GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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| Subject name and code | , PG_00072911 | | |
| Field of study | Civil Engineering | | |
| Date of commencement of studies | October 2026 | Academic year of realisation of subject | 2026/2027 |
| Education level | second-cycle studies | Subject group | Optional 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 | 1 | ECTS credits | 2.0 |
| Learning profile | general academic profile | Assessment form | assessment |
| Conducting unit | Department of Geotechnical and Hydraulic Engineering -> Faculty of Civil and Environmental Engineering -> Faculties of Gdańsk University of Technology | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr inż. Rafał Ossowski | |
| | Teachers | dr inż. Rafał Ossowski<br>dr Mariusz Wyrośląk | |

**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

eNauczanie source address: https://enauczanie.pg.edu.pl/2025/course/view.php?id=8175

**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**

The aim of the course is to acquire advanced knowledge and skills in the design, construction, operation and monitoring of earthworks, with particular emphasis on engineering embankments, excavations, reinforced earth retaining structures, dams and flood defences, and landfill sites.

**Learning outcomes**

| Course outcome | Subject outcome | Method of verification |
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| [K7_W04] analyses in-depth complex problems on the basis of reliable data and appropriately chosen methods, reaching logical conclusions | Analyses phenomena relating to the use of soil as a construction material | [SW2] Assessment of knowledge contained in presentation |
| [K7_U02] interprets, in an in-depth way, phenomena and relationships between processes in the construction industry, using modern knowledge in line with the main trends in the development of scientific disciplines related to the field of study | Interprets phenomena relating to advanced soil models in the context of groundworks | [SU2] Assessment of ability to analyse information<br>[SU4] Assessment of ability to use methods and tools |
| [K7_U03] uses, to a deeper extent, appropriately selected analytical, numerical and experimental tools and methods to carry out tasks in the construction industry | Carries out calculations relating to earthworks in terms of stability, bearing capacity and strength | [SU4] Assessment of ability to use methods and tools<br>[SU5] Assessment of ability to present the results of task |
| [K7_W01] identifies in-depth the phenomena related to the field of study and the theories describing them, indicating reliable sources of knowledge and information relevant to the issues analysed | Carries out extensive bibliographic and source-based analyses in order to resolve and analyse a problem | [SW1] Assessment of factual knowledge<br>[SW3] Assessment of knowledge contained in written work and projects |

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| Subject contents | Course content – lecture<br><br>The lecture programme covers comprehensive topics relating to the design, construction, operation and monitoring of earthworks, taking into account the principles of Eurocode 7 and geotechnical risk assessment.<br><br>W1. Classification and design of earthworks<br><br>Types and functions of earthworks, limit states, mechanical and hydraulic actions, Eurocode 7.<br><br>W2. Materials for earthworks<br><br>Selection of natural and man-made soils, compactability, soil stabilisation, geosynthetics.<br><br>W3. Road, railway and industrial embankments<br><br>Design of embankments, weak subgrades, settlement, consolidation and reinforcement techniques.<br><br>W4. Stability of slopes and embankments<br><br>Failure mechanisms, stability analysis methods, the effect of seepage and loads.<br><br>W5. Reinforced earth structures<br><br>Geosynthetic reinforcement, retaining structures, design and durability.<br><br>W6. Excavations and Slope Stabilisation<br><br>Stability of excavations, drainage, hydraulic hazards, nailing and anchoring.<br><br>W7. Construction Techniques and Quality Control<br><br>Earthworks, compaction, inspection tests and acceptance of works.<br><br>W8. Earth and embankment dams<br><br>Dam design, sealing, drainage, stability and failure mechanisms. |

W9. Filtration and anti-filtration measures

Water flow, pore pressure, internal erosion, filters and drainage.

W10. Flood defences

Design of embankments, effects of flood waves, risks and methods of modernisation.

W11. Landfills – structures
Types of landfills, basins, embankments, slopes, phased construction and stability.

W12. Landfill linings and drainage
Mineral barriers, geomembranes, leachate drainage and groundwater protection.

W13. Mining waste landfills
Capping technologies, sediment consolidation, stability and safety.

W14. Geotechnical monitoring
Measurements of displacements and pore pressures, InSAR, automation and digital twins.

W15. Failures of earthworks
Analysis of disasters, causes of damage, risk assessment and remedial measures.

Course content – project

1. Introduction to the design of earthworks – basic design requirements, design scenarios.
2. Earth noise barriers – selection of parameters for calculations, effects on the structure.
3. Improvement of the geotechnical properties of soils during consolidation – soil, water and ground conditions.
4. Design of ground reinforcement using aggregate columns – geometry, materials, principles of forming and compaction, construction techniques.
5. Stability of nailed slopes – mechanisms of stability failure, calculation methods, safety factors, software.
6. Technical specifications for earthworks – principles for drawing up specifications, technical solutions, useful information for design and construction.
7. Geotechnical documentation – examples, discussion.

## Prerequisites and co-requisites

## Assessment methods and criteria

| Subject passing criteria | Passing threshold | Percentage of the final grade |
|---|---|---|
| project excersises | 50.0% | 50.0% |
| presentation | 50.0% | 50.0% |

## Recommended reading

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| Basic literature | • **Wiłun Z.**, *Zarys geotechniki*, Wydawnictwa Komunikacji i Łączności, Warszawa.<br>• **Pisarczyk S.**, *Gruntoznawstwo inżynierskie*, Wydawnictwo Naukowe PWN, Warszawa.<br>• **Pisarczyk S.**, *Mechanika gruntów*, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa.<br>• Aktualne **normy i Eurokody dotyczące projektowania geotechnicznego**, w szczególności PN-EN 1997-1 oraz PN-EN 1997-2, wraz z aktualnymi załącznikami krajowymi. |
| Supplementary literature | 1. **Kisiel I.**, *Mechanika gruntów i fundamentowanie*.<br>2. **Gryczmański M.**, materiały dotyczące stateczności skarp i zboczy oraz projektowania geotechnicznego.<br>3. Aktualne specyfikacje techniczne, wytyczne i instrukcje techniczne dotyczące projektowania, wykonywania i kontroli budowli ziemnych.<br>4. Dokumentacje geotechniczne i przykłady projektów budowli ziemnych. |
| eResources addresses | |

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| Example issues/ example questions/ tasks being completed | **Sample project assignment**<br>**Project topic:** A design to enhance selected geotechnical parameters of natural soils subjected to overburden from a construction embankment, under conditions of a complex soil-water system and one-dimensional consolidation.<br>As part of the project, the student is provided with geotechnical data, soil layer parameters, the groundwater level and load data. The task is to:<br>• determine the geometry of the proposed earthwork structure,<br>• determine the design parameters of the soil,<br>• carry out consolidation calculations,<br>• estimate changes in soil parameters over time,<br>• to present and justify the chosen solution. |
| Practical activites within the subject | Not applicable |

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