MSC programmes at CEG
Cross-over modules information booklet

TU Delft

Cross-over modules introduction

In the 6th quarter of the Master of Science (MSc) programmes of Civil Engineering, Environmental Engineering and Applied Earth Sciences, the Cross-over (CO) modules take place. Cross-over modules are 10 credit modules offered to students of the 3 programmes of our faculty. In general, these modules may be of two kinds: a) methodological, which are oriented around common techniques and methods or b) topical, that are oriented around common topics of interest. These module "types" are not mutually exclusive of each other since methodological COs will also include different topics, while topical oriented COs may also introduce new methodologies and techniques. In most modules however, one of the two types is more clearly present than the other.

Each cross-over module spans the domain of at least two of the three MSc programmes in order for students to expand their current expertise, learn from other programmes and learn to properly function in a multidisciplinary environment. A large number of instructors have gone through a design process for these modules starting in October 2021. This booklet introduces the 9 Cross-over modules that will be offered and indicates the main characteristics of each module such as key topics, form of instruction and form of assessment. If you are planning to follow a CO module we hope this booklet will give you extra information to help you making your choice. You can always reach module managers for additional information. We wish you all the best in the last steps of your studies and hope to see you in one of our CO modules.

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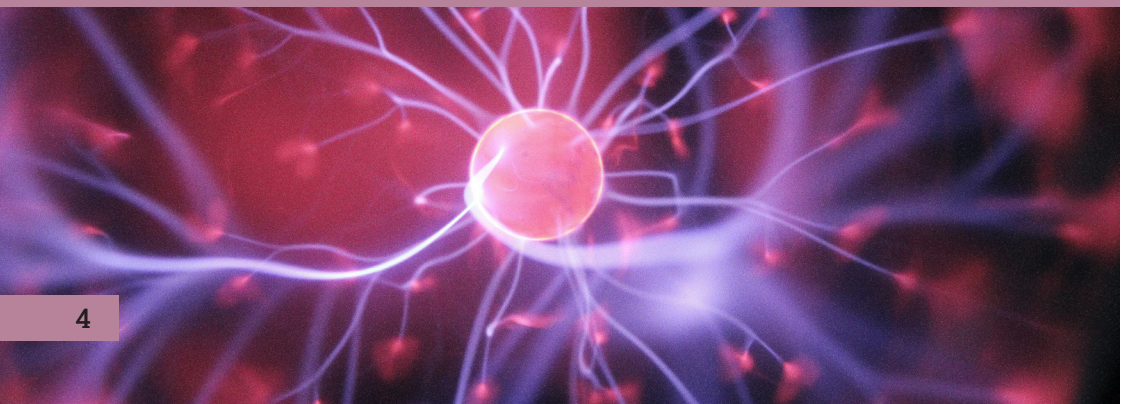
Data Science and Artificial Intelligence for Engineers (DSAIE)

In the era of digitalization, engineers require enhanced data-related skills to solve outstanding challenges. This module teaches students how to use data science and artificial intelligence to tackle engineering problems related to the natural, the living and the built environments. You will learn foundational as well as advanced topics, moving from basic data handling skills to state-of-the-art machine learning techniques (e.g., Deep Learning). You will work on realistic datasets and learn how to develop workable solutions in Python and PyTorch.

Skills: Analysis of complex problems | critical thinking | coding | project management | team work | written and oral communication.



Unit 1: Probabilistic Machine Learning	**Unit 2:** Deep Learning	**Unit 3:** Project
Key topics		
• Regression and Classification • Probabilistic Machine Learning • Kernel Methods • Clustering and Mixtures	• Convolutional neural networks • Recurrent neural networks • Physic-based machine learning • Generative AI and Large Language Models	• Group work • Application of acquired skills on real case studies
Form of instruction		
Lectures Coding workshops	Lectures Coding workshops	Group work
Assessment		
Individual ANS exam (50%)		Code repository + Final presentation (50%)

Module manager: Riccardo Taormina

Scan the QR code for more info!

