

Academic year 2025/2026

Courses offered by the programme

**Génie Civil et Urbain (GCU)
Civil Engineering and Urban Planning**

Semester(s) : 5-6-7-8-9-10

Curricula are organized in groups of courses (Unités d'Enseignement (UE)), consisting of several courses (Eléments Constitutifs (EC)). An EC is a teaching module including lectures (cours magistraux (CM)), tutorials (travaux dirigés (TD)), laboratory work (travaux pratiques (TP)), projects (PR), conferences (CONF), personal work (TA) and possibly other pedagogical activities (DIV). Some internships (stages (ST)) are compulsory

Commonly used abbreviations

CM : Lectures
TD : Tutorials
TP : Laboratory Work
CONF : Conferences
TA : Personal Work
PR : Project
ST : Internship
DIV : Miscellaneous

Code	Libelle
------	---------

No course taught in English at GCU department

Semestre 5
Parcours Formation Initiale GCU

1	GCU05-ESM		MUTUAL SCIENTIFIC COURSES	2.50
	GCU05-PROBA	O	Probabilistic approach for engineers	1.50
	ESM05-MATLAB	O	Initiation Matlab	1.00
2	GCU05-1		MECHANICS OF SOLIDS AND STRUCTURES	8.50
	GCU05-MSD	O	Mechanics of Deformable Solids	6.00
	GCU05-MSTR1	O	Structural Analysis I	2.50
3	GCU05-2		GEOLOGY AND WATER	5.50
	GCU05-GEOL	O	Engineering Geology	3.00
	GCU05-MFLU1	O	Fluid Mechanics 1	2.50
4	GCU05-3		MATERIALS AND ARCHITECTURE	6.50
	GCU05-CMM	O	Materials Science 1A	2.50
	GCU05-CIME	O	Matériaux Cimentaires	2.50
	GCU05-ARCH	O	Architecture & plan reading	1.50
5	HUM05		Non-scientific syllabus S5	7.00
	HUM05-RISQ	O	Risk Management. Sustainable Development	1.50
	HUM05-ANGL	O	English	2.00
	HUM05-PSH	O	Human sciences project	2.50
	HUM05-EPS	O	Sport and physical Education	1.00
6	GCU05-OMM		MATHEMATICAL TOOL FOR MECHANICS	0.00
7	HUMF1-RIE		RIE : Recherche Innovation Entrepreneuriat	1.00
	HUMF1- RI	F	Recherche Innovation	1.00
	HUMF1- IE	F	INNOVATION & ENTREPRENEURSHIP	1.00
10	HUMF1-ELSA Mus		Music with studies	1.00
	HUMF1-MUS	F	Music Studies	1.00
12	HUMF1-SAMSTA2-3		SAM : Stage 2ème année / 2nd Year Work Placement	3.00
	GCU05-STA2-3	F	Stage 2ème année	3.00

O = compulsory, C= in choice , F= optional

Probabilistic approach for engineers	GCU05-PROBA
Number of hours : 20.00 h	1.50 ECTS credit
CM : 10.00 h, CM : 10.00 h, TD : 10.00 h, TD : 10.00 h	
Reference Teacher(s) : SOMJA Hugues	

Objectives :

Structures can be submitted to external forces that are changing over time (wind pressure, snow, humidity, temperature ...). There exists also the uncertainties and the high variation in the strength of materials (soil, steel, concrete, composite materials ...). These uncertainties must be taken into account in the design of the structures. The objectives of this course are the following:

1. Study the theory of probability,
2. Construct the representation of statistical data,
3. Study the concept of reliability index,
4. Construct probabilistic models based on a mechanical model for evaluating the probability of failure,
5. Understand the semi-probabilistic approaches,
6. Know how to calculate and then interpret the partial coefficients of security.

Content :

1. Recall of probability theories: definition, conditional probability, random variables ...
2. Concept of statistics,
3. Concept of reliability: probability of failure, reliability index (Cornell, Hasofer-Lind),
4. Semi-probabilistic approaches : representation of forces, representation of resistance, interpretation of safety coefficients.

Bibliography :

1. Dimitri P. Bertsekas and John N. Tsitsiklis, Introduction to probability, 2008
2. Jean-Armand Calgaro, Éléments de fiabilité des constructions: Introduction aux eurocodes, Groupe Moniteur, 2016.
3. Jean-Armand Calgaro, Introduction aux eurocodes, Presse de l'ENPC, 1996.

Requirements :

1. Concept of strength of material
2. Mathematics

Organisation :

Lectures and tutorials

Evaluation :

Written final exam

Target :

5GCU

Initiation Matlab	ESM05-MATLAB
Number of hours : 12.00 h	1.00 ECTS credit
CM : 2.00 h, TP : 10.00 h	
Reference Teacher(s) : PEDESSEAU Laurent	

Objectives :

- Transfer the basic pedagogical support needed for the use of Matlab code.
- Matrix calculation and also the use of Simulink applying to realistic problems
- Assimilate the basic concepts of "script" and "function"
- Be familiar with the method fft and also the "ode" method to solve various problems in materials science, solid state physics, flow mechanics, quantum mechanics, heat flux, electromagnetic, semiconductor.

Content :

Introduction, generalities, Matrix calculation, read and write in a file, Basic starting to solve problem with Simulink.

Bibliography :

- Kelly Bennett: MATLAB Applications for the Practical Engineer. InTech 2014.
- Wikibooks 2012: MATLAB Programming. http://en.wikibooks.org/wiki/MATLAB_Programming
- Subhas Chakravarty: Technology and Engineering Applications of Simulink. InTech 2012

Requirements :

Algebra, Matrix calculation, numerical analysis, simulation.

Organisation :

10 h of training + 2h of amphitheater

Evaluation :

Exam 1h + proceeding of the training.

Target :

Mechanics of Deformable Solids	GCU05-MSD
Number of hours : 64.00 h	6.00 ECTS credit
CM : 24.00 h, TD : 28.00 h, TP : 12.00 h	
Reference Teacher(s) : MEFTAH Fekri	

Objectives :

Learn to pose and solve initial-boundary value problems in the context of elastic, viscoelastic or thermos-elastic deformable solids in order to determine displacement, strain and stress fields needed to proceed to the analysis of the deformability and elastic failure of these solids.

Content :

I. Deformation theory

- I.1 Transformation – Deformation – Strain
- I.2 Green-Lagrange strain tensor
- I.3 Small perturbation hypothesis – Linearisation
- I.4 Computation of length / volume / angle variations
- I.5 Compatibility equations – Integration of strains
- I.6 Applications

II. Stress theory

- II.1 Global equilibrium – Internal efforts
- II.2 Cauchy's postulate – Stress vector – Stress tensor
- II.3 Local equilibrium equations
- II.4 Elementary stress states
- II.5 Stress based failure criteria
- II.6 Applications

III. Boundary value problem for elasticity

- III.1 Structure of a boundary value problem
- III.2 Constitutive law – Isotropic linear elasticity
- III.3 Navier's equations – Beltrami's Equations
- III.4 Linearity – Superposition principle
- III.5 Plane elasticity – Airy stress function
- III.6 Degenerated formulations: Barre – Bending beam
- III.7 Applications

IV. Boundary value problem for viscoelasticity

- IV.1 One-dimensional non-aging linear viscoelastic behaviour
 - Creep / Relaxation – Constant Solicitation and response
 - Varying Solicitation – Superposition principle
 - Laplace-Carson transform – Correspondence principle
 - Rheological models
- IV.2 Three-dimensional non-aging isotropic linear viscoelastic behaviour
- IV.3 Boundary value problem for non-aging linear viscoelasticity
- IV.4 Solution Strategies based on Laplace-Carson transform
 - Navier's equations – Beltrami's Equations
 - Linearity – Superposition principle
 - Plane states – Airy stress function
 - Degenerated formulations: Barre – Bending beam
- IV.5 Applications

V. Initial-Boundary value problems for transient thermo-elasticity

- V.1 thermo-elastic behaviour
 - Free thermal strain – Mechanical strain
 - One-dimensional constitutive law
 - Three-dimensional constitutive law
- V.2 Thermal transfer Initial-Boundary value problem
- V.3 Mechanical boundary value problem – Thermal and mechanical loadings
- V.4 Solution Strategies of the mechanical problem
 - Navier's equations – Beltrami's Equations
 - Linearity – Superposition principle
 - Plane states – Airy stress function
 - Degenerated formulations: Barre – Bending beam
- V.5 Applications

Bibliography :

A. E. H. Love, A treatise on the mathematical theory of elasticity, Dover, 1944 (1906).
J. Mandel, Cours de Mécanique des Milieux Continus, Jacques Gabay, 1994 (1966).
L. Sedov, Mécanique des Milieux Continus, Tome I et Tome II, Editions Mir, 1971.
J. Salençon, Mécanique des Milieux Continus, Tome I : Concepts Généraux, Ecole Polytechnique, 2005.
J. Salençon, Viscoélasticité pour le Calcul des structures, Ecole Polytechnique, 2008.
P. Chadwick, Continuum mechanics: Concise theory and problems, Dover, 1999.
H. Dumontet, F. Léné, P. Muller, N. Turbé, Exercices de Mécanique des Milieux Continus, Masson, 1994
P. Royis, Mécanique des Milieux Continus, Cours, Exercices et problèmes, Pul, 2005.
R. M. Christensen, Theory of viscoelasticity, Dover, 2003.

Requirements :

Linear algebra (Tensors) – Differential geometry – ODE & PDE – Rational Mechanics – Physical & mechanical behavior of materials.

Organisation :

Plenary lectures are dedicated to presenting the theoretical concept of this course. Applications of this concept and worked during tutorial classes. Practical work classes are dedicated experimental approach of deformation, stress, constitutive behavior and failure criteria.

Evaluation :

2 hours mid-term and final-term Exams plus an evaluation of the practical work projects.

Target :

3GCU

Structural Analysis I	GCU05-MSTR1
Number of hours : 48.00 h	2.50 ECTS credit
CM : 0.00 h, CM : 24.00 h, TD : 24.00 h	
Reference Teacher(s) : HJIAJ Mohammed	

Objectives :

This module, which takes place during the first semester, provides students of Civil Engineering and Urban Planning with the basics necessary for the calculation and dimensioning of the elements of construction by drawing upon their knowledge of Solids Mechanics, Continuum Mechanics and the Theory of Elasticity.

Content :

1. Introduction to beam theory (hypothesis and conventions, actions and loading, equilibrium of a beam)
2. Calculation of stress due to axial force
3. Calculation of stress due to bending: simple, combined, oblique
4. Calculation of shear stress: thick sections (Jouravski's hypothesis), thin sections (open, closed, partitioned), shear centre
5. Calculation of torsional stress: thick sections (membrane analogy), thin sections: Bredt's formulas , non- uniform torsion theory of Vlassov

Bibliography :

1. FREY F., ""Statique appliquée et Mécanique des structures"", volumes 1 et 2 Presses Polytechniques et Universitaires Romandes
2. ALBIGES M. et COIN A., ""Résistance des matériaux appliquée"", tomes I et II, Ed. Eyrolles, Paris

Requirements :

Mathematical basics and General Mechanics acquired during the first two-years of preparation in general engineering studies.
Continuum Mechanics of Solids and Mechanics of Deformable media.

Organisation :

21 hours per semester: ninety minutes per week + preparation of practical work.

Evaluation :

Three-hour written synthesis examination.

Target :

Engineering Geology	GCU05-GEOL
Number of hours : 36.00 h	3.00 ECTS credit
CM : 12.00 h, TD : 12.00 h, TP : 12.00 h	
Reference Teacher(s) : MOLEZ Laurent	

Objectives :

Understanding the structure of the Earth and the movement of the continents. Theoretical and practical study of rocks; properties and usage.

Content :

1. The planet Earth: structure and important geological phenomena.
2. Igneous, metamorphic and sedimentary rock.
3. Physical and mechanical properties of rocks.
4. Exploitation of Quarries, characteristics of aggregates.
5. Identification of rocks: from visual observation to the polarising microscope.
6. X-ray Analysis (clayey rock).

Bibliography :

ARQUIE G., TOURENQ C., 1990, ""Granulats"", 717 p., Ed. Presses de l'E.N.P.C. RAUTUREAU, CAILLERE, HENINI,
 ""Les argiles"", Ed. Septima POMEROL, LAGABRIELLE, RENARD,
 ""Eléments de géologie"", Ed. Dunod HOMAND,
 DUFFAUT, Manuel de Mécanique des Roches, Tome 1, Presses de l'Ecole des Mines de Paris HOMAND,
 DUFFAUT,
 Manuel Mécanique des Roches, Tome 2, Presses de l'Ecole des Mines de Paris

Requirements :

Organisation :

Revision of lecture notes.
 Preparation of the practical work and Tutorials.

Evaluation :

Two-hour written examination.
 One-hour practical examination "Identification and exploitation of rocks".

Target :

Fluid Mechanics 1	GCU05-MFLU1
Number of hours : 24.00 h	2.50 ECTS credit
CM : 12.00 h, TD : 12.00 h	
Reference Teacher(s) : LOMINE Franck	

Objectives :

Introduction to the fundamentals of fluid mechanics

Content :

1. Physics of fluids – Flow models
2. Fluid kinematics
3. Ideal fluid –Bernoulli's equation – Applications
4. Momentum equation –Euler's theorem – Applications to fluid force on the boundaries

Bibliography :

1. MOREL M.A. et LABORDE J.P., 1992, "Exercices de mécanique des fluides" (tome 1), Ed. Eyrolles
2. OUZIAUX, 1994, Mécanique des fluides appliquée, Ed. Dunod
3. COMOLET R., 1994, Mécanique des fluides (tome 1), Ed. Masson
4. CHASSAING P., 1997, Mécanique des fluides, Ed. Polytech
5. JOULIE R., 1998, Mécanique des fluides appliquée, Ed. Ellipses
6. NAKAYAMA, Y., 2018, Introduction to fluid mechanics, Ed. Butterworth-Heinemann

Requirements :

Mechanics, Mechanics of continuous media

Organisation :

Lecture and preparation of practical work: two hours per week

Evaluation :

Two-hour written synthesis examination

Target :

3GCU

Materials Science 1A	GCU05-CMM
Number of hours : 24.00 h	2.50 ECTS credit
CM : 12.00 h, TD : 12.00 h	
Reference Teacher(s) : DARQUENNES Aveline	

Objectives :

Essential links between the intrinsic characteristics of materials, their properties and usage; notably chemical, physical, thermal, optical and mechanical properties.

Content :

Definitions: material, raw material, ore - Various classifications of materials - Life cycle of Materials. Essential differences between solid, liquid and gas - The origin of cohesion in materials - Atomic architectures in solids (from order to disorder, from perfect crystal to real crystal) - The fundamental role of chemical bonds and properties of materials - The fundamental role of crystalline imperfections on the properties of materials - Incidence of microstructure on properties and usage of materials (fragility, ductility, rigidity, hardness, tenacity, thermal conduction, electric conductivity). - Physico-chemical methods for the study of materials (X-Ray Diffractometry, thermal analysis, X-Ray fluorescence, microscopy (optical, MEB, PUTS), spectrophotometric methods. Materials under stress: theoretical resistance and real resistance; defects; stress concentration coefficient. Elastic limit of ductile materials; Critical shear stress for interfacial slip; role of dislocations; crystallinity and ductility. Tenacity of fragile materials. Mechanical characteristics.

Bibliography :

1. Introduction à la science des matériaux. Wilfried Kurz, Jean Pierre Mercier, Gérard Zambelli, Ecole Polytechnique Fédérale de Lausanne. Matériaux : Propriétés et Applications M.F. Ashby, D.R.H Jones. Edition Dunod, Paris.
Science des Matériaux. Jean Paul Baillon, Jean-Marie Dorlot. Presses internationales polytechnique.

Requirements :

Organisation :

Evaluation :

Written examination.

Target :

Matériaux Cimentaires	GCU05-CIME
Number of hours : 30.00 h	2.50 ECTS credit
CM : 12.00 h, TD : 6.00 h, TP : 12.00 h	
Reference Teacher(s) : HANNAWI Kinda	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Architecture & plan reading	GCU05-ARCH
Number of hours : 36.00 h	1.50 ECTS credit
CM : 0.00 h, TD : 18.00 h, TP : 8.00 h	
Reference Teacher(s) : KEO Pisey	

Objectives :

Architecture: Providing historical references on the design and implementation of civil engineering works, allowing students to situate and understand their training and their role as engineers in a long-term evolution. Plan reading: Providing students with the necessary basics to exploit the various plans and written documents concerning a construction project in the construction industry (roads, public buildings, offices, industrial and agricultural buildings, individual houses, public establishments receiving the public, etc.). Exploiting architectural plans (site plan, mass plan, elevations, floor plans, vertical sections, and details). Exploiting engineering design plans (form work plan, reinforcement plan, roof plan, foundation plan, framing plan, road and sanitation network plans, topography plan, plumbing plan, heating and ventilation plan, soil report, electrical plan). Exploiting construction site and implementation plans (site setup plan, installation plan, shoring plan, layout plan). Raising students' awareness of standards, technical specifications, and technical opinions. Raising students' awareness of the choice of materials and construction methods (roofing, framing, flooring, vertical walls, partitions, terraced roofs, insulation (RT 2012)). Acquiring the necessary basics to be able to make modifications to existing plans.

Content :

Architecture: History of engineers and their training. History of bridges: From ancient bridges to those of Perronet; bridges of the Industrial Revolution; bridges of the 20th century. Calculation methods of engineering in the 19th century. Building against the wind: a brief history of aerodynamics. Military architecture and its urban context. Plan Reading: Graphic representation, various standards and conventions, abbreviations, scales, representation of materials, measurements, estimates, stakeholders in the construction industry, building technology.

Bibliography :

Architecture: [1] BLANCHARD (Anne), Vauban, Fayard, 1996. [2] CARMONA (Michel), Eiffel, Fayard, 2002. [3] COTTE (Michel), Le choix de la révolution industrielle : les entreprises de Marc Seguin et ses frères (1815-1835), Rennes, Presses Universitaires de Rennes, coll. Carnot, 2007. [4] MARTIN (Thierry) dir., VIROL (Michèle) dir., Vauban, architecte de la modernité, actes du colloque du 11&12octobre 2007 à Besançon, Presses Universitaires de Franche Comté, 2009. [5] VACANT (Claude), Jean-Rodolphe Perronet (1708-1794), Paris, Presses de l'ENPC, 2006. [6] PICON (Antoine), L'invention de l'ingénieur moderne : l'École des Ponts et Chaussées 1747-1851, Paris, Presses de l'ENPC, 1992. Articles en ligne : [1] MONTEL (Nathalie) La mise en revue des savoirs de l'ingénieur au XIXe siècle. [2] La création des Annales des ponts et chaussées en 1831, LATTES ENPC. [3] GRELON (André) La naissance de l'enseignement supérieur industriel en France, 1996. [4] HARTE (Hélène), Les échanges techniques au XIXème : l'exemple du génie civil américain, Institut Pierre Renouvin, Bulletin no 4, 21 juillet 2004. Lecture de plan: Dicobat, guides pratique des VRD, précis de chantier, précis du bâtiment, normes, DTU, avis techniques, projets divers de professionnels...

