



## Subject card

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| Subject name and code                       | TEAM PROCESS PROJECT, PG_00064410                                                                                                                                                                                                                                                                                                                                                                                                      |                                                          |                                         |                                     |                                                |            |     |
| Field of study                              | Chemistry                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                          |                                         |                                     |                                                |            |     |
| Date of commencement of studies             | October 2024                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                          | Academic year of realisation of subject |                                     | 2026/2027                                      |            |     |
| Education level                             | first-cycle 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                               | 3                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                          | Language of instruction                 |                                     | Polish                                         |            |     |
| Semester of study                           | 6                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                          | ECTS credits                            |                                     | 4.0                                            |            |     |
| Learning profile                            | general academic profile                                                                                                                                                                                                                                                                                                                                                                                                               |                                                          | Assessment form                         |                                     | assessment                                     |            |     |
| Conducting unit                             | Department of Process Engineering and Chemical Technology -> Faculty of Chemistry -> Faculties of Gdańsk University of Technology                                                                                                                                                                                                                                                                                                      |                                                          |                                         |                                     |                                                |            |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                          | dr inż. Robert Aranowski                |                                     |                                                |            |     |
|                                             | Teachers                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                          |                                         |                                     |                                                |            |     |
| Lesson types                                | Lesson type                                                                                                                                                                                                                                                                                                                                                                                                                            | Lecture                                                  | Tutorial                                | Laboratory                          | Project                                        | Seminar    | SUM |
|                                             | Number of study hours                                                                                                                                                                                                                                                                                                                                                                                                                  | 0.0                                                      | 0.0                                     | 0.0                                 | 45.0                                           | 0.0        | 45  |
|                                             | E-learning hours included: 0.0                                                                                                                                                                                                                                                                                                                                                                                                         |                                                          |                                         |                                     |                                                |            |     |
|                                             | eNauczanie source addresses:<br>Moodle ID: 6827 Projekt procesowy zespołowy, Chemia, 2026/27-02<br><a href="https://enauczanie.pg.edu.pl/2025/course/view.php?id=6827">https://enauczanie.pg.edu.pl/2025/course/view.php?id=6827</a>                                                                                                                                                                                                   |                                                          |                                         |                                     |                                                |            |     |
| 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                                                       |                                         | 10.0                                |                                                | 45.0       | 100 |
| Subject objectives                          | The aim of the course is to develop the ability to design, analyze, and evaluate technological processes based on real engineering data and current design standards used in the chemical, energy, and environmental industries. The course builds competencies in team-based project work, including role distribution, task management, integration of results, and responsibility for jointly developing a complete process design. |                                                          |                                         |                                     |                                                |            |     |

