Law:</b> <ul style="list-style-type: none"> <li>• Describes the relationship between current flow and the magnetic field generated around a conductor.</li> </ul> </li> <li>• <b>Parallel Current-Carrying Conductors:</b> <ul style="list-style-type: none"> <li>• Magnetic interaction between parallel wires carrying currents.</li> </ul> </li> </ul> <p><b>Electromagnetic Induction</b></p> <ul style="list-style-type: none"> <li>• <b>Faradays Law of Induction:</b> <ul style="list-style-type: none"> <li>• Induced electromotive force (EMF) in a loop due to changes in magnetic flux.</li> </ul> </li> <li>• <b>Self-Inductance:</b> <ul style="list-style-type: none"> <li>• Concept of a circuit generating EMF in response to changes in its own current.</li> </ul> </li> <li>• <b>Gausss Law for Magnetism:</b> <ul style="list-style-type: none"> <li>• No magnetic monopoles exist; magnetic field lines are continuous.</li> </ul> </li> </ul> <p><b>Induced Fields</b></p> <ul style="list-style-type: none"> <li>• <b>Electric Field Induction:</b> <ul style="list-style-type: none"> <li>• Creation of an electric field from a time-varying magnetic field.</li> </ul> </li> <li>• <b>Magnetic Field Induction:</b> <ul style="list-style-type: none"> <li>• Creation of a magnetic field from a time-varying electric field.</li> </ul> </li> </ul> <p><b>Fundamental Electrical Engineering Principles</b></p> <p><b>Electric Current and Its Properties</b></p> <ul style="list-style-type: none"> <li>• <b>Electric Current:</b> <ul style="list-style-type: none"> <li>• Flow of electric charge, measured as current intensity (III).</li> <li>• <b>Current density</b> and the conventional direction of current flow.</li> </ul> </li> <li>• <b>Sources of Electrical Energy:</b> <ul style="list-style-type: none"> <li>• Ideal vs. real energy sources and their characteristics.</li> </ul> </li> </ul> <p><b>Key Laws in Electrical Circuits</b></p> <ul style="list-style-type: none"> <li>• <b>Ohms Law:</b> <ul style="list-style-type: none"> <li>• Relationship between voltage, current, and resistance: <math>U=IR</math> <math>U=I \cdot R</math></li> </ul> </li> <li>• <b>Kirchhoffs Laws:</b> <ul style="list-style-type: none"> <li>• Current Law (KCL): Sum of currents entering a junction equals the sum exiting.</li> <li>• Voltage Law (KVL): Sum of voltage drops around a closed loop equals zero.</li> </ul> </li> </ul> <p><b>DC Circuit Analysis</b></p> <ul style="list-style-type: none"> <li>• <b>Branching Circuits:</b> <ul style="list-style-type: none"> <li>• Understanding and solving complex, branched direct current (DC) circuits.</li> </ul> </li> <li>• <b>Circuit Analysis Methods:</b> <ul style="list-style-type: none"> <li>• <b>Kirchhoffs Laws Equations:</b> Deriving systems of equations based on KCL and KVL.</li> <li>• <b>Circuit Transformation:</b> Simplifying circuits using series-parallel combinations.</li> <li>• <b>Mesh Analysis:</b> Solving circuits by focusing on loop currents.</li> <li>• <b>Node Analysis:</b> Focusing on voltages at circuit nodes.</li> <li>• <b>Superposition Theorem:</b> Analyzing circuits with multiple sources by superimposing effects.</li> <li>• <b>Thevenins and Nortons Theorems:</b> Simplifying networks to equivalent single-source models.</li> </ul> </li> </ul> |
| Prerequisites and co-requisites | Knowledge in the fields of algebra, trigonometry of complex numbers, and the fundamentals of electromagnetism.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       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|----------------------------------------------------------------|----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| Assessment methods and criteria                                | Subject passing criteria                                             | Passing threshold                                                                                                                        | Percentage of the final grade |
|                                                                |                                                                      | 61.0%                                                                                                                                    | 100.0%                        |
| Recommended reading                                            | Basic literature                                                     | KURDZIEL R.: Podstawy elektrotechniki. WNT, Warszawa 1973.<br>WYSZKOWSKI S.: Elektrotechnika okrętowa. Wydawnictwo morskie, Gdańsk 1972. |                               |
|                                                                | Supplementary literature                                             | KOSTYSZYN R.: Elektroenergetyka okrętowa. Akademia Morska, Gdynia 2016                                                                   |                               |
|                                                                | eResources addresses                                                 | Adresy na platformie eNauczanie:                                                                                                         |                               |
| Example issues/<br>example questions/<br>tasks being completed | Pytania oraz zadania są powiązane bezpośrednio z treścią przedmiotu. |                                                                                                                                          |                               |
| Work placement                                                 | Not applicable                                                       |                                                                                                                                          |                               |

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