Requirements :

Architecture: None. Plan Reading: Technical drawing rules / Elements of building technology.

Organisation :

Architecture: Lecture. Plan Reading: 2 sessions of 4 hours each per group of 8-10 students/individual work.

Evaluation :

Architecture: 5-page mini-thesis on an ancient work of your choice (built structure or book), in pairs. Plan Reading: Exam.

Target :

3GCU

Risk Management. Sustainable Development	HUM05-RISQ
Number of hours : 22.00 h	1.50 ECTS credit
CM : 22.00 h, CM : 22.00 h	
Reference Teacher(s) : GALL Philippe	

Objectives :

To create awareness that the environment in which the engineer works is full of uncertainties and risks. The engineer must nevertheless be in control of his choices and actions within the limits that are defined by acceptable risk in the contemporary context of sustainable development
 How do you position yourself as a scientist in relation to the 17 Sustainable Development Goals (SDGs)
 Acquire the basics of risk prevention, in particular for health
 Learn about occupational risk prevention
 Understand the links between work and health
 Understand types of work accident
 Professional risk assessment
 Application of an occupational health and safety approach
 Awareness of the impact of decisions
 Talks given by Professionals

Content :

How do you position yourself as a scientist in relation to the 17 Sustainable Development Goals (SDGs)
 Acquire the basics of risk prevention, in particular for health
 Learn about occupational risk prevention
 Understand the links between work and health
 Understand types of work accident
 Professional risk assessment
 Application of an occupational health and safety approach
 Awareness of the impact of decisions
 Talks given by Professionals

Bibliography :

Requirements :

Organisation :

Sulitest
 2 Modules by distance learning (INRS)
 Face to face meetings with professionals
 MOOC – OpenClassroom: develop an OHS strategy
 Hybrid training alternating face-to-face training and distance learning with validation tests and peer work evaluation

Evaluation :

Tests upon completion of each training module
 Grade out of 20 is derived from the Sulitest test, 2 grades out of 10
 A module is validated if the grade is superior or equal to 10/20 for INRS modules and one grade out of for the MOOC (combining 3 quizzes and a peer evaluation)
 _ Le rattrapage ne concerne que l'élément de module ayant une note inférieure à 10/20. La note du module après rattrapage ne peut en aucun cas excéder 10/20.
 _ La note de rattrapage est prise en compte dans le calcul de la nouvelle note finale du module uniquement si elle améliore cette note.
 Un module non validé (Moyenne finale inférieure à 10/20) peut être acquis par compensation à la fin du semestre si la moyenne générale du semestre (moyenne de tous les modules du semestre en cours) est supérieure ou égale à 10/20.

Target :

English	HUM05-ANGL
Number of hours : 28.00 h	2.00 ECTS credit
TD : 28.00 h	
Reference Teacher(s) : LE VOT Philippe	

Objectives :

Improve expression, comprehension and interaction skills within everyday contexts, with special emphasis on professional and social life.

Language Objectives

Obtain or reinforce B2 level (as required for graduation and defined by CECRL)

Content :

-Action-oriented approach - learning by doing :

students have to listen and speak, write documents while using their problem-solving, reasoning, arguing, and demonstrating capabilities, in an articulate manner.

-Expressing oneself accurately by a rigorous use of syntax and phonology :

Activities requiring creative and reactive skills, ranging from debating, role-playing, individual oral presentations (PowerPoint), projects ... are based on scientific topics and current events.

-Building up specific skills in connection with the working world :

- writing e-mails
- conducting telephone conversations
- technical English
- intercultural contexts

In addition to the English course, a 90-minute remedial course takes place every week (over 10 weeks), in which students can update their various skills (listening and reading, writing, speaking and interacting) in small groups. Remedial classes are compulsory for all students that did poorly in their start-of-term placement test - and optional for those who feel they need to attend. There is no specific assessment for this course.

Bibliography :

- Dictionnaire Robert et Collins bilingue, or Collins Cobuild unilingue
- English Grammar in Use (Cambridge University Press)

Requirements :

A good command of the STPI curriculum is essential : B1/B2

Organisation :

Each class lasts two hours and most classrooms are equipped with video and audio. A multimedia lab and computer rooms are also available for students to work in a stimulating environment.

-Teaching resources include press articles, audio and video documents (TV reports, film and series extracts) as well as the Internet.

-Regular personal work is required. Students must be curious and practise their English outside the classroom.

Evaluation :

Two-hour written test.(2/3)

Individual oral presentation in class.(1/3)

Target :

Human sciences project	HUM05-PSH
Number of hours : 26.00 h	2.50 ECTS credit
TD : 26.00 h	
Reference Teacher(s) : ECHARD Philippe	

Objectives :

Conduct a rigorous and synthetic reflection on a given topic dealing with one subject of interest developed by the Specialty Department. .

Learning outcomes expected:

- Knowing how to define a study subject and associate a relevant problematic.
- Knowing how to find relevant information by using the resources available from the Internet
- Knowing how to produce quality communication events and documents (written report, pwpt or prezi presentation, organization of professional meeting)
- Knowing how to manage a collective project: planning and coordinating actions to produce documents to be delivered within a given time-limit.

Content :

The students will make up teams and choose a topic that will be approved by the teacher. Their documentary research shall lead to the definition of a problematic and a written report (comprising a synthetic note + commented bibliography + abstract/summary) in accordance with academic requirements.

Methodological gain :

- documentary search on the net. Acquisition of ZOTERO software
- brainstorming techniques and heuristic approach
- problematic definition
- academic-type writing of report or bibliography
- project management technique

Bibliography :

available on-line through the teacher

Requirements :

Organisation :

Alternately methodology courses and progress report sessions of the team projects

Evaluation :

Continuous assessment :

- 1 written report comprising : 1 synthetic note + 1 commented bibliography + abstract/summary)
- 1 oral submission (with pwpt or prezi presentation)

Target :

Sport and physical Education	HUM05-EPS
Number of hours : 24.00 h	1.00 ECTS credit
TD : 24.00 h, TD : 24.00 h	
Reference Teacher(s) :	

Objectives :

Team work, discovery of one's capabilities, communication, invention and management responsibilities.

Content :

Choice of two activities from a menu. Adapting to destabilising situations and taking responsibility when risk is involved.

Speaking to groups. Leading group stretching exercises. Indoors: Rock climbing or badminton in teams. Outdoors: C.O or Kayak or golf

Bibliography :

Several specialized books are available to the students at the library. Links to internet sites are given on the EPS website.

Requirements :

Organisation :

Evaluation :

Evaluation is based upon student participation, progress and acquisition. The student is asked to criticise his own progress with respect to the objectives of the course. The ability to be self-critical leads to self-discovery. Sharing this knowledge with a group reinforces one's confidence.

Target :

Recherche Innovation	HUMF1- RI
Number of hours : 8.00 h	1.00 ECTS credit
TD : 8.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

INNOVATION & ENTREPRENEURSHIP	HUMF1- IE
Number of hours : 8.00 h	1.00 ECTS credit
TD : 8.00 h	
Reference Teacher(s) :	

Objectives :

The aim of this module is to inspire future engineers and stimulate their creativity and initiative, by instilling a spirit of entrepreneurship.

Expected skills:

- observe and consider what exists to generate new ideas,
- make the most of the environment to challenge new concepts,
- communicate and federate around an innovative project.

Content :

Using a list of preselected events, the students build their exploration program and choose to attend 1 to 2 events over semester 5.

Students have an academic coach and regularly report on their progress.

Bibliography :

Provided during the course.

Requirements :

None.

Organisation :

Students are encouraged to identify technologies or inspiring trends by taking advantage of events dealing with innovation and entrepreneurship (tradeshows, conferences, etc.).

Evaluation :

Students write post-event reports focusing on inspiring aspects of their experiences.

Target :

Music Studies	HUMF1-MUS
Number of hours : 25.00 h	1.00 ECTS credit
TD : 25.00 h	
Reference Teacher(s) : HOLZNER-JACQUES Cecile	

Objectives :

Targeted skills :

- working and communicating in a team
- cultural openness
- listening to others
- managing stress

Students have the opportunity to combine their studies with their passion for music. By joining two Jazz and Classical orchestras, they can continue their instrumental practice and also participate in a quality musical training course supervised by teachers from the Rennes Regional Conservatory. Through group practice, they will be able to develop their skills in listening, collaboration and their ability to adapt, all of which are essential to every kind of teamwork. They will participate actively in the cultural life of the school and frequently perform in public. Collective artistic practice within the institution will promote the personal development of the student.

Content :

2h collective lessons per week in the JAZZ et classical music ensembles with instrumental practice training in chamber music. Participation in festivals and organisation of cultural events at INSA. Several concerts and recitals over the year at INA and externally.

Bibliography :

Musical scores are distributed at the beginning of the year

Requirements :

Good instrumental ability, music studies in conservatory or school of music; ability to read music.
Admission to the programme is based on dossier and an audition organised at the beginning of the year.

Organisation :

2 hours group practice per week

Evaluation :

validation without grade

Target :

INSA students, INP, Centrale/Supélec and external students

Stage 2ème année	GCU05-STA2-3
Number of hours : 180.00 h	3.00 ECTS credit
DIV : 0.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Semestre 6
Parcours Formation Initiale GCU

1	GCU06-1		STRUCTURAL ANALYSIS	6.00
	GCU06-MSTR2	O	structural Analysis II	4.00
	GCU06-BA1	O	Reinforced Concrete 1: Design of Reinforced Concrete Structures According to Eurocode 2.	2.00
2	GCU06-2		SOIL, WATER AND TRANSFER	8.50
	GCU06-MFLU2	O	Fluid Mechanics 2	2.00
	GCU06-MDS1	O	Mécanique des Sols I	3.50
	GCU06-THER1	O	Thermique I	3.00
3	GCU06-3		MATERIALS AND CONSTRUCTION METHODS	4.50
	GCU06-MAT	O	Matériaux de Construction	1.50
	GCU06-TECH	O	Construction techniques	1.50
	GCU06-TOPO	O	Topography, GIS, Computer aided design	1.50
4	HUM06-GCU		ENSEIGNEMENTS D'HUMANITE S6-GCU	7.00
	HUM06-IEB	O	Impact Environnemental des Batiments	1.50
	HUM06-ANGL	O	English	2.00
	HUM06-SIM	O	BUSINESS SIMULATION GAME	1.50
	HUM06-EPS	O	Sport and physical Education	1.00
	HUM06-PPI	O	Professional Project	1.00
5	GCU-STAGE06		traineeship 3GCU	4.00
	GCU06-STAGE	O	3rd Year Work Placement	4.00

O = compulsory, C= in choice , F= optional

structural Analysis II	GCU06-MSTR2
Number of hours : 60.00 h	4.00 ECTS credit
CM : 24.00 h, TD : 24.00 h, TP : 12.00 h	
Reference Teacher(s) : COUCHAUX Mael	

Objectives :

This module is the continuation of the first semester and aims to finalize the study of the effect of loadings on beams in terms of stresses and displacements by studying the case of shear force and torque. Methods for studying hyperstatic structures are discussed (energetic and three-moment theorems). Finally, more complex structures are studied (curved beams or on elastic supports, second order effects). This module provides the necessary knowledge for Elastic Structural Analysis module as well as specialized teaching in Reinforced Concrete, Steel and Timber Construction.

Content :

- 1- Shear force
- 2- Torque
- 3- Energetic theorems, hyperstatic structures
- 4- Continuous beams, 3 bending moment theorem
- 5- Curved beams, second order effects

Bibliography :

- [1] Courbon J., Résistance des Matériaux, Dunod, Paris, 1964.
- [2] Massonnet C., Cescotto S., Mécanique des Matériaux, De Boeck-Wesmael, 1992.
- [3] Timoshenko S.P., Résistance des matériaux 1, Editions Dunod, 1968
- [4] Frey F.: Analyse des structures et milieux continus. Statique appliquée. Traité de Génie Civil de l'EPFL, volume 1. Presses Polytechniques et Universitaires Romandes (PPUR). Lausanne, 2005.
- [5] Frey F.: Analyse des structures et milieux continus. Mécanique des structures. Traité de Génie Civil de l'EPFL, volume 2. Presses Polytechniques et Universitaires Romandes (PPUR). Lausanne, 2000.
- [6] Vlassov V. Z. – Thin walled elastic beams, National Technical Information Service, 2nd Edition, 1984
- [7] Timoshenko S.P., Théorie de la stabilité élastique, Editions Dunod, 1966
- [8] Delaplace A., Gatuingt F., Ragueneau F., Mécanique des Structures : Résistance des matériaux, Edition Dunod, 2008.
- [9] La Borderie C., Méthodes Energétiques, Cours de l'ISA BTP, Université de Pau et des Pays de l'Adour.

Requirements :

Undergraduate Mathematics, Undergraduate General Mechanics, Deformable Solid Mechanics, Structural Analysis I

Organisation :

Lecture with application of concepts discussed in tutorials and practical work.

Evaluation :

Three-hour written synthesis examination. Three practical work reports.

Target :

3GCU

Reinforced Concrete 1: Design of Reinforced Concrete Structures According to Eurocode 2.	GCU06-BA1
Number of hours : 24.00 h	2.00 ECTS credit
CM : 12.00 h, TD : 12.00 h	
Reference Teacher(s) : NGUYEN Quang Huy	

Objectives :

The objectives are to provide a basic understanding of the behaviour of reinforced concrete members and structures; to provide a basic understanding of standard methods of analysis and design of reinforced concrete behaviour (including an understanding of capabilities and limitations); and to provide basic design training in a simulated professional engineering environment. At the end of this course students will gain proficiency in design of reinforced concrete structures according to Eurocode 2.

The syllabus comprises the behaviour of reinforced concrete members and structures, including: material properties, 'elastic' analysis, durability, cover to reinforcement, ultimate strengths of beams (flexure), design calculation procedures, reinforcement detailing, structural drawings.

Content :

- Basis of design in accordance with regulatory requirements: EUROCODES 0, 1 et 2.
- Material properties : concrete and steel rebar
- Structural analysis and design method
- Flexion without axial force at Ultimate limit states (ULS)
- Durability and cover to reinforcement
- Detailing of reinforcement

Bibliography :

- Eurocode 0: Basis of design
- Eurocode 1: Actions on structures
- Eurocode 2: Design of concrete structures
- CEB-FIP Model Code 1990: Design code

Requirements :

Beam theory, basic concepts of solid mechanics and structural mechanics.

Organisation :

12 hours of lectures and 6 hours of tutorials

Course Supports :

- Copies of handouts
- Online documents
- Softwares : Autodesk Robot ; Revits ; Autocad

Evaluation :

Written examination (2h)

Target :

Thirth year student

Fluid Mechanics 2	GCU06-MFLU2
Number of hours : 42.00 h	2.00 ECTS credit
CM : 12.00 h, TD : 18.00 h, TP : 12.00 h	
Reference Teacher(s) : LOMINE Franck	

Objectives :

The focus will be on solving viscous fluid flow problems and the design of pipelines and equipment for fluid transport

Content :

1. Viscous fluid dynamics – Navier Stokes equation – Exact solutions
2. Laminar boundary layer
3. Energy loss
4. Design of pipelines and equipment for fluid transport

Bibliography :

1. MOREL M.A. et LABORDE J.P., 1992, "Exercices de mécanique des fluides" (tome 1), Ed. Eyrolles
2. OUZIAUX, 1994, Mécanique des fluides appliquée, Ed. Dunod
3. COMOLET R., 1994, Mécanique des fluides (tome 1), Ed. Masson
4. CHASSAING P., 1997, Mécanique des fluides, Ed. Polytech
5. JOULIE R., 1998, Mécanique des fluides appliquée, Ed. Ellipses
6. NAKAYAMA, Y., 2018, Introduction to fluid mechanics, Ed. Butterworth-Heinemann

Requirements :

Mechanics, Mechanics of continuous media, Fluid mechanics 1

Organisation :

Lectures and preparation of practical work: 3 hours per week

Evaluation :

Three-hour written synthesis examination

Target :

3GCU

Mécanique des Sols I	GCU06-MDS1
Number of hours : 60.00 h	3.50 ECTS credit
CM : 24.00 h, TD : 24.00 h, TP : 12.00 h	
Reference Teacher(s) : MASSON Samuel	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Thermique I	GCU06-THER1
Number of hours : 36.00 h	3.00 ECTS credit
CM : 18.00 h, TD : 18.00 h	
Reference Teacher(s) : DUPONT Pascal	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Matériaux de Construction	GCU06-MAT
Number of hours : 24.00 h	1.50 ECTS credit
CM : 12.00 h, TP : 12.00 h	
Reference Teacher(s) : DARQUENNES Aveline	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Construction techniques	GCU06-TECH
Number of hours : 12.00 h	1.50 ECTS credit
CM : 12.00 h	
Reference Teacher(s) : KEO Pisey	

Objectives :

To discover the most commonly used construction techniques in construction projects (housing, functional structures, civil engineering works, and civil engineering structures). To understand the scheduling, organization, and lifecycle of a construction project. To acquire the basics of infrastructure works. To acquire the basics of structural works. To discover specific construction methods (watertight structures, sliding formwork, etc.).

Content :

Introduction to the stakeholders involved in a construction project and the project lifecycle. Construction methods. Infrastructure works. Structural works. The sliding formwork technique. The technique for watertight structures. Construction project scheduling. Construction site layout plan.

Bibliography :

[1] Norme NF EN 206-1, AFNOR, Avril 2004. [2] BOUTEVEILLE Ursula, La construction, comment ça marche ?, Le Moniteur, 2012. [3] LARRE J-M, Memotech bâtiment et construction, Casteilla, 2015

Requirements :

Strength of materials, Civil engineering materials, Mechanics of soils

Organisation :

12 hours courses.

Evaluation :

Exam

Target :

3GCU

Topography, GIS, Computer aided design	GCU06-TOPO
Number of hours : 25.00 h	1.50 ECTS credit
CM : 6.00 h, TP : 19.00 h	
Reference Teacher(s) : KEO Pisey	

Objectives :

TOPOGRAPHY: Determine the altitude of ground points and an inaccessible point. Know how to use an automatic level and a total station. GIS: Learn the basics of a Geographic Information System and its interest in exchanges between topography professionals and civil engineering. CAD: Introduction and advanced training in the use of AutoCAD, the most widely used drawing software by professionals in the construction industry. Produce graphic documents for simple projects. Exploit existing drawings for possible modification. Acquire the necessary basics on AutoCAD for possible use during internships or projects.