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| Learning outcomes               | Course outcome                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Subject outcome                                                                                                                                                                                                                                                              | Method of verification                                  |
|                                 | [K6_U08] applies computer-aided, common methods, chemical apparatus and tools necessary for the solution of simple engineering tasks involving for example technological processes, with a preliminary economic analysis of the engineering activities undertaken                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Is able to use computer-based calculation, simulation and design tools to develop a technological process design, perform material and energy balances, select basic process equipment and carry out a preliminary economic analysis.                                        | [SU1] Assessment of task fulfilment                     |
|                                 | [K6_W04] identifies the conditions of chemical processes occurring in the analysed systems through the appropriate selection of methods to solve them, by taking into account the interdependence of the structure and properties of key materials in sustainable development technologies                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Has knowledge of the physicochemical and process-related conditions necessary for the development of a technological process design, including the selection of construction materials with consideration of their properties and the principles of sustainable development. | [SW2] Assessment of knowledge contained in presentation |
|                                 | [K6_U06] analyses the operation of equipment, apparatus and process lines used in laboratories and the chemical industry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Is able to analyse the operation of process equipment and devices and their interconnections within a designed technological installation, and to select the basic equipment required for the process.                                                                       | [SU1] Assessment of task fulfilment                     |
|                                 | [K6_U01] gathers information from literature, databases and other sources, interpreting, critically evaluating, summarising, formulating and justifying opinions, independently analyses and produces technical drawings with the use of computer assistance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Is able to obtain, analyse and critically evaluate information from literature, databases and technical sources and use it to justify the adopted design solutions and prepare project documentation, including process diagrams using computer-aided tools.                 | [SU1] Assessment of task fulfilment                     |
| Subject contents                | <p>Course content – project</p> <p>Introduction to the implementation of a team-based technological project. Definition of the project scope, documentation requirements, project structure and principles of teamwork organization. Development of a preliminary technological process concept, definition of process fundamentals and functional description, and selection of main unit operations. Preparation of a conceptual process diagram and identification of input and output streams. Selection of technological parameters and data required for process calculations. Development of a detailed process description and relationships between process equipment and streams. Preparation of a Process Flow Diagram (PFD). Preparation of material and energy balances and analysis of process variants using computational and simulation tools. Determination of utility requirements and analysis of possibilities for reducing energy consumption. Selection of construction materials considering process fluid properties and corrosion risks. Selection of main process equipment, determination of key equipment parameters, and preparation of an equipment list and operating schedule. Development of a process monitoring and control concept, including key controlled variables, measurement points and final control elements. Analysis of process safety and occupational health and safety requirements. Assessment of environmental impact, identification of emissions, wastewater and waste, and determination of measures to minimize their generation. Preparation of a preliminary economic justification considering capital expenditures (CAPEX) and operating expenditures (OPEX). Development of basic design guidelines for civil, mechanical and electrical engineering, instrumentation and control. Integration of project documentation, presentation and defence of the completed project.</p> |                                                                                                                                                                                                                                                                              |                                                         |
| Prerequisites and co-requisites | <p>The student should have a fundamental knowledge of chemical engineering, including mass and energy balances, heat and mass transfer, chemical reaction kinetics, hydraulics, and basic unit operations and process equipment. Knowledge of the fundamentals of technological process design, identification of process streams and operating parameters, as well as basic process safety and environmental protection principles is required. The student should be able to perform basic process calculations and use numerical computing environments and process simulation software. Basic knowledge of technical drawing, preparation of process diagrams and components of process installations, as well as the fundamentals of measurement and automatic process control systems, is required. The student should be able to search for and analyse technical data, prepare technical documentation and present results, and collaborate effectively within a project team.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                              |                                                         |
| Assessment methods and criteria | Subject passing criteria                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Passing threshold                                                                                                                                                                                                                                                            | Percentage of the final grade                           |
|                                 | Assessment of activity and teamwork                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 60.0%                                                                                                                                                                                                                                                                        | 20.0%                                                   |
|                                 | Assessment of the team project                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 60.0%                                                                                                                                                                                                                                                                        | 60.0%                                                   |
|                                 | Project presentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 60.0%                                                                                                                                                                                                                                                                        | 20.0%                                                   |

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| Recommended reading | Basic literature         | <ol style="list-style-type: none"> <li>1. L. Synoradzki, J. Wisiański, Projektowanie Procesów Technologicznych, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2019.</li> <li>2. L. Synoradzki, J. Wisiański (praca zbiorowa), Projektowanie procesów technologicznych. Bezpieczeństwo procesów chemicznych, Oficyna Wydawnicza Politechniki Warszawskiej, 2012.</li> <li>3. J. Głowiński, Przykłady i zadania do przedmiotu Podstawy technologii chemicznej, Politechnika Wrocławska, Wrocław 1991.</li> <li>4. S. Kucharski, J. Głowiński, Podstawy obliczeń projektowych w technologii chemicznej, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                     | Supplementary literature | <ol style="list-style-type: none"> <li>1. W. M. Lewandowski, R. Aranowski, Technologie ochrony środowiska w przemyśle i energetyce, Wydawnictwo Naukowe PWN, Warszawa, 2016.</li> <li>2. Stelecki, L. Gradaoń, Podstawowe procesy przemysłu chemicznego, WNT, Warszawa 1985.</li> <li>3. N.G. Anderson, Practical Process Research and Development, Academic Press, San Diego, California, USA 2000.</li> <li>4. P.W. Atkins, Chemia fizyczna, PWN, Warszawa 2001.</li> <li>5. Grzywa, Edward Jan, Technologia podstawowych syntez organicznych. T. 1, Surowce do syntez, Warszawa : Wydaw. Nauk.-Techn., 1995.</li> <li>6. Pikoń Jerzy, Podstawy konstrukcji aparatury chemicznej. Cz. 1, Tworzywa konstrukcyjne, Warszawa: Państw. Wydaw. Nauk., 1979.</li> <li>7. Myers Alan L., Obliczenia komputerowe w inżynierii chemicznej, Warszawa : Wydaw. Naukowo-Techniczne, 1979.</li> <li>8. Pavlov, Konstantin Feofanovič, Przykłady i zadania z zakresu aparatury i inżynierii chemicznej. Tł.z j. ros, Warszawa : Państw. Wydaw. Tech., 1964.</li> <li>9. Pikoń Jerzy, Aparatura chemiczna, Gliwice : Politechnika Śląska, 1971.</li> <li>10. Szarawara Józef, Podstawy inżynierii reaktorów chemicznych, Warszawa : Nauk.-Techn., 1980.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|                     | eResources addresses     | <p>Basic</p> <p><a href="https://webbook.nist.gov/chemistry/?utm_source=chatgpt.com">https://webbook.nist.gov/chemistry/?utm_source=chatgpt.com</a> - A database of physicochemical and thermodynamic properties of chemical substances. It provides thermochemical data, phase-change properties, critical parameters and heat capacities. It can be used to obtain data required for material and energy balances and process design calculations.</p> <p><a href="https://www.aiche.org/ccps/?utm_source=chatgpt.com">https://www.aiche.org/ccps/?utm_source=chatgpt.com</a> - Resources of the Center for Chemical Process Safety concerning the safety of chemical processes and installations. The resource supports hazard identification, risk assessment and consideration of process safety principles when developing process concepts and technological project documentation.</p> <p><a href="https://pubchem.ncbi.nlm.nih.gov/?utm_source=chatgpt.com">https://pubchem.ncbi.nlm.nih.gov/?utm_source=chatgpt.com</a> - A chemical information database providing data on molecular structures, physicochemical properties, safety and hazards, as well as references to literature sources. It is useful for characterizing raw materials, products and auxiliary substances used in the designed process.</p> <p><a href="https://www.epa.gov/green-engineering/green-engineering-textbook-and-training-modules?utm_source=chatgpt.com">https://www.epa.gov/green-engineering/green-engineering-textbook-and-training-modules?utm_source=chatgpt.com</a> - Educational resources on incorporating environmental aspects into chemical process design. They cover emissions and waste assessment, pollution prevention, process flowsheet analysis, raw material and energy use, and environmental assessment of designed processes.</p> |

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| <p>Example issues/<br/>example questions/<br/>tasks being completed</p> | <p>Project Problem Description</p> <p>The goal of the project is to develop a complete carbon dioxide absorption unit for flue gas treatment using an aqueous monoethanolamine (MEA) solution. The task of the project team is to design a process enabling at least 85% CO<sub>2</sub> removal efficiency from a process gas stream with a typical composition for fossil-fuel combustion (1015% CO<sub>2</sub>, 46% O<sub>2</sub>, remainder N<sub>2</sub>). The project includes preparing the technological concept, performing process calculations, selecting equipment, and conducting safety, environmental, and economic analyses of the installation.</p> <p>In the first stage, a conceptual process flow diagram must be developed and fully described, including CO<sub>2</sub> absorption in the contactor column and solvent regeneration in the desorption column. As part of the process design, students must determine the MEA concentration, select operating parameters (temperatures, pressures, flow rates), and prepare mass and energy balances based on process simulations performed in ChemCAD, supplemented with engineering calculations in Scilab/Matlab.</p> <p>Next, the student should prepare the technological Process Flow Diagram (PFD) and a simplified Piping and Instrumentation Diagram (P&amp;ID), created in AutoCAD, including the main equipment, process streams, basic control instruments, and measurement points. In the further part of the project, selecting and sizing the equipment is required, including the absorption column, desorption column, heat exchangers, pumps, and storage tanks. A 3D model of one selected piece of equipment must also be created in Inventor to illustrate its design and assembly principles.</p> <p>The project must include an analysis of construction materials and corrosion protection methods, an assessment of operational safety, and identification of hazards related to high temperatures, steam, chemical substances, and pressurized systems. The student must also prepare an environmental impact assessment, including emissions after treatment, spent solvent management, and proposed measures to reduce the installations environmental impact.</p> <p>The final element of the project is preparing a preliminary economic justification, including an estimate of capital expenditures (CAPEX), operating costs (OPEX), utility consumption, and a basic profitability assessment (e.g., payback period or NPV). The project should conclude with the preparation of complete project documentation and its presentation, in which the team justifies the adopted technical, construction, and operational solutions.</p> |
| <p>Practical activities within the subject</p>                          | <p>Not applicable</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

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