Engineering for Global Development

Many Delft engineers mobilize their skills within global engineering initiatives promoting societal development. As views on what is desirable development are diverse, engineering solutions are always positioned within a social political debate. With the use of several workshops including discussions, guest lectures, design sessions etc. and a project in a team of 5 to 7 students based on a real life issue, students learn how to recognize different ideas, how to engage their own expertise within debates with experts and other stakeholders, and how to employ co-creative practices when developing technologies.

Skills: Analysis of societal positions | reading texts | analysis of positions in discussions | discussion skills | multi-disciplinary problem solving | project management | written and oral communication | teamwork.

Unit 1: Engineering and Development 1	**Unit 2:** Engineering and Development 2
Key topics	
• Development theory, including the role of technology • Processes of co-creation and stakeholder analysis • Engineering design approaches and interventions • Sustainable development goals	• Design teams working on a specific challenge • Team working sessions under guidance of a moderator • Exchange meetings between teams (discussions and workshops) • Reporting on team results • Presenting team results in different formats
Form of instruction	
Workshop, discussions and design sessions	Workshop, discussions and design sessions
Guest lectures	Guest lectures
Assessment	
Individual essay on a theme (50%)	Individual feedback essay (50%)

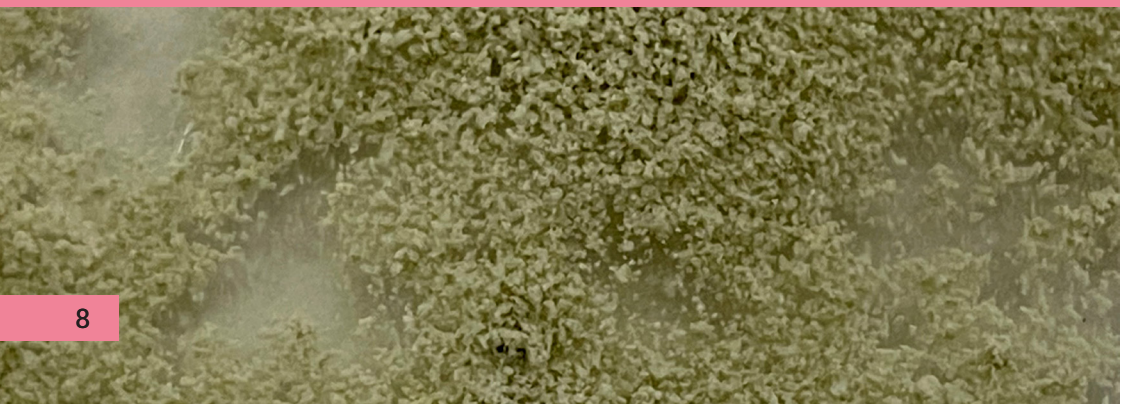
Module manager: Maurits W. Ertsen

Scan the QR code for more info!

From Sediments and Sludges to Solids and Soils

Sediments, sludges and slurries are mixtures of mineral clay, organic material and water. Sediment and slurries are dredged for port maintenance purposes. Sludges are a by-product of water treatment plants. Slurries and sludges are dewatered before disposal or reuse in engineered constructions like dikes or land reclamation, hereby becoming soils. In this module, the biochemical and physical properties of sediments, sludges and soils will be reviewed. The way to assess these properties will be studied using a large variety of techniques, in the laboratory as well as in the field. Module activities comprise interactive lectures, group assignments and practical work.

Skills: Building state-of-the art documentation | Problem definition | Critical thinking | Multi-disciplinary analysis | Transdisciplinary problem solving | Multilevel communication and reporting.