Content :

TOPOGRAPHY: Direct leveling (4 hours with an automatic level) and indirect leveling (4 hours with a total station). GIS: Introduction to projection systems and those officially adopted for France; General cartography; Definition of topological rules to be respected to produce a coherent GIS; Practical exercises to get started with a GIS and define spatial queries. CAD: AutoCAD environment/main commands/layer management/model space/paper space/layout manager and scales/printing output/drawing standards and representation of materials/building technology.

Bibliography :

Modern Surveying and Mapping (by Serge Milles): AutoCAD application, standards compliance, project planning, and detailed technical specifications.

Requirements :

TOPOGRAPHY: None. GIS: Mathematical geometry. CAD: Technical drawing rules/elements of building technology/plan reading.

Organisation :

TOPOGRAPHY: In the classroom for 1 hour for the presentation of the equipment, the method, an example. In the field 3 hours for setting up the device, measurements. GIS: 6 hours of lessons then 3 x 1 hour of practical work on dedicated GIS software. CAD: 2 sessions of 4 hours per group of 8 to 10 students/individualization.

Evaluation :

TOPOGRAPHY: practical work report. GIS: evaluation at the end of practical work. CAD: Project

Target :

3GCU

Impact Environnemental des Batiments	HUM06-IEB
Number of hours : 24.00 h	1.50 ECTS credit
TD : 24.00 h	
Reference Teacher(s) : SOMJA Hugues	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

English	HUM06-ANGL
Number of hours : 28.00 h	2.00 ECTS credit
TD : 28.00 h	
Reference Teacher(s) : LE VOT Philippe	

Objectives :

Improve expression, comprehension and interaction skills within everyday contexts, with special emphasis on professional and social life.

Language Objectives

Obtain or reinforce B2 level (as required for graduation and defined by CECRL)

Content :

-Action-oriented approach - learning by doing :

students have to listen and speak, write documents while using their problem-solving, reasoning, arguing, and demonstrating capabilities, in an articulate manner.

-Expressing oneself accurately by a rigorous use of syntax and phonology :

Activities requiring creative and reactive skills, ranging from debating, role-playing, individual oral presentations (PowerPoint), projects ... are based on scientific topics and current events.

-Building up specific skills in connection with the working world :

- writing e-mails
- conducting telephone conversations
- technical English
- intercultural contexts

In addition to the English course, a 90-minute remedial course takes place every week (over 10 weeks), in which students can update their various skills (listening and reading, writing, speaking and interacting) in small groups. Remedial classes are compulsory for all students that did poorly in their start-of-term placement test - and optional for those who feel they need to attend. There is no specific assessment for this course.

Bibliography :

- Dictionnaire Robert et Collins bilingue, or Collins Cobuild unilingue
- English Grammar in Use (Cambridge University Press)

Requirements :

A good command of the STPI curriculum is essential : B1/B2

Organisation :

Each class lasts two hours and most classrooms are equipped with video and audio. A multimedia lab and computer rooms are also available for students to work in a stimulating environment.

-Teaching resources include press articles, audio and video documents (TV reports, film and series extracts) as well as the Internet.

-Regular personal work is required. Students must be curious and practise their English outside the classroom.

Evaluation :

Two-hour written test (50%)

Individual oral presentation (50%)

Target :

BUSINESS SIMULATION GAME	HUM06-SIM
Number of hours : 16.00 h	1.50 ECTS credit
TD : 16.00 h	
Reference Teacher(s) : GOURRET Fanny	

Objectives :

This course focuses on the complexity of the decision-making process in a company.

Main learning outcomes:

- Understanding information relative to marketing and finance
- The ability to use specific tools and vocabulary in the field of management
- Understanding the importance of teamwork: making collective decisions and producing the expected work in time

Content :

The course is mainly focused around a Business simulation, which empowers participants to run their own virtual businesses. Just like in real life, the teams compete against each other in order to gain market shares. The right decisions lead to success while the wrong ones engender invaluable problem solving experiences. The learning process becomes efficient and fun, and allows "learning by doing" as well as "learning from mistakes".

As an outcome of the simulation exercise, participants will fully comprehend the different aspects of the marketing decision making process, their relationship with each other, and their impact on the company's overall results. In addition, participants will gain invaluable experience in teamwork and problem solving.

The simulation is based on an online platform that allows students to make some decisions outside the classroom.

Bibliography :

Provided during the course

Requirements :

None

Organisation :

2 hours per week

Evaluation :

Continuous assessment (collective work)

Target :

Sport and physical Education	HUM06-EPS
Number of hours : 24.00 h	1.00 ECTS credit
TD : 24.00 h	
Reference Teacher(s) :	

Objectives :

Team work, discovery of one's capabilities, communication, invention and management responsibilities.

Content :

Choice of two activities from a menu. Adapting to destabilising situations and taking responsibility when risk is involved.

Speaking to groups. Leading group stretching exercises. Indoors: Rock climbing or badminton in teams. Outdoors: C.O or Kayak or golf.

Bibliography :

Several specialized books are available to the students at the library. Links to internet sites are given on the EPS website.

Requirements :

Organisation :

Evaluation :

Evaluation is based upon student participation, progress and acquisition. The student is asked to criticise his own progress with respect to the objectives of the course. The ability to be self-critical leads to self-discovery. Sharing this knowledge with a group reinforces one's confidence.

Target :

Professional Project	HUM06-PPI
Number of hours : 6.00 h	1.00 ECTS credit
TD : 6.00 h	
Reference Teacher(s) :	

Objectives :

Third Year PPI aims at training students to the job interview, thanks to specialits in Human Ressources.

Content :

Bibliography :

Requirements :

Being able to write a CV and cover letter

Organisation :

The course is organised as follows :

- First course PPI third year- group of 24 to 28 students
- The job interview as seen by the HR : goals, expectations, proceeding of the interviews, ...

Second course PPI third year-group of 12 to 14 students

How to get ready for an interview?

Tests

Trailer

Third course PPI third year-group of 4 or 5 students

mock job interviews

The contributors for this course are professionals in Human Resources

- Advisors in Human Resources in recruitment offices
- Responsible for Human Resources in companies

Evaluation :

A mark will be given by the contributor

Target :

All the 3rd-year-students

3rd Year Work Placement	GCU06-STAGE
Number of hours : 240.00 h	4.00 ECTS credit
ST : 240.00 h	
Reference Teacher(s) : GUEZOULI Samy	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Semestre 7

Parcours Formation Initiale GCU

1	GCU07-1		STRUCTURAL ANALYSIS	9.00
	GCU07-AES	O	Matrix Structural Analysis I	5.00
	GCU07-BA2	O	Reinforced Concrete 2 : Design of Reinforced Concrete Structures According to Eurocode 2.	4.00
2	GCU07-2		SOILS AND WATER	9.00
	GCU07-MDS2	O	Geotechnical Engineering and road Building II	3.50
	GCU07-PMDS	O	Project of Soil Méchanics	3.00
	GCU07-ESL	O	Open Channel Flow	2.50
3	GCU07-3		PHYSICAL HABITAT	6.00
	GCU07-THER2	O	Heat Transfer Engineering II	2.00
	GCU07-ACOUS	O	Building Acoustics	2.00
	GCU07-ECLA	O	Lighting Design	2.00
4	HUM07		Non-scientific syllabus S7	6.00
	HUM07-ANGL	O	English	2.00
	HUM07-EI	C	Entrepreneurship and Innovation	3.00
	HUM07-IE	C	INNOVATION & ENTREPRENEURSHIP (RIE)	3.00
	HUM07-EPS	O	Sport and physical education	1.00

O = compulsory, C= in choice , F= optional

Matrix Structural Analysis I	GCU07-AES
Number of hours : 60.00 h	5.00 ECTS credit
CM : 24.00 h, TD : 24.00 h, TP : 12.00 h	
Reference Teacher(s) : GUEZOULI Samy	

Objectives :

The objective of this course is to give the fundamental bases in the Elastic Analysis of Structures. After a reminder of the achievements of the 3rd GCU year, the resistance then the stability of the structures are analyzed in detail as much in analytical approach as in energy approach.

To understand the mechanical phenomena that governs the behavior of structures (redundancy, stability) and to provide useful solution strategies such as Matrix Methods)

Content :

- 1 Energy Principles: An overview with applications to beams
 - 1.1 Principle of Virtual Work
 - 1.2 Principle of Stationary Potential Energy
 - 1.3 Principle of Complementary Virtual Work
 - 1.4 Principle of Stationary Complementary Energy
 - 1.5 Reciprocal Theorems
- Part 1: Matrix Analysis of Structures (Direct Stiffness Method)
- 2 Truss Structures
 - 2.1 Idealization / Degree of Freedom
 - 2.2 Local and Global Coordinate Systems
 - 2.3 Nodal and Element Equilibrium
 - 2.4 Element Stiffness Equations in the Local Coordinate System
 - 2.5 Coordinate Transformation
 - 2.6 Element Stiffness Equations in the Global Coordinate System
 - 2.7 Assembly of the Global Stiffness Matrix
 - 2.8 Incorporation of Boundary Equations
 - 2.9 Static Condensation / Substructuring
 - 2.10 Support Settlement / Elastic Support
 - 2.11 Temperature Effects
- 3 Continuous Beams
 - 3.1 Idealization / Degree of Freedom
 - 3.2 Nodal and Element Equilibrium
 - 3.3 Element Stiffness Equations
 - 3.4 Assembly of the Global Stiffness Matrix
 - 3.5 Incorporation of Boundary Equations
 - 3.6 Static Condensation / Substructuring
 - 3.7 Support Settlement / Elastic Support
 - 3.8 Beam with Internal Hinge
 - 3.9 Semi-Rigid Connection
 - 3.10 Temperature Effects
- 4 Frames Structures: Beam/Column Element
 - 4.1 Idealization / Degree of Freedom
 - 4.2 Local and Global Coordinate Systems
 - 4.3 Nodal and Element Equilibrium
 - 4.4 Element Stiffness Equations in the Local Coordinate System
 - 4.5 Coordinate Transformation
 - 4.6 Element Stiffness Equations in the Global Coordinate System
 - 4.7 Assembly of the Global Stiffness Matrix
 - 4.8 Incorporation of Boundary Equations
 - 4.9 Static Condensation / Substructuring
 - 4.10 Support Settlement / Elastic Support
- Part 2: Static Stability of Structures
- 5 Fundamental Concepts in Static Stability
 - 5.1 Introduction
 - 5.2 Bifurcation of Geometrically Perfect Systems
 - 5.3 The Effect of Imperfection
 - 5.4 The Role of Linearized Buckling Analysis
 - 5.5 Systems with Multiple Degrees of Freedom
- 6 Elastic Buckling Of Planar Columns

- 6.1 Introduction
- 6.2 Large-Deflection Solution of an Elastic Column
- 6.3 Differential Equation of Planar Flexure
- 6.4 The Basic Case: Pin-Ended Column
- 6.5 Energy Methods / Ritz Approach
- 6.6 Five Fundamental Cases
- 6.7 The Effect of Imperfections
- 6.8 Stability of a Rigid Frame
- 6.9 End-Restrained Columns
- 7 Lateral-Torsional Buckling
 - 7.1 Introduction
 - 7.2 Basic Case: Beams Subjected to Uniform Moment
 - 7.3 The Effect of Boundary Conditions
 - 7.4 The Effect of Loading Conditions
 - 7.5 Lateral-Torsional Buckling of Singly-Symmetric Cross-Sections

Bibliography :

Requirements :

Continuum Mechanics , Elasticity, Beam Theory.

Organisation :

Lecture Review. Personal work: 50 hours

Evaluation :

Three-hour written examination; Practical work reports.

Target :

Reinforced Concrete 2 : Design of Reinforced Concrete Structures According to Eurocode 2.	GCU07-BA2
Number of hours : 48.00 h	4.00 ECTS credit
CM : 24.00 h, TD : 24.00 h	
Reference Teacher(s) : NGUYEN Quang Huy	

Objectives :

The objectives are to provide a basic understanding of the behaviour of reinforced concrete members and structures; to provide a basic understanding of standard methods of analysis and design of reinforced concrete behaviour (including an understanding of capabilities and limitations); and to provide basic design training in a simulated professional engineering environment. At the end of this unit students will gain proficiency in design of reinforced concrete structures according to Eurocode 2.

The syllabus comprises the behaviour of reinforced concrete members and structures, including: material properties, 'elastic' analysis, ultimate strengths of beams (flexure), ultimate strength of columns (short and slender), behaviour of reinforced concrete slabs. The reinforced concrete truss analogy (shear/torsion/and detailing implications). Design of typical elements of a reinforced concrete building, structural modelling, analysis of load-effects, design criteria (for durability, fire-resistance, serviceability and strength), design calculation procedures, reinforcement detailing, structural drawings.

Content :

- Members under flexion with and without axial force at Serviceability limit states (SLS)
- Members under flexion with axial force.
- Members under deviated flexion
- Members under shear
- Members under torsion

Bibliography :

- Eurocode 0: Basis of design
- Eurocode 1: Actions on structures
- Eurocode 2: Design of concrete structures
- CEB-FIP Model Code 1990: Design code

Requirements :

Course of Reinforced Concrete 1 ; Beam theory, basic concepts of solid mechanics and structural mechanics.

Organisation :

21 hours of lectures and 21 hours of tutorials

Course Supports:

Copies of handouts

Online documents

Softwares: Autodesk Robot - Revits - Autocad

Evaluation :

Written examination (3h) and mini-project report

Target :

Fourth year students

Geotechnical Engineering and road Building II	GCU07-MDS2
Number of hours : 64.00 h	3.50 ECTS credit
CM : 24.00 h, TD : 24.00 h, TP : 16.00 h	
Reference Teacher(s) : MASSON Samuel	

Objectives :

Various aspects of soil mechanics. Methods for calculation and dimensioning of works. Stability and settling during the construction phase /after the handover.

Content :

1. Resistance to drained and undrained shear. Elastoplastic behaviour.
2. Regulations and norms. Limit state calculations.
3. Stability of Slopes. Method of slices.
4. Rigid and flexible retaining structure screens. Limit equation. Reaction module.
5. Shallow and deep foundations. Carrying capacity coefficient.
6. Finite element calculation of the works.

Bibliography :

1. COSTET J., SANGLERAT G., 1985, ""Cours pratique de Mécanique des Sols"", Ed. Dunod.
2. CORDARY D, 1994, ""Mécanique des Sols"", Ed. Tec Doc.
3. LAMBE T.W. et WHITMAN R.V., 1969, ""Soil Mechanics"", J. Wiley.
4. ATKINSON J.H. et BRANSBY, 1978, ""The Mechanics of Soils : an introduction to Critical State Mechanics"", Mac Graw Hill.

Requirements :

Soil Mechanics 1 - Solids Mechanics- Resistance of Materials- Continuum Mechanics, Numeric Calculation, Finite Element.

Organisation :

Review of lecture notes. Research and writing of the project: 40 hours

Evaluation :

Project report.
Oral presentation.
Practical work reports.

Target :

Project of Soil Méchanics	GCU07-PMDS
Number of hours : 10.00 h	3.00 ECTS credit
PR : 10.00 h	
Reference Teacher(s) : MASSON Samuel	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Open Channel Flow	GCU07-ESL
Number of hours : 42.00 h	2.50 ECTS credit
CM : 12.00 h, TD : 18.00 h, TP : 12.00 h	
Reference Teacher(s) : DUPONT Pascal	

Objectives :

Content :

Applied fluid mechanics course for gravitationnal flows in open channel

Bibliography :

Requirements :

Organisation :

Evaluation :

Written examination.
Practical work reports.

Target :

Heat Transfer Engineering II	GCU07-THER2
Number of hours : 24.00 h	2.00 ECTS credit
CM : 12.00 h, TD : 12.00 h	
Reference Teacher(s) : DUPONT Pascal	

Objectives :

Thermal sciences applied to building energetic budget.

This module provides the elements necessary for a profound understanding of the technical and theoretical problems of

Thermics for Buildings. There are four objectives:

1. An extension of the third year programme to standard elements of man-made structures;
2. Global understanding of and critical attitude towards the principles and methods of thermal code RT2000;
3. Method for integrating Thermics into the design process for buildings;
4. Technical solutions for the construction of thermically-efficient buildings.

Content :

1. Problems associated with thermics in residential buildings. The Energy Challenge.
2. Opaque walls in steady and time-dependent flow.
3. Air film thermics.
4. Thermal bridges.
5. Thermics of glass walls.
6. Solar thermal gain.
7. Humid air and hygrometry.
8. Energy consumption of buildings.

Bibliography :

1. Cortès H. et Blot J., ""Transferts thermiques-Application à l'habitat"", chez Ellipse, 1999
2. Croiset M., ""L'hygrothermique dans l'habitat"", chez Eyrolles Paris, 1970
3. ""Traité de physique du bâtiment, Tome 1 : connaissances de base"", édition du CSTB
4. ""RT200"", Base de données I-Reef du CSTB
5. Hernot D., Porcher G., ""Thermique appliquée aux bâtiments"", aux éditions parisiennes CFP, 1984
6. Recknagel et col., ""Manuel pratique du génie climatique- tome 1: données fondamentales"", chez PYC, édition Paris, 1995, présent à la BU INSA

Requirements :

Thermics

Organisation :

Review of lecture notes(15 hours).

Evaluation :

Two-hour written examination.

Target :

Building Acoustics	GCU07-ACOUS
Number of hours : 22.00 h	2.00 ECTS credit
CM : 10.00 h, TD : 8.00 h, TP : 4.00 h	
Reference Teacher(s) : MOLEZ Laurent	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Lighting Design	GCU07-ECLA
Number of hours : 26.00 h	2.00 ECTS credit
CM : 18.00 h, TD : 8.00 h	
Reference Teacher(s) : DUPONT Pascal	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

English	HUM07-ANGL
Number of hours : 28.00 h	2.00 ECTS credit
TD : 28.00 h	
Reference Teacher(s) : RANNOU Isabelle	

Objectives :

Acquiring the required skills for working in a firm as an engineer. Reaching the required level (B2) is compulsory in order to graduate.

Content :

-Learning by doing:

The student will have to be able to talk and listen, write documents while showing he/she can solve problems, reason, convince and demonstrate in an articulate manner.

-Expressing oneself accurately and fluently.

The student will engage in activities requiring creative and reactive skills (such as debates, role-plays, individual oral presentations using PowerPoint, projects), which will be based on scientific topics and current events.

-Writing CVs and cover letters

-Scientific English

-Discovering the professional world in an international context

-Preparing for the TOEIC (during the second semester, a specific ϵ Toeic Booster ϵ course will be available)

Bibliography :

- Oxford Advanced learners ϵ Dictionary

- English Grammar in Use (Cambridge University Press)

Requirements :

1st, 2nd and 3rd year English courses (or equivalent)

Organisation :

Each class lasts two hours and most classrooms are equipped with video and audio. A multimedia language lab and computer rooms are also available and make it possible for the students to work in a stimulating environment. Our teaching resources include press articles, audio and video documents (TV reports, extracts from films and series). We also use the Internet.

