



## Subject card

|                                             |                                                                                                                                                                                                                                                                                                                                                                                                       |                                                          |                                                                                          |                                     |                                       |            |     |
|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|------------------------------------------------------------------------------------------|-------------------------------------|---------------------------------------|------------|-----|
| Subject name and code                       | Material degradation, PG_00066103                                                                                                                                                                                                                                                                                                                                                                     |                                                          |                                                                                          |                                     |                                       |            |     |
| Field of study                              | Chemistry                                                                                                                                                                                                                                                                                                                                                                                             |                                                          |                                                                                          |                                     |                                       |            |     |
| Date of commencement of studies             | February 2027                                                                                                                                                                                                                                                                                                                                                                                         |                                                          | Academic year of realisation of subject                                                  |                                     | 2027/2028                             |            |     |
| Education level                             | second-cycle studies                                                                                                                                                                                                                                                                                                                                                                                  |                                                          | Subject group                                                                            |                                     | Specialty subject group               |            |     |
| Mode of study                               | Full-time studies                                                                                                                                                                                                                                                                                                                                                                                     |                                                          | Mode of delivery                                                                         |                                     | at the university                     |            |     |
| Year of study                               | 1                                                                                                                                                                                                                                                                                                                                                                                                     |                                                          | Language of instruction                                                                  |                                     | Polish                                |            |     |
| Semester of study                           | 2                                                                                                                                                                                                                                                                                                                                                                                                     |                                                          | ECTS credits                                                                             |                                     | 2.0                                   |            |     |
| Learning profile                            | general academic profile                                                                                                                                                                                                                                                                                                                                                                              |                                                          | Assessment form                                                                          |                                     | assessment                            |            |     |
| Conducting unit                             | Department of Corrosion and Electrochemistry -> Faculty of Chemistry -> Faculties of Gdańsk University of Technology                                                                                                                                                                                                                                                                                  |                                                          |                                                                                          |                                     |                                       |            |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor                                                                                                                                                                                                                                                                                                                                                                                    |                                                          | prof. dr hab. inż. Juliusz Orlikowski                                                    |                                     |                                       |            |     |
|                                             | Teachers                                                                                                                                                                                                                                                                                                                                                                                              |                                                          |                                                                                          |                                     |                                       |            |     |
| Lesson types                                | Lesson type                                                                                                                                                                                                                                                                                                                                                                                           | Lecture                                                  | Tutorial                                                                                 | Laboratory                          | Project                               | Seminar    | SUM |
|                                             | Number of study hours                                                                                                                                                                                                                                                                                                                                                                                 | 15.0                                                     | 0.0                                                                                      | 0.0                                 | 15.0                                  | 0.0        | 30  |
|                                             | 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                                                                                                                                                                                                                                                                                                                                                                                 | 30                                                       |                                                                                          | 5.0                                 |                                       | 15.0       | 50  |
| Subject objectives                          | The aim of this course is to provide students with knowledge about the degradation of structural materials associated with operation in high-temperature conditions and the presence of aggressive chemical media. The knowledge gained will enable them to implement appropriate diagnostic methods to detect structural damage to materials and take steps to minimize the risk of future failures. |                                                          |                                                                                          |                                     |                                       |            |     |
| Learning outcomes                           | Course outcome                                                                                                                                                                                                                                                                                                                                                                                        |                                                          | Subject outcome                                                                          |                                     | Method of verification                |            |     |
|                                             | [K7_W01] recognizes problems of modern chemistry, including properties and obtaining chemical compounds, necessary for making calculations, including the dependence of the compound's structure and its reactivity                                                                                                                                                                                   |                                                          | has knowledge of the main chemical factors causing degradation of construction materials |                                     | [SW1] Assessment of factual knowledge |            |     |
|                                             | [K7_U01] integrates and interprets information from literature, databases and other sources                                                                                                                                                                                                                                                                                                           |                                                          | is able to apply standards to determine the degradation mechanism                        |                                     | [SU1] Assessment of task fulfilment   |            |     |
|                                             | [K7_K02] is able to cooperate and work in a group, taking on different roles                                                                                                                                                                                                                                                                                                                          |                                                          | is ready to work on a team responsible for conducting a degradation risk analysis        |                                     | [SK1] Assessment of group work skills |            |     |
| Subject contents                            | Course content – lecture                                                                                                                                                                                                                                                                                                                                                                              |                                                          |                                                                                          |                                     |                                       |            |     |
|                                             | High-temperature metal degradation mechanisms based on structural change. Corrosion cracking processes based on chloride cracking, caustic embrittlement, polythionic acid interaction, the presence of wet H2Su, ammonia, and ethyl alcohol. Hydrogen embrittlement and high-temperature hydrogen attack mechanisms.                                                                                 |                                                          |                                                                                          |                                     |                                       |            |     |
|                                             | Course content – project                                                                                                                                                                                                                                                                                                                                                                              |                                                          |                                                                                          |                                     |                                       |            |     |
|                                             | Analysis of degradation mechanisms of construction materials based on API571 and API581 standards for a specific practical case of a chemical installation                                                                                                                                                                                                                                            |                                                          |                                                                                          |                                     |                                       |            |     |
| Prerequisites and co-requisites             | Basics of inorganic chemistry                                                                                                                                                                                                                                                                                                                                                                         |                                                          |                                                                                          |                                     |                                       |            |     |
| Assessment methods and criteria             | Subject passing criteria                                                                                                                                                                                                                                                                                                                                                                              |                                                          | Passing threshold                                                                        |                                     | Percentage of the final grade         |            |     |
|                                             | Passing the lecture                                                                                                                                                                                                                                                                                                                                                                                   |                                                          | 60.0%                                                                                    |                                     | 50.0%                                 |            |     |
|                                             | Project execution                                                                                                                                                                                                                                                                                                                                                                                     |                                                          | 60.0%                                                                                    |                                     | 50.0%                                 |            |     |

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|----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Recommended reading                                            | Basic literature                                                                                                                                                                                                                                                                       | Standards:<br><br>API571<br><br>API581<br><br>API 934 A-E<br><br>API 939 C-E |
|                                                                | Supplementary literature                                                                                                                                                                                                                                                               | Not applicable                                                               |
|                                                                | eResources addresses                                                                                                                                                                                                                                                                   |                                                                              |
| Example issues/<br>example questions/<br>tasks being completed | Degradation Mechanisms of High-Temperature Unalloyed Steels<br>Conditions for the Occurrence of Hydrogen Embrittlement<br>Causes of Sigma-Phase Embrittlement in High-Alloy Steels<br>Critical Temperature and Hydrogen Content Conditions for High-Temperature Hydrogen Attack (HTHA) |                                                                              |
| Practical activities within<br>the subject                     | Not applicable                                                                                                                                                                                                                                                                         |                                                                              |

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