CENTRALE NANTES

Master of Science (MSc)

2025-2026

YEAR 1

MARINE TECHNOLOGY

Hydrodynamics for Ocean Engineering

PROGRAMME SUPERVISORS:
Lionel GENTAZ / Guillaume DUCROZET

YEAR 1 - Autumn Semester

CORE COURSES

Course code	Title	ECTS Credits	Page number
ALEMO	Algorithmics for Engineering Modeling	4	4
COMEC	Continuum Mechanics	5	5
FLUM1	Fluid Mechanics 1	5	7
MARHY1	Marine Hydrodynamics 1	5	8
NUMME	Numerical Methods	5	9
TOME1	Tools and Methods for Research 1	4	10

LANGUAGE COURSES (one module from a choice of three) *

Course code	Title	ECTS Credits	Page number
CCE1	Cultural and Communication English	2	11
ESP1	Spanish Language	2	13
FLE1	French Language	2	14

* 'French as Foreign Language' except for French native speakers who will study 'Cultural and Communicational English' or Spanish (depending on sufficient demand)

NB Course content may be subject to minor changes

YEAR 1 - Spring Semester

CORE COURSES

Course code	Title	ECTS Credits	Page number
FLUII	Fluid Mechanics 2	5	16
MarHy 2	Marine Hydrodynamics 2	5	17
STRME	Structural Mechanics	5	19
TOME2	Tools and Methods for Research 2	5	21
ENERG	Energetics	5	22
PROPUL	Propulsion	5	23

LANGUAGE COURSES (one module from a choice of three) *

Course code	Title	ECTS Credits	Page number
CCE2	Cultural and Communication English	2	24
ESP2	Spanish Language	2	25
FLE2	French Language	2	27

* 'French as Foreign Language' except for French native speakers who will study 'Cultural and Communicational English' or Spanish (depending on sufficient demand)

NB Course content may be subject to minor changes

YEAR 1 - Autumn Semester

Algorithmics for Engineering Modeling [ALEMO]

LEAD PROFESSOR(S): Domenico BORZACCHIELLO / Jose-Vicente AGUADO

Objectives

At the end of the course the students will be able to:

- Identify and properly apply numerical methods to different engineering problems
- Understand algorithmic aspects and handle practical implementation issues
- Program and optimize algorithms in Python
- Use standard libraries for scientific computing
- Produce reports and notebooks using Jupyter

Course contents

The course proposes a gentle introduction to numerical methods in scientific computing and their respective algorithms through practical problems that are often encountered in engineering applications. It will cover five fundamental topics : interpolation and differentiation, numerical quadrature, time-stepping integration techniques for ordinary differential equations, iterative solvers and nonlinear solvers.

Each topic will be presented through a practical application, that will serve as a basis to review implementation aspects as well as theoretical principles of the numerical methods involved. Several exercises in Matlab/Octave are proposed.

Course material

- Slides and Course Notes
- Deepnote Labs
- An Introduction to Programming and Numerical Methods

Assessment

Individual assessment: EVI 1 (coefficient 1)

Language of instruction	ECTS Credits	Lectures	Tutorials	Lab	Project	Exam
English	4	10 hrs	20 hrs	0 hrs	0 hrs	2 hrs

YEAR 1 - Autumn Semester

Continuum Mechanics [COMEC]

LEAD PROFESSOR(S): Siddhartha Harsha OMMI

Objectives

This course is an introduction to continuum mechanics, and more generally to the modelling in mechanics. The basic concepts are introduced here, which will be required for more advanced fluid and solid mechanics courses. In its second part, the course focuses on the study of the equilibrium of deformable solid bodies in linear elasticity and infinitesimal strain. This allows to supply some basic tools required for engineers to design simple mechanical systems.
The fundamental concepts introduced in this course are also useful for the courses of fluid mechanics (though recalled within it) and numerical methods (it provides models to be discretized with numerical methods) occuring during the first semester. It is also used as a basis for the course of structural mechanics occuring during the second semester for students that will have chosen the "solid" or "civil engineering" options. A last, it provides useful tools for the course of "Mechanical design analysis" to mechanically design parts.

At the end of the course (30 hours + personal work), the students will:

- Understand strain and stress notions, and be able to write correctly their mathematical representation.
- Know that there are different kinds of equations with different purposes (balance equations, constitutive equations, boundary conditions).
- Be able to define the problem of the equilibrium of a deformable elastic solid body in infinitesimal strain by writing a Boundary Value Problem (BVP), and to choose the right set of boundary conditions.
- Know the different possible approaches available to solve that BVP, and be able to solve it.