Regular personal work is obviously required. The student must be curious and practise English outside the classroom as well.

Evaluation :

One two-hour written exam.

Target :

Entrepreneurship and Innovation	HUM07-EI
Number of hours : 48.00 h	3.00 ECTS credit
CM : 24.00 h, TD : 24.00 h	
Reference Teacher(s) : GOURRET Fanny	

Objectives :

The aim of this module is to assemble a team of students on a business start-up project or product development plan (business plan).

Content :

Through conferences, interviews and lectures, students gather the information and advice necessary to set out a business plan. Working in small work groups, the students find, develop and formulate their own business start-up project or product-development plan. Progress is evaluated through progress reports in the form of oral presentations.

Groups also benefit from tutorial sessions.

Bibliography :

Provided during the course

Requirements :

management simulation module S6

Organisation :

4 hours per week

Evaluation :

Oral defense and written deliverable

Target :

INNOVATION & ENTREPRENEURSHIP (RIE)	HUM07-IE
Number of hours : 54.00 h	3.00 ECTS credit
TD : 54.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Sport and physical education	HUM07-EPS
Number of hours : 24.00 h	1.00 ECTS credit
TD : 24.00 h	
Reference Teacher(s) : LE LAGADEC Pierre	

Objectives :

Team work, discovery of one's capabilities, communication, invention and management responsibilities.

Content :

Choice of two activities from a menu. Adapting to destabilising situations and taking responsibility when risk is involved.

Speaking to groups. Leading group stretching exercises. Indoors: Rock climbing or badminton in teams. Outdoors: C.O or Kayak or golf

Bibliography :

Several specialized books are available to the students at the library. Links to internet sites are given on the EPS website.

Requirements :

Organisation :

Evaluation :

Evaluation is based upon student participation, progress and acquisition. The student is asked to criticise his own progress with respect to the objectives of the course. The ability to be self-critical leads to self-discovery. Sharing this knowledge with a group reinforces one's confidence.

Target :

Semestre 8
Parcours Formation Initiale GCU

1	GCU08-1		ADVANCED STRUCTURAL ANALYSIS	5.50
	GCU08-ADP	O	Dynamics of Structures	2.00
	GCU08-CPS	O	Plastic Calculation of Structures	1.50
	GCU08-MEF	O	Finite Element Modelling	2.00
2	GCU08-2		GEOLOGY AND MATERIALS	4.50
	GCU08-SGH	O	Geology and Hydrogeology	1.50
	GCU08-CDB	O	Behavior of hardened concrete	1.50
	GCU08-IR	O	Introduction to scientific research	1.50
3	GCU08-3		DESIGN OF STRUCTURES	6.00
	GCU08-BA3	O	Reinforced Concrete Structures 3.	2.50
	GCU08-CM1	O	Steel structures	1.50
	GCU08-R&C	O	Pavement engineering	2.00
4	HUM08		Non-scientific syllabus S8	6.00
	HUM08-ANGL	O	English	2.00
	HUM08-TEJS	C	ECONOMIC, LEGAL AND SOCIAL ISSUES	1.00
	HUM08-SHES1	O	Engineer & Society - M1	1.00
	HUM08-SHES2	C	Engineer & Society - M2	1.00
	HUM08-EPS	O	Sport and Physical Education	1.00
	HUM08-IE	C	INNOVATION & ENTREPRENEURSHIP (RIE)	2.00
5	GCU-STAGE08		traineeship 4GCU	8.00
	GCU08-STAGE	O	Fourth year work placement	8.00

O = compulsory, C= in choice , F= optional

Dynamics of Structures	GCU08-ADP
Number of hours : 48.00 h	2.00 ECTS credit
CM : 24.00 h, TD : 24.00 h	
Reference Teacher(s) : HJIAJ Mohammed	

Objectives :

The stability of elastic structures using the functions of stability. Local buckle and discharge. Analysis of dynamic structures as applied to earthquake-resistant engineering.

Content :

1. Elastic buckling of bars and structures
2. Calculation of critical load using the energy method
3. Calculation of critical load using the successive approximations method
4. Influence of initial curvature - phenomenon of inversion of flexion
5. Functions of stability
6. Problem Solving: for rigid-knot structures / articulated-knot structures / continuous beams
7. Classification of sections (Eurocodes) (Reminder) - Theoretical models of collapse by buckling (local - shearing) in structural calculations
8. Understanding Discharge in structural calculations
9. Understanding Seismology
10. Simple damped oscillator
11. Response spectra
12. Multiple oscillators
13. Dimensioning of Structures
14. Potential energy
15. Earthquake-resistance
16. Applications

Bibliography :

1. TIMOSHENKO S., GERE J.M., 1966, ""Théorie de la stabilité élastique"", Dunod
2. APK (BOURRIER P. et BROZETTI J.), 1996, ""Construction métallique et mixte acier-béton"", Eyrolles
3. DAVIDOVICI V., 1980 ""Calcul dynamique des structures en zone sismique"", Eyrolles
4. ABSI E., 1987, ""Introduction au génie parasismique"", Annales ITBTP
5. Eurocodes 3, 4 et 8

Requirements :

General Mechanics and Mathematical Analysis (vectorial analysis, Partial derivative problems, functions of a complex variable, etc).

Organisation :

Review of lecture notes. Homework; 90 hours.

Evaluation :

Two written examinations of two and three hours respectively.

Target :

Plastic Calculation of Structures	GCU08-CPS
Number of hours : 18.00 h	1.50 ECTS credit
CM : 12.00 h, CM : 12.00 h, TD : 6.00 h, TD : 6.00 h	
Reference Teacher(s) : COUCHAUX Mael	

Objectives :

This module allows to approach the plastic calculation of structures starting from the elastoplastic behavior of materials. The plastic resistance of sections is initially studied for the six components of internal force (normal and shear forces, bending and torsional moments) by considering in particular their interaction. The fundamental concepts of limit analysis and the associated theorems are then applied to beams and then to plates. This module lays the foundations of plastic calculation necessary for its understanding and mastery in the courses of steel and wood structures but also in reinforced concrete.

Content :

- 1- Elasto-plastic mechanics of materials
- 2- Plastic resistance of sections
- 3- Limit analysis of beams
- 4- Limit analysis of plates.

Bibliography :

- [1] Lescouarc'h Y., Calcul en plasticité des structures, COTECO, 1983.
- [2] Lemaitre J., Chaboche J.-L., Mécanique des Matériaux Solides, Dunod, 2nd édition, 2004.
- [3] Save M.A., Massonnet C.E., De Saxce G., Plastic limit analysis of plates, shells and disks, North-Holland Series in applied mathematics and mechanics, 1997.
- [4] Frey F., Analyse des structures et milieux continus, Traité de Génie Civil de l'Ecole Polytechnique Fédérale de Lausanne, Volume 2, 1994.

Requirements :

Deformable Solid Mechanics, Structural Analysis I and II, Dynamic Analysis & Plates.

Organisation :

Lecture with application of concepts discussed in tutorials.

Evaluation :

Two-hour written synthesis examination.

Target :

Finite Element Modelling	GCU08-MEF
Number of hours : 42.00 h	2.00 ECTS credit
CM : 12.00 h, TD : 18.00 h, TP : 12.00 h	
Reference Teacher(s) : MEFTAH Fekri	

Objectives :

Be able to start from the strong formulation of a continuous initial-boundary value problem in order to derive its weak form and then the associated discrete finite element model. Be able to derive a finite element for a given formulation. Be able to discretize and solve an engineer problem using finite element method.

Part I. FEM - Static analysis in linear elasticity

Part II. FEM - Stationary and transient thermal and thermos-elastic analysis

Content :

I. Partial differential equations (PDE)

I.1 Classification

I.2 Examples of PDE in engineering

I.3 Discrete approximation of derivatives – Finite different schemas

I.4 Mechanical formulation in elasticity: Bars – Beams – Plane states – Axisymmetric states – Plates

I.4 Applications

II. Linear static analysis

II.1 Strong form of boundary value problem (BVP) in elasticity

II.2 Average formation and Weak form of BVP

II.3 Space discretization and fields interpolation

II.4 Discretized problem – Set of algebraic equations

II.5 Kinematic boundary conditions.

II.6 Force versus Displacement control

II.7 Iso-parametric transformation

II.8 Numerical integration

II.9 Applications

III. Linear and nonlinear thermal analysis

III.1 Strong form – Weak form of a thermal initial boundary value problem (IBVP)

Heat transfer problem

Mechanical problem

III.2 Space discretization and fields interpolation

III.3 Time discretization schemes – Stability and precision

III.4 Discrete form – Set of algebraic equations

Heat transfer problem

Mechanical problem

III.5 Boundary conditions

Thermal conditions – Convection / Radiation

Kinematical conditions

III.6 Compatibility of interpolations of thermal and mechanical fields

III.7 Applications

IV. Linear dynamic analysis

IV.1 Strong form – Weak form of a dynamic initial boundary value problem (IBVP)

IV.2 Space discretization and fields interpolation

IV.3 Time discretization schemes – Stability and precision criteria

IV.5 Discreteform – Set of algebraic equations

IV.5 Viscous dumping effects

IV.6 Kinematical initial and boundary conditions

IV.7 Analysis of free vibration systems

IV.8 Applications

Bibliography :

K. J. Bathe, Numerical methods in finite element analysis, Prentice-Hall (1976)

R. H. Gallagher, Introduction aux éléments finis, Pluralis (1977)

T.J.R Hugues, The Finite Element Method: Linear Static and Dynamic Finite Element Analysis. Dover (2000)

O. C. Zienkiewicz, R. L. Taylor, J. Z. Zhu, The Finite Element Method: Its Basis and Fundamentals, Butterworth-Heinemann (2005)

Requirements :

Continuum mechanics with the emphasis on deformable solids. Numerical methods (interpolation, integration...) – Linear algebra (matrices). Matlab programming environment.

Organisation :

Practical work classes are dedicated to projects of programming under Matlab environment.

Evaluation :

2 hours Exam at the end of the semester plus an evaluation of the practical work projects.

Target :

4GCU

Geology and Hydrogeology	GCU08-SGH
Number of hours : 36.00 h	1.50 ECTS credit
TD : 24.00 h, TP : 12.00 h	
Reference Teacher(s) : LOMINE Franck	

Objectives :

To master the principles of geological sectioning. To be able to describe mathematically the flow in porous mediums involved in the field of civil engineering in order to be able to dimension pumping installations.

Content :

- 1 - Principles of geological sections and applications
- 2 - Fresh water on Earth: water cycle, use, availability, quality, functioning of aquifers
- 3 - Complements of fluid and soil mechanics, field and laboratory tests to determine the characteristics of porous media
- 4 - Mathematical description of flows in porous media
- 5 - Pumping in groundwater: dimensioning and classical problems in civil engineering

Bibliography :

Sorel et Vergely, Atlas d'initiation aux cartes et aux coupes géologiques

Requirements :

GCU06-MDS1 , GCU06-MFLU1 , GCU06-MFLU2

Organisation :

Lectures/TD, TD, TP

Evaluation :

3 supervised assignments (1 hour each)

Target :

Behavior of hardened concrete	GCU08-CDB
Number of hours : 24.00 h	1.50 ECTS credit
CM : 12.00 h, TP : 12.00 h	
Reference Teacher(s) : HANNAWI Kinda	

Objectives :

This module aims to teach to students the usage properties of hardened concrete and its behavior under different solicitations.

Content :

Mechanical behavior of hardened concrete:
Specificities of the concrete material. Metrology and experimental conditions. Behavior of concrete under uniaxial solicitations (direct traction, indirect traction by splitting and by bending, uniaxial compression). Behavior of concrete under multiaxial solicitations.
Concrete deformations (deformations under load or without load)
Statistical analysis of results and supplier risk.

Transfer properties of hardened concrete.
Physical bases of fluid transfers in porous environments
Porosity accessible to water,
Electrical resistivity
Permeability (gas permeability, water permeability at constant or variable load, relationship between porosity and permeability in a porous medium - principle of Blaine's method).
Diffusion (diffusion tests in transient or steady state, migration tests).
Capillary absorption (capillary phenomena, notion of surface tension, methods of measuring surface tension, Laplace's law, Jurin's law, capillary absorption coefficient).

Non - Destructive Testing methods of concrete:
Acoustic emission technique, ultrasonic wave propagation speed, sclerometric index, infrared thermography.

Bibliography :

Comportement mécanique du béton. Jean-Marie Reynouard, Gilles Pijautier-Cabot.

Requirements :

Good base in Physics and Chemistry of the 1st Cycle.

Organisation :

Lectures (12 h) + laboratory Work (12 h).

Evaluation :

Written synthesis examination (2h) + Report of laboratory Work.

Target :

4GCU

Introduction to scientific research	GCU08-IR
Number of hours : 12.00 h	1.50 ECTS credit
PR : 12.00 h	
Reference Teacher(s) : DARQUENNES Aveline	

Objectives :

At the end of this module, the student must have understood and can explain:

- the approach and the tools of a targeted research of scientific bibliography
- the principles of the scientific approach
- the basic methods of conducting research projects

The student must be able to:

- identify and deepen a scientific research topic
- to take stock of the past and current research on this subject and to find the main specialist teams
- autonomously implement an experimental scientific approach to answer questions
- return the result in a scientific format (article, poster)
- put in place a project management approach.

Content :

Research on construction materials

Research on construction technology

Research on Sustainable Development in Civil Engineering

Research on advanced methods of structural calculation

Bibliography :

Articles related to the problematic of the candidate can be consulted and download from the library of INSA Rennes

Requirements :

Notions of bibliographical study

All areas of scientific knowledge related to the project

Organisation :

8 hours of tutorials

Copies of handouts

Online documents

Evaluation :

Writing a document in a scientific format (article, poster)

Target :

fourth year students

Reinforced Concrete Structures 3.	GCU08-BA3
Number of hours : 48.00 h	2.50 ECTS credit
CM : 24.00 h, TD : 24.00 h	
Reference Teacher(s) : NGUYEN Quang Huy	

Objectives :

Safety in the field of construction sciences. The importance of the suitability of building materials. Understand and apply the results of Limit analysis. Calculations relative to limitation of normal stress for the Service Limit State. Calculations relative to Service Limit State and Ultimate Limit State.

Content :

Reinforced concrete and safety principles

- Phenomenological and regulatory characterisation of materials. Structural modelling
- Construction law details for local properties
- General rules to justify the normal stress of prismatic pieces subjected to normal forces. Service Limit State of fissuring, deformation. Ultimate Limit State of bending.

Bibliography :

http://www.btp.equipement.gouv.fr/article.php3?id_article=224

http://www.btp.equipement.gouv.fr/article.php3?id_article=378

http://www.btp.equipement.gouv.fr/article.php3?id_article=389

http://www.btp.equipement.gouv.fr/article.php3?id_article=377

THONIER H., 2006, Conception et calcul des structures de bâtiment, l'Eurocode 2 pratique, Ed. Presses de

l'ENPC CALGARO J.A., CORTADE J. et ALL, 2006,

Applications de l'Eurocode 2, Ed. Presses de l'ENPC GUILLEMONT P., 2005,

Aide-mémoire béton armé, Ed. Dunod pour Editions Le Moniteur MATANA M., 2004,

Béton armé, Ed. Alternatives Norme européenne EN 1992-1-1 :2004, Ed. AFNOR MOUGIN J.P., 2000,

""Béton armé BAEL 91 modifié 99"" , Ed. Eyrolles MIEHLBRADT M., 1997,

Béton armé bases. Structure I, Ed. EPFL NICOT R., 1997, ""Béton armé, Application de l'eurocode 2"" , Ed. Ellipse DAVIDOVICI V., 1995,

""Formulaire du béton armé"" , Ed. Le Moniteur PERCHAT J. et ROUX A., 1994,

""Pratique du BAEL 91"" , Ed. Eyrolles

LACROIX R., FUENTES A. et THONIER H., 1985,

""Traité de béton armé"" , Ed. Eyrolles COIN A., 1983, ""Ossatures des bâtiments"" , Ed. Eyrolles

Requirements :

Materials. Stress and strain states in a beam. Beam Theory.

Organisation :

Evaluation :

Written examination (3h) and mini-project report

Target :

4GCU

Steel structures	GCU08-CM1
Number of hours : 24.00 h	1.50 ECTS credit
CM : 14.00 h, TD : 10.00 h	
Reference Teacher(s) : BERNARD Fabrice	

Objectives :

Global understanding of the behaviour of metal frame structures. Identification of the combination of actions on each element of the structure. Basic principles of verification of; structural safety and serviceability; elasticity and plastic dimensioning of metallic elements; assembly and stability theory.

Content :

1. History and main points.
2. The utility steels in steel construction: methods of manufacture, finished products, performances and testing.
3. Eurocodes One and Three. Different types of analysis.
4. Strength of sections.
5. Strength of elements.
6. Weld assembly, bolted joints.

Bibliography :

1. M.A. Hirt et R. Bez, 1996, Construction Métallique. Notions fondamentales et méthodes de dimensionnement, Presses Polytechniques et Universitaires Romandes
2. M.A. Hirt, A. Nussbaumer, M. Crisinel et J.P. Lebet , 2004, Construction Métallique : bases de calcul et exemples numériques adaptés aux nouvelles normes, Presses Polytechniques et Universitaires Romandes

Requirements :

Beam theory. Strength of materials. Structural mechanics. Calculation of plasticity of structures. Mechanics of elastic solids.
Stability.

Organisation :

50 hours.

Evaluation :

Three-hour written examination.

Target :

Pavement engineering	GCU08-R&C
Number of hours : 48.00 h	2.00 ECTS credit
CM : 24.00 h, TD : 12.00 h, TP : 12.00 h	
Reference Teacher(s) : MASSON Samuel	

Objectives :

ROAD AND TERRACING TECHNIQUES:

Road geotechnics (soil classification, compacting, soil utilisation - subgrades and embankment), earthmoving (terracing sketch), Road design (horizontal alignment, longitudinal section, cross-section). Road design software.

ROAD MATERIALS AND ROAD STRUCTURE:

Various elements of road structure (principles, thickness of the different types of layers). Constituents and requirements of road materials - focus on bituminous mixes. Principles of the French method of road design; Quality control tests for road surfaces.

Content :

ROAD AND TERRACING TECHNIQUES:

1. GTR classification of soils. Subgrades and embankment compacting.
2. Earthmoving/ Terracing.
3. Bearing capacity and roadbed classification.
4. Soil treatments.
5. Frost and defrost phenomena: consequences and solutions.
6. Road design: horizontal alignment, longitudinal section, cross-section.

