



## Subject card

|                                             |                                                                                                                                                                                                                                                                                                                                                                                            |                                                          |                                         |                                     |                                                                                              |            |     |
|---------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|-----------------------------------------|-------------------------------------|----------------------------------------------------------------------------------------------|------------|-----|
| Subject name and code                       | Vacuum technology, PG_00037288                                                                                                                                                                                                                                                                                                                                                             |                                                          |                                         |                                     |                                                                                              |            |     |
| Field of study                              | Technical Physics                                                                                                                                                                                                                                                                                                                                                                          |                                                          |                                         |                                     |                                                                                              |            |     |
| Date of commencement of studies             | October 2025                                                                                                                                                                                                                                                                                                                                                                               |                                                          | Academic year of realisation of subject |                                     | 2027/2028                                                                                    |            |     |
| Education level                             | first-cycle studies                                                                                                                                                                                                                                                                                                                                                                        |                                                          | Subject group                           |                                     | Optional 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                               | 3                                                                                                                                                                                                                                                                                                                                                                                          |                                                          | Language of instruction                 |                                     | Polish                                                                                       |            |     |
| Semester of study                           | 5                                                                                                                                                                                                                                                                                                                                                                                          |                                                          | ECTS credits                            |                                     | 2.0                                                                                          |            |     |
| Learning profile                            | general academic profile                                                                                                                                                                                                                                                                                                                                                                   |                                                          | Assessment form                         |                                     | assessment                                                                                   |            |     |
| Conducting unit                             | Department of Atomic Physics and Luminescence -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology                                                                                                                                                                                                                                                |                                                          |                                         |                                     |                                                                                              |            |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor                                                                                                                                                                                                                                                                                                                                                                         |                                                          | dr inż. Sebastian Bielski               |                                     |                                                                                              |            |     |
|                                             | Teachers                                                                                                                                                                                                                                                                                                                                                                                   |                                                          |                                         |                                     |                                                                                              |            |     |
| Lesson types                                | Lesson type                                                                                                                                                                                                                                                                                                                                                                                | Lecture                                                  | Tutorial                                | Laboratory                          | Project                                                                                      | Seminar    | SUM |
|                                             | Number of study hours                                                                                                                                                                                                                                                                                                                                                                      | 15.0                                                     | 0.0                                     | 15.0                                | 0.0                                                                                          | 0.0        | 30  |
|                                             | E-learning hours included: 0.0                                                                                                                                                                                                                                                                                                                                                             |                                                          |                                         |                                     |                                                                                              |            |     |
|                                             | eNauczanie source addresses:<br>Moodle ID: 2907 Technika próżniowa (od 2026/27)<br><a href="https://enauczanie.pg.edu.pl/2025/course/view.php?id=2907">https://enauczanie.pg.edu.pl/2025/course/view.php?id=2907</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                                                                                                                                                                                                                                                                                                                                                                      | 30                                                       |                                         | 2.0                                 |                                                                                              | 18.0       | 50  |
| Subject objectives                          | <p>The aim of the course is to provide knowledge of modern vacuum technology, with particular focus on the following topics:</p> <ul style="list-style-type: none"><li>• properties of gases</li><li>• surface processes (adsorption, desorption)</li><li>• vacuum generation</li><li>• vacuum measurement</li><li>• components of vacuum systems, construction, leak detection.</li></ul> |                                                          |                                         |                                     |                                                                                              |            |     |

