GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00070542		
Field of study	Civil Engineering		
Date of commencement of studies	October 2022	Academic year of realisation of subject	2025/2026
Education level	first-cycle studies	Subject group	Optional subject group
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	4	Language of instruction	Polish
Semester of study	8	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 hab. inż. Marcin Cudny	
	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

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	0.0	0.0	30

Subject objectives

Broadening of knowledge in the field of soil mechanics beyond the scope of the undergraduate engineering course. The main objective is to introduce the fundamentals necessary for material modeling at a level that enables conscious and informed numerical modeling of geotechnical problems (the MohrCoulomb model and its advanced extensions implemented in commercial finite element method systems). In addition, the lecture includes an overview of stability analysis methods as well as special cases of active and passive earth pressure, which also complement and extend the knowledge gained in the undergraduate engineering course.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U05] Conducts research (obtaining information, simulations, experimental methods) in the field of construction in order to solve specific tasks and report research results.	Ability to interpret basic laboratory soil tests and to determine mechanical parameters for different material models.	[SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject [SU5] Assessment of ability to present the results of task
[K6_W03] Demonstrate knowledge and understanding of the processes, established standards and design methods in the civil engineering subject area and of their limitations.	Critical assessment of results obtained using analytical methods and numerical modelling. Principles of developing numerical models for basic geotechnical problems, including the selection of constitutive models and parameters.	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects
[K6_K04] Engages in independent lifelong learning and individually follows the development of science and technology in the field of civil engineering.	Knowledge of key international literature and major journals in geotechnical engineering, enabling independent study when addressing new problems not covered in the course.	[SK5] Assessment of ability to solve problems that arise in practice [SK4] Assessment of communication skills, including language correctness
[K6_K01] Is aware of the key aspects of professional, ethical and social responsibility related to management, business operation, decision making and opinion formulation in civil engineering.	Is aware of the professional, ethical and social responsibility associated with the interpretation of geotechnical analysis results and the formulation of engineering opinions and recommendations in geotechnical practice.	[SK5] Assessment of ability to solve problems that arise in practice
[K6_K03] Can effectively, clearly and unambiguously convey information, describe activities and communicate their results/ outcomes to engineers or a wider audience using appropriate communication methods and tools.	Ability to clearly communicate the assumptions, methods and results of geotechnical analyses, including numerical modelling, to both specialist and non-specialist audiences.	[SK1] Assessment of group work skills [SK3] Assessment of ability to organize work

Subject contents

Course content – lecture
Introduction and review of previous knowledge in soil mechanics.

Discussion of necessary notation and key literature.

Shear strength and the MohrCoulomb criterion under various drainage conditions.

Limit equilibrium and numerical methods for stability analysis in geotechnical problems.

Soil stiffness logarithmic and power-type compressibility laws (barotropy).

Changes in soil stiffness with strain (Duncan model and S-curve).

Advanced soil models: Cap-type and Hardening Soil models.

Special cases of active and passive earth pressure.

Soil creep.

Course content – laboratory
Interpretation of oedometer tests (IL and CRS).

Interpretation of triaxial tests (CIU, CID).

Other laboratory soil testing methods.

Prerequisites and co-requisites

Basic courses in soil mechanics, strength of materials, structural mechanics, engineering geology, and mathematics.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
exam	50.0%	70.0%
lab	50.0%	30.0%

Recommended reading

Basic literature

Geotechnical Engineering Handbook, Editor: Urlich Smotczyk, Ernst & Sohn, Darmstadt 2002.
Helwany S.: Applied Soil Mechanics with Abaqus Applications. John Wiley & Sons, Inc., USA, 2007.
Duncan J.M., Wright S.G.: Soil Strength and Slope Stability. John Wiley & Sons, Inc., USA, 2005.
Material Models Manual Plaxis, Bentley, version 2025.
Derski W., Izbicki R., Kisiel I., Mróz Z.: Mechanika Skał i Gruntów, PWN, Elsevier, 1988.
Terzaghi K., Peck R.B., Mesri G.: Soil Mechanics in Engineering Practice, John Wiley & Sons, USA, 1996.
Muir Wood D.: Geotechnical Modelling, Spon Press, Taylor & Francis Group, 2004.

	Supplementary literature	Journals: Inżynieria Morska i Geotechnika (polish) Géotechnique ASCE Geotechnical and Environmental Engineering Computers and Geotechnics Numerical and Analytical Methods in Geomechanics Canadian Geotechnical Journal Geotechnical Testing Journal Soils and Foundations Geotechnik (german)
	eResources addresses	
Example issues/ example questions/ tasks being completed	1. Compare Spencers and MorgensternPrices slope stability methods. Under which slope geometries is each method preferred? 2. What is the difference between Skemptons parameter A and the dilatancy angle ψ? With which mechanical phenomenon observed in soils are these parameters associated? 3. When describing soil behavior under undrained conditions using the MohrCoulomb model, when should Method B be applied and when can Method A be used? Please justify your answer. 4. What are the differences (preferably illustrated with graphs) between the following sets of compressibility parameters: (Cs, Cc); (κ, λ); (κ, λ)? Why is it not possible to determine an exact relationship between Cs and κ or Cs and κ*?** 5. Calculate the settlement of an embankment foundation during construction and operation. Beneath the embankment is a 4 m thick layer of saturated compressible silts resting on a layer of sands with negligible compressibility. The silt layer is slightly preconsolidated (OCR = 1.2) with an effective unit weight γ = 15 kN/m³. The load from the embankment is 50 kPa. The compressibility index from the oedometer test is λ = 0.21, and the recompression index is κ = λ*/5. Assume that the embankment width is much greater than the thickness of the silt layer and neglect consolidation calculations (drained conditions).	
Practical activites within the subject	Not applicable	

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