Master in Civil Engineering

Intern. Program of Hydraulics and Civil Engineering

http://master-hydraulic.grenoble-inp.fr/

ENSE³ — GreEn-Er

École Nationale Supérieure de l'Énergie, l'Eau et l'Environnement
21 Avenue des Martyrs
CS 90624
38031 GRENOBLE Cedex 1 — FRANCE

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Program Director
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v092023

M2 program description

Semester 3

Sept. — Jan.

5 compulsory modules
2 optional modules (among 6)

Semester 4

Feb. — Aug.

6 months internship (private companies, research lab., etc.)

- Job in a private company
- Ph. D.

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M2 HCE

Semester 3
30 ECTS, 300 Teaching Hours

5 compulsory modules

- **River Dynamics**, 6 ECTS, 60 h
- **Flood Propagation and Mitigation**, 4 ECTS, 40 h
- **Mechanical Structure Design**, 6 ECTS, 60 h
- **French as a Foreign Language,** 2 ECTS, 40 h
- **Professional skill support,** 10h

2 optional modules (among 6)

- **Water Quality and treatment**, 6 ECTS, 60 h
- **Water Management in a non stationary environment**, 6 ECTS, 60 h
- **Natural Hazards and Soil Improvements**, 6 ECTS, 60 h
- **Asset Management for Civil Engineering Works and Networks,** 6 ECTS, 60 h
- **Hydraulique maritime et hydraulique urbaine,** 6 ECTS, 60 h
- **Advanced Simulation Tools for Mechanics,** 6 ECTS, 60 h

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Semester 3 : compulsory modules description

▪ **River Dynamics**, 6 ECTS, 60 h

Module leader

Prof. Éric BARTHELEMY

— Objectives and Content —

Course 100% in English

First part: fluvial dynamics

- Understand the physics and the modeling of unsteady flows in the rivers and canals (propagation of the tide, floods and of rapidly varying flows in the rivers and canals)
- Saint Venant equation formulation
- Design the volume of retention dams for flood protection
- Understanding the links between the physical reality, its perception and its modeling
- Brief presentation of the market software properties dealing with this problem

Second part: sediment transport

- Students will become acquainted with the pluridisciplinary aspects of this topic
- Student will be asked to master: the concept and the quantitave determination of sediment mouvement inception, computation of sediment transport rates, the concept of sedimentary equilibrium (river bed slope, grain size distributions), engineering tools of the field

Lecture courses	32h
Tutorial classes	12h
Engineering work	8h
Practicals	8h
Exams	*4h*
Optional learning support	*10h*

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Semester 3 : compulsory modules description

Flood Propagation and Mitigation, 4 ECTS, 40 h

— Objectives and Content —

First part: Flood propagation
- Hydraulic modelling of rivers with HEC-RAS (Hydrologic Engineering Centers River Analysis System)

Second part: Hydraulic Structures
- Hydraulic design of structures

Course 100% in English

Lecture courses	8h
Engineering work	32h

Module leader

Dr. Isabella ZIN

Mechanical Structure Design, 6 ECTS, 60 h

— Objectives and Content —

- Understanding and modelling of mechanical behaviour of geomaterials
- Global understanding of the design phase of a structure
- Comprehension and modelling of a structure including its foundation.

Course 100% in English

Lecture courses	52h
Engineering work	8h
Exams	*3h*
Optional learning support	*10h*

Module Leader

Prof. Gaël COMBE

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Semester 3 : compulsory modules description

- **French as a Foreign Language (FLE),** 2 ECTS, 40 h

— Objectives and Content —

During 10 weeks, 4hours of FLE per weeks
Grade level small group

Lecture courses	40h

- **Professional Skills Support,** 10h

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Semester 3 : Optional modules description

Asset Management for Civil Engineering Works and Networks, 6 ECTS, 60 h

— Objectives and Content —

- Understanding of modeling tools used to describe the change over time of structures and their functioning
- Developing strategies for monitoring, assessment and diagnosis of civil engineering structures and networks (water and wastewater networks, dams, dikes, tunnels and railways)
- Knowledge of physical phenomena of degradation of materials and structures, knowledge of the main pathologies
- Being able to choose among the main techniques for structures rehabilitation and to know the respective impact on their serviceability and safety.

Course partially taught in French

Lecture courses	20h
Tutorial classes	26h
Engineering work	14h
Exams	*3h*
Optional learning support	*10h*

Module Leader

Prof. Frédéric DUFOUR

MONDAY MORNING

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Semester 3 : Optional modules description

❋ Hydraulique maritime et hydraulique urbaine, 6 ECTS, 60 h

Objectifs

- Cette UE vise à donner un éclairage particulier sur certains aspects liés à l'hydraulique et aux aménagements, tant en milieu urbains, en milieu littoral ou milieu naturel. Il vient en complément de modules plus disciplinaires rencontrés par ailleurs au cours de la formation.
Le module comprend 3 parties correspondant à une physique particulière et aux aménagements associés.

Course 100% in French

Module Leader

Assoc. Prof.
Philippe SECHET

MONDAY MORNING

Content

Le module comprend 2 parties :
Hydraulique maritime : ce cours vise à familiariser les étudiants avec la dynamique de la zone littorale, via : (i) L'analyse des niveaux de l'océan (ii) La compréhension de la génération des états de mer (iii) La maitrise de la propagation des houle, de leur réfraction, diffraction et réflexion en zone littorale (iv) La connaissance des principaux systèmes morphologiques littoraux (v) L'analyser des impacts sédimentaires à long terme des ouvrages littoraux (vi) Le dimensionnement des ouvrages de protection du littoral
Hydraulique urbaine : ce cours vient en complément des disciplines théoriques vues au s3 et s4. Après de bref rappel d'hydrologie urbaine, le cours se consacre au dimensionnement d'ouvrage en réseaux d'assainissement en prenant en compte leur spécificité. Le cours est complété par un mini projet sur le dimensionnement d'un mini réseau d'assainissement séparatif incluant certains ouvrages spéciaux (station de relevage, bassins de rétentions,...) afin d'utiliser de manière intégrée les outils de dimensionnement vus en cours.

Lecture courses	44h
Engineering work	16h
Exams	*3h*

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Semester 3 : Optional modules description

❋ Advanced Simulation Tools for Mechanics, 6 ECTS, 60 h

Course 100% in English

Module Leader

Ass. Prof.
Julien CHAUCHAT

WEDNESDAY AFTERNOON

Objectives

• Aquire a knowledge on the numerical methods for solving coupled and heterogeneous non-linear problems, methods for interface tracking (free surface flows) and discrete element methods (DEM) for modeling the granular microstructure.
• Aquire a knowledge of the state of the art models of turbulence (RANS / LES / DNS) and models for particulate transport (passive scalar and two-phase flow).
• Aquire a knowledge on how to set-up an advanced simulation tool for solving problems in mechanics and control the quality of the resulting solution.

Content

• Numerical methods for nonlinear coupled, heterogeneous problems, interface tracking and discrete element method
• Models and simulation of turbulence
• Models for particles transport / sediment (passive scalar and two-phase flow

Lecture courses	28h
Engineering work	32h
Exams	*4h*

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Semester 3 : Optional modules description

- **Water Quality and treatment**, 6 ECTS, 60 h

— Objectives and Content —

- Understand and model pollutions transfer processes on natural ponds & urbanized area
- Understand their impact on the natural and urban environment
- Develop strategies in terms of planning and pollution control to limit these impacts
- Ensure the production of water suitable for various uses (domestic, industrial, ...).

Course 100% in English

Module Leader

Assoc. Prof. Philippe SECHET

FRIDAY MORNING

Lecture courses	20h
Tutorial classes	26h
Engineering work	6h
Practicals	8h
Exams	*3h*
Optional learning support	*10h*

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Semester 3 : Optional modules description

❋ **Water Management in a non stationary environment**, 6 ECTS, 60 h

Course 100% in English

Module Leader

Prof. Anne-Catherine FAVRE

Objectives

- To be able to produce regionalized (spatial) data using several methods.
-To understand notions of meteorology and climatology required for hydrological forecasting.
- To be aware of the need to take into account non stationarities (climate or change in land use) in long-term hydrological forecasting and management of water resources.
- To be able to apply new methodologies for hydrological forecasting at several lags.

Content

An approach linked with research is privileged in this in-depth module.
It is divided into three parts:
i - Meteorology and climatology.
ii - Geostatistics and spatial data;
iii - Forecast and management of water resources in a non stationary context.

A short-project in the module called "Engineering of hydraulic structure" III will allow to link the three areas teached in this module.

FRIDAY AFTERNOON

Lecture courses	48h
Engineering work	8h
Practicals	4h
Exams	*3h*
Optional learning support	*10h*

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Semester 3 : Optional modules description

* **Natural Hazards and Soil Improvements**, 6 ECTS, 60 h

Course 100% in English

Module Leader

Prof. Fabrice EMERIAULT

Objectives

- To understand the tools used for defining the regional and local seismic hazard
- Advanced knowledge of soil dynamics and the associated mechanical phenomena (including liquefaction)
- To know how to design a structure considering the seismic hazard (including dams, natural slopes, retaining structures and foundations)
- Knowledge of physical and mechanical phenomena at the origin of gravity risk (landslide, rock fall, avalanche)
- To understand the behavior of unsaturated soils and the impact on the stability of structures or natural slopes
- Knowledge of the main techniques used for improving soil and the design of protec structures

FRIDAY AFTERNOON

Content

This course provides an overview of the issues natural hazards and climate change on the stability of structures (especially related to the transition between unsaturated and saturated soil). It covers in particular the seismic risk and the slope stability. The physical and mechanical phenomena induced in the soil and structures are addressed. The consequences in terms of stability of structures and natural slopes are analyzed. Finally the techniques usually used for risk mitigation (including soil improvement or installation of protective structures) are identified and discussed in more depth in the context of a design project.

Lecture courses	30h
Tutorial session	8h
Engineering work	22h
Exams	*3h*
Optional learning support	*10h*

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Semester 4
30 ECTS

- **5 months intership**

Internship in
Industry
or
Research lab

Time slot for
your defence :
1st week of July
Or
From 2nd week of Sept.

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Hydraulics and Civil Engineering

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