

**Subject card**

|  |   |   |                            |  |  |                   |            |
|--|---|---|----------------------------|--|--|-------------------|------------|
| <b>Subject name and code</b>                       | Electromagnetism , PG_00204537  |   |                            |  |  |                   |            |
| <b>Field of study</b>                              | Nuclear safety and radiological protection  |   |                            |  |  |                   |            |
| <b>Date of commencement of studies</b>             | October 2026  | <b>Academic year of realisation of subject</b>                  |                            |  | 2026/2027  |                   |            |
| <b>Education level</b>                             | Bachelor's studies  | <b>Subject group</b>  |                            |  | Obligatory subject group in the field of study<br>Subject group related to scientific research in the field of study |                   |            |
| <b>Mode of study</b>                               | full-time studies   | <b>Mode of delivery</b>   |                            |  | at the university  |                   |            |
| <b>Year of study</b>                               | 1   | <b>Language of instruction</b>                                  |                            |  | Polish   |                   |            |
| <b>Semester of study</b>                           | 2   | <b>ECTS credits</b>   |                            |  | 6.0  |                   |            |
| <b>Learning profile</b>                            | academic  | <b>Assessment form</b>  |                            |  | exam   |                   |            |
| <b>Conducting unit</b>                             | Faculty of Mathematics, Physics and Informatics -> Rector   |   |                            |  |  |                   |            |
| <b>Name and surname of lecturer (lecturers)</b>    | <b>Subject supervisor</b>   |   | dr hab. Ryszard Drozdowski |  |  |                   |            |
|  | <b>Teachers</b>   |   |                            |  |  |                   |            |
| <b>Lesson types</b>                                | <b>Lesson type</b>  | Lecture   | Tutorial                   | Laboratory                                 | Project  | Seminar           | SUM        |
|  | <b>Number of study hours</b>  | 45.0  | 45.0                       | 0.0  | 0.0  | 0.0               | 90         |
|  | E-learning hours included: 0.0  |   |                            |  |  |                   |            |
| <b>Learning activity and number of study hours</b> | <b>Learning activity</b>  | <b>Participation in didactic classes included in study plan</b> |                            | <b>Participation in consultation hours</b> |  | <b>Self-study</b> | <b>SUM</b> |
|  | <b>Number of study hours</b>  | 90  |                            | 0.0  |  | 90.0              | 180        |
| <b>Subject objectives</b>                          | Understanding:<br>- the laws of electrostatics<br>- the behavior of free charges in an electromagnetic field<br>- the laws and effects associated with the flow of direct and alternating current<br>- the relationships between magnetic fields and the currents that generate them<br>- the mechanism of electromagnetic wave generation<br>- the principles of operation and use of various types of electrical devices used in metrology, industry, and everyday life<br>- the effects of electromagnetic radiation on biological tissues |   |                            |  |  |                   |            |

| Learning outcomes | Course outcome  | Subject outcome  | Method of verification   |
|-------------------|---|--|--|
|                   | [BJORL3_W05] Has advanced knowledge of the elementary components of matter and the types of fundamental interactions between them, the manifestations of these interactions in phenomena occurring at scales ranging from subatomic to subatomic, knows the time and energy scales associated with these phenomena. | The student knows:<br>- what are the elementary carriers of electricity?<br>- what methods can be used to electrify bodies and how to accumulate electric charges?<br>- what is the mechanism of generating magnetism in matter?<br>- how to generate constant and variable magnetic fields?<br>- how to generate and receive electromagnetic waves?<br>- the effects of electric and magnetic fields on living tissues.   | [SW4] test/exam - oral or written<br>[SW1] oral statement/conversation/discussion<br>[SW3] text preparation/written work |
|                   | [BJORL3_W01] Has a detailed knowledge of the basic concepts and principles of nuclear physics and chemistry, understands their historical development and their importance not only for nuclear safety and radiation protection, but also for understanding the modern world.                                       | Student understand the laws of electrostatics and magnetostatics. He understand the laws of direct and alternating current flow and the importance of electric current for economic development. Furthermore, student understand how electromagnetic waves are generated and the importance of using them for information transfer and medical diagnostics. Students also understand the effects of electromagnetic radiation on biological tissues.   | [SW4] test/exam - oral or written<br>[SW1] oral statement/conversation/discussion<br>[SW3] text preparation/written work |
|                   | [BJORL3_W02] Understands the role of physical and chemical experimentation, mathematical theoretical models approximating reality, and computer simulations in scientific research methodology; is aware of technological, apparatus, and methodological limitations in scientific research.                        | The student knows:<br>- what methods can be used to electrify bodies and how to store electric charges,<br>- how to generate direct and alternating electric current and what are the effects of current flowing through a given material medium,<br>- how to generate direct and alternating magnetic fields and what are the effects of their interaction with matter,<br>- what phenomena can be used to measure the intensity of direct and alternating current,<br>- what are the operating principles of DC and AC ammeters and voltmeters, galvanic cells, transformers, DC and AC generators, and electric motors?<br>- how to generate and receive electromagnetic waves, and how to use them to transmit information?<br>- the effects of electric and magnetic fields on organisms. | [SW4] test/exam - oral or written<br>[SW1] oral statement/conversation/discussion<br>[SW3] text preparation/written work |
|                   | [BJORL3_U01] Can formulate the laws of physics and chemistry using mathematical formalism.  | The student is able to:<br>- apply elements of field theory to describe electromagnetic phenomena<br>- write Maxwell's equations in differential and integral form<br>- present solutions to Maxwell's equations and provide their interpretation.   | [SU1] oral statement/conversation/discussion<br>[SU3] text preparation/written work<br>[SU4] test/exam - oral or written |