Course contents

After some necessary lectures, the course is built on alternating the introduction of fundamental concepts and training examples, each lasting approximately 2hours.

The course outline is as follows:

- Mathematics for continuum mechanics
- Introduction
- Kinematics
- Stresses
- Balance equations
- Constitutive equations
- Equations of linear elasticity in infinitesimal strain

Course material

- Introduction to Continuum Mechanics, W. Michael Lai, David Rubin and Erhard Krempl, Elsevier, 2010.
- Continuum Mechanics, A.J.M. Spencer, Dover Publications, 2004.
- Mécanique des Milieux Continus et discrets, Handbook of N. Moës, 2011,
- Mécanique, P. Germain, 1985, Ecole Polytechnique, volumes 1 & 2.
- Introduction to the mechanics of a continuous medium, L.E. Malvern, Prentice-Hall, 1969.
- An introduction to continuum mechanics, M.E. Gurtin, Academic Press, 1981.

Assessment

Individual assessment: EVI 1 (coefficient 1)

Language of instruction	ECTS Credits	Lectures	Tutorials	Lab	Project	Exam
English	5	16 hrs	14 hrs	0 hrs	0 hrs	2 hrs

YEAR 1 - Autumn Semester

Fluid Mechanics 1 [FLUM1]

LEAD PROFESSOR: Guillaume DUCROZET

Objectives

This course aims to present the foundations and general principles of fluid mechanics.

After completing the course, students will be able to:

- Describe the main physical properties of a fluid.
- Identify the specificity of fluid mechanics in the continuum mechanics framework (i.e. compared to solid mechanics).
- Identify the non-dimensional numbers at play in any fluid mechanics problem and deduce how to perform experiments with appropriate similarity.
- Understand the notion of stresses and its representation through stress tensor.
- Describe the physical meaning of each term in the Navier-Stokes' equations.
- Identify the different flow regimes.
- Evaluate the generalized force applied on any object in still water.
- Understand when the perfect fluid assumption is valid.

Course contents

The lectures cover the following topics:

- Physics of fluids
- Dimensional analysis
- Stress tensors and fluids
- Navier Stokes' equations
- Flow regimes: introduction to turbulence
- Fluid statics
- Bernoulli's equation for a perfect fluid

In addition to those lectures, tutorials and lab sessions will allow the students to apply the theoretical knowledge to practical configurations.

Course material

- F. White, Fluid mechanics, McGraw-Hill, New York.
- B.R. Munson et al., Fundamentals of fluid mechanics, John Wiley, New York.

Assessment

Individual assessment: EVI 1 (coefficient 1)

Language of instruction	ECTS Credits	Lectures	Tutorials	Lab	Project	Exam
English	5	14 hrs	12 hrs	4 hrs	0 hrs	2 hrs

YEAR 1 - Autumn Semester

Marine Hydrodynamics 1 [MARHY 1]

LEAD PROFESSOR(S): Félicien Bonnefoy

Objectives

The objectives of this course are to give a general overview to students about the use of Hydrodynamics in marine and ocean engineering fields, about modelling and physics of free surface flows, hydrostatics and stability of floating structures.
This global overview will then be detailed in other courses of the Master's program.

Course contents

- Lesson 1 - Industrial, R&D and research activities connected to free surface hydrodynamics and ocean engineering. A state-of-the-art of the problems of engineering or applied research use of Hydrodynamics is detailed.
- Lesson 2 - Introduction to experimental approach in hydrodynamics. Physical problems which can be treated using an experimental approach and related facilities (towing tang, wave tank ...) are presented.
- Lesson 3 – Introduction to wave structure interaction. The spectral description of water waves is introduced as well as the main concepts of marine structure design, such as natural periods, buoyancy and wave loads, moorings, extreme loads and fatigue.
- Lesson 4 - Hydrostatic and Stability of ships and marine structures. Intact and damaged stability of floating structures are investigated through theoretical and practical aspects. Computer lab work is done with state-of-art industry software.