ROAD MATERIALS AND ROAD STRUCTURE:

1. Introduction.
2. Road structure.
 - 2.1. Functional description of road layers.
 - 2.2. Categories of road structure.
 - 2.3. Pavement design, various structures.
3. Road materials.
 - 3.1. Basic constituents: aggregates, hydraulic binders and hydro-carbonated binders.
 - 3.2. Mixes: non treated materials, treated materials with hydraulic binders, treated materials with hydro-carbonated binders.
4. Surface quality.
 - 4.1. Evenness
 - 4.2. Pavement skid resistance

Bibliography :

SETRA-LCPC, 1992, ""Réalisation des remblais et des couches de forme - Guide Technique"", LCPC IST-Publications.
 LCPC- SETRA, 2000, ""Traitement des sols à la chaux et/ou aux liants hydrauliques - Guide Technique"", LCPC IST-Publications. SETRA, 1994,
 "" Aménagements des Routes Principales (ARP) "" , Guide Technique. SETRA, 1985,
 "" Instruction sur les Conditions Techniques d'Aménagement des Autoroutes de Liaison (ICTAAL)"" , Guide Technique. SETRA-LCPC, 1994,
 ""Conception et dimensionnement des structures de chaussée - Guide Technique"", LCPC IST-Publications.
 DI BENEDETTO. H., CORTE J.-F., Matériaux routiers bitumineux, tomes 1 2, éd. Hermes, Lavoisier, 2005.
 HERSCHKORN P., Couches de roulement, Presses de l'ENPC, 1988.
 PEYRONNE C., KAROFF G., Dimensionnement des chaussées, Presses de l'ENPC, 1991.
 NISSOUX J.-L., VILLEMAGNE M., Chaussées en béton de ciment, Presses de l'ENPC, 1988.

Requirements :

Soil physics. Plane geometry. Aggregates and hydraulic binders. Basic knowledge of Mechanics of elastic solids.

Organisation :

Review of lecture notes.

Evaluation :

2 two-hour written examinations. Practical Work reports.

Target :

English	HUM08-ANGL
Number of hours : 24.00 h	2.00 ECTS credit
TD : 24.00 h	
Reference Teacher(s) :	

Objectives :

Acquiring the required skills for working in a firm as an engineer. Reaching the required level (B2) is compulsory in order to graduate.

Content :

-Learning by doing:

The student will have to be able to talk and listen, write documents while showing he/she can solve problems, reason, convince and demonstrate in an articulate manner.

-Expressing oneself accurately and fluently.

The student will engage in activities requiring creative and reactive skills (such as debates, role-plays, individual oral presentations using PowerPoint, projects), which will be based on scientific topics and current events.

-Writing CVs and cover letters

-Scientific English

-Discovering the professional world in an international context

-Preparing for the TOEIC. Furthermore, during the second semester, a specific *Toeic Booster* course is available for students wishing to attend.

Bibliography :

- Oxford Advanced learners' Dictionary

- English Grammar in Use (Cambridge University Press)

Requirements :

1st, 2nd and 3rd year English courses (or equivalent)

Organisation :

Each class lasts two hours and most classrooms are equipped with video and audio. A multimedia language lab and computer rooms are also available and make it possible for the students to work in a stimulating environment. Our teaching resources include press articles, audio and video documents (TV reports, extracts from films and series). We also use the Internet.

Regular personal work is obviously required. The student must be curious and practise English outside the classroom as well.

Evaluation :

TOEIC

15 minute oral exam

Target :

ECONOMIC, LEGAL AND SOCIAL ISSUES	HUM08-TEJS
Number of hours : 10.00 h	1.00 ECTS credit
TD : 10.00 h	
Reference Teacher(s) : GOURRET Fanny	

Objectives :

This course focuses on economic, legal and social matters. Students are encouraged to develop their curiosity and their ability to analyse topics related to the general environment of a company.

Main learning outcomes:

- Understanding key concepts related to a firm's environment
- Establishing a specific-vocabulary base
- Develop their curiosity and critical thinking

Content :

The topics covered may vary depending on the speakers and the the current events, however attention will be paid to two subjects in particular: the financial and monetary system (MSM), climate change (STIC).

Bibliography :

Provided during the course

Requirements :

None

Organisation :

Evaluation :

Continuous assessment (collective work)

Target :

Engineer & Society - M1	HUM08-SHES1
Number of hours : 14.00 h	1.00 ECTS credit
TD : 14.00 h	
Reference Teacher(s) : ECHARD Philippe	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Engineer & Society - M2	HUM08-SHES2
Number of hours : 14.00 h	1.00 ECTS credit
CM : 14.00 h	
Reference Teacher(s) : ECHARD Philippe	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Sport and Physical Education	HUM08-EPS
Number of hours : 20.00 h	1.00 ECTS credit
TD : 20.00 h, TD : 20.00 h	
Reference Teacher(s) :	

Objectives :

Team work, discovery of one's capabilities, communication, invention, autonomy, self-discovery and management responsibilities.

Content :

Whole class: "role of the coach, role of the referee, management" (knowledge of the rules, getting involved, leading, decision making and communicating). Practice and knowledge of the sociomotive roles involved in the strategies of team attack and team defence. Finding one's place in a group and awareness of your team-mates and their responsibilities. Organisation of Physical and Sports Education: two 15-hour and one 30-hour sports or physical activity programmes in groups.

Bibliography :

Specialised publications are available at the library. Internet links are posted and updated on the INSA Physical Education website.

Requirements :

Organisation :

Evaluation :

Evaluation is based upon student participation, progress and acquisition. The student is asked to criticise his own progress with respect to the objectives of the course. The ability to be self-critical leads to self-discovery. Sharing this knowledge with a group reinforces one's confidence.

Target :

INNOVATION & ENTREPRENEURSHIP (RIE)	HUM08-IE
Number of hours : 48.00 h	2.00 ECTS credit
TD : 48.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Fourth year work placement	GCU08-STAGE
Number of hours : 240.00 h	8.00 ECTS credit
ST : 240.00 h	
Reference Teacher(s) : GUEZOULI Samy	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Semestre 9
Parcours Formation Initiale GCU

1	GCU09-1		COMMON CORE 1	10.00
	GCU09-DUR	O	Durability	1.50
	GCU09-BA4	O	Reinforced Concrete Structures III	2.00
	GCU09-BP1	O	Prestressed Concrete Structures	2.00
	GCU09-MARS	O	Ground improvement	2.00
	GCU09-MRO	O	Maintenance and Rehabilitation of Infrastructure	1.50
	GCU09-CBOI1	O	Wood structures 1	1.00
2	GCU09-2		COMMON CORE 2	4.00
	GCU09-DDC	O	Construction Law and Legislation	1.00
	GCU09-CPA1	O	Conception Parasismique 1	1.50
	GCU09-URBA1	O	Urban planning	1.50
3	GCU09-3		THREE POSSIBLE SPECIALIZATIONS: BUILDING ENGINEERING OR URBAN ENGINEERING OR PUBLIC WORKS	10.50
	GCU09-CBOI2	C	Wood Structures 2	1.00
	GCU09-CM2	C	Steel structures 2	2.00
	GCU09-CPA2	C	Seismic Design II	1.00
	GCU09-ABAT	C	Building Acoustics	1.00
	GCU09-THER3	C	Heat Transfer Engineering III	1.50
	GCU09-TCOND	C	Thermal Conditioning	1.50
	GCU09-FETB	C	Fluids and Building Equipment	1.00
	GCU09-HYU	C	Urban Hydrogeology	1.50
	GCU09-HUR	C	Design of Water Supply & Waste Conveyance Systems	1.50
	GCU09-GTD	C	Waste Management & Contaminated Sites	1.00
	GCU09-QAIR	C	Urban air quality	1.00
	GCU09-AURB	C	Urban Acoustics	1.00
	GCU09-VIT	C	Public Road & Transportation Infrastructure	1.50
	GCU09-DURB	C	Sustainable Mobility in Cities	1.50
	GCU09-URBA2	C	Urban planning 2	1.50
	GCU09-MECH	C	Pavement Mechanics	2.00
	GCU09-OGEO	C	Geotechnical constructions	2.00
	GCU09-HYTM	C	Marine Hydraulic Engineering	1.00
	GCU09-HYDR	C	Hydrogeology	1.00
	GCU09-BP2	C	Prestressed Concrete	1.00
	GCU09-POUV	C	Bridges and Infrastructures	2.00
	GCU09-CMX	C	Composite Steel - Concrete Structures	1.50
4	HUM09		Non-scientific syllabus S9	5.50
	HUM09-ANGL-CONV	C	English S9 Conversation	1.50
	HUM09-ANGL-TOEIC	C	TOEIC 5th year	1.50
	HUM09-PM-A	C	Economics, Law and Business Studies A - LEAN MANAGEMENT	2.00
	HUM09-PM-B	C	Economics, Law and Business Studies B (Human Resources Management)	2.00
	HUM09-PM-C	C	Economics, Law and Business Studies C (Human Resources Management)	2.00

	HUM09-PM-D	C	Economics, Law and Business Studies D MANAGEMENT AND ETHICS FOR ENGINEERS	2.00
	HUM09-PM-E	C	Economics, Law and Business Studies E (INTERNATIONAL DEVELOPPEMENT & STRATEGIES)	2.00
	HUM09-PM-F	C	Economics, Law and Business Studies F (sustainable development)	2.00
	HUM09-PM-G	C	Economics, Law and Business Studies G (serious game)	2.00
	EII09-EVST	C	Internship evaluation	1.00
	EII09-HUMT	C	Societal responsibility of business	1.00
	EII09-EVST	C	Internship evaluation	1.00
	INF09-STGDATING	C	Internship Dating	1.00
	GPM09-SOUT	C	4 th year Work Placement / Presentation	1.50
	GCU09-SPEC-IIEC	C	Integration of environmental impacts in construction	1.00
	GCU09-SPEC-GPD	C	BIM Project Management	1.00
	INF09-ETHIQUE	C	Formation éthique de l'ingénieur	1.00
	HUM09-PM-PRO	C	Economics, Law and Business Studies (Professional management)	2.00
	DET10-SPEC PRO	C	Expérience en entreprise	2.00
7	HUMF1-ELSA Mus		Music with studies	1.00
	HUMF1-MUS	F	Music Studies	1.00

O = compulsory, C= in choice , F= optional

Durability	GCU09-DUR
Number of hours : 12.00 h	1.50 ECTS credit
CM : 12.00 h	
Reference Teacher(s) : KAMALI BERNARD Siham	

Objectives :

Identification of and understanding the main causes of damage to building materials. Characterisation techniques.
The principles of prevention.

Content :

I. DURABILITY OF CONCRETE:

1. The physico-chemical basics of the durability of concretes: hydrates, porous network of concrete - Interfaces, surface properties, properties of capillary transport, permeability, diffusion, migration.
2. The chemical processes of the degradation of concrete. Effect of acid, sea water, sulphates on concrete. Degradation by alkali-silica reaction - Carbonation, Corrosion.
3. The physical processes of the degradation of concrete. Freeze - thaw cycling, Abrasion, Erosion, Cavitation.
4. Principles of prevention .

II. DURABILITY AFTER IMPLEMENTATION:

1. Factors of intrinsic alteration (effects connected to the mineralogical composition, role of hydric properties, mechanical properties and transfer properties).
2. Factors of extrinsic alteration (freeze, effects of salts, effects of gaseous atmospheric pollution, biological colonisation).
3. Patina.

Bibliography :

1. La durabilité des bétons. Collection de l'Association Technique de l'Industrie des Liants Hydrauliques, sous la direction de Jacques Baron et Jean-Pierre Ollivier. Edition Presse de l'Ecole Nationale des Ponts et Chaussées.
2. La dégradation des bétons: couplage fissuration dégradations chimiques. Sous la direction de Jean Michel TORRENTI, Olivier DIDRY, Jean Pierre OLLIVIER, Frederic PLAS. Edition HERMES.
3. Les bétons à hautes performances : caractérisation, durabilité, applications. Sous la direction de Yves MALIER. Edition Presse de l'Ecole Nationale des Ponts et Chaussées.

Requirements :

Organisation :

Evaluation :

Written examination.
Mini-project (Report and oral presentation).

Target :

5GCU

Reinforced Concrete Structures III	GCU09-BA4
Number of hours : 12.00 h	2.00 ECTS credit
CM : 12.00 h	
Reference Teacher(s) : NGUYEN Quang Huy	

Objectives :

Give to students a simple concrete building to apply previous lectures in a coordinated way.

Content :

Every week students meet the professor first to discuss the project and ask the questions they have encountered in the project, then to prepare with the professor the work for next week.

Bibliography :

1. DAVIDOVICI V., 1995, "Formulaire du béton armé", Ed. Le Moniteur
2. RENAUD H., 1989, "Constructeur bâtiment", Ed. Foucher
3. DREUX G., 1981, "Calcul pratique du béton armé", Ed. Eyrolles
4. "EC2", 1992, Ed. AFNOR
5. "BAEL 91", 1991, Ed. Journal Officiel
6. PERCHAT J. et ROUX A., 1994, "Pratique du BAEL 91", Ed. Eyrolles
7. LACROIX R., FUENTES A. et THONIER H., 1985, "Traité de béton armé", Ed. Eyrolles
8. MOUGIN J.P., 1995, "Béton armé, BAEL 91 et DTU associés", Ed. Eyrolles
9. ALBIGES M. et MINGASON M., 1984, "Théorie et pratique du béton armé aux états limites", Ed. Eyrolles
10. COIN A., 1983, "Ossatures des bâtiments", Ed. Eyrolles.

Requirements :

Beam theory, reinforced concrete I, II, III

Organisation :

4 à 6 homework a week for a total around 70 h.

Evaluation :

Mini-project

Target :

5GCU

Prestressed Concrete Structures	GCU09-BP1
Number of hours : 18.00 h	2.00 ECTS credit
CM : 18.00 h	
Reference Teacher(s) : DARQUENNES Aveline	

Objectives :

Principles of prestressed structures. Application to concrete.

Content :

1. Main points - history.
2. Understanding of safety and regulation in construction.
3. Materials.
4. Process of prestressing concrete.
5. Phases of construction.
6. Execution and inspection.
7. Cable Tension and assessment of loss of tension.
8. Simple longitudinal flexion study (Service Limit State).
9. Simple longitudinal flexion study (Ultimate Limit State).
10. Tangent loading (Justification).
11. Tensioning cables.
12. Synthesis exercises.

Bibliography :

1. THONIER H., LE BETON PRECONTRAIT AUX ETATS LIMITES, Presse des Ponts et Chaussées, 1992.
2. CHAUSSIN R., FUENTES A., LACROIX R. , PERCHAT J. LA PRECONTRAINTTE, Presse des Ponts et Chaussées 1992
3. Cours de béton précontraint INSA Document photocopié, par Jean BACOT
4. Documents techniques des fabricants de systèmes de précontrainte et des constructeurs.
5. Films, CD rom, etc ; reportages personnels sur des chantiers.

Requirements :

Modules on; General Mechanics. Resistance of Materials. Reinforced Concrete.

Organisation :

Review of lecture notes. Completion of drawings. 30 hours

Evaluation :

Mini-project (in pairs).

Target :

5GCU

Ground improvement	GCU09-MARS
Number of hours : 24.00 h	2.00 ECTS credit
CM : 24.00 h	
Reference Teacher(s) : MASSON Samuel	

Objectives :

The students are lead to deepen and to develop their knowledge about rocks mechanics as a discontinuous medium and about current elastic-plastic models of soils.

Content :

Advanced mechanics of rocks

- geometrical and mechanical characterization of rock joints
- water in rocks : permeability of sound rock and joints
- modelling approaches: scale, homogenisation, discontinuous medium
- the distinct element method
- stability of rock mass : sliding, rock falls

Advanced mechanics of soils

- different moduli of compressibility
- oedometric and isotropic compressibility
- shear tests (reminds)
- critical state and limit state concepts
- elastic-plastic models : Mohr-Coulomb, Cam Clay, Soft Soil

Bibliography :

Homand F., Duffaut P., (coord.), Manuel de mécanique des roches. Presses de l'Ecole des Mines, 2000.
 Lambert S., Nicot F., (dir.), Géomécanique des instabilités rocheuses. Hermès & Lavoisier, 2010.
 Itasca C. G., UDEC, Universal Distinct Element Code, 2004. www.itascacg.com/udec/symp.html
 Hicher P.Y., Shao J.F., Modèles de comportement des sols et des roches, Hermès 2002.
 Plaxis, Material models manual. www.terrasol.fr

Requirements :

Fundamentals of soil mechanics : compressibility, permeability, shear resistance
 GCU06-22, GCU07-21, GCU05-32, GCU08-22

Organisation :

Lectures, exercises, use of numerical codes

Evaluation :

Written examination

Target :

5th year and master of research students

Maintenance and Rehabilitation of Infrastructure	GCU09-MRO
Number of hours : 24.00 h	1.50 ECTS credit
CM : 24.00 h	
Reference Teacher(s) : DARQUENNES Aveline	

Objectives :

Problems associated with works maintenance and problem diagnosis. Modern, non-destructive techniques for diagnosing abnormalities. Principles and methods for treating degraded concrete.

Content :

1. Policy for the maintenance of classified buildings
 - Implementation of maintenance policy
 - Technical evaluation
 - Classification of the works
 - Indication of the state
 - Technical priority
 - Socioeconomic priority
 - Strategy of intervention.
2. The problem of auscultation, evaluation and diagnosis of the works.
3. Basics and principles of the usual non-destructive physical methods of the qualification of concrete
 - Non-destructive evaluation methods using ultrasound, electromagnetism (radar), thermal imagery (infrared thermography), electric and electrochemical methods (resistivity, potential and speed of corrosion), radiographic and gammagraphic methods, optical methods
 - Applications: evaluation of the state of the material. Evaluation of the waterproofness of the works.
4. Reparation of concrete
 - Damage to concrete
 - Concepts for carrying out repairs
 - Repair procedures
 - Choice of materials
 - Preparation of the surface to be repaired
 - Implementation techniques
 - Crack injection
5. Reinforcing the structure
 - Strengthening
 - Addition of material
 - Principles of dimensioning.
6. Case studies:
 - bridges
 - Buildings
 - Protection of steel
 - Reparation with screed
 - Reparation and reinforcement by sprayed concrete
 - Reparation by casting or injection of concrete or mortar.

Bibliography :

Requirements :

Understanding of diagnosis abnormalities in buildings.

Organisation :

Review of lecture notes.

Evaluation :

Two-hour written examination.

Target :

5GCU

Wood structures 1	GCU09-CBO11
Number of hours : 12.00 h	1.00 ECTS credit
CM : 12.00 h	
Reference Teacher(s) : BERNARD Fabrice	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Construction Law and Legislation	GCU09-DDC
Number of hours : 12.00 h	1.00 ECTS credit
CM : 12.00 h	
Reference Teacher(s) : BERNARD Fabrice	

Objectives :

Understanding of law and judicial reasoning in preparation for future dealings with the legal department of a company.

Content :

1. Introduction to law (characteristics, specialisation: classification).
2. Origins and the hierarchy of standards.
3. Legal organisation (jurisdictions, law practitioners).
4. The decennial responsibility of builders and the presentation of a legal proceeding regarding construction law.
5. Employment and the employment contract (rules, sanctions).