Unit 1: From Suspensions to Slurries	**Unit 2:** From Slurries to Soils	**Unit 3:** In-situ Characterization of Sediments
Key topics		
• Microscopic properties of clay and organic matter • Flocculation of particles • Properties of slurries	• Changes in sediment properties • Processes and their environmental impact	• Monitoring in-situ properties of sediments
Form of instruction		
Interactive lectures	Interactive lectures	Interactive lectures
Selfstudy of articles/ reports	Selfstudy of articles/ reports	Selfstudy of articles/ reports
Laboratory and field work	Laboratory and field work	Laboratory and field work

Assessment

Individual exam (60%)

Group exam about a case study (40%)

Module managers: Claire Chassagne, Julia Gebert, Alex Kirichek, Evert Slob, Bas Heijman and Jules van Lier
Scan the QR code for more info!

Monitoring of Structural Health and Geohazards

Lifecycle engineering is currently one of the great challenges in civil and geotechnical applications. Rapid developments in sensor technology and monitoring techniques has opened many possibilities in this domain. In this module, you will be introduced to a large variety of state-of-the-art monitoring options that can nowadays be used to assess the health and integrity of civil structures, rock, and soil masses. You will learn how to process and interpret data for monitoring purposes, and how to create and update models from the data. The module is taught using theoretical sessions on monitoring methods and data collection/processing, live coding sessions, and workshops. We conclude with case study projects in which you apply your gained knowledge to real-world monitoring problems in different domains.

Skills: Information collection and evaluation | project management | collaboration | written and oral communication.

Unit 1: Theory & Techniques

Key topics

- Degradation & failure mechanisms
- Sensors, data acquisition, and advanced signal processing
- Inversion and prediction techniques
- System identification and model updating
- Feature engineering, deep learning, anomaly detection, and decision-making

Form of instruction

Theoretical teaching sessions

Live coding sessions, workshops

Assessment

Case study 1 report (35%)
Case study 2 report (35%)
Written exam (30%)

Unit 2: Case studies

Key topics

- Monitoring case studies in the domain of civil engineering and geosciences
- E.g. structural health monitoring of bridges, or monitoring changes of the surface or in the subsurface
- Executed in combined groups

Form of instruction

Theoretical teaching sessions

Workshops

Module manager: Eliz-Mari Lourens

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Noise and Vibration: Generation, Propagation and Effect on Humans and Environment

Noise refers to the unpleasant, loud, and disruptive sound that arises from structural vibrations. While urban noise and vibrations from transportation or construction works bring a negative influence on human health, underwater noise pollution (from pile driving, seismic surveys, etc.) threatens the living space of marine mammals and fish. In striving for a sustainable environment, tackling noise pollution and excessive vibrations is crucial. In this module, you will learn the fundamentals of noise and vibrations by focusing on (i) structural vibrations generating noise, (ii) propagation of waves, (iii) noise and vibrations perception by inhabitants, and (iv) noise and vibration control strategies to mitigate adverse effects on the urban and marine environments.

Skills: Analysis of complex (multi-cause) problems | data collection and evaluation | multi-disciplinary and integral problem solving | project management | written and oral communication | teamwork.

Unit 1: Theory	**Unit 2:** Project

Key topics

- Fundamentals of acoustics and vibrations
- Urban and underwater noise and vibrations
- Analysis of noise generation by structural vibrations
- Effect of noise and vibrations on humans and other species
- Noise control strategies

- Eye on real-life applications
- Interdisciplinary groups

Form of instruction

Laboratory tests

Field tests

Lectures and hands-on workshops

Group work on project

Assignments and self-study

Feedback sessions

Assessment

Report and in-class presentation (100%)