Course material

- J.N. Newman, Marine Hydrodynamics, The MIT press, 1977
- O. Faltinsen, Sea Loads on Ships and Offshore Structures, Cambridge Ocean Technology Series, 1993
- V. Bertram, Practical Ship hydrodynamics, Elsevier, 2012 (2nd Edition)
- A.J. Hermans, Water Waves and Ship Hydrodynamics: An Introduction, Springer, 2010 (2nd Edition)
- Biran, Ship Hydrostatics and Stability, Butterworth-Heinemann, 2003
- J.H. Ferziger, M. Peric, Computational Methods for Fluid Dynamics, Springer
- https://ittc.info/downloads/proceedings/ : proceedings of ITTC conferences

Assessment

Individual assessment:EVI 1 (coefficient 1.0) Details of assessment: Exam (0.6) / Labs (0.4)

Language of instruction	ECTS Credits	Lectures	Tutorials	Lab	Project	Exam
English	5	12 hrs	6 hrs	12 hrs	0 hrs	2 hrs

YEAR 1 - Autumn Semester

Numerical Methods [NUMME]

LEAD PROFESSOR(S): Grégory LEGRAIN

Objectives

At the end of the course (30 hours + personal work) the students will be able to:

- Classify standard second order PDEs (elliptic, parabolic, hyperbolic)
- Solve simple elliptic problems by means of finite differences or finite elements
- Determine the level accuracy of the schemes they use (convergence order)
- Program finite differences and finite elements in both 1D and 2D

Course contents

These lectures aim to present standard numerical methods, their features and limitations.

- Classification of PDEs
- Classification of boundary conditions, well-posed problems
- Introduction to finite differences (1D, 2D)
- Introduction to finite elements (1D, 2D)

Homework and lab sessions will provide an understanding of the programming and main features of the methods.

Course material

- The Finite Element Method: Linear Static and Dynamic Finite Element Analysis. T.J.R. Hughes
- Numerical Methods for Engineers and Scientists. J.D. Hoffman and S. Frankel

Assessment

Individual assessment: EVI 1 (coefficient 1)

Language of instruction	ECTS Credits	Lectures	Tutorials	Lab	Project	Exam
English	5	16 hrs	4 hrs	10 hrs	0 hrs	2 hrs

YEAR 1 - Autumn Semester

Tools and Methods for Research 1 [TOME1]

LEAD PROFESSOR(S): Erwan VERRON

Objectives

At the end of the course, the students will be able to:

- Write a scientific and technical paper on mechanical engineering area
- Establish the reasoning of scientific paper writing
- Present orally and clearly scientific data in the context of mechanical engineering
- Write the abstract on an article

Course contents

The goal is preparing undergraduate students to start a PhD or any relative research activity (academic or industrial) in the context of mechanical engineering.
The course is composed of four main parts :

- Part A : lecture on IMRAD concept
- Part B : Scientific paper reading and analysis based on IMRAD
- Part C : Oral presentation and discussion
- Part D: How to write the abstract of an article

These parts represent how to organize and publish (Part B and part D), how to communicate (Part C) and how to prepare and present a technical and scientific report (Part A). Applications are given for engineering works.

In addition, students will have to write a report based on a bibliographical study on a subject related to ocean engineering.

Assessment

Individual assessment: EVI 1 (coefficient 1)

Language of instruction	ECTS Credits	Lectures	Tutorials	Lab	Project	Exam
English	4	2 hrs	12 hrs	0 hrs	0 hrs	0 hrs

YEAR 1 - Autumn Semester

Cultural and Communication English [CCE1]

LEAD PROFESSOR(S): David TROYA

Objectives

This course aims at improving your critical thinking and persuasion skills in English. Using documentaries, we will explore, discuss and debate a range of cultural, political, social, and environmental issues relevant to current world events.

Speaking and understanding English as a second or third language is a great achievement, but does it mean you are an effective communicator? The next step involves, among other things, critical thinking and persuasive skills, both of crucial importance in the modern professional environment. We will address these issues by analyzing documentaries that will lead to formal debates.

Several competencies will be developed through class exercises. Oral presentations will be an opportunity put your verbal as well as your non-verbal communication skills into practice. During debate, you will be able to sharpen your analytical skills, provide constructive feedback, defend an argument, and prove a point.

Course objectives :

- Improving your communication skills
- Becoming an active listener
- Enhancing your non-verbal communication skills
- Developing critical thinking toward media
- Boosting leadership skills through moderating
- Organizing evidence and arguments

Course contents

Each session will be dedicated to a particular cultural, political, social or environmental topic of relevance in the wider anglophone world. Each topic will include multimedia material in the form of a short documentary or documentary excerpt. During class, students will lead a primer presentation, a moderated discussion and a formal debate.

Primer Presentation:

In pairs, you will hold a short talk to prime us on the topic of that week's documentary: you will introduce us to the topic by setting it in a wider context and establishing what's at stake.