Bibliography :

1. LYON-CAEN, ""Manuel de Droit du Travail"", Précis Dalloz
2. Dictionnaire Permanent, Droit de la Construction, Droit social.
3. Dictionnaire des termes juridiques - Editions Dalloz

Requirements :

Knowledge of materials used in building and public works. Overview of French institutions and the separation of the three powers of government.

Organisation :

Evaluation :

Exam.

Target :

5GCU

Conception Parasismique 1	GCU09-CPA1
Number of hours : 12.00 h	1.50 ECTS credit
CM : 12.00 h	
Reference Teacher(s) : GUEZOULI Samy	

Objectives :

The objective of the Seismic Design I course is to provide the fundamental bases of good design for both building structures and bridges. The objective is to learn how to optimize the seismic performance of a structure and is based, among other things, on the normative aspect (EUROCODE 8). This course is a continuation of the Dynamic Analysis of Structures (more theoretical course taught in 4GCU).

Content :

The course begins with a reminder of the fundamental bases of good seismic design. Regularity in plan and in elevation, bracing, monolithism, center of mass and center of torsion. In the second part, we discuss the presentation of the new paraseismic standard, reminder of the different classes of ductility (DCL-DCM-DCH), concept of capacitive design, damping and ductility, soil-structure interaction - chaining in the foundation as in the superstructure - vulnerability and reinforcement. In accordance with the mini-project of Reinforced Concrete IV, as soon as the latter is presented, the mini-project of Paraseismic Design I consists of taking up the architectural plans of the project and carrying out a detailed study with the aim of improving the performance earthquake resistance of the studied structure.

Bibliography :

Eurocode 8 – Structural Dynamic Analysis Course (S. Guezouli)

Requirements :

Structural dynamics

Organisation :

As soon as possible, the mini-project is worked on in class in order to benefit from interactivity.

Evaluation :

Mini-project

Target :

5GCU

Urban planning	GCU09-URBA1
Number of hours : 24.00 h	1.50 ECTS credit
CM : 24.00 h	
Reference Teacher(s) : MEFTAH Fekri	

Objectives :

The aim of this course is to equip students with a culture of the city and regional planning, teaching them some technical operational planning tools.

Content :

This course is divided into two parts of 12 hours each :

Part 1: Urban and Regional Planning

The challenges of the contemporary metropolis: live and move sustainably

Mobility, city, city planning

- Cerda, Soria, Haussmann
- Le Corbusier, Frank Lloyd Wright
- Mobility and Urban Planning in the 60s
- The urban transport plans

Urban planning, climate and energy

- The greening of development tools
- Energy assessment of a planning operation

Part 2: Urban planning jobs. The different players

A practice to serve projects. Urban projects, city projects. Examples and models

Production of housing as an engine of urban development.

Land. Fundamentals, regulatory tools, land interventions

The spatial approach. Theories and tools

Mobility and urban shapes

The operational approach: administrative procedures, project management : 6th course

Bibliography :

Requirements :

Organisation :

The course is mainly based on experiments on various french sites, some courses present other international contexts to students

Evaluation :

Exam (2h)

Target :

5GCU

Wood Structures 2	GCU09-CBOI2
Number of hours : 12.00 h	1.00 ECTS credit
CM : 12.00 h	
Reference Teacher(s) : BERNARD Fabrice	

Objectives :

Familiarisation with wood as a building material. An approach to the dimensioning of wooden structures.

Content :

1. Description of wood, durability, treatment, pathology.
2. Using the plan of a house: calculations for wooden elements under flexion, compression, shearing.
3. Buckling and discharge.
4. Calculation for assemblies.
5. Calculation of fire resistance.
6. Presentation of the most common types of wooden structures.

Bibliography :

1. Règles CB71
2. Règles Eurocode 5.

Requirements :

Basics of Resistance of Materials used in Civil Engineering.

Organisation :

10 hours.

Evaluation :

Two-hour written examination.

Target :

5GCU (BAT)

Steel structures 2	GCU09-CM2
Number of hours : 36.00 h	2.00 ECTS credit
CM : 36.00 h	
Reference Teacher(s) : COUCHAUX Mael	

Objectives :

This module provides the basis of designing a steel building and its assemblies. The main stages in the design of a steel building are then studied and applied within the framework of a project.

Content :

- 1- Design of steel buildings and connections
- 2- Actions on steel buildings (combination, snow, wind)
- 3- Global analysis of steel buildings (modelling, imperfections, second order, SLS)
- 4- Resistance of the elements (resistance in section, buckling, lateral-torsional buckling, etc.)
- 5- Calculation of the connections (column base plates, bracing connections, bolted end-plates).

Bibliography :

- [1] Bonnes pratiques pour la construction en acier, bâtiments à usages industriels, Eurobuild
- [2] Bonnes pratiques pour la construction en acier, bâtiments à usages commerciaux, Eurobuild
- [3] Lescouarc'h Y., Construction Métallique : Conception des structures de bâtiments, Cours de l'Ecole Nationale des Ponts et Chaussées, 2008.
- [4] Volume 1 - Assemblages de continuité de poutres réalisés par platines d'about – Guide de choix et dimensionnement- Collection : « les guides Ascac », CTICM.
- [5] Volume 2 - Encastrement de poutres sur poteaux réalisés par platines d'about – Guide de choix et dimensionnement - Collection : « les guides Ascac », CTICM.
- [6] Volume 3 - Attaches de poutres réalisées par double cornière– Guide de choix et dimensionnement - Collection : « les guides Ascac », CTICM.
- [7] Joints in Steel Construction: Simple Joints to Eurocode 3, SCI P358, ISBN : 978-1-85942-201-4.
- [8] Rodier A. – Calcul suivant les Eurocodes d'un bâtiment en acier à l'usage des praticiens, CTICM, 2015.

Requirements :

Steel Structures I, Plastic Calculation of Structures, Elastic Analysis of Structures

Organisation :

Lecture and design project in groups of 3/4 students.

Evaluation :

1 project, followed by an oral evaluation in the form of feedback on correction.

Target :

5GCU

Seismic Design II	GCU09-CPA2
Number of hours : 12.00 h	1.00 ECTS credit
CM : 12.00 h	
Reference Teacher(s) : COUCHAUX Mael	

Objectives :

This module covers seismic design of building and focuses on concrete and steel buildings. It is accompanied by a project that backs up to the Steel Structures II project. The constructive and calculation details related to each material are discussed as well as the consequences of the different ductility classes (DCL, DCM and DCH).

Content :

- 1- Seismic analysis of steel buildings,
- 2- Steel buildings in DCL class,
- 3- Steel buildings in DCM/DCH class.

Bibliography :

- [1] P.O. Martin, Conception parasismique des bâtiments industriels à ossature métallique, Editions CTICM, 2014
- [2] M.Bruneau, O.Clifton, G.MacRae, R.Leon, A.Fussell, Comportement des bâtiments métalliques lors du séisme de Christchurch, Nouvelle Zélande, en 2010 et 2011, Revue Construction Métallique, N°4, 2011
- [3] A.Rodier – Calcul suivant les Eurocodes d'un bâtiment en acier à l'usage des praticiens, CTICM, 2015
- [4] P-O. Martin, J-M. Aribert – Effets du séisme sur les structures métalliques – D'après l'Eurocode 8 – Calcul de la résistance au séisme des ossatures en acier – Plan Europe – CSTB Editions – Avril 2011

Requirements :

Steel structures II, Concrete Structures II and III, Plastic Calculation of Structures, Seismic design I

Organisation :

Lecture and design project in groups of 3/4 students.

Evaluation :

1 project coupled with the Steel Structures II project, followed by an oral evaluation in the form of feedback on correction.

Target :

5GCU

Building Acoustics	GCU09-ABAT
Number of hours : 12.00 h	1.00 ECTS credit
CM : 12.00 h	
Reference Teacher(s) : MOLEZ Laurent	

Objectives :

Basics of building acoustics.

Content :

1. Environmental noiseproofing.
2. Impact noiseproofing.
3. Equipment noiseproofing.
4. Regulations.
5. Understanding the acoustics of a large room.

Bibliography :

1. JOSSE R., 1977, ""Notions d'acoustique"", Ed. Eyrolles
2. JOUHANNEAU J., 1997, ""Acoustique des salles et sonorisation"", Lavoisier Tec et Doc

Requirements :

Basics of physics-acoustics.

Organisation :

Calculations from class notes: 16 hours.

Evaluation :

Mark for on-site calculations taken over a period of four hours.

Target :

5GCU (Building department option)

Heat Transfer Engineering III	GCU09-THER3
Number of hours : 24.00 h	1.50 ECTS credit
CM : 24.00 h	
Reference Teacher(s) : DUPONT Pascal	

Objectives :

Standard quality of building is mainly studied through the global static parameter Ubat and then the main issue of this course is to work further on unstationary situations. For this purpose, the concept of thermal inertia is introduced through the quantification of stored energy either in external wall or internal one. An upgrade of the latest French Thermal regulatory calculus is made with professional lecturers.

Content :

- I. Introduction
- II. Thermal basis
 - II.1. Building budget
 - II.2. Thermal stresses
 - II.3. Free parameters in the conception
- III. Simplified dynamical model
 - III.1. Equivalent electrical scheme
 - III.2. Simple wall model
 - III.3. Two time constante model
 - III.4. Thermal regulation model
- IV. RT 2012
 - IV.1. Actual thermal regulation
- V. Software
 - V.1. DPE
 - V.2. Dynamic simulation
 - V.3. Regulatory calculus

Bibliography :

- Cortès H. et Blot J., "Transferts thermiques-Application à l'habitat ", chez Ellipse, 1999, présent à la BU INSA
- "Traité de physique du bâtiment, Tome 1 : connaissances de base", edition du CSTB, présent à la BU INSA
- "RT2005", Base de données I-Reef du CSTB en ligne sur l'intranet de l'INSA dans les services de la BU
- Hernot D., Porcher G., "Thermique appliquée aux bâtiments", aux éditions parisiennes CFP, 1984, présent à la BU INSA
- Incropera F.P., De Witt D.P., "Introduction to heat transfert ", chez Wiley New York, 1996.
- Recknagel et col., "Manuel pratique du génie climatique- tome 1 :données fondamentales",
- Cours de Nicolas Tixier enseignant-Chercheur à l'Ecole d'Architecture de Grenoble (disponible sur le net)

Requirements :

Thermal sciences 1&2 of the forth year.

Organisation :

The course is organized through a general presentation of the thermal science applied to building with a major focus on unstationary regimes. Many hours are spent in the computer room to write mathematical model and realize progressively personal small project. Some lectures were done by external people on actual issues and thermal regulation (RT). A precise building is given to perform unstationary analysis and regulatory calculus.

Evaluation :

It is achieve through personal project on a precise building.

Target :

5GCU

Thermal Conditioning	GCU09-TCOND
Number of hours : 12.00 h	1.50 ECTS credit
CM : 12.00 h	
Reference Teacher(s) : RAGHAVAN Balaji	

Objectives :

Familiarize students with the concepts of thermal conditioning. Learn to dimension. Raise awareness to energy saving context.

Content :

- 1) what you need to know before starting
- 2) a heating system
- 3) a ventilation system
- 4) an air conditioning system
- 5) control of an hvac installation

Bibliography :

LIBERT, A., Génie climatique de A à Z. N° spécial de la revue Chaud-froid plomberie
LE RECKNAGEL, Manuel Pratique du Génie Climatique - 3ème édition, librairie du centre

Requirements :

Thermic, aeraulic

Organisation :

Course, study of cases

Evaluation :

Small project

Target :

5GCU

Fluids and Building Equipment	GCU09-FETB
Number of hours : 12.00 h	1.00 ECTS credit
CM : 12.00 h	
Reference Teacher(s) : RAGHAVAN Balaji	

Objectives :

Mastering the regulatory aspects concerning security in buildings. Become familiar with the technical layouts for the implementation of building networks.

Content :

- 1) Regulatory approach: Charts and related texts (ERP, Residential CDT)
- 2) Key concepts: stability and fire resistance, reaction to fire (M4-M2-M1), clearances (widths depending on numbers), Stairs, external defense
- 3) Smoke evacuation (manual and mechanical)
- 4) Fire & Security systems
- 5) Alarm
- 6) Elevator
- 7) Fluids and networks : Electricity, heating systems, gas

Bibliography :

- Collectif CSTB, Sécurité incendie & Réglementation -Habitations, ERP, locaux d'activité, Editions CSTB
- Casso et Associés, Guide Sécurité incendie - Guide d'application de la réglementation incendie, Editions Le Moniteur

Requirements :

Organisation :

Study of cases, pedagogy by projects

Evaluation :

Project in group

Target :

5GCU

Urban Hydrogeology	GCU09-HYU
Number of hours : 24.00 h	1.50 ECTS credit
CM : 24.00 h	
Reference Teacher(s) : LOMINE Franck	

Objectives :

Urban Hydrology: This course is designed to familiarize students with the problems associated with stormwater management in urban areas. It aims to train the engineer to analyze the reaction of urban watersheds to precipitation, but also to calculate and design stormwater drainage structures. With the aim of forming engineers to solutions often considered more efficient and sustainable, a presentation and analysis of alternative solutions to the "all in pipe" and more integrated strategies, will be conducted through case studies.

Content :

1. Characteristics of watersheds:
 - morphological and topographical characteristics of watersheds and river systems
 - Special case of urbanized watersheds
3. Statistical analysis of rainfall data
 - precipitation: formation, classification, measurement
 - rainfall intensity, frequency and return period
 - analysis of rainfall at a given station
 - analysis of rainfall over an entire basin
 - project rainfall
3. rainfall-flow transformation: temporal analysis
 - definition of the hydrograph: shape and factors influencing it, differentiation of flows
 - theory of the unit hydrograph
 - capacitive models
 - detailed models
4. estimation of flood flows by summary methods (in particular the rational method and the Caquot method)
5. Presentation of control structures and alternative techniques (Low Impact Development)
6. Sizing of retention structures
- 7 Application 1: Sizing of a stormwater evacuation network
8. application 2: detailed modeling of the response of basins and networks during rainy events: optimizations and alternative solutions

Bibliography :

Documentation available through the course website (Moodle).

Requirements :

Statistics, Free Surface Flow, Hydraulics, Hydrogeology

Organisation :

Lecture followed by application sessions. Realization of a project.

Evaluation :

project

Target :

5GCU

Design of Water Supply & Waste Conveyance Systems	GCU09-HUR
Number of hours : 24.00 h	1.50 ECTS credit
CM : 24.00 h	
Reference Teacher(s) : BOURBATACHE Mohamed Khaled	

Objectives :

Hydraulic design of networks and gravity systems.
Study of hydraulic structures.
Regulatory aspect of sanitation and distribution of drinking water

Content :

1. Adduction systems
2. Water treatment
3. Calculation of Hydraulic networks: Hardy-Cross, Newton-Raphson, EPANET
4. Modeling
5. Structure sewerage (collection networks, buffer tank, alternative solutions)

Bibliography :

Jacques BONNIN, Hydraulique urbaine, Ed. Eyrolles, 1986
F. VALIRON, gestion des eaux, Presses de l'ENPC, 1990
W. H. GRAF et M. Altinakar, Hydraulique fluviale, PPUR, 2008
R. BOURRIER, Techniques de la gestion et de la distribution de l'eau, Ed. le Moniteur, 2010
R. BOURRIER, Les réseaux d'assainissement: calculs, applications, perspectives, Ed. Tec&Doc, 2008

Requirements :

Fluid mechanics; Hydraulics ; Hydrology

Organisation :

Project: Urban hydraulics engineering
Students are encouraged to analyse and criticise case studies

Evaluation :

Mini-Project

Target :

5GCU

Waste Management & Contaminated Sites	GCU09-GTD
Number of hours : 12.00 h	1.00 ECTS credit
CM : 12.00 h	
Reference Teacher(s) : KAMALI BERNARD Siham	

Objectives :

Give a general training on urban waste management

Content :

- 1) Waste: Numbers and Definitions
- 2) socio-economic issues associated with waste
- 3) methods of management and treatment
- 4) Household waste: characterization, collection and sorting
- 5) GIS tools and waste management
- 6) Methane
- 7) Composting

Bibliography :

Requirements :

Organisation :

Education provided by professionals and researchers. Case study

Evaluation :

exam (2h)

Target :

5GCU

Urban air quality	GCU09-QAIR
Number of hours : 12.00 h	1.00 ECTS credit
CM : 12.00 h	
Reference Teacher(s) : MEFTAH Fekri	

Objectives :

This course aims at presenting physico-chemical and environmental parameters that control the air quality in urban sites. Pollutants and pollution origins, methods and indicators of the analysis of air quality together with methods and tools for air handling are presented and articulated with regard to regulatory frameworks. Finally, methods and tools for supervision, modelling approaches and tools for the estimation / forecast of air quality and post-processing data / results for decision-making are also covered.

Content :

Part I

Introduction to air quality

Pollution : origins and consequences

International protocols and national regulation

Methods of air quality analysis

Methods of handling polluted air

Regulated / partially regulated / lowly regulated compounds

Part II

Quality air supervision: Setups – Data processing

Forecast models and tools

Models for Chemistry – Transport

Site modelling: Region scale / Urban site scale

Post-processing of results

Confrontation Modelling – Measurements

Case studies

Exploitation of results in the context of urban policy of planning / regulation

Bibliography :

Requirements :

Organisation :

12 hours of plenary lectures for presenting the main concepts of urban quality air assessment, supplemented by different case studies for illustrating the approaches and tools.

Evaluation :

One final-term exam.

Target :

5GCU – Urban Engineering Program

Urban Acoustics	GCU09-AURB
Number of hours : 12.00 h	1.00 ECTS credit
CM : 12.00 h	
Reference Teacher(s) : MOLEZ Laurent	

Objectives :

Identification of the sources of noise in urban zones. Analysis under current regulations. Main technical solutions in the fight against the noise pollution.

Content :

- 1 Introduction - What is noise?
- 2 Acoustics (reminders); Physical acoustics. Physiological acoustics. Effects of noise on health.
- 3 Sources of noise. Multitude of sources. Road traffic. Air traffic. Rail traffic. Other sources
- 4 Models of noise distribution. Urban environment. Open field. Meteorological effects
- 5 Noise measurement.
- 6 Regulation: The law regarding
 - (a) road traffic noise
 - (b) air traffic noise
 - (c) rail traffic noise. European directives.
- 7 Technical solutions: Anti-noise walls. Earthen mounds. Road surfaces. Urban-planning.

Bibliography :

Requirements :

Organisation :

Evaluation :

Small project.

Target :

5GCU

Public Road & Transportation Infrastructure	GCU09-VIT
Number of hours : 24.00 h	1.50 ECTS credit
CM : 24.00 h	
Reference Teacher(s) : KAMALI BERNARD Siham	

Objectives :

Learning the basics for the Geometric design and pavement design of urban roads and crossroads.
Development a critical analysis on urban projects: Various restrictions related to urban environment are covered.
Different degradations of urban roads are studied.

