Module Descriptor Form

Civil and Environmental Engineering

CL810 - Climatic Hazard To Earth Infrastructure

Module Code	CL810	**Module Title**	Climatic Hazard To Earth Infrastructure				
Module Registrar	Tarantino, Prof Alessandro						
Other Staff Involved							
Credit Weighting	10	**Semester**	1	**Elective**	No	**Academic Level**	5
Pre-requisites	CL217, CL314						
Required for							

Module Format and Delivery (hours):

Lectures	Tutorials	Assignments	Labs	Private Study	Total
24	16	30	0	30	100

Educational Aim

This module aims to:

This module aims to introduce advanced tools to analyse geotechnical structures at the ultimate limit state taking into account the effect of climate loading

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Syllabus

This module will teach the following:

Topic 1: Water flow in saturated and unsaturated soils
Concept of suction, water retention behaviour, mass balance equation, Darcy's law for unsaturated porous media, water flow equation for saturated/unsaturated porous media, analytical solutions for uncoupled flow, 'engineering' approach for conservative analysis of uncoupled water flow, Penman-Monteith equation and modified Feddes function to model the 'evapotranspiration' hydraulic boundary condition.

Topic 2: Shear strength of unsaturated soils
Extension of Mohr-Coulomb criterion to unsaturated soils, characterisation of shear strength of unsaturated soils using conventional equipment

Topic 3. Analysis of climate-induced collapse of engineered and natural slopes
Plane-strain. Rigid-perfectly plastic behaviour. Plastic deformation and associated flow rule. Lower and upper bounding theorem of plastic collapse and application to drained and undrained analysis. Stability analysis of excavations (including critical height of vertical cuts). Analytical and numerical analysis of climate-induced instability. Case studies.

Topic 4. Nature-based adaptation measures
Effect of the root zone on hillslope hydrology and beneficial impact on stability. Effect of evapotranspiration on soil suction and hydraulic conductivity and beneficial impact on stability.

Learning Outcomes

On Completion of the module, the student is expected to be able to:

LO: 1	Understand and characterise the hydro-mechanical behaviour of soils under saturated and unsaturated conditions
LO: 2	Understand and model ground-climate interaction
LO: 3	Assess climatic hazard to engineered and natural slopes
LO: 4	Use numerical codes to analyse the response of plant-based adaptation measures for earth infrastructure

(UK SPEC suggests no more than 4 learning outcomes per module. Statements must be broad and be syllabus free and link in with the intended learning outcomes on the programme specifications.)

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Assessment of Learning Outcomes - Criteria

Learning Outcome: **1**

	Criteria
1	C1 Ability to estimate shear strength parameters of soils under unsaturated conditions from routine geotechnical data.
2	C2 Ability to estimate hydraulic parameters of soils under unsaturated conditions from routine geotechnical data.

Learning Outcome: **2**

	Criteria
1	C1 Ability to quantify potential evapotranspiration from meteorological data
2	C2 Ability to model the effect of evapotranspiration and rainfall on groundwater regime

Learning Outcome: **3**

	Criteria
1	C1 Ability to calculate critical height of excavation
2	C2 Ability to analyse collapse conditions of slopes subjected to climatic loading

Learning Outcome: **4**

	Criteria
1	C1 Ability to assess the effect of higher hydraulic conductivity of the root zone on slope stability
2	C2 Ability to analyse the effect of evapotranspiration on slope stability

Assessment Method(s) Including Percentage Breakdown and Duration of Exams

To Pass the module, students need to gain a summative mark of: 50%

Description	Semester	Start Week	Duration	Weight	Submission Week	Linked Criteria
Coursework	1	1		30%	10	
Exam. Closed Book	1		3.00	70%	E	

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Principles of Assessment Feedback

Principle 1. Assessment and feedback practices promote effective student learning
Feedback is provided in real-time in an interactive fashion. Students are asked to solve problems of different level of complexity during the lecture and the lecture is tuned to the gaps shown by the students. In tutorials sessions, students are asked to become teachers by explaining tasks

Principle 2. Assessment and feedback practices are appropriate, fair, and transparent
These are discussed with the students at the beginning of the course and students' comments are taken into account

Principle 3. Assessment and feedback practices are clearly communicated to students and staff
These are discussed with the students at the beginning of the course and any point during the course should practices be revised

Principle 4. Assessment and feedback practices are continuously reviewed
We made use of mid-term questionnaires design to possibly adjust teaching approach

Additional Information

Resit Procedure

• Re-examination consists of exam only if the summative mark (exam + coursework) is lower than 50% and the exam mark is lower than 50% (regardless of the coursework mark). Resit mark is the maximum between resit exam only (100%) or resit exam + coursework (70/30%)

• Re-examination consists of individual coursework only if the summative mark (exam + coursework) is lower than 50% and the exam mark is equal or greater than 50%. Resit mark is given by exam + resit coursework (70/30%)

Recommended Reading

**Highly recommended reading *For reference

**Tarantino, A & Di Donna, A. (2019). Mechanics of unsaturated soils: simple approaches for routine engineering practice. Italian Geotechnical Journal.
**Craig, R.F. & Knappett, J.A., Craig's Soil Mechanics, 8th edn., (2012) Spon Press, ISBN 978-0-415-56126-6.
*Powrie, W., Soil Mechanics; Concepts and Applications, 2nd edn., (2004), Spon Press, ISBN 0-415-31156-X.
*Atkinson, J.H., Mechanics of Soils and Foundations, 2nd edition (2007). CRC Press, ISBN 978-0-415-36256-6.

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Module Timetable

Week	Semester 1	Semester 2
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10	Submission 30%	
11		
E	Examination 70%	

Date of Last Modification

10-09-2025