Moderated Discussion :

In pairs, you will moderate a discussion related to the themes explored by the documentary. Moderators will come prepared with open-ended questions pertaining to the strengths and weakness of the documentary. They will distinguish between content and form and encourage critical, constructive opinions.

Formal Debate:

What's the difference between an opinion and an argument? You will soon find out. After the moderated discussion, and persuasive skills.

During the debate, each speaker will be assigned an audience member who evaluates their individual performance and provides a short debrief. A panel of two judges will determine which side wins.

Course material

Written and televised press, information and digital tools, general documents, business environment and company strategies. Internet conferences (Ted Talks, etc.), our own educational materials on Hippocampus (Moodle).

Assessment

Individual assessment: EVI 1 (coefficient 1)

Language of instruction	ECTS Credits	Lectures	Tutorials	Lab	Project	Exam
English	2	0 hrs	32hrs	0 hrs	0 hrs	0 hrs

Spanish Language [ESP1]

LEAD PROFESSOR(S): Marta HERRERA

Objectives

For beginners:

- Practice and reinforcement of the five skills (oral and written expression and comprehension as well as interaction) Acquisition of vocabulary and linguistic structures
- Be able to talk about yourself and those around you Be able to express oneself during daily activities Know how to give your opinion

For advanced students:

- Practice and reinforcement of the five skills (oral and written expression and comprehension as well as interaction) Acquisition of specialised vocabulary
- Be able to understand the essential content of concrete or abstract subjects including a technical discussion Be able to communicate spontaneously and fluently
- Be able to express oneself in a clear and detailed manner, to express an opinion on a topical subject

Course contents

For beginners:

- Personal environment (introduce yourself, express yourself, your tastes, your character, your hobbies, etc.), your surroundings (friends, family, location, climate), your interests (sports, leisure)
- Present tense (regular and irregular)
- Language patterns to express habit, obligation, "gustar" and its equivalents, Possessive adjectives
- Differences between "es", "está", "hay" Use of "por" and "para"
- Adverbs and frequency patterns Numeral adjectives

For advanced students:

- Knowledge of the Hispanic world (economic, technical, cultural and social environment) Present tense (regular and irregular)
- Imperative Past tenses
- Direct / indirect style Future tense Conditional tense
- Present and past subjunctive moods

Course material

Preparation manuals, our own tailor-made documents, written and internet press, general civilization documents, digital tools

Assessment

Individual assessment: EVI 1 (coefficient 1)

Language of instruction	ECTS Credits	Lectures	Tutorials	Lab	Project	Exam
Spanish	2	0 hrs	32hrs	0 hrs	0 hrs	0 hrs

YEAR 1 - Autumn Semester

French Language [FLE1]

LEAD PROFESSOR(S): Silvia ERTL

Objectives

The objective is to familiarize the learner with the French language and French culture through an entertaining task-based communicative language teaching, focused on speaking combined with:

- Phonetics
- Self-correcting exercises on our learning platform
- Learning Lab activities
- Project work
- Tutoring

Course objectives include the acquisition and reinforcement of vocabulary, syntax, and pronunciation by both traditional means and through the use of digital resources.

Students will learn general French, develop language skills of oral and written comprehension and expression.

After completing this course (32 hours + personal work), the students will be able to communicate in spoken and written French, in a simple, but clear manner, on familiar topics in the context of study, hobbies etc. Another important goal of this course is to introduce the student to French culture. At the end of the course (2 semesters), complete beginners can achieve an A1 level and some aspects of the A2 of The Common European Framework of Reference for Languages. More advanced students may aim for B1/B2 levels.

Course contents

Full range of practical communication language exercises: reading comprehension, listening comprehension, written expression, oral expression.

Learners will be able to use the foreign language in a simple way for the following purposes:

1. Gving and obtaining factual information:

- Personal information (e.g. name, address, place of origin, date of birth, education, occupation)
- Non-personal information (e.g. about places and how to get there, time of day, various facilities and services, rules and regulations, opening hours, where and what to eat, etc.)

2. Establishing and maintaining social and professional contacts, particularly:

- Meeting people and making acquaintances
- Extending invitations and reacting to being invited

- Proposing/arranging a course of action
- Exchanging information, views, feelings, wishes, concerning matters of common interest, particularly those relating to personal life and circumstances, living conditions and environment, educational/occupational activities and interests, leisure activities and social life

3. Carrying out certain transactions:

- Making arrangements (planning, tickets, reservations, etc.) for travel, accommodation, appointments, leisure activities
- Making purchases
- Ordering food and drink

Course material

Preparation manuals, our own tailor-made documents, written and televised press, internet, general civilization documents, digital tools, our own educational materials on Hippocampus (Moodle).