Content :

1. Urban roads: Geometric design, Pavement design. Degradation of urban roads .
2. Urban crossroads: Different types, Geometric design, Pavement design.
3. Urban expressways (VRU)
4. Road system for public transportation: Metro. Bus.
5. Some equipments for urban roads: lighting, signalling..

Bibliography :

1. "Dimensionnement des structures des chaussées urbaines", 2000, CERTU
2. "Carrefours urbains : guide", 1999, CERTU
3. "Conception structurelle d'un giratoire en milieu urbain", 2000, CERTU
4. "Guide pratique de la voirie urbaine", 1999, RGRA
5. "Catalogue des dégradations de surface des chaussées", 1998, LCPC
6. "ICTAVRU, Instructions sur les conditions techniques d'aménagement des voies rapides urbaines", 2009, CERTU

Requirements :

Basics of the French method of road design.

Organisation :

Courses, Applications and use of software, mini-project

Evaluation :

Exam and Mini-project.

Target :

5GCU

Sustainable Mobility in Cities	GCU09-DURB
Number of hours : 24.00 h	1.50 ECTS credit
CM : 24.00 h	
Reference Teacher(s) : KAMALI BERNARD Siham	

Objectives :

Learning the basics of travel management in urban agglomerations taking into account all transport modes: Urban travel plan.

Learning the basics of urban travel modelling. The external negative effects of the urban travelling are studied.

Content :

1. Urban travelling : modes, database, legislation.
2. Urban travelling models.
3. External negative effects: Pollution, traffic congestion, noise, insecurity
4. Drawing up diagnostics. Travel planning scenarios
5. Urban travel plans: Examples of France's urban travel plans.

Bibliography :

1. "" Quelle est la mobilité quotidienne des personnes dans les agglomérations : approche de la question et proposition d'indicateurs "", 2004, CERTU
2. "" Etude Méthodologique de la connaissance des déplacements des périurbains "", 2004, CERTU
3. "" PDU de Rennes 2007/2017"", 2006, Rennes Métropole.
4. COHEN S., 1990, ""Ingénierie du trafic routier - Eléments de théorie du trafic et applications "", Presses de l'Ecole Nationale des Ponts et Chaussées

Requirements :

Organisation :

Courses, Applications and use of software, mini-project

Evaluation :

Mini-project.

Target :

5GCU

Urban planning 2	GCU09-URBA2
Number of hours : 12.00 h	1.50 ECTS credit
CM : 12.00 h	
Reference Teacher(s) : KAMALI BERNARD Siham	

Objectives :

This course aims to understand the meaning of urban morphologies .Courses explore the conditions of formation of cities : internal part system ; relationship centers on the other. Why and how a hierarchy of cities and their geographical distribution . How their functions are expressed in a particular type.

Courses voluntarily offer a wide range - in a very short available time-, in order to offer students a synthetic overview, but which allows them to understand a city map. It is trying to understand how urban typologies are related to a part in political and social contexts that are expressed in a system of urban law waveform generator, and other systems to local organizations that value infrastructure networks and balances or imbalances space built and unbuilt space.

Content :

The course is provided by a professional (architect-planner) .

The syllabus is :

- 1 . Urban Explosion : This course covers . Synthetically passing the ancient city to the metropolis and the question of land.
- 2 . Planning and training centers morphology 1: Understanding the forms of territorial organization : a study in parallel with the formation of the rural system and the urban system
- 3 . Planning and training centers morphology 2 : Urban organic The city inside / outside.
- 4 . Planning and training centers morphology 3: Comic - Reading City: city paths and islands.
- 5 . Formation of the modern city : the theme of the city infrastructure , the course covers the formation of the modern city.
- 6 . Contemporary City: structure and challenges : Urban Study : Methodology.

This course is associated with a common planning workshop with MASTER 2 AUDIT from the University of Rennes 2 . In this context the students are working on a public commission more or less fictitious , with the aim to go to APS to define a sketch of realistic action program. This workshop is being accompanied by methodological design of an urban development project carried out by a teacher from the University of Rennes 2 .

Bibliography :

Classic urban palling bibliography

Requirements :

Previous related courses in 3GCU and 4GCU

Organisation :

This course includes 12 hours of analysis of urban morphologies and 12 hours of organization of an urban planning project methodology. Concrete urban development project is given to mixed groups of students from INSA / 5GCU and UR2 / AUDIT to accustom our future engineers to work in multidisciplinary urban engineering.

Evaluation :

Target :

5GCU

Pavement Mechanics	GCU09-MECH
Number of hours : 24.00 h	2.00 ECTS credit
CM : 24.00 h	
Reference Teacher(s) :	

Objectives :

Get a deep knowledge of the mechanical behaviour of pavement structures and the practice of their design. Get an expertise of analysis software. Practice evaluation and reinforcement of structures.

Content :

1. Functionality and classification of roads.
2. Traffic characterisation, Equivalent traffic calculation.
3. Mechanical behaviour of subgrade soils and roadbeds.
4. Mechanical behaviour of road materials: fatigue laws and creep.
5. Calculation of allowable stresses and strains: reliability aspects.
6. Structural design: methods and practice, Alizé software.
7. Structural survey methods.
8. Methods and practice of structural reinforcement

Bibliography :

1. PEYRONNE C., CAROFF G., Dimensionnement des chaussées. Presses de l'ENPC. 1984.
2. L.C.P.-SETRA, Conception et dimensionnement des structures de chaussées - Guide Technique. 1994.
3. ULLIDTZ P., Pavement analysis, Elsevier. 1987.

Requirements :

Mechanics of deformable media (GCU05-11), Roads and pavements (GCU08-21)

Organisation :

Lectures, exercises, case studies.

Evaluation :

Project by groups of 2 students

Target :

5GCU

Geotechnical constructions	GCU09-OGEO
Number of hours : 24.00 h	2.00 ECTS credit
CM : 24.00 h	
Reference Teacher(s) : MASSON Samuel	

Objectives :

Knowledge of working techniques and of analysis methods of different typical geotechnical constructions.

Content :

Geotechnique of dams

- foundations pathology: examples and case studies
- earth dams : types, pathology, water flow, stability

Underground works

- geotechnical investigation, characterisation of rock mass
- boring techniques, support types
- mechanical analysis : analytical solutions, convergence-confinement method, numerical methods

Soil reinforcement techniques

- general methods of analysis
- nailing, Reinforced Earth, geotextiles
- other techniques : sand piles, jet grouting, dynamic compaction..

Bibliography :

- Bordes J.-L., Les barrages-réservoirs du milieu du XVIIIe siècle au début du XXe siècle en France, Presses de l'ENPC, 2005.
- Schleiss A. J., Pougatsch H., Les barrages, traité de Génie Civil, Presses de l'EPFL.
- Thomas H., The engineering of large dams. Wiley & Sons, 1976.
- Colombet G., Esteulle F., Bouvard-Lecoanet A., Ouvrages souterrains : conception, réalisation, entretien. Presses de l'ENPC, 1992.
- Panet M., Le calcul des tunnels par la méthode convergence-confinement. Presses de l'ENPC, 1995.
- Hoek E., Practical Rock engineering, www.rocscience.com
- Recommendations Clouterre 1991, Presses de l'ENPC, 1991
- Additif 2002 aux recommandations CLOUTERRE 1991, Presses de l'ENPC, 2002.

Requirements :

Soil mechanics I (GCU06-22), Soil mechanics II (GCU07-21), Engineering geology (GCU05-32), Mechanics of deformable media (GCU05-11), Applied numerical methods (GCU08-13)

Organisation :

Lectures, exercises, case studies.

Evaluation :

Project of construction analysis by group of 2 students

Target :

5GCU

Marine Hydraulic Engineering	GCU09-HYTM
Number of hours : 12.00 h	1.00 ECTS credit
CM : 12.00 h	
Reference Teacher(s) : LOMINE Franck	

Objectives :

- Maritime hydraulics: Modelling of swell. Effect of swell on maritime works.
- Modelling of the phenomena of erosion and sedimentation in estuaries.
- Maritime works & coastal management: An outline of the various arrangements possible to satisfy industry and simultaneously protect the coastal environment.

Content :

1. Maritime hydraulic Concepts : wave theory, wave physics
2. Sea level, wave and stirring, action of waves on structures
3. Sedimentology: definitions, sediment movements, impacts of port development
4. Dredging: dredging techniques, the materials become
5. Design of sea dikes: typologies of

Bibliography :

1. BONNEFILLE R., 1993, ""Cours d'hydraulique maritime"", Ed. Eyrolles
2. LARRAS J., 1979, ""Physique de la houle et des lames"", Ed. Eyrolles
3. GRAF W., ""Hydrodynamique"", ""Hydraulique fluviale"", Presses polytechniques et universitaires romandes
4. LEBRETON J.C., 1974, ""Dynamique fluviale"", Ed. Eyrolles

Requirements :

Physics , waves, fluid mechanics, hydraulics

Organisation :

Calculation of swell deformation in the neighbourhood of maritime works.
Dimensioning of coastal protection structures.
Study of the phenomena of erosion and fluvial deposits.

Evaluation :

Mini project (8 hours).

Target :

5GCU

Hydrogeology	GCU09-HYDR
Number of hours : 12.00 h	1.00 ECTS credit
CM : 12.00 h	
Reference Teacher(s) : LOMINE Franck	

Objectives :

Analysis of behaviour of catchments (urbanized and rural) during precipitation events. Determination of discharge hydrographs and maximum discharging rates. Design of drainage systems.

Content :

1. Characteristics of catchments
2. Statistical analysis of the pluviometric data.
3. Rain-flow transformation
4. Flood flow estimation
5. 1st application I : design of drainage systems
6. 2nd application : numerical modelling of the behaviour of catchments and drainage systems

Bibliography :

1. REMENIERAS G., 1976, "Hydrologie de l'ingénieur, Ed. Eyrolles
2. LLAMAS J., 1993, "Hydrologie générale - Principes et applications", Ed. Gaëtan Morin
3. Ministère de l'Agriculture, 1982, "Synthèse nationale des crues de bassins versants"
4. MUSY, A., 2002, "Hydrologie générale ", Ed. EPFL
5. ANCTIL, F., 2005, Hydrologie, Presses Internationales, Polytechnique Montréal

Requirements :

Statistics, Free surface flow, Hydraulics, Hydrogeology

Organisation :

Course + small project

Evaluation :

Small project

Target :

5GCU

Prestressed Concrete	GCU09-BP2
Number of hours : 12.00 h	1.00 ECTS credit
CM : 12.00 h	
Reference Teacher(s) : DARQUENNES Aveline	

Objectives :

Advanced structures prestressed concrete calculations.

Content :

Indeterminate effects of prestressing
 Case of a cable
 Case of a parabolic cable
 Calculation of indeterminate times
 concordant cable
 Practical calculation of rotations at the ends
 Exercise: 2 slab bridge spans
 shear
 Following rules BPEL
 Next Eurocodes
 Study of about zones (BPEL)
 Action anchors to abouts (single cable)
 Action anchors to abouts (more cables)
 Balance the lower corner

Bibliography :

THONIER H., LE BETON PRECONTRAIT AUX ETATS LIMITES, Presse des Ponts et Chaussées, 1992.
 CHAUSSIN R., FUENTES A., LACROIX R. , PERCHAT J. LA PRECONTRAINTTE, Presse des Ponts et Chaussées 1992
 FAVRE R., JACCOUD J.-P., BURDET O. et CHARIF H., Dimensionnement des structures en béton, Presses Polytechniques et Universitaires Romandes, 2004

Requirements :

Reinforced concrete, prestressed concrete

Organisation :

Evaluation :

Small project

Target :

5GCU

Bridges and Infrastructures	GCU09-POUV
Number of hours : 36.00 h	2.00 ECTS credit
CM : 36.00 h	
Reference Teacher(s) : SOMJA Hugues	

Objectives :

Learning of the general principles of the design of bridges, with account of :

- the different roles of the bridges
- the mechanical design
- the constitutive materials
- the erection phases

The project consists in the design of a bridge from the scratch.

Content :

1. Bridge schemes and classification
2. Piers, abutments, support systems
3. Concrete and prestressed concrete bridges
4. Steel bridges
5. Arch bridges, cable stayed bridges
6. Erection of the bridges
7. Dynamic loadings :High speed trains, footbridges, seismic action

Bibliography :

1. CREMER J.M. , "PONTES", notes de cours, université de Liège, 2006.
2. APK, 1996, "construction métallique et mixte acier-béton", tomes 1 et 2, éditions Eyrolles
3. MAQUOI R. , Cours de construction métallique, université de Liège
4. CD ROM ESDEP, leçons de construction métallique, APK, 1999

Requirements :

Steel and concrete design, dynamic and stability analysis

Organisation :

Lectures, and project made by groups of two students

Evaluation :

By the project

Target :

5GCU

Composite Steel - Concrete Structures	GCU09-CMX
Number of hours : 24.00 h	1.50 ECTS credit
CM : 24.00 h	
Reference Teacher(s) : GUEZOULI Samy	

Objectives :

This course provides the fundamental bases concerning composite steel-concrete construction, both for buildings and bridges. Understanding the behavior of this type of construction as well as the design in accordance with the Eurocodes standards.

Content :

1. Basic concepts, terminology and areas of application (beams - columns and slabs).
2. Designs buildings and structures, development of calculation methods and codes, Eurocode 4.
3. Study of composite sections: elastic and plastic flexural strength, local buckling and shear, lateral torsional buckling. Classification of composite sections.
4. Load combinations ULS-SLS and pre-design (global analyzes cracked and uncracked). Connection design.
5. Fatigue continuous bridge girders
6. Verifications for composite piles and slabs.
7. Fire resistance.
8. Numerical Modeling.

Bibliography :

1. Comité Européen de Normalisation, 1992, Eurocode 4 - Partie 1,1
2. JOHNSON R.P., 1994, "Composite Structures of Steel and Concrete", Blackwell Scientific Publications
3. A.P.K., 1996, "Construction Métallique et Mixte Acier-Béton", chapitre 8, Ed. Eyrolles
4. A.F.P.C., 1997, "Calcul des ouvrages généraux de construction", chapitre 8, "Modélisation des ouvrages mixtes acier- béton avec leur connexion", Ed. Hermes

Requirements :

Elastic theory of structures and plastic calculations.

Organisation :

Revision of course, personal exercises to perform: 20 hours.

Evaluation :

1 mini-project different for each (Option Buildings and TP).

Target :

5GCU (Options Buildings and TP).

English S9 Conversation	HUM09-ANGL-CONV
Number of hours : 10.00 h	1.50 ECTS credit
TD : 10.00 h	
Reference Teacher(s) : LE VOT Philippe	

Objectives :

- Improving communication skills in everyday life situations as well as in a professional or social context.
- Obtaining or reinforcing C1 level, strongly advised/recommended by the CTI. t.

Content :

- Learning by doing: students will have to be able to speak and listen, write a document while showing they can solve problems, reason, convince and demonstrate in an articulate manner.
- Expressing oneself accurately and fluently: students will engage in activities requiring creative and reactive skills such as debates, role-plays, individual oral Power Point presentations, projects, based on scientific topics and current events.

Bibliography :

1. English Grammar in Use (Cambridge University Press)
2. Dictionnaire Collins Cobuild
3. Polycopié de l' INSA

Requirements :

Having taken and passed the TOEIC test during the previous two years (800 required)
or any other B2 certification recognized by the CTI.

Organisation :

- Each class lasts one hour and most classrooms are equipped with video and audio. A multimedia lab and computer rooms are also available for the students to work in a stimulating environment.
- Teaching resources include press articles, audio and video documents (TV reports, extracts from films and series) as well as the Internet.

Evaluation :

Continuous assessment: The final mark (out of 20) will be based on the attendance rate and the personal implication of the student during the class.

Target :

TOEIC 5th year	HUM09-ANGL-TOEIC
Number of hours : 20.00 h	1.50 ECTS credit
TD : 20.00 h	
Reference Teacher(s) : LE VOT Philippe	

Objectives :

- Improving communication skills in everyday life situations as well as in company and business context.
- Obtaining or reinforcing the B2 level requested by the CTI.
- Obtaining 800 score at the final TOEIC test.

Content :

Learning by doing : students will have to be able to speak and listen, write a document while showing they can solve problems, reason, convince and demonstrate in an articulate manner.

Expressing oneself accurately and fluently : students will engage in activities requiring creative and reactive skills such as debates, role-plays, individual oral Power Point presentations, projects, based on scientific topics and current events.

Bibliography :

- English grammar in Use, Intermediate Edition (CUP)
- Robert and Collins bilingual dictionary or Collins Cobuild

Requirements :

Not having already taken and passed the TOEIC test during the previous two years
B1/B2 level advised

Organisation :

Each class lasts two hours and most classrooms are equipped with video and audio. A multimedia lab and computer rooms are also available for the students to work in a stimulating environment.

Teaching resources include press articles, audio and video documents (TV reports, extracts from films and series) as well as the Internet. B2 level tests are also taken throughout the course.

Evaluation :

Final mark based on :

TOEIC score at final exam + attendance (more than 4 non justified absences result in 0/20 mark).

Target :

5th year students who haven't already passed their TOEIC

Economics, Law and Business Studies A - LEAN MANAGEMENT	HUM09-PM-A
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, TD : 4.00 h	
Reference Teacher(s) :	

Objectives :

The Management Course should enable students:

to engage with «management-oriented» themes d'aborder des thèmes « orientés métiers » relative to management,
to personalise their programme by choosing modules «à la carte», in accordance with their interests and professional projects.

Each student chooses one course from the list of suggested courses.

Beyond the specific skills that are the focus of each course, the learning outcomes can be identified as follows:

to understand and know how to use the specialised vocabulary of management
to recognise the main issues in a chosen management theme
to practise teamwork: taking decisions collectively and be able to deliver within set deadlines

Lean Management (28h)

To master the theoretical concepts and practices of Lean and Six Sigma
To develop your capacity to manage and lead value-creating projects
To understand the issues of associated with a culture of continuous progress and, by extension, its implementation within an organisation

Legal Knowledge (6h)

Objectives

To acquire a general knowledge of the law
To understand the organisation and main principles of the legal environment

Content :

«Lean Management» Course Programme

Lean Management (28h)

Lean Management is a structured management method. It is increasingly becoming an approach to improve the performance of companies through improved process efficiency.

Applied to company management, « Lean Management » offers a range of methods to work towards operational excellence.

Associated with the «Six Sigma» methodology which is designed to improve quality, Lean offers an approach that ensures that all customer expectations in terms of quality, deadlines and costs are taken into account.

Programme

The content of this course develops and deepens understanding of certain notions seen in the core curriculum for 3rd Year (IMO).

