



Subject card

|   |  |  |  |                                     |  |   |     |
|---|--|--|--|-------------------------------------|--|---|-----|
| Subject name and code                       | Materials and technological challenges in security and protection systems, PG_00071212   |  |  |                                     |  |   |     |
| Field of study                              | Nanotechnology   |  |  |                                     |  |   |     |
| Date of commencement of studies             | February 2027  |  | Academic year of realisation of subject  |                                     |  | 2026/2027   |     |
| Education level                             | second-cycle studies   |  | Subject group  |                                     |  | 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   |                                     |  | 1.0   |     |
| Learning profile                            | general academic profile   |  | Assessment form  |                                     |  | assessment  |     |
| Conducting unit                             | Institute of Nanotechnology and Materials Engineering -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology  |  |  |                                     |  |   |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor   |  | dr hab. inż. Agnieszka Witkowska   |                                     |  |   |     |
|   | Teachers   |  |  |                                     |  |   |     |
| Lesson types                                | Lesson type  | Lecture  | Tutorial   | Laboratory                          | Project  | Seminar   | SUM |
|   | Number of study hours  | 15.0   | 0.0  | 0.0                                 | 0.0  | 0.0   | 15  |
|   | 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  | 15   |  | 1.0                                 |  | 9.0   | 25  |
| Subject objectives                          | <p>The aim of the course is to familiarize students with the specific material and technological challenges in the field of protection and security, with particular emphasis on sectors related to medical care, human and environmental protection under biological and chemical threat conditions, critical infrastructure protection, and dual-use technologies.</p> <p>Students acquire both theoretical and practical knowledge through study visits to research institutes and R&amp;D centers operating in the area of protection and security, as well as through lectures and presentations delivered by experts from the socio-economic environment. The course also develops students ability to critically analyze material-related problems and to identify key technological challenges in the above-mentioned areas.</p> |  |  |                                     |  |   |     |
| Learning outcomes                           | Course outcome   |  | Subject outcome  |                                     | Method of verification   |   |     |
|   | [K7_U06] is able to apply acquired specialist knowledge to problems in other physical, natural, or technical sciences and to critically analyze and evaluate the functioning of the adopted solutions  |  | The student can apply specialized nanotechnology knowledge to interdisciplinary protection and security problems and critically assess the effectiveness and limitations of existing technological solutions.  |                                     | [SU2] Assessment of ability to analyse information                   |   |     |
|   | [K7_W03] has knowledge of current development trends and the latest discoveries in the fields of physics, chemistry, technology, and applications of nanostructures  |  | The student is familiar with current development trends and recent advances in nanostructure technologies and their applications in protection and security systems, including dual-use technologies, based on real-world case studies and expert contributions. |                                     | [SW3] Assessment of knowledge contained in written work and projects |   |     |

| Subject contents   | <p>Course content – lecture</p> <p><b>1. Introduction to technologies and materials used in protection and security systems</b>, including applications in:</p> <ul style="list-style-type: none"> <li>the medical sector and battlefield medicine,</li> <li>biological and environmental protection,</li> <li>the military sector.</li> </ul> <p><b>2. Dual-use technologies:</b> definition and selected examples.</p> <p><b>3. Lectures and discussions led by experts</b>, including:</p> <ul style="list-style-type: none"> <li>case studies - analysis of real-world material-related problems in protection and security sectors,</li> <li>exchange of experience and discussion of conclusions relevant to the development of nanomaterials and advanced technologies.</li> </ul> |  |                   |                               |  |       |       |  |       |       |  |  |
|--|---|--|-------------------|-------------------------------|--|-------|-------|--|-------|-------|--|--|
| Prerequisites and co-requisites  |   |  |                   |                               |  |       |       |  |       |       |  |  |
| Assessment methods and criteria  | <table border="1"> <thead> <tr> <th>Subject passing criteria</th> <th>Passing threshold</th> <th>Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td>Active participation in classes and discussions with experts</td> <td>50.0%</td> <td>40.0%</td> </tr> <tr> <td>Preparation of a short analysis or reflective report on selected case studies or material-related problems discussed during the course</td> <td>50.0%</td> <td>60.0%</td> </tr> </tbody> </table>  | Subject passing criteria   | Passing threshold | Percentage of the final grade | Active participation in classes and discussions with experts | 50.0% | 40.0% | Preparation of a short analysis or reflective report on selected case studies or material-related problems discussed during the course | 50.0% | 60.0% |  |  |
| Subject passing criteria   | Passing threshold   | Percentage of the final grade  |                   |                               |  |       |       |  |       |       |  |  |
| Active participation in classes and discussions with experts   | 50.0%   | 40.0%  |                   |                               |  |       |       |  |       |       |  |  |
| Preparation of a short analysis or reflective report on selected case studies or material-related problems discussed during the course | 50.0%   | 60.0%  |                   |                               |  |       |       |  |       |       |  |  |
| Recommended reading  | <p>Basic literature</p> <p>Supplementary literature</p> <p>eResources addresses</p>   | <p>[1] Bezpieczeństwo przyszłości wybrane zagadnienia, redakcja naukowa Rafał Miernik, Tomasz Jarocki, Wydawnictwo UJK Kielce, 2023</p> <p>[2] Inżynieria systemów bezpieczeństwa, redakcja naukowa Piotr Sienkiewicz, Warszawa, PWE, 2015</p> <p>[3] <a href="https://ik.org.pl/2024/12/27/technologie-dual-use-nowe-wyzwania-i-mozliwosci-dla-europy/">https://ik.org.pl/2024/12/27/technologie-dual-use-nowe-wyzwania-i-mozliwosci-dla-europy/</a> [luty 2026]</p> <p>[4] Grzegorz Gierelak, <a href="https://defence24.pl/sily-zbrojne/medycyna-przyszlosci-na-polu-walki-inteligentne-technologie-zwieksza-szanse-przezycia-zolnierzy-czesc-i">https://defence24.pl/sily-zbrojne/medycyna-przyszlosci-na-polu-walki-inteligentne-technologie-zwieksza-szanse-przezycia-zolnierzy-czesc-i</a> [4 lipca 2025]</p> |                   |                               |  |       |       |  |       |       |  |  |
| Example issues/<br>example questions/<br>tasks being completed   | <p>Criteria for the selection of protective materials for battlefield conditions.</p> <p>Material challenges in the development of biological and chemical barriers.</p> <p>Case studies of dual-use technology applications in the security sector.</p> <p>Risk assessment and environmental safety aspects of nanomaterial applications.</p>  |  |                   |                               |  |       |       |  |       |       |  |  |
| Practical activities within the subject  | Not applicable  |  |                   |                               |  |       |       |  |       |       |  |  |

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