Assessment

Individual assessment: EVI 1 (coefficient 1)

Language of instruction	ECTS Credits	Lectures	Tutorials	Lab	Project	Exam
French	2	0 hrs	48 hrs	0 hrs	0 hrs	0 hrs

YEAR 1 - Spring Semester

Fluid Mechanics 2 [FLUII]

LEAD PROFESSOR(S): Guillaume DUCROZET

Objectives

At the end of the course (30 hours + personal work) the students will be able to:

- Apply the potential flow theory to simple configurations in fluid dynamics.
- Identify the limitations of the potential flow theory.
- Identify the sources of head loss in an internal flow.
- Evaluate the necessary power of a pump in a hydraulic system.
- Calculate the forces exerted on an object in a flow using Euler's theorem.
- Design experimental facilities for head loss identification and force measurements.

Course contents

This course is a follow-up to 'Fluid Mechanics 1', which presents the fundamentals and general principles of fluid mechanics. The aim is now to provide simple tools/formula to extract global information which is useful from an engineering point of view for fluid mechanics problems.

The lectures cover the following topics:

- Potential flows
- Transport theorems and integral balances in fluid mechanics
- Head losses and the generalized Bernoulli's equation
- Momentum balance: Euler's theorem

In addition to those lectures, tutorials and lab sessions (4 3h-lab sessions) will allow the students to apply the theoretical knowledge to practical configurations.

Course material

- F. White, Fluid mechanics, McGraw-Hill, New York.
- B.R. Munson et al., Fundamentals of fluid mechanics, John Wiley, New York.

Assessment

Individual assessment: EVI 1 (coefficient 1)

Language of instruction	ECTS Credits	Lectures	Tutorials	Lab	Project	Exam
English	5	8 hrs	10 hrs	12 hrs	0 hrs	2 hrs

YEAR 1 - Spring Semester

Marine Hydrodynamics 2 [MARHY2]

LEAD PROFESSOR(S): Antoine DUCOIN

Objectives

The objectives of this course are to give a general overview to students about:

- Classes of approximation in hydrodynamics for modelling of some typical problems
- Numerical simulation in Hydrodynamics
- Specificities of flows around lifting profiles and their application to naval engineering or Marine Renewable Energies

This global overview will be then detailed in other courses of the Master program.

After completing the course, students will be able to:

- Classes of approximation in hydrodynamics:

- Know which mathematical models are available in hydrodynamics for ocean engineering
- Select which mathematical models are adapted for different typical problems in ocean engineering

- Numerical simulation:

- Methodology for numerical simulation: how to go from modelling to analysis of results
- How is numerical simulation used in marine hydrodynamics at present time?

- Lifting profiles:

- Design a blade for marine propellers and wind/tidal turbines applications
- Calculate performance using potential flow theory
- Determine which flow regime could occurs around the lifting profile and be able to determine its direct effect on hydrodynamic performance

Course contents

Different classes of approximation used in Hydrodynamics

- Presentation of free surface boundary conditions and influence of vorticity in fluid mechanics.
- Presentation of different fundamental problems in hydrodynamics for ocean engineering in terms of main physical phenomena.
- Mathematical models which can be used in Hydrodynamics to describe isovolume free surface flows (Navier-Stokes equations, Euler equations, boundary layer equations, Potential flow model).
- How these mathematical models are fitted with the different fundamental problems defined before?

Introduction to Numerical Simulation

- Following parts will be described:Methodology for numerical simulation of a physical problem
- Space and time discretization
- Discrete equations solving
- Convergence, verification and validation

Lifting profiles

The objective is to understand the fundamentals of lifting profiles, focusing on the specificity of marine applications. We will focus on the main operating principle, followed by an understanding of flow physics around marine profiles and their resulting performances. The theory focuses on potential flow theory to calculate the flow around a lifting profile, and to obtain the performances.

