



## Subject card

|                                             |                                                                                                                                                                                                                            |                                                          |                                                                                                                                                                                                                                         |                                     |         |                                                                                                                              |     |
|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|---------|------------------------------------------------------------------------------------------------------------------------------|-----|
| Subject name and code                       | PHYSICAL AND CHEMICAL METHODS OF ENERGY GENERATION, PG_00064334                                                                                                                                                            |                                                          |                                                                                                                                                                                                                                         |                                     |         |                                                                                                                              |     |
| Field of study                              | Chemical Technology                                                                                                                                                                                                        |                                                          |                                                                                                                                                                                                                                         |                                     |         |                                                                                                                              |     |
| Date of commencement of studies             | February 2027                                                                                                                                                                                                              |                                                          | Academic year of realisation of subject                                                                                                                                                                                                 |                                     |         | 2026/2027                                                                                                                    |     |
| Education level                             | second-cycle studies                                                                                                                                                                                                       |                                                          | Subject group                                                                                                                                                                                                                           |                                     |         | Optional subject group<br>Specialty subject group<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                               | 1                                                                                                                                                                                                                          |                                                          | Language of instruction                                                                                                                                                                                                                 |                                     |         | Polish                                                                                                                       |     |
| Semester of study                           | 1                                                                                                                                                                                                                          |                                                          | ECTS credits                                                                                                                                                                                                                            |                                     |         | 3.0                                                                                                                          |     |
| Learning profile                            | general academic profile                                                                                                                                                                                                   |                                                          | Assessment form                                                                                                                                                                                                                         |                                     |         | assessment                                                                                                                   |     |
| Conducting unit                             | Department of Energy Conversion and Storage -> Faculty of Chemistry -> Faculties of Gdańsk University of Technology                                                                                                        |                                                          |                                                                                                                                                                                                                                         |                                     |         |                                                                                                                              |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor                                                                                                                                                                                                         |                                                          | dr hab. inż. Katarzyna Januszewicz                                                                                                                                                                                                      |                                     |         |                                                                                                                              |     |
|                                             | Teachers                                                                                                                                                                                                                   |                                                          |                                                                                                                                                                                                                                         |                                     |         |                                                                                                                              |     |
| Lesson types                                | Lesson type                                                                                                                                                                                                                | Lecture                                                  | Tutorial                                                                                                                                                                                                                                | Laboratory                          | Project | Seminar                                                                                                                      | SUM |
|                                             | Number of study hours                                                                                                                                                                                                      | 15.0                                                     | 0.0                                                                                                                                                                                                                                     | 30.0                                | 0.0     | 0.0                                                                                                                          | 45  |
|                                             | 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                                                                                                                                                                                                      | 45                                                       |                                                                                                                                                                                                                                         | 3.0                                 |         | 27.0                                                                                                                         | 75  |
| Subject objectives                          | The aim of the classes is to familiarize students with aspects of physical and chemical methods of generating energy, as well as to discuss their advantages, disadvantages and challenges associated with them.           |                                                          |                                                                                                                                                                                                                                         |                                     |         |                                                                                                                              |     |
| Learning outcomes                           | Course outcome                                                                                                                                                                                                             |                                                          | Subject outcome                                                                                                                                                                                                                         |                                     |         | Method of verification                                                                                                       |     |
|                                             | [K7_W03] selects methods of data analysis, including statistical and modelling, useful for solving scientific and technological problems                                                                                   |                                                          | knows the physical and chemical processes related to the production, conversion and storage of energy. Understands the processes involved in the production and movement of pollutants associated with the energy industry              |                                     |         | [SW2] Assessment of knowledge contained in presentation                                                                      |     |
|                                             | [K7_U05] uses instrumental methods applied in technology and related fields                                                                                                                                                |                                                          | is able to calculate the costs of producing energy from various sources and the environmental costs related to the generation, conversion and transmission of energy.                                                                   |                                     |         | [SU4] Assessment of ability to use methods and tools<br>[SU3] Assessment of ability to use knowledge gained from the subject |     |
|                                             | [K7_U04] predicts the properties of the materials obtained and the course of processes involving them, based on knowledge of technology and related fields and computer methods of data analysis, modelling and simulation |                                                          | is able to explain the physical and chemical processes related to the production, conversion and storage of energy. Understands the processes involved in the production and movement of pollutants associated with the energy industry |                                     |         | [SU3] Assessment of ability to use knowledge gained from the subject<br>[SU1] Assessment of task fulfilment                  |     |

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| Subject contents                                               | Course content – lecture<br><br>Global and Polish energy market.2. Sustainability.3. Conventional energy sources: coal, natural gas, crude oil: resources, amount of energy generated, construction of power plants. Nuclear energy: resources, construction and principles of operation of power plants.4. Chemical and physical methods of energy conversion.5. Obtaining energy from renewable sources.6. Waste as a new potential energy source.7. Processes of extraction, processing and use of raw materials. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                               |
|                                                                | Course content – laboratory<br><br>Work in groups using research stations. Familiarization with the principles of operation, laws and calculations in the field of physical and chemical methods of energy conversion.1. Low-temperature solar energy systems.2. Wind energy.3. Biomass recycling (biodiesel, combustion, pyrolysis)4. Fuel cells.5. Heat pump.                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                               |
| Prerequisites and co-requisites                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                               |
| Assessment methods and criteria                                | Subject passing criteria                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Passing threshold                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Percentage of the final grade |
|                                                                | Lecture - Exam                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 60.0%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 50.0%                         |
|                                                                | Laboratory tests                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 60.0%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 50.0%                         |
| Recommended reading                                            | Basic literature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1. Klugmann-Radziemska E., Lewandowski W., Wilamowska-Zawłocka M., Dettlaff A., Januszewicz K., Ryms M., Kuczyńska-Łażewska A., Energetyka i ochrona środowiska. Generowanie i magazynowanie energii. Odpady energetyczne. Analiza cyklu życia, PWN, 2023<br>2. W. M. Lewandowski, E. Klugmann-Radziemska Proekologiczne odnawialne źródła energii. Kompendium, Wydawnictwo Naukowe PWN, 2017<br>3. W. M. Lewandowski, M. Ryms Biopaliwa. Proekologiczne odnawialne źródła energii, WNT, 2013 |                               |
|                                                                | Supplementary literature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 1. E. Klugmann-Radziemska. Fundamentals of Energy Generation. Wyd. P.G. Gdańsk 2009<br>2. B. Viswanathan Energy Sources. Fundamentals of Chemical Conversion Process and Applications, Elsevier, 2017                                                                                                                                                                                                                                                                                         |                               |
|                                                                | eResources addresses                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                               |
| Example issues/<br>example questions/<br>tasks being completed | Discuss the principle of operation of a nuclear power plant,<br><br>What determines the efficiency of a solar collector or wind farm?<br><br>What methods can be used to obtain energy from waste?<br><br>Describe the process of obtaining biofuel.                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                               |
| Practical activities within the subject                        | Not applicable                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                               |

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