|  | Course outcome   | Subject outcome   | Method of verification   |
|--|--|---|--|
|  | [BJORL3_U03] Is able to use the formalism of physics and chemistry to describe phenomena in the microworld.  | The student is able to:<br>- calculate the electric field strength and electric potential of a system of electric charges,<br>- calculate the capacitance of a system of capacitors,<br>- calculate the resistance of a system of resistors and the distribution of currents flowing through them,<br>- calculate the magnetic field strength generated by a system of current-carrying conductors,<br>- calculate the electromotive force generated in conductors moving in a magnetic field,<br>- calculate the electrodynamic force acting on current-carrying conductors in a magnetic field,<br>- write Maxwell's laws and use them to derive the electromagnetic wave equation,<br>- calculate the energy transferred by an electromagnetic wave. | [SU1] oral statement/conversation/discussion<br>[SU3] text preparation/written work<br>[SU4] test/exam - oral or written |
| Subject contents                                       | <ol style="list-style-type: none"> <li>1. Mathematical introduction - elements of vector analysis and field theory</li> <li>2. Electric charge.</li> <li>3. Electric field.</li> <li>4. Magnetic field.</li> <li>5. Electrical and magnetic properties of substances.</li> <li>6. Generation of electric currents.</li> <li>7. DC and AC circuits.</li> <li>8. Maxwell's equations in vacuum and matter.</li> <li>9. Electromagnetic waves</li> <li>10. Elements of electrical engineering</li> <li>11. The effects of electromagnetic radiation on living tissue</li> </ol> |   |  |
| Prerequisites and co-requisites                        | A student who has passed the "Mechanics" subject can attend the classes.   |   |  |
| Assessment methods and criteria                        | Subject passing criteria   | Passing threshold   | Percentage of the final grade  |
|  | not applicable   | 51.0%   | 45.0%  |
|  | not applicable   | 0.0%  | 5.0%   |
|  | not applicable   | 51.0%   | 50.0%  |
| Recommended reading                                    | Basic literature   | D. Halliday, R. Resnick, J. Walker, Podstawy fizyki Tom III, IV Wyd. Nauk. J. Orear, Fizyka, Tom II, Wydawnictwo Naukowo-Techniczne, 1979.<br>A. K. Wróblewski, J. A. Zakrzewski, Wstęp do fizyki tom 2 część 2, PWN<br><br>I. V. Sawieliew, Wykłady z fizyki, PWN, Warszawa 1987;<br><br>E. Koziej, B. Sochoń, Elektrotechnika i elektronika, PWN Warszawa 198<br>A. Hennel, W. Szuszkiewicz, Zadania i problemy z fizyki, PWN, 1993.<br><br>J. Kalisz, M. Massalska, J. M. Massalski, Zbiór zadań z fizyki z rozwiązaniami, Wydawnictwo Naukowo-Techniczne, 1984.<br>W. Barański, M. A. Herman, L. Widomski, Zbiór zadań z fizyki. Elektryczność i magnetyzm, PWN, Warszawa 1987.   |  |
|  | Supplementary literature   | not applicable  |  |
|  | eResources addresses   |   |  |
| Example issues/example questions/tasks being completed | not applicable   |   |  |
| Work placement   | Not applicable   |   |  |

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