Basics and applications

- Flow physics – hydrodynamics: characterization of flow regimes, performance analysis
- Methods and theory: thin profiles theory, lifting line theory
- Tutorial: calculate the performances of a NACA section using the thin profile theory
- Lab sessions: coding of lifting line theory using Matlab to analyse the effect of various blade geometries and aspect ratio on the hydrodynamic performances

Course material

- Guyon, E., Hulin, J.P., Petit, L. Hydrodynamique physique, 3ème édition (in French), Editions du CNRS (available on internet)
- Newman, J.N. Marine Hydrodynamics, The MIT press, 1977
- Bertram, V. Practical Ship hydrodynamics, Elsevier, 2012 (2nd Edition)
- Ferziger, J.H., Peric, M. Computational Methods for Fluid Dynamics, Springer, 2002 (available on internet)
- Abott, I. H., Von Doenhoff, A.E. Theory of wing sections, Dover publication, 1949
- Glauert, H. Airplane propellers. In: Durand WF, editor. Aerodynamic theory. New York: Dover Publications, 1963

Assessment

Individual assessment: EVI (coefficient 0.6)

Collective assessment: EVC (coefficient 0.4)

Language of instruction	ECTS Credits	Lectures	Tutorials	Lab	Project	Exam
English	5	22 hrs	2 hrs	6 hrs	0 hrs	2 hrs

YEAR 1 - Spring Semester

Structural Mechanics [STRME]

LEAD PROFESSOR(S): Patrice CARTRAUD

Objectives

This course is an introduction to structural mechanics, focuses more particularly on the study of the equilibrium of linear elastic slender structures like beams, but also lattice trusses, undergoing infinitesimal strain and displacements in order to design them with respect to external loads. This will provide some of the basic tools for engineers to design simple mechanical systems with simplified approaches. The basic concepts required for this course will have already been introduced in the continuum mechanics course during the first semester. These concepts are here particularized for slender structures; the same methodology of analysis of a problem is also followed during this course.

At the end of the course (30 hours + personal work), the students will be able to:

Understand what are the key points in defining the kinematics of a beam.

- Define the problem of the equilibrium of a beam or a lattice trusses in infinitesimal strain by writing a Boundary Value Problem (BVP), and choose the right set of boundary conditions.
- Understand the different possible approaches available for the solution of that BVP, and solve it.

Course contents

The course outline is as follows:

- Study of 3D solutions of beams: torsion and pure bending
- Introduction to the Bernoulli beam theory:
  - kinematics,
  - modelling of internal forces,
  - equilibrium and boundary conditions,
  - writing of the Boundary Value Problem (BVP).
- Study of the in-plane bending subproblem:
  - Force and displacement solution approaches
  - Isostatic/hyperstatic beams, and strength criteria applied to beams
- Study of lattice trusse :
  - Writing of the Boundary Value Problem (BVP); solution.

- Opening. Choice between (depending on the year):

  - Buckling of beams,

  - Vibration of beams

  - Introduction to curved beams

Course material

- Beams, plates and shells. Donnell Lloyd Hamilton (1976). Mc Graw-Hill.
- Poutres et arcs élastiques. Patrick Ballard, (2009), Editions de l'Ecole Polytechnique.
- Handbook of Structural Mechanics. (2001) Patrice Cartraud.
- Poutre et plaques. Jean-Louis Batoz (1990). Editions Hermès.
- Théorie des poutres. Serge Laroze (1980). Paris Eyrolles.
- Mécanique des structures. Tome2: Poutres. Serge Laroze. Éditeur Toulouse Cépaduès-Éd. DL 2005.
- Mécanique des structures. Tome 5: Poutres exercices. Serge Laroze. Éditeur Toulouse Cépaduès-Éd. DL 2005.

Assessment

Individual assessment: EVI 1 (coefficient 1)

Language of instruction	ECTS Credits	Lectures	Tutorials	Lab	Project	Exam
English	5	16 hrs	14 hrs	0 hrs	0 hrs	2 hrs

YEAR 1 - Spring Semester

Tools and Methods for Research [TOME2]

LEAD PROFESSOR(S): Guillaume DUCROZET

Objectives

To contribute to solving an applied problem in a research framework.

Course contents

- The main features of the project are as follows:
- A subject related to the thesis topic of a PhD student, who supervises the Master student.
- An activity of an operational nature. Examples: writing a program to process experimental data, or post-processing numerical results. Performing finite element calculations and analyzing the results, testing software, carrying out a bibliographical study…
- A deliverable in the form of a poster presented at the end of the semester

Assessment

Language of instruction	ECTS Credits	Lectures	Tutorials	Lab	Project	Exam
English	5	0 hrs	0 hrs	0 hrs	32 hrs	0 hrs

YEAR 1 - Spring Semester

Energetics [ENERG]

LEAD PROFESSOR(S): Xavier TAUZIA

Objectives

At the end of the course (30 hours + personal work) the students will be able to:

