
ENGINEERING PROGRAMME

2025-2026

Year 2 / Year 3

Specialisation option

Civil Engineering and Sustainable Construction

OD GC2D

PROGRAMME SUPERVISOR

Benoit HILLOULIN



ENGINEERING - OD GC2D

Autumn Semester

Course unit	ECTS Credits	Track	Course code	Title
UE 73	12	Core course	GCBMC GCCPS GCPHY GCSOL	Civil engineering materials Structural calculations Mechanics and physics of materials Soil and rock mechanics
UE 74	13	Core course	GCBA1 GCCAS GCCEO GCMOD P1GC	Reinforced concrete Case studies Geotechnical Engineering Methods and management Project 1

Spring Semester

Course unit	ECTS Credits	Track	Course code	Title
UE 83	14	Core course	GCECO GCMBA GCSIS GCURB P2GC	Eco Construction and mixed Constructions Structural design 1 Earthquake Engineering Civil engineering projects and urban planning Project 2

ENGINEERING - OD GC2D

Year 2 / Year 3 - Autumn Semester - Course Unit 73 / 93

Civil engineering materials [GCBMC]

LEAD PROFESSOR(S): Ahmed LOUKILI

Objectives

The purpose of this course is to give future designers basic data on the physical, chemical and mechanical properties of the materials used in building design.

Soil mechanics is an essential discipline in civil engineering. This course aims to present the essential concepts of this discipline while framing it in the context of the mechanics of continuous media, and experimental geotechnics.

Course contents

- cement manufacturing,
- cement hydration,
- concrete formulation,
- sustainability

Definition and identification of soils

- Soil mechanics
- Soil hydraulics
- Soil consolidation
- Shear strength of soils

Course material

A. Neville "Propriétés des bétons",
F Schlosser "Eléments de mécanique des sols" Presses de l'école nationale des Ponts et Chaussées

Skills developed through this course

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure / Responsible consumption and production / Sustainable cities and communities

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	22 hrs	8 hrs	0 hrs	0 hrs	2 hrs

ENGINEERING - OD GC2D

Year 2 / Year 3 - Autumn Semester - Course Unit 73 / 93

Structural calculations [GCCPS]

LEAD PROFESSOR(S): Emmanuel ROZIÈRE

Objectives

General objective: to master the data and calculation techniques, in order to understand better the behavior and the dimensioning of the structural elements justified in the design office.

Specific objectives :

Apply solid mechanics to solving static problems: trusses, beams.

Determine the degree of hyperstaticity of a structure and choose the appropriate resolution method.

Determine the actions and stresses and deduce the stresses in the sections.

Course contents

- Forensic engineering: case studies of structural collapses. Introduction to social responsibility and ethics in the construction sector
- General elements: loads, mechanical connections, modelling assumptions, degree of static redundancy, Eurocodes
- Bending of beams
- Statically indeterminate structures: stress, displacement, continuous beams
- Three-moments method and Force method
- Buckling

Skills developed through this course

Sustainable Development Goals (SDGs) covered by this course

Decent work and economic growth / Industry, innovation and infrastructure / Responsible consumption and production

Sustainable Development and Social Responsibility Positioning

Introduction to social responsibility and ethics in the construction sector. Presentation of the overall principle of structural design (Eurocodes), where the main objective is user safety. Models enable the optimisation of design and quantity of materials for a given use.

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	22 hrs	8 hrs	0 hrs	0 hrs	2 hrs

ENGINEERING - OD GC2D

Year 2 / Year 3 - Autumn Semester - Course Unit 73 / 93

Mechanics and physics of materials [GCPHY]

LEAD PROFESSOR(S): Frédéric GRONDIN

Objectives

The diversity of disciplines in civil engineering today is accompanied by a move towards ever increasingly precise requirements and tool developments. The engineer in charge of monitoring projects needs to have a multidisciplinary background, to adopt a transversal approach to problem solving and to select the appropriate methods. To achieve these objectives, the engineer must work on two levels: fundamental physics and applied physics.

This course aims to introduce the essential elements of general physics relevant for addressing civil engineering problems. It provides a refresher on core knowledge and presents the fundamentals necessary to understand all the other courses of the Civil Engineering Specialisation.

Applications concern an introduction in mechanics of structures, the heat and moisture flux into materials for the building envelop, and acoustic insulation methods.

Course contents

- Introduction to the finite element modelling of heat flux.
- Introduction to mechanics of structures.
- Mechanics of porous media.
- Radiation and heat propagation.
- RE 2020
- Moisture transfert in building.
- Acoustic waves.

Course material

"Traité de physique du bâtiment, Tome I, Connaissance de base", Centre Scientifique et Technique du Bâtiment, 1995.

Skills developed through this course

Sustainable Development Goals (SDGs) covered by this course

Climate action / Responsible consumption and production / Sustainable cities and communities

Sustainable Development and Social Responsibility Positioning

This course in building physics aims to provide the scientific foundations necessary for the design of energy-efficient, comfortable, and resource-saving buildings. It is fully aligned with the objectives of sustainable development, particularly those related to energy, climate, and sustainable cities, and contributes to the training of engineers who are aware of their social and environmental responsibility.

Assessment

Collective assessment: EVC 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	22 hrs	8 hrs	0 hrs	0 hrs	2 hrs

ENGINEERING - OD GC2D

Year 2 / Year 3 - Autumn Semester - Course Unit 73 / 93

Soil and rock mechanics [GCSOL]

LEAD PROFESSOR(S): Giulio SCIARRA

Requirements

Continuum mechanics of solids and fluids

Objectives

Introduction to soil and rock mechanics in the framework of continuum mechanics: constitutive law, solid-fluid interaction, failure conditions.

Course contents

Physical properties of soils
Continuum mechanics applied to soils
Hydraulics
Consolidation theory
The shear strength of soils
Mechanical behavior of rocks

Course material

François Schlosser *Eléments de mécanique des sols* Presses de l'école nationale des Ponts et chaussées 2003
Polycopié *Mécanique des Sols - Eléments de Mécanique des Sols et de Géotechnique* Y.Riou

Skills developed through this course

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure / Sustainable cities and communities

Sustainable Development and Social Responsibility Positioning

The course aims to provide students with introductory knowledge in the field of geotechnics in order to train them to critically analyze cutting-edge projects in the increasingly important field of sustainable construction.

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	22 hrs	8 hrs	0 hrs	0 hrs	2 hrs

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Year 2 / Year 3 - Autumn Semester - Course Unit 74 / 94

Reinforced concrete [GCBA1]

LEAD PROFESSOR(S): Ahmed LOUKILI

Objectives

Reinforced concrete structures: introduction to the calculation, verification and dimensioning of reinforced concrete elements (BAEL 91 and Eurocode2).

Course contents

- General information on the design of reinforced concrete structures.
- Works security concepts.
- Evaluation of the stresses, limit load and operation.
- Principle justifications of the ultimate limit state (ULS) and service (ELS).
- Calculation of elements in simple compression and bending.
- Justification of the steel-concrete adhesive bonding, anchorage and training.
- Construction provisions.

Course material

- Les bétons, base de données pour les formulations (Editions. Eyrolles)
- BAEL91 and Eurocode 2
- Béton Armé Guide de calcul (J. LAMIRAULT, H.RENAUD - Editions Foucher)

Skills developed through this course

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure / Sustainable cities and communities

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	22 hrs	8 hrs	0 hrs	0 hrs	2 hrs

ENGINEERING - OD GC2D

Year 2 / Year 3 - Autumn Semester - Course Unit 74 / 94

Case studies [GCCAS]

LEAD PROFESSOR(S): Benoit HILLOULIN

Objectives

Implement, analyse and interpret standard laboratory tests on concrete (hydraulic cement) and geomaterials.

Course contents

Concrete:

Lab 1 - Cement and Mortar

Lab 2 - Characterisation of concrete composition

Lab 3 - Concrete composition

Lab 4 - Preparing and adjusting concrete composition

Lab 5 - Simple bending test on reinforced concrete beams

Lab 6 - Determination of the mechanical characteristics of concrete using destructive and non-destructive methods

Soil mechanics:

Session 1: Identification tests. (Atterberg Limits; Proctor Compaction; Cone Penetration)

Session 2: Shear properties of sands and clays (Shear meter; Casagrande box shear)

Session 3: The hydraulic properties of the soil (Permeability at constant head; Permeability at variable head)

Course material

European standards

Skills developed through this course

Sustainable Development Goals (SDGs) covered by this course

Climate action / Industry, innovation and infrastructure / Responsible consumption and production / Sustainable cities and communities

Sustainable Development and Social Responsibility Positioning

Formulation and Use of low-carbon materials

Assessment

Collective assessment: EVC 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	0 hrs	0 hrs	32 hrs	0 hrs	0 hrs

ENGINEERING - OD GC2D

Year 2 / Year 3 - Autumn Semester - Course Unit 74 / 94

Geotechnical Engineering [GCGEO]

LEAD PROFESSOR(S): *Giulio SCIARRA*

Requirements

Soil and rock mechanics

Objectives

To present methods of dimensioning retaining walls, shallow foundations and deep foundations. Slope stability analysis.

Course contents

Lower bound and Upper bound approaches to determine the limit load
Characteristic line method: 2D solution of soil problems under failure conditions
Retaining wall: Rankine, Coulomb and Sokolowski solutions
Shallow foundations: Terzaghi's approach
Deep foundations: the pressuremeter method
Slope stability

Course material

W.F. Chen, X.L. Liu Limit Analysis in Soil Mechanics Elsevier 1990
R. Lancellotta Geotechnical Engineering Taylor & Francis 2009
Y. Riou C. Dano Polycopié GCGEO - Eléments de Mécanique des Sol et de Géotechnique
F. Schlosser Eléments de mécanique des sols Presses de l'École nationale des Ponts et Chaussées 2003
V.V. Sokolovskii Statics of Granular Media, Pergamon Press 1965
C. Viggiani, A. Mandolini, G. Russo Piles and pile foundations Taylor & Francis 2012

Skills developed through this course

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure / Sustainable cities and communities

Sustainable Development and Social Responsibility Positioning

The course aims to provide students with knowledge and enable the development of skills in the field of geotechnics that can be used not only to understand the classic formulas for the design of civil engineering infrastructures but also to implement cutting-edge projects in the increasingly important field of sustainable construction, such as the exploitation of geothermal energy (geothermal wells and piles), underground energy storage, etc.

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	22 hrs	8 hrs	0 hrs	0 hrs	2 hrs

ENGINEERING - OD GC2D

Year 2 / Year 3 - Autumn Semester - Course Unit 74 / 94

Methods and management [GCMOD]

LEAD PROFESSOR(S): Syed Yasir ALAM

Objectives

The project manager plays a crucial role in the implementation and managing construction works. This requires knowledge of complete process of construction project and ability to create project environment with Building Information Modelling (BIM)

Course contents

This course provides knowledge of several aspects of construction process including construction cost analysis, construction techniques and machinery and several terminologies related to construction engineering works. Course provides a hands on training on BIM using Revit. At the end of this course students will be able to develop advanced BIM models with architectural and structural details, construction phases, construction costs and risk analysis

Course material

Professional and experienced engineers from the industry will take part in the teaching of this course.

Skills developed through this course

Sustainable Development Goals (SDGs) covered by this course

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	18 hrs	6 hrs	8 hrs	0 hrs	0 hrs

ENGINEERING - OD GC2D

Year 2 / Year 3 - Autumn Semester - Course Unit 74 / 94

Project 1 [P1GC]

LEAD PROFESSOR(S): Syed Yasir ALAM

Objectives

Project on Initiation to research - in group of three or four students

Course contents

- Identify, analyse and improve understanding of a scientific research topic
- Autonomously implement an experimental or numerical scientific approach to answer questions (using prior bibliographic analysis)
- Present the result in a scientific format (article, poster, report)

Course material

- Scientific articles
- Numerical codes
- Experimental protocols

Skills developed through this course

- C1 : Design and prototype innovative systems that create value
 - C1C1 : Develop
 - Intermediate
 - Proficient
 - C1C2 : Dare
 - Intermediate
 - Proficient
 - C1C3 : Deliver and create value
 - Intermediate
 - Proficient
- C2 : Analyse a complex system from all angles (scientific, economic, human, social) and propose a solution
 - C2C2 : Solve and arbitrate
 - Intermediate
 - Proficient
 - C2C3 : Think and act in an unpredictable and uncertain environments
 - Intermediate
 - Proficient