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| Learning outcomes               | Course outcome                                                                                                                                                                                                                                                                                                                                                                                                                | Subject outcome                                                                                                                                                                                                                                                                                                                                                                                                | Method of verification                                               |
|                                 | [K6_U04] plans and conduct experiments, critically analyzes their results, draw conclusions and forms opinions, has laboratory work experience                                                                                                                                                                                                                                                                                | Laboratory experience within the Vacuum Technology Laboratory.                                                                                                                                                                                                                                                                                                                                                 | [SU1] Assessment of task fulfilment                                  |
|                                 | [K6_U02] analyzes and solves simple scientific and technical problems, based on possessed knowledge, using analytical, numerical, simulation and experimental methods                                                                                                                                                                                                                                                         | Ability to start up, test, and use a vacuum device for experimental purposes.                                                                                                                                                                                                                                                                                                                                  | [SU1] Assessment of task fulfilment                                  |
|                                 | [K6_W07] has knowledge of the construction and operation of physical instruments, measurement and research equipment                                                                                                                                                                                                                                                                                                          | Knowledge of the construction, operation, and application of vacuum devices.                                                                                                                                                                                                                                                                                                                                   | [SW1] Assessment of factual knowledge                                |
|                                 | [K6_W08] has knowledge of planning and conducting physical experiments, and critical analysis of its results                                                                                                                                                                                                                                                                                                                  | Ability to plan and conduct a laboratory experiment.                                                                                                                                                                                                                                                                                                                                                           | [SW3] Assessment of knowledge contained in written work and projects |
| Subject contents                | Course content – lecture<br><b>Lecture</b><br><br>1) The concept of vacuum<br>2) Selected properties of gases<br>3) Absorption and adsorption of gases<br>4) Gas flow<br>5) Vacuum generation<br><br><ul style="list-style-type: none"> <li>Mechanical vacuum pumps</li> <li>Jet vacuum pumps</li> <li>Sorption pumps</li> </ul> 6) Vacuum measurement<br>7) Mass spectrometry<br>8) Leak Detection                           |                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                      |
|                                 | Course content – laboratory<br><br><b>Laboratory</b><br><br><ul style="list-style-type: none"> <li>Assembly of a vacuum system with a pump, valve, and measuring head.</li> <li>Disassembly and assembly of a rotary vane pump and a diffusion pump.</li> <li>Operation of a vacuum system with a turbomolecular pump and a wide-range gauge.</li> <li>Effective pumping speed; characteristics of a dosing valve.</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                      |
| Prerequisites and co-requisites | None                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                      |
| Assessment methods and criteria | Subject passing criteria                                                                                                                                                                                                                                                                                                                                                                                                      | Passing threshold                                                                                                                                                                                                                                                                                                                                                                                              | Percentage of the final grade                                        |
|                                 | Laboratory: performance of 4 laboratory experiments                                                                                                                                                                                                                                                                                                                                                                           | 100.0%                                                                                                                                                                                                                                                                                                                                                                                                         | 0.0%                                                                 |
|                                 | Laboratories: reports                                                                                                                                                                                                                                                                                                                                                                                                         | 100.0%                                                                                                                                                                                                                                                                                                                                                                                                         | 0.0%                                                                 |
|                                 | Lecture: final test                                                                                                                                                                                                                                                                                                                                                                                                           | 50.0%                                                                                                                                                                                                                                                                                                                                                                                                          | 38.0%                                                                |
|                                 | Laboratories: oral assessment                                                                                                                                                                                                                                                                                                                                                                                                 | 50.0%                                                                                                                                                                                                                                                                                                                                                                                                          | 50.0%                                                                |
|                                 | Lecture: online quizzes                                                                                                                                                                                                                                                                                                                                                                                                       | 0.0%                                                                                                                                                                                                                                                                                                                                                                                                           | 12.0%                                                                |
| Recommended reading             | Basic literature                                                                                                                                                                                                                                                                                                                                                                                                              | S. Bielski, materials published on the moodle platform<br>"Modern vacuum physics" Austin Chambers CRC Press 2004<br><br>Fundamentals of leak detection, Leybold GmbH, 2024 <a href="https://www.leybold.com/content/dam/brands/leybold/downloads/gated/Fundamentals-of-leak-detection-2024.pdf">https://www.leybold.com/content/dam/brands/leybold/downloads/gated/Fundamentals-of-leak-detection-2024.pdf</a> |                                                                      |

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|                                                                | Supplementary literature                                                                                                                                                                                                                                                                                                                                     | Materials and data available on the websites<br><a href="https://www.leyboldproducts.com/media/pdf/87/a8/be/FVT_Fundamentals_of_Vacuum_Technology_EN58774555441f3.pdf">https://www.leyboldproducts.com/media/pdf/87/a8/be/FVT_Fundamentals_of_Vacuum_Technology_EN58774555441f3.pdf</a><br><a href="http://www.idealvac.com/files/manuals/Kinney_Piston_Vacuum_Pump_Brochure.pdf">http://www.idealvac.com/files/manuals/Kinney_Piston_Vacuum_Pump_Brochure.pdf</a><br><a href="https://www.agilent.com/cs/library/usermanuals/Public/6999-01-140C_Eng%20High%20Throughput%20Diffusion%20Pumps%20Brochure.pdf">https://www.agilent.com/cs/library/usermanuals/Public/6999-01-140C_Eng%20High%20Throughput%20Diffusion%20Pumps%20Brochure.pdf</a><br><a href="http://www.idealvac.com/files/literature/03_Edwards_2011_Vapour_Diffusion_Pumps.pdf">http://www.idealvac.com/files/literature/03_Edwards_2011_Vapour_Diffusion_Pumps.pdf</a><br><a href="http://www.idealvac.com/files/brochures/Pfeiffer-Adixen-Leak-Detectors-Brochure.pdf">http://www.idealvac.com/files/brochures/Pfeiffer-Adixen-Leak-Detectors-Brochure.pdf</a> |
|                                                                | eResources addresses                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Example issues/<br>example questions/<br>tasks being completed | <p><b>Lecture</b></p> <p>Discuss the physical principles of operation of an ionization vacuum gauge.<br/> Discuss the construction, operating principle, and properties of a rotary pump.</p> <p><b>Laboratory</b></p> <p>Assemble a vacuum system with a pump, valve, and measuring head.<br/> Measure the effective pumping speed of the given system.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Practical activities within<br>the subject                     | Not applicable                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

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