- Understand a complex energetic system
- Make a comprehensive application of the laws of thermodynamics
- Determine the pertinent information to describe the system
- Identify the nature of the transformations
- Establish an equation of energy balance
- Calculate the characteristic parameters of a two-phase flow
- Calculate the power and efficiency of different thermal machines
- Calculate heat flux in processes involving conduction and convection

Course contents

The main objective of the course is for students to acquire the fundamental principles of thermodynamics and to apply them to the study of industrial processes involving energy transformation or transfer phenomena. The main elements covered in the course are:

- Principles of thermodynamics and selected elementary results: closed/open systems, perfect and real fluids.
- Energy transformations-compressors, nozzles, turbines, expander.
- Phase transitions: properties of mixtures, thermodynamic tables and diagrams.
- Thermodynamic cycles and thermal machines. Direct cycles: Carnot, Rankine, Hirn, reheating cycles, Joule's cycle, Otto and Diesel cycles.
- Introduction to turbocharging.
- Inverse compression cycles: Carnot and Joule's cycles, heat pump, refrigeration and air conditioning. Humid air. Steam absorption cycles.
- Thermodynamics of unbalanced systems - general principles. Heat transfer. Newton and Fourier's laws.
- Thermodynamic study of heat radiation. Black bodies, Planck, Stefan, and Kirchoff laws.

Course material

- Thermodynamique et énergétique, M. BOREL (Presses polytechniques Romandes)
- Thermodynamique générale et application, R. KLING (Technip)
- Thermodynamique, J.P. PEREZ (Masson)
- Energétique, M. FEIDT (Dunod)
- Introduction aux problèmes énergétiques globaux, R. GICQUEL (Presses des Mines)
- Fundamentals of thermodynamics, Sonntag, Borgnakke & Van Wylen (Wiley ed.)
- Internal combustion engines, Fergusson (Wiley)
- Introduction to ICE, Stone (MacMillan)

Assessment: Individual assessment: EVI 1 (coefficient 1)

Language of instruction	ECTS Credits	Lectures	Tutorials	Lab	Project	Exam
English	5	16 hrs	14 hrs	0 hrs	0 hrs	2 hrs

YEAR 1 - Spring Semester

Propulsion [PROPUL]

LEAD PROFESSOR(S): Georges SALAMEH

Objectives

At the end of the course (30 hours + personal work) the students will be able to:

- Describe the main parts of a reciprocating piston engine and of an automotive powertrain
- Distinguish between various types of engine: 4 stroke/2 stroke; SI/CI; NA/supercharged/turbocharged
- Describe the main internal processes and their interactions
- Calculate theoretical cycles
- Evaluate engine performance and efficiency
- Describe the main parts of a gas turbine and a turbojet/turbofan

Course contents

These introductory lectures aim to present the main characteristics of IC engines, the main thermofluid processes involved and the main performance and energy conversion calculations.

This course also presents briefly gas turbine and aircraft engines. The contents are as follows:

- Main engine parts
- Theoretical cycles
- Geometrical characteristics
- Performance and efficiency indicators
- Intake and exhaust systems
- Supercharging and turbocharging - downsizing
- Types of fuel and fuel systems
- Combustion (SI and CI) and emissions – after-treatment
- Automotive powertrain: clutch, manual gearbox, automatic GB, CVT, power requirement, hybridization
- Gas turbines and aircraft engines

Course material

- JB Heywood, Internal Combustion Engine Fundamentals, Mc Graw Hill 1995
- W Pulkrabek Engineering Fundamentals of the Internal Combustion Engine, Pearson 2013

Assessment

Individual assessment: EVI 1 (coefficient 1)

Language of instruction	ECTS Credits	Lectures	Tutorials	Lab	Project	Exam
English	5	16 hrs	14 hrs	0 hrs	0 hrs	2 hrs

YEAR 1 - Spring Semester

Cultural and Communication English [CCE2]

LEAD PROFESSOR(S): David TROYA

Objectives

Interview techniques and communicational English:

- Understand the general concepts of interactive communication
- Build a media project
- Acquire interview techniques
- Understand the process of sourcing and checking facts and figures
- Understand issues related to plagiarism
- Create a bibliography
- Behavioral skills in an inter-cultural environment:
- Strengthen self-confidence and capacity for interaction
- Develop active listening and reformulation skills
- Develop networking skills

Course contents

- Cultural and Communicational English: exercises to explore in practice the areas of culture and communication.
- Media project (for example: prepare, conduct and promote interviews for a radio programme: L'Heure Centralienne (http:
- //www.euradionantes.eu/emission/l-heure-centralienne), with the contribution of professors, PhD students, industrial partners, industry players at fairs, etc.