Introduction to improvement

DMAIC Project

Organising and Leading a team

specific Lean tools

specific Six Sigma tools

field-oriented Lean and Six Sigma tools

feedback from industry and industrial applications

Students registered in this module will be able to participate in the Hackathon of quality and operational excellence organized in December in Nantes. This event will bring together for a whole day teams made up of 4 to 6 students from several educational institutions from Bac + 2 to Master 2 level, supervised by professionals in operational excellence, QHSE management, continuous improvement ...

Together, the students will have to take up the challenge of responding to a real business problem and proposing a relevant action plan. At the end of the day, each team will pitch their final work. The best presentation will be rewarded with a vote from the public and the jury of experts.

Legal Knowledge (6h)

sources of law, the hierarchy of rules, notion of jurisprudence;
jurisdictions;
types of law practitioners;
the contract;
civil and criminal liability in a company

Bibliography :

A specific bibliography on the themes developed is suggested to students in class

Requirements :

Eco-Management Modules in S7 and S8

Organisation :

The different Management courses bring together students from the various speciality Departments. Each course includes the participation of external speakers (industry professionals, lawyers or consultants). Interactive pedagogy and project work are favoured, with students working in teams on projects that are defined in collaboration with the speakers.

Evaluation :

Continuous Assessment: teamwork with oral and/or written assignment

Target :

Economics, Law and Business Studies B (Human Resources Management)	HUM09-PM-B
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, TD : 4.00 h	
Reference Teacher(s) : BOUGUENNEC Christelle	

Objectives :

Objectives of Management Courses

The Management Course should enable students:

to engage with «management-oriented» themes relative to management,
to personalise their programme by choosing modules «à la carte», in accordance with their interests and professional projects.

Each student chooses a course from a list of suggested options:

Beyond the specific skills that are the focus of each course, the learning outcomes can be identified as follows:

1. to understand and know how to use the specialised vocabulary of management
2. to recognise the main issues in a chosen management theme
3. to practise teamwork: taking decisions collectively and be able to deliver within set deadlines

Human Resources Management (20h)

This module therefore specifically aims to:

make future engineers aware of individual and collective management
identify the expectations associated with the manager's mission
equip students with the tools and techniques suited to the manager's mission

Labour Law (8h)

To make future engineers aware of the right to work by giving them key aspects of comprehension in this area which has been rendered more complex due to the diversity of its origins, the multiplication of reforms and frequent changes in jurisprudence.

To enable future engineers therefore to access the labour market with a concise overview of their rights and obligations within a company

Legal Knowledge (6h)

- To acquire a general knowledge of the law
- To understand the organisation and main principles of the legal environment

Content :

«Human Resources Management» Course Programme

Human Resources Management (20h)

Confronted with numerous and ever rapid changes, it is imperative for companies to adapt in order to ensure their sustainability and development. In this context, man management is capital. Leaders must know how to lead, develop and organise the skills of their teams that are necessary to meet objectives and at the same time create commitment in ways that nurture energies sustainably

Programme

the essentials of management
communication and motivation
knowing how to set objectives
leadership and team leadership
developing teamwork skills
managing complexity
supporting change

Labour Law (8h)

background to Labour law

the work contract : study of some essential clauses (workplace, salaries, work hours, non-competitive clause
some elements on the different types of work contract termination

Legal Knowledge (6h)

- sources of law, the hierarchy of rules, notion of jurisprudence;

- jurisdictions;
- types of law practitioners;
- the contract;
- civil and criminal liability in a company

Bibliography :

A specific bibliography on the themes developed is suggested to students in class.

Requirements :

Eco-Management Modules in S7 and S8

Organisation :

The different Management courses bring together students from the various speciality Departments. Each course includes the participation of external speakers (industry professionals, lawyers or consultants). Interactive pedagogy and project work are favoured, with students working in teams on projects that are defined in collaboration with the speakers

Evaluation :

Continuous Assessment: teamwork with oral and/or written assignment

Target :

Economics, Law and Business Studies C (Human Resources Management)	HUM09-PM-C
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, TD : 4.00 h	
Reference Teacher(s) : BOUGUENNEC Christelle	

Objectives :

This course aims to enable students to develop specific management skills in accordance with their personal objectives and professional motivations. Students chose one option among six.

Main learning outcomes are:

- Establishing a strong, specific vocabulary base
- Understanding the main issues that industrial companies deal with (in a specific management field)
- Understanding the importance of teamwork: making collective decisions and producing the expected work in time

Content :

- * Human Resource Management (20h / in French)
 - Main current challenges of Human Resource Management
 - Human Resource Management's tools and organization
 - Focus on how team managers deal with Human Resource Management
- * Law (8h / in French)
 - Main principles of the French legal system
- * Social legislation (8h / in French)
 - Main principles of French social legislation
 - Employment contract

Bibliography :

Given during the course

Requirements :

ECONOMICS AND BUSINESS MANAGEMENT - 1
ECONOMICS AND BUSINESS MANAGEMENT - 2

Organisation :

This course is opened to students with different engineering backgrounds. Students work together in small groups and gather the necessary information and advices to set out a final report. Groups also benefit from conferences and tutorial sessions performed by professional speakers.

Evaluation :

Continuous assessment (collective work)

Target :

Economics, Law and Business Studies D MANAGEMENT AND ETHICS FOR ENGINEERS	HUM09-PM-D
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, TD : 4.00 h	
Reference Teacher(s) : GOURRET Fanny	

Objectives :

This course aims to enable students to develop specific management skills in accordance with their personal objectives and professional motivations. Students chose one option among six.

Main learning outcomes are:

- Establishing a strong, specific vocabulary base
 - Understanding the main issues that industrial companies deal with (in a specific management field).
- Understanding the importance of teamwork : making collective decisions and producing the expected work in time

Content :

- The fundamentals of management
 - Ethics and business practices (international and corporate frameworks and regulations, impact on project management and decision processes)
 - Reflexion on personal motivations related to social and environmental impact of innovation and business, personal values vs professional goals)
- Transversal approach by industry sector case studies

Bibliography :

Given during the course

Requirements :

NONE

Organisation :

This course is opened to students with different engineering backgrounds. Students work together in small groups and gather the necessary information and advices to set out a final report. Groups also benefit from conferences and tutorial sessions performed by professional speakers.

Evaluation :

Continuous assessment (collective work)

Target :

Economics, Law and Business Studies E (INTERNATIONAL DEVELOPPEMENT & STRATEGIES)	HUM09-PM-E
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, TD : 4.00 h	
Reference Teacher(s) : GOURRET Fanny	

Objectives :

This course aims to enable students to develop specific management skills in accordance with their personal objectives and professional motivations. Students chose one option among six.

Main learning outcomes are:

- Establishing a strong, specific vocabulary base
- Understanding the main issues that industrial companies deal with (in a specific management field).
- Understanding the importance of teamwork : making collective decisions and producing the expected work in time

Content :

This course provides students with the tools necessary to understand and work effectively in today's international economic environment. It explores how innovative firms address new markets and compete outside their national frontiers. The course

Bibliography :

Given during the course

Requirements :

None

Organisation :

This course is opened to students with different engineering backgrounds. Students work together in small groups and gather the necessary information and advices to set out a final report. Groups also benefit from conferences and tutorial sessions performed by professional speakers.

Evaluation :

Continuous assessment (collective work)

Target :

Economics, Law and Business Studies F (sustainable development)	HUM09-PM-F
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, TD : 4.00 h	
Reference Teacher(s) : BOUGUENNEC Christelle	

Objectives :

Sustainable Development (28h)

Sustainable development is a major societal issue that challenges all stakeholders, including training and research institutions. The INSA group has taken up this theme and actively engages with the ways and means of "training engineers to a very high technical level... [but who are also] aware of today's global challenges & capable of helping their companies to make their own energy and ecological transition "(Inter-INSA Energy-Climate Challenges Working Group in engineer training).

INSA Rennes has committed to the SDSR (Sustainable Development and Social Responsibility) accreditation process. The Engineering students enrolled in Course F will be able to contribute concretely to this process by presenting projects that meet the requirements of this standard, in collaboration with the COPIL-DD (Sustainable Development Piloting Committee) and the CRIC-DD (Rennes Inter-Campus Collective for Sustainable Development).

Objectives

- To deepen your knowledge of SDS issues and be able to raise awareness of them;
- To understand the SD standards and the stages of the accreditation process;
- To build a team project that serves the accreditation of INSA Rennes ;
- To know how to convince others of your project's relevance and to assess its feasibility (technical and economic)

Legal Knowledge (6h)

Objectives

- To acquire a general knowledge of the law
- To understand the organisation and main principles of the legal environment

Content :

Programme

Presentation of COPIL-DD (Sustainable Development Piloting Committee), CRIC-DD (Rennes Inter-Campus Collective for Sustainable Development) and SD-SR accreditation
Conferences on SD: environmental impacts of digital technology , biodiversity and gardens, SSS (Social et Solidarity Space), etc.
Training on the «Fresco for the Climate» tool

Legal Knowledge (6h)

Programme

sources of law, the hierarchy of rules, notion of jurisprudence;
jurisdictions;
types of law practioners;
the contract;
civil and criminal liability in a company

Bibliography :

A specific bibliography on the themes developed is suggested to students in class

Requirements :

Eco-Management Modules in S7 and S8

Organisation :

The different Management courses bring together students from the various speciality Departments. Eacg course includes the participation of external speakers (industry professionals, lawyers or consultants). Interactive pedagogy and project work are favoured, with students working in teams on projects that are defined in collaboration with the speakers

As part of this module, the student engineers:

- will attend conferences on SD themes
- will be trained on how to use the «Fresco for the Climate» tool

- will work in pluridisciplinary teams to develop a project that is eligible for SD-SR accreditation and can be implemented on campus.

Personal study time will be provided for within the schedule in order to allow students to advance with the team projects

Evaluation :

Continuous assessment (collective work)

Target :

Economics, Law and Business Studies G (serious game)	HUM09-PM-G
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, TD : 4.00 h	course taught in English
Reference Teacher(s) : BOUGUENNEC Christelle	

Objectives :

This course aims to enable students to develop specific management skills in accordance with their personal objectives and professional motivations. Students chose one option among six.

Main learning outcomes are:

- Establishing a strong, specific vocabulary base
- Understanding the main issues that industrial companies deal with (in a specific management field).
- Understanding the importance of teamwork : making collective decisions and producing the expected work in time

Content :

* Business Simulation (serious game) (28h / in English)

The business simulation ¿Global Challenge¿ (a CESIM product) has been designed to improve the understanding and knowledge of the complexity of global business operations in a dynamic, competitive environment. It focuses on strategic management, international management and business policy.

The task for the student teams is to manage a global mobile telecommunications company as its technology and markets evolve. Students will develop and execute strategies for their simulated company operating in the USA, Asia, and Europe.

The simulation is based on an online platform that allows students to play in their own language (many languages available: English, Spanish, Portuguese, Chinese,¿).

* Law (8h / in French)

Main principles of the French legal system

Bibliography :

Given during the course

Requirements :

ECONOMICS AND BUSINESS MANAGEMENT - 1
ECONOMICS AND BUSINESS MANAGEMENT - 2

Organisation :

This course is opened to students with different engineering backgrounds. Students work together in small groups and gather the necessary information and advices to set out a final report. Groups also benefit from conferences and tutorial sessions performed by professional speakers.

Evaluation :

Continuous assessment (collective work)

Target :

Internship evaluation	EII09-EVST
Number of hours : 5.00 h	1.00 ECTS credit
EP : 1.00 h, EP : 1.00 h, TA : 4.00 h, TA : 4.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Societal responsibility of business	EII09-HUMT
Number of hours : 20.00 h	1.00 ECTS credit
CM : 20.00 h	
Reference Teacher(s) : BOUGUENNEC Christelle	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Internship evaluation	EII09-EVST
Number of hours : 5.00 h	1.00 ECTS credit
EP : 1.00 h, EP : 1.00 h, TA : 4.00 h, TA : 4.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Internship Dating	INF09-STGDATING
Number of hours : 24.00 h	1.00 ECTS credit
CONF : 10.00 h	
Reference Teacher(s) : BLOUIN Arnaud	

Objectives :

The purpose of this module is to complete the curriculum by knowledge, practices, industrial problems not seen in other modules. It gives students a better knowledge of business world, its internal and external ecosystem, professions. It is also a way to build links between students and companies.

Content :

The "stage dating" allows students to have several short interviews of 10mn with different companies.

Conferences are done by industrial contributors, on different subjects like:

- data management, data science, big data
- introduction to the profession of IT architect

Conferences can be 2 hours long, several modules of 2 hours or organized on a whole day.

Bibliography :

Requirements :

Organisation :

A group of student volunteers, with the teacher in charge of the module, define and organize the different conferences.

Evaluation :

Validation on the presence of the student

Target :

4 th year Work Placement / Presentation	GPM09-SOUT
Number of hours : 34.00 h	1.50 ECTS credit
CONF : 4.00 h, ST : 30.00 h	
Reference Teacher(s) : LEVALLOIS Christophe	

Objectives :

Professionals from a wide range of companies hold conferences on the various career options open to students in the SGM department. The guest speakers describe their companies' engineering work and market structure. The aim is to help students in their choice of career. This fourth year placement is followed by an oral presentation during the fifth year, in front of a jury composed of three teachers from the SGM department. This oral presentation must be validated by the jury. Validation of the module gives 2 ECTS credits. A total mark will be awarded on completion and validation of both the fourth year placement report and the oral presentation.

Content :

- Career guidance through conferences.
- Report on the fourth year placement written either in English or in French.
- Poster.
- Oral presentation (Done in 5th year).

Bibliography :

Requirements :

Organisation :

Evaluation :

Conferences: Signed attendance sheets.

Placement: Evaluation takes into account the Supervisor's assessment (given with the report).

The placement report may be written in French or in English.

An Oral presentation is conducted in front of a jury composed of three teachers from the MNT department.

Final valuation will be given in terms of a mark scaled from 0 to 20 following the oral presentation.

Target :

Integration of environmental impacts in construction	GCU09-SPEC-IIEC
Number of hours : 18.00 h	1.00 ECTS credit
TD : 18.00 h	
Reference Teacher(s) : FLISCOUNAKIS AGNES	

Objectives :

Ask students to analyze civil engineering design/management/rehabilitation projects in order to minimize their environmental impact. Main objectives: Understand the issues at stake, See the implications in terms of design and possible technical choices, Carry out a critical analysis.

Content :

Taking sustainable development into account in construction entails action that can be considered from two angles: how to maintain the level of performance of each function of use over time, and how to choose a strategy of action with the best possible efficiency in the use of resources. The work consists of case studies in small groups. A presentation to the whole class is planned at the end of the project

Bibliography :

Requirements :

Concepts of life cycle analysis.

Organisation :

Group work on a project.

Evaluation :

Oral presentation of the group's work and submission of presentation material. Participation in work sessions.

Target :

5GCU

BIM Project Management	GCU09-SPEC-GPD
Number of hours : 18.00 h	1.00 ECTS credit
CM : 18.00 h	
Reference Teacher(s) : NGUYEN Quang Huy	

Objectives :

BIM technology is a process that involves the creation and use of an intelligent and configurable 3D model to make better decisions about a project and communicate them. This will involve designing, visualizing, simulating, collaborating and managing more easily throughout the project lifecycle. This course aims to introduce you to BIM technology in building project management.

Content :

Introduction to BIM

- The digital technology in the construction industry
- The main national and international users
- Technical terms of the BIM
- The digitization of trades
- Technological watch
- The implementation of a BIM approach

Interoperability

- The challenges of openBIM
- The IFC
- The BCF
- The Facility management

Modeling by BIM approach

- Modeling a project by tender mission
- Structural modeling
- The point clouds
- Introduction to Dynamo
- Content creation
- Architectural modeling

Network modeling

- Communicating in a BIM approach
- PC and digital DOE
- Collaborative platforms
- Digital communication tools
- Virtual reality and augmented reality
- 4D simulation

Quality control in BIM approach

- Automated and iterative control
- Steering and refereeing a synthesis
- The point clouds
- The digital synthesis model

BIM approach methods

- The site installation plan
- 3D phasing
- The layout of facades
- The branches cycle
- The establishment of security element
- The operating mode
- BCF in different applications
- Interference detection in Revit

Interference detection in Solibri Model Checker
Taking into account the specificities of the trades
Consideration of transitional phases of construction site or maintenance phases

Bibliography :

- De la maquette numérique au BIM, Eyrolles
BIM et architecture, DUNOD
Le BIM appliqué à la gestion du projet de construction: Outils, méthodes et flux de travaux, David McCool et Brad Hardin

Requirements :

Revit

Organisation :

8 hours of lectures and 8 hours of tutorials
Copies of handouts

Evaluation :

Mini-Project

Target :

5GCU

Formation éthique de l'ingénieur	INF09-ETHIQUE
Number of hours : 16.00 h	1.00 ECTS credit
CM : 12.00 h, TD : 4.00 h	
Reference Teacher(s) : CELLIER-BELLINA Peggy	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Economics, Law and Business Studies (Professional management)	HUM09-PM-PRO
Number of hours : 70.00 h	2.00 ECTS credit
TA : 70.00 h, TA : 70.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Expérience en entreprise	DET10-SPEC PRO
Number of hours : 30.00 h	2.00 ECTS credit
PR : 0.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Music Studies	HUMF1-MUS
Number of hours : 25.00 h	1.00 ECTS credit
TD : 25.00 h	
Reference Teacher(s) : HOLZNER-JACQUES Cecile	

Objectives :

Targeted skills :

- working and communicating in a team
- cultural openness
- listening to others
- managing stress

Students have the opportunity to combine their studies with their passion for music. By joining two Jazz and Classical orchestras, they can continue their instrumental practice and also participate in a quality musical training course supervised by teachers from the Rennes Regional Conservatory. Through group practice, they will be able to develop their skills in listening, collaboration and their ability to adapt, all of which are essential to every kind of teamwork. They will participate actively in the cultural life of the school and frequently perform in public. Collective artistic practice within the institution will promote the personal development of the student.

Content :

2h collective lessons per week in the JAZZ et classical music ensembles with instrumental practice training in chamber music. Participation in festivals and organisation of cultural events at INSA. Several concerts and recitals over the year at INA and externally.

Bibliography :

Musical scores are distributed at the beginning of the year

Requirements :

Good instrumental ability, music studies in conservatory or school of music; ability to read music.
Admission to the programme is based on dossier and an audition organised at the beginning of the year.

Organisation :

2 hours group practice per week

Evaluation :

validation without grade

Target :

INSA students, INP, Centrale/Supélec and external students

Semestre 10

Parcours Formation Initiale GCU

1	GCU-PFE10		end of studies' project	30.00
	GCU10-PFE	O	Final Year Project	30.00

O = compulsory, C= in choice , F= optional

Final Year Project	GCU10-PFE
Number of hours : 350.00 h	30.00 ECTS credit
ST : 350.00 h, ST : 350.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :