9.3 CE0912 – Cut Slopes & Embankments Design

(1) GENERAL

SCHOOL	ENGINEERING SCHOOL		
ACADEMIC UNIT	CIVIL ENGINEERING DEPARTMENT		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**CE0912**	**SEMESTER**	**9**
COURSE TITLE	**Cut Slopes & Embankments Design**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
	3	5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialization Course
PREREQUISITE COURSES:	Soil Mechanics (CE0540)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://eclass.uniwa.gr/courses/CIV194/

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Failure mechanisms in soil slopes – parameters that influence the stability. Loading conditions of soil slopes, long term and short term, undrained or drained loading. Soil slope stability analysis. Failure mechanisms of rock slopes – affecting parameters. Kinematically admissibly slides. Rock slope stability analysis. Landslides in soil slopes, causes, activation and remediation. Rock slopes failures, causes, activation and remediation. Embankments design, analysis and construction methods. Landslide instrumentation monitoring of embankments and cut slopes: methods, layout and interpretation.

Upon the successful accomplishment of the course the student will:

- Posses the basic mechanics principles that are included in the slope stability problem.
- Know the geotechnical design parameters and their influence.
- Be able to set up a geotechnical investigation programme (in situ and in the laboratory) for the determination of the geotechnical design parameters and to suggest their values for design.
- Apply numerical methods of slope stability calculations and will know the available numerical analysis packages fot the slope stability calculation.
- Design and analyse natural and cut slopes and embankments with the application of the normative documents (Eurocode)
- Apply in the design methods of seismic analysis of slopes and embankments.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?;.

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Search for, analysis and synthesis of data and information, with the use of the necessary technology*
Adapting to new situations	*Adapting to new situations*
Decision-making	*Decision-making*
Working independently	*Working independently*
Team work	*Team work*
Working in an international environment	*Working in an international environment*
Working in an interdisciplinary environment	*Working in an interdisciplinary environment*
Production of new research ideas	*Production of new research ideas*

The course aims that the student acquires - practice the following general skills:

- Search for, analysis of, and synthesis of data and information, implementing appropriate technologies
- Independent work - Team work - Working in an international / interdisciplinary environment
- Decision-taking
- Proact free, creative and inductive thinking
- Project planning and management

(3) SYLLABUS

1. Introduction: basic principles and definitions, landslide activation mechanism, groundwater influence, Greek case histories.
2. Soil slopes loading conditions: short or long term loading conditions, undrained or drained shearing strength, selection of geotechnical design parameters, parameters that affect the stability of slopes.
3. Soil slopes stability analyses: infinite slope plane failure, plane stress rotational slide (method of slices), slpecial conditions (stiff clays, tension crack effect, groundwater flow conditions, unconfined piezometric level, etc), stability analysis of embankments, influence of rapid impoundment or draw down, influence of the third dimension, design of slopes according to Eurocode, probabilistic design methods
4. Rock slopes stability analyses: determination of kinematically admissible slips (stereographic projection), analysis of planar slip and wedge failure, determination of anchor force, seismic loading influence.
5. Soil slopes landslides: causes and activation of the phenomenon, back analyses of failures, determination of failure limits, the concept of residual shear strength, landslide remediation methods (slope geometry change, drainage system, retaining structures).
6. Rock slope failures: causes and activation of the phenomenon, parameters estimation and analyses methods, rockfall mitigation methods (active and passive protection measures)
7. Embankment design: design assumptions, analysis methodologies and checks, embankments compaction methods, materials and construction technics, principles of reinforced embankments.
8. Instrumentation monitoring: methods, technics, layout, interpretation of instrumentation monitoring.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face in-class teaching. When needed, distance teaching (synchronous/asynchronous)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of I.C.T. in Teaching and Student Communication
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non- directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open- ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Language of evaluation: Greek Written examination, 2,5-hours Problem solving, Multiple choice test, Questions and Answers, Written Essay / Project The evaluation criteria are announced to the students well before the examination; weights per subject /exercise are explicitly indicated. The examination results (including total / partial grading) are announced on the web. Students may require to have access to their tests, they may ask for clarifications on mistakes, grading etc.

Activity	***Semester workload***
In Class (/Distance) Teaching	39
Literature Study	39
Exercises / Paradigms	36
Project assignmenet / Essay	36
Course total	**150**

(5) ATTACHED BIBLIOGRAPHY

Greek Bibliography:

1. Kostopoulos S. 2009. Geotechnical Structures, Analysis of Design and Construction Principles. (in Greek)
2. Anagnostopoulos C, Chatzigogos T., Anastasiadis A., Pitilakis D. 2012. Foundations – Retaining Structures and Geotechnical Works. (in Greek)
3. Komodromos A. 2008. Computational Geotechnical Engineering : Soil – Structures Interaction. (in Greek)
4. Capper, Cassie, Geddes. 2016. Soil Mechanics Applications. (in Greek)
5. Papaspirou S. Embankments Compaction. (in Greek)

Foreign Bibliography:

1. Hoek E., Bray J. 1981. Rock Slope Engineering, CRC Press
2. Eberhardt E. Rock Engineering, Practice and Design. ISRM
3. Bromhead EN. 1992. The Stability of Slopes, CRC Press
4. Duncan JM., Wright SG. 2014. Soil Strength and Slope Stability. Willey.
5. Abramson LW., Lee TS., Sharma S., Boyce GM. 1996. Slope Stability and Stabilization Methods. TRB