Skills assessed through this course

- C1 : Design and prototype innovative systems that create value
 - Intermediate
 - Proficient
- C2 : Analyse a complex system from all angles (scientific, economic, human, social) and propose a solution
 - Intermediate

Sustainable Development Goals (SDGs) covered by this course

Assessment

Collective assessment: EVC 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	1	0 hrs	0 hrs	0 hrs	32 hrs	0 hrs

ENGINEERING - OD GC2D

Year 2 / Year 3 - Spring Semester - Course Unit 103 / 83

Eco Construction and mixed Constructions [GCECO]

LEAD PROFESSOR(S): Abdelhafid KHELIDJ

Objectives

Choice of structural materials in a context of sustainable development
Verification and dimensioning of wooden and steel structures

Course contents

1. Calculation of actions:
Calculation of snow and wind loads according to Eurocode 1.
2. Introduction to earth construction
3. Wood construction:
Introduction to the wood material and its derivatives
Calculation and verification of structural elements to Eurocode 5
Topics for reflection on the material wood and wood derivatives: collective work
4. Metal construction:
Practice of Eurocode 3. Classification of sections. Calculation and verification of structures

Course material

EN 1993-1-1: Eurocode 3: Design of steel structures
EN 1995-1-1: Eurocode 5: Design of timber structures

Skills developed through this course

Sustainable Development Goals (SDGs) covered by this course

Climate action / Decent work and economic growth / Industry, innovation and infrastructure / Responsible consumption and production

Sustainable Development and Social Responsibility Positioning

See course outline Issues and principles of eco-construction. The use of a variety of materials in construction aims to achieve optimal design, based on the choice of materials according to their physical, chemical and mechanical properties and the stresses to which they will be subjected.

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	22 hrs	8 hrs	0 hrs	0 hrs	2 hrs

ENGINEERING - OD GC2D

Year 2 / Year 3 - Spring Semester - Course Unit 103 / 83

Structural design 1 [GCMBA]

LEAD PROFESSOR(S): Ahmed LOUKILI

Objectives

1) Design and justify by calculation the main structural elements of reinforced concrete.
2) Understand the justification for prestressed concrete components by addressing design office aspects with the current regulations.

1) Concevoir et justifier par le calcul les principaux éléments de structures en béton armé.
2) Appréhender la justification des pièces en béton précontraint en abordant les aspects du bureau d'études avec la réglementation actuelle.

Course contents

Following the course entitled 'reinforced concrete', buckling, continuous beams, special studies (slabs and other).

Skills developed through this course

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure / Sustainable cities and communities

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	22 hrs	10 hrs	0 hrs	0 hrs	0 hrs

ENGINEERING - OD GC2D

Year 2 / Year 3 - Spring Semester - Course Unit 103 / 83

Earthquake Engineering [GCSIS]

LEAD PROFESSOR(S): Panagiotis KOTRONIS

Requirements

Reinforced concrete, mechanics of structures, continuum mechanics, numerical analysis

Objectives

Raise students' awareness of the seismic risk, learn to analyze the dynamic behavior of a structure, general principles of earthquake-resistant design..

Course contents

Outline:

Dynamics of structures

- Seismic risk, seismic zones
- Dynamic equation of a simple oscillator, methods to solve the equation
- Dynamic equation of a multi-degree of freedom system, methods to solve the equation
- Modal analysis, modal superposition technique, modal spectrum analysis
- Earthquake resistant structures design according to EC8, capacity design
- Certain aspects of the design of nuclear power plants.
 - advanced methods for modal-spectral analysis
 - Capra-Maury method for estimating the reinforcement from the static and seismic forces of reinforced concrete shells
- pushover and transient non-linear calculations: examples of application to real cases

Acquired skills:

Calculating a structure submitted to an earthquake loading.

Course material

Dynamique des structures - Application aux ouvrages de génie civil, Patrick Paultre, Hermès, Lavoisier, 2004.

Génie parasismique. Volumes I-II-III, Betbeder-Matibet, J., Hermes sciences publ., Lavoisier, 2003.

Dynamics of Structures, Theory and Applications to Earthquake Engineering, Anil K. Chopra, second edition, Prentice-Hall, 2001.

M. Géradin and D. Rixen. Mechanical vibrations. John Wiley and Sons, 1997.

Pratique du calcul sismique guide d'application de l'Eurocode. Sous la direction de V. Davidovici. Eyrolles, Afnor éditions, 2013.

Pratique du calcul sismique guide d'application de l'Eurocode. Sous la direction de V. Davidovici. Eyrolles, Afnor éditions, 2013.

Skills developed through this course

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure / Sustainable cities and communities

Sustainable Development and Social Responsibility Positioning

The design of buildings is not limited to seismic resistance alone but also incorporates a sustainable development and corporate social responsibility approach, aiming to create resilient structures while ensuring the safety of populations and the longevity of infrastructure for future generations.

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	22 hrs	8 hrs	0 hrs	0 hrs	2 hrs

ENGINEERING - OD GC2D

Year 2 / Year 3 - Spring Semester - Course Unit 103 / 83

Civil engineering projects and urban planning [GCURB]

LEAD PROFESSOR(S): Benoit HILLOULIN

Objectives

Present issues of urban engineering and methods for dimensioning infrastructures.
Underground work and road engineering
Master LCA for civil engineering

Course contents

Life cycle analysis
Road and Highway engineering
Large infrastructures (bridges)

Skills developed through this course

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure / Sustainable cities and communities

Sustainable Development and Social Responsibility Positioning

This course integrates sustainable development principles into the design and dimensioning of urban infrastructures. Life Cycle Assessment (LCA) is used to evaluate the environmental impacts of civil engineering structures. The course also raises awareness of the engineer's social responsibility in the ecological transition and urban resilience.

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	22 hrs	8 hrs	0 hrs	0 hrs	2 hrs

ENGINEERING - OD GC2D

Year 2 / Year 3 - Spring Semester - Course Unit 103 / 83

Project 2 [P2GC]

LEAD PROFESSOR(S): Benoit HILLOULIN

Objectives

To design a civil engineering work based on a real call for tender.

- To illustrate or present one particular aspect of the civil engineering field, in addition to courses, and make the most of lecture and visit opportunities.

- To present the information centres and organizations involved in construction and the environment.

To prepare engineering students to join a company by discovering the principal stages in a building project (construction and civil engineering works), related terminologies, materials and techniques, launch and costing.

Students will also study in groups a set technological subject by reading reports, contacting companies and or suppliers. This work is the subject of a written report and oral presentation to all the students and participating professionals.

Course contents

Following on from the civil engineering project in the first semester, the design of the structure will be checked by structural calculations and the selection of insulation material and methods should be proposed.

Course material

- Joint Technical Report, professional rules, Technical Evaluation Document
- Supplier documentation.
- Calculation software structures (Robot, etc.).

Skills developed through this course

- C3 : Manage complex programmes or change responsibly
 - C3C1 : Design a project/programme
 - Intermediate
 - Proficient
 - C3C2 : Manage/lead a project/programme
 - Intermediate
 - Proficient
 - C3C3 : Finalise and leverage feedback
 - Intermediate
 - Proficient
- C2 : Analyse a complex system from all angles (scientific, economic, human, social) and propose a solution
 - C2C1 : Represent and model
 - Intermediate
 - Proficient
 - C2C2 : Solve and arbitrate
 - Intermediate
 - Proficient

Skills assessed through this course

- C2 : Analyse a complex system from all angles (scientific, economic, human, social) and propose a solution
 - Intermediate
 - Proficient
- C3 : Manage complex programmes or change responsibly

- Intermediate
- Proficient

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure / Responsible consumption and production

Sustainable Development and Social Responsibility Positioning

Development of building solutions with reduced environmental footprint

Assessment

Collective assessment: EVC 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	2	0 hrs	0 hrs	0 hrs	48 hrs	0 hrs