Course material

Written and televised press, information and digital tools, general documents business environment and company strategies. Internet conferences (Ted Talks, etc.), our own educational materials on Hippocampus (Moodle).

Assessment

Individual assessment: EVI 1 (coefficient 1)

Language of instruction	ECTS Credits	Lectures	Tutorials	Lab	Project	Exam
English	2	0 hrs	32 hrs	0 hrs	0 hrs	0 hrs

YEAR 1 - Spring Semester

Spanish Language [ESP2]

LEAD PROFESSOR(S): Marta HERRERA

Objectives

For beginners:

- Practice and reinforcement of the five skills (oral and written expression and comprehension as well as interaction) Acquisition of vocabulary and linguistic structures
- Be able to talk about yourself and those around you Be able to express oneself during daily activities Know how to give your opinion

For advanced students:

- Practice and reinforcement of the five skills (oral and written expression and comprehension as well as interaction) Acquisition of specialised vocabulary
- Be able to understand the essential content of concrete or abstract subjects including a technical discussion Be able to communicate spontaneously and fluently
- Be able to express oneself in a clear and detailed manner, to express an opinion on a topical subject

Course contents

For beginners:

- Personal environment (introduce yourself, express yourself, your tastes, your character, your hobbies, etc.), your surroundings (friends, family, location, climate), your interests (sports, leisure)
- Present tense (regular and irregular)
- Language patterns to express habit, obligation, "gustar" and its equivalents, Possessive adjectives
- Differences between "es", "está", "hay" Use of "por" and "para"
- Adverbs and frequency patterns Numeral adjectives

For advanced students:

- Knowledge of the Hispanic world (economic, technical, cultural and social environment) Present tense (regular and irregular)
- Imperative Past tenses
- Direct / indirect style Future tense Conditional tense
- Present and past subjunctive moods

Course material

Preparation manuals, our own tailor-made documents, written and internet press, general civilization documents, digital tools

Assessment

Individual assessment: EVI 1 (coefficient 1)

Language of instruction	ECTS Credits	Lectures	Tutorials	Lab	Project	Exam
Spanish	2	0 hrs	32 hrs	0 hrs	0 hrs	0 hrs

YEAR 1 - Spring Semester

French Language [FLE2]

LEAD PROFESSOR(S): Silvia ERTL

Objectives

The objective is to familiarize the learner with the French language and French culture through an entertaining task-based communicative language teaching, focused on speaking combined with:

- Phonetics
- Self-correcting exercises on our learning platform
- Learning Lab activities
- Project work
- Tutoring

Course objectives include the acquisition and reinforcement of vocabulary, syntax, and pronunciation by both traditional means and through the use of digital resources.

Students will learn general French, develop language skills of oral and written comprehension and expression.

After completing this course (32 hours + personal work), the students will be able to communicate in spoken and written French, in a simple, but clear manner, on familiar topics in the context of study, hobbies etc. Another important goal of this course is to introduce the student to French culture. At the end of the course (2 semesters), complete beginners can achieve an A1 level and some aspects of the A2 of The Common European Framework of Reference for Languages. More advanced students may aim for B1/B2 levels.

Course contents

Full range of practical communication language exercises: reading comprehension, listening comprehension, written expression, oral expression. Learners will be able to use the foreign language in a simple way for the following purposes:

Giving and obtaining factual information:

- Personal information (e.g. name, address, place of origin, date of birth, education, occupation)
- Non-personal information (e.g. about places and how to get there, time of day, various facilities and services, rules and regulations, opening hours, where and what to eat, etc.)

Establishing and maintaining social and professional contacts, particularly:

- Meeting people and making acquaintances
- Extending invitations and reacting to being invited
- Proposing/arranging a course of action

- Exchanging information, views, feelings, wishes, concerning matters of common interest, particularly those relating to personal life and circumstances, living conditions and environment, educational/occupational activities and interests, leisure activities and social life

Carrying out certain transactions:

- Making arrangements (planning, tickets, reservations, etc.) for travel, accommodation, appointments, leisure activities
- Making purchases
- Ordering food and drink+-

Course material

Preparation manuals, our own tailor-made documents, written and televised press, internet, general civilization documents, digital tools, our own educational materials on Hippocampus (Moodle).

Assessment

Individual assessment: EVI 1 (coefficient 1)

Language of instruction	ECTS Credits	Lectures	Tutorials	Lab	Project	Exam
French	2	0 hrs	48 hrs	0 hrs	0 hrs	0 hrs