CENTRALE NANTES

ENGINEERING PROGRAMME

2024-2025

Year 2 / Year 3

Specialisation option

Civil Engineering and Sustainable Construction

OD GC2D

PROGRAMME SUPERVISOR

Benoit HILLOULIN

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 Mechanics and physics of materials
UE 74	13	Core course	GCBA1 GCCAS GCGEO 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

Civil engineering materials [GCBMC]

LEAD PROFESSOR(S): Ahmed LOUKILI

Requirements

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

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

Structural calculations [GCCPS]

LEAD PROFESSOR(S): Emmanuel ROZIÈRE

Requirements

Objectives

General objective: to master the data and calculation techniques, in order to better understand 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

Course material

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

Mechanics and physics of materials [GCPHY]

LEAD PROFESSOR(S): Frédéric GRONDIN

Requirements

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.

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

Mechanics and physics of materials [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

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

Reinforced concrete [GCBA1]

LEAD PROFESSOR(S): Ahmed LOUKILI

Requirements

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)

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

Case studies [GCCAS]

LEAD PROFESSOR(S): Benoit HILLOULIN

Requirements

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

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

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 Gotechnical 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

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

Methods and management [GCMOD]

LEAD PROFESSOR(S): Syed Yasir ALAM

Requirements

Objectives

The project manager plays a crucial role in the implementation and maaging construction works. This requires knowledge of complete process of construction project and ability to create project environment wwith 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. A the end of this wourse students will be able to develop advanced BIM models with architechtural and structural details, construction phases, construction costs and risk analysis

Course material

Pofessional and experienced engineers from the industry will take part in the teaching of 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

Project 1 [P1GC]

LEAD PROFESSOR(S): Syed Yasir ALAM

Requirements

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

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

Eco Construction and mixed Constructions [GCECO]

LEAD PROFESSOR(S): Emmanuel ROZIÈRE

Requirements

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

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

Structural design 1 [GCMBA]

LEAD PROFESSOR(S): Ahmed LOUKILI

Requirements

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).

Course material

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

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.

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

Civil engineering projects and urban planning [GCURB]

LEAD PROFESSOR(S): Giulio SCIARRA

Requirements

Objectives

Present issues and methods for dimensioning infrastructures. Underground work and road engineering

Course contents

Rock mechanics reminders
Mechanical blasting and Tunnelers.
Blasting
Calculation of underground structures
Highway engineering

Course material

Comité français de mécanique des roches Manuel de mécanique des roches Tome 1: Fondaments, Presses de l'Ecole de Mines de Paris 1999
Comité français de mécanique des roches Manuel de mécanique des roches Tome 2: les applications, Presses de l'Ecole de Mines de Paris 2003
P. Gesta Tunneliers 1992
P. Gesta Travaux souterrains 1994
P. Lunardi Conception et execution des tunnels d'après l'analyse des déformations contrôlées dans les roches et dans les sols: proposition d'une nouvelle approche. Revue Française de Géotechnique 86, 1999
F. Martin, A. Saïtta, Mécanique des Roches et Travaux Souterrains, ENS Cachan 2012
Ministère de l'équipement, des transports et du logement. Direction des routes Dossier pilote des tunnels, génie civil 1998

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

Project 2 [P2GC]

LEAD PROFESSOR(S): Benoit HILLOULIN

Requirements

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.).

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