Module manager: Apostolos Tsouvalas

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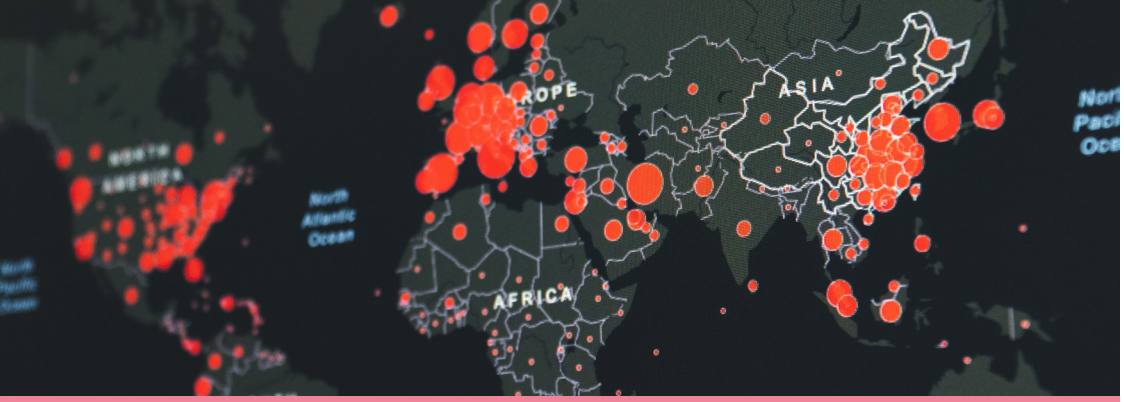
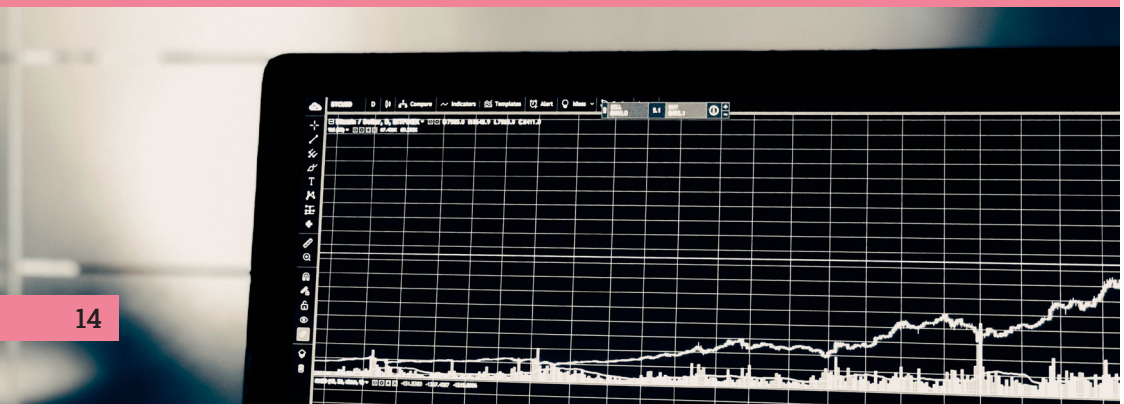


Probabilistic Modelling of real-world phenomena through ObseRvations and Elicitation (MORE)

Real-world phenomena (e.g., rainfall, earthquakes, cars crossing bridges, ocean waves) are random and unpredictable! How can we take this into account in our engineering research and design? In this module, you will use advanced probabilistic methods that incorporate observations and expert opinion to support decisions that make our lives safer and more manageable. The module is of the methodological type, and you will also learn how to translate theoretical knowledge into computer codes. As part of this course, you will apply the methods learned in an interdisciplinary group project around a specific theme of your choice.

Skills: Analysis of complex real-world phenomena | discussion skills | multi-disciplinary problem solving | project management | written and oral communication | teamwork.



Unit 1:
Theory and applications

Unit 2:
Group project

Key topics

- Nonstationary extreme value analysis
- Data assimilation
- Expert judgment
- Multivariate probability via copulas, vine-copulas and Bayesian networks

- Interdisciplinary projects
- Group of 4 students
- Your choice of topic
- Project theme example: reliability of aging infrastructure under a changing climate

Form of instruction

Lectures

Group work

Weekly assignments

Assessment

Individual oral exam (50%)

Written report (50%)

MORE Info and Examples Here!

Module manager: Elisa Ragno

Scan the QR code for more info!

Resilient Deltas

This topical cross-over deals with the societal challenge of making deltas resilient to climate change, subsidence, unprecedented economic growth and urbanisation. Future increases in sea level rise, droughts, extreme precipitation and flooding can have adverse effects on the physics and dynamics of delta's, salt intrusions and groundwater, which requires new delta interventions to be developed. The focus is on deltas globally, using the Dutch Delta as a nearby example and laboratory.

Skills: metacognitive skills | collaboration | project management | communication.

Unit 1: Physics of the Delta System	**Unit 2:** Climate Change and Scenarios	**Unit 3:** Adaptation Pathways for Deltas

Key topics

• Interaction of atmospheric, fluvial and marine processes • Response of delta system to human interventions and sensibility to climate change	• Statistical and dynamical downscaling techniques and longterm observational datasets • Application on different regions	• Develop new delta technologies • Use of Dynamic Adaptive Policy Pathway method • Guided by SCRUM project management

Form of instruction

Lectures	Lectures	Workshops and fieltrip
Quizzes/ theory test	Quizzes/ theory test	Computer labs
	Computer labs	

Assessment

Individual written exam (40%)	Proposal adaptation pathway / solution for delta, written or oral (60)%

Module manager: Joep Storms

Scan the QR code for more info!

Subsurface Storage for Energy, Water and Climate Applications

The subsurface is increasingly used to store fluids associated with energy and for climate change mitigation. There are many potential technologies, and each has its place. In this module, the key technologies which are available and underdevelopment are detailed, including key aspects of flow of fluids in the subsurface. These concepts are utilised to evaluate the technologies, such that we can efficiently use the subsurface. Students will move from broad concepts and theoretical concepts to modeling real systems.

Skills: Analysis of complex (multi-cause) problems | information collection and evaluation multi-disciplinary and integral problem solving | project management | written and oral communication | teamwork.

Unit 1: Subsurface Storage of Heat, Solute and Compressible fluid

Key topics

- Subsurface storage technologies
- Modeling of heat, solute and compressible fluid transport
- Reactivity and effect on transport
- Coupled behaviour of processes

Form of instruction

Lectures

Computer modelling exercises

Assessment

Portfolio of individual learning activities (50%)

Unit 2: Storage Design and Evaluation Project

Key topics

- Evaluation of energy scenario and most appropriate storage concept
- Present a detailed design

Form of instruction

Group work

Computer modelling

Assessment

Group report and presentation (50%)

Module managers: Mark Bakker and Hadi Hajibeygi

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Sustainable Cities: Ecoengineering Solutions for Climate Resilient and Healthy Cities

Current society desires sustainable cities and therefore aged or desolate cities and infrastructures need to be converted to climate resilient, healthy, liveable and circular ones. In this module an existing city quarter is quantitatively analysed for climate resilience and environmental quality, followed by a review of possible nature-based improvement methods, concepts and products. Finally, in a case study assignment, the gathered knowledge is applied by designing an integral naturebased solution.

Skills: Analysis of complex (multi-cause) problems | information collection and evaluation multi-disciplinary and integral problem solving | project management | written and oral communication | teamwork.

Unit 1: Assess	**Unit 2:** Review	**Unit 3:** Design

Key topics

• Site visit • Build a sensor • Quantitive analysis of its current state	• Review of specific techniques and methods for solving problems found in area • Focus on green/ eco-engineering solutions	• Integral solutions will be proposed and evaluated • Teamwork with differen track backgrounds • Critical review of design solutions

Form of instruction

Lectures	Lectures	Group work
Case study portfolio	Case study portfolio	
Workshop and excursion	Peer review	

Assessment

Individual exam (30%)	Individual case study portfolio (70%)

Module managers: Henk Jonkers and Marc Ottele

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Notes

Colophon

Cross-over modules, Msc Civil Engineering, Environmental Engineering and Applied Earth Sciences. Faculty Civil Engineering and Geosciences, Technical University Delft.
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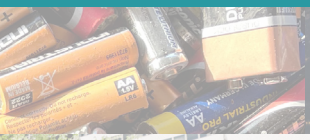




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