SHAKE THE FUTURE.

CENTRALE NANTES

MASTER OF SCIENCE, TECHNOLOGY AND HEALTH

MARINE TECHNOLOGY

HYDRODYNAMICS FOR OCEAN ENGINEERING

YEAR 2

PROGRAMME SUPERVISORS:
GUILLAUME DUCROZET, LIONEL GENTAZ

Établissement public sous tutelle du ministère de l'Enseignement supérieur, de la Recherche et de l'Innovation

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MARINE TECHNOLOGY - HYDRODYNAMICS FOR OCEAN ENGINEERING

YEAR 2 - AUTUMN SEMESTER

CORE COURSES

Water Waves and Sea States Modeling

Numerical Hydrodynamics

Wave-structure Interactions and Moorings

General Concepts of Hydrodynamics

Experimental Hydrodynamics

Cultural and Communication English

French Language

SPECIALISATION COURSE – CHOOSE 1 OF 3

Naval Engineering

Hydrodynamics R&D

Marine Renewable Energy

WATER WAVES AND SEA STATES MODELLING

MARINE TECHNOLOGY - HYDRODYNAMICS FOR OCEAN ENGINEERING
YEAR 2 - AUTUMN SEMESTER

LEAD PROFESSOR: Guillaume DUCROZET

Objectives

First, we give an overview of some of the numerous mathematical models used to represent free surface gravity waves, and the associated underlying flow. The scope is voluntarily restricted to the most useful models generally used by naval engineers and researchers. In a few cases, a deeper theoretical insight is presented in order to allow the students to understand the subtleties of water wave theory. In the second part, the use of the statistical approach is presented, both for the representation of sea states and for the sea structure's response.

Course contents

Lesson 1 - Introduction to marine environment
Description of the ocean and the different kind of waves. Focus on gravity waves and the processes responsible for their generation.

Lesson 2 - Gravity wave modelling
Derivation of the governing non-linear equations and introduction of the multiple scale method to generate a particular subset of equations

Lesson 3 - Dispersive waves

- Airy Potential; derivation of the solution by separation of variables. Expression of all the related physical quantities: group velocity, energy density, energy flux, limits of the linear model.
- Higher order Stokes solutions (3rd order, 5th order). Sequential construction of the Stokes higher order solutions. Specific nonlinear features of Stokes waves.
- From deep to shallow water
- Refraction and shoaling of dispersive waves
- Shallow-water (non-dispersive) waves

Lesson 4 - Statistical models for wave field description

- Random sea state modeling.
- Usual wave spectra models.
- Wave generation.

Lesson 5 - Random responses of structures at sea

- Random responses of a linear system.
- Review of the results for ship responses by a deterministic theory.
- Motion on a real sea state.
- Extreme responses, design factors.

Course material

- Robert G. Dean & Robert A. Dalrymple, Water wave mechanics for engineers and scientists, Advanced Series on Ocean Engineering (vol.2).
- A.J. Hermans, Water waves and ship hydrodynamics: an introduction.
- C.C. Mei, M. Stiassnie & D.K.P. Yue, Theory and application of ocean surface waves, Advanced Series on Ocean Engineering (vol.23). Part I: Linear aspects; Part II: Non-linear aspects

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LABO	PROJECT	**EXAM**
English	**4**	**14 hrs**	**4 hrs**	**14 hrs**	**0 hrs**	**2 hrs**

NUMERICAL HYDRODYNAMICS

MARINE TECHNOLOGY - HYDRODYNAMICS FOR OCEAN ENGINEERING
YEAR 2 - AUTUMN SEMESTER

LEAD PROFESSOR: Zhe LI

Objectives

The goal of this class is to provide students with an overview of the Computational Fluid Dynamics (CFD) methods and simulation environment for the computation free-surface unsteady flows of ocean engineering. The different methods rely on different physical approximations of the wavestructure interaction problem. The latter approximations are based upon the space-time scales (from hours and km2 to seconds and m2) at stake and the engineering objectives (energy conversion quantification, design for standard operation, extreme condition design, maintenance operations, etc.). According to the approximations made, different numerical methods can be developed.

The primary objective is that students gain a clear vision of the use of the different approximations and methods, and of their respective range of application, computational cost, human and resource cost of use, versatility, limitations, ease of use, space discretization (mesh), etc. The methods reviewed range from potential flow theory (BEM: Boundary Element Method, HOS: High-Order Spectral), to full description of the Navier-Stokes equations (FD: Finite Differences, FD: Finite Volumes, FE: Finite Elements) associated with interface models (VoF: Volume of Fluid, LS: Level Set).

For each method, the mathematical model, discretization and implementation principles are explained. Turbulence modeling principles (RANS: Reynolds Averaged Navier-Stokes, LES: Large-Eddy Simulation, hybrid RANS/LES) are provided. The link with the space discretization (structured surface meshes, unstructured volume meshes, meshless etc) is detailed. Numerical properties (convergence, stability, consistency) are reviewed.

Finally, the links between the numerical method and the current simulation environment are developed: existing commercial software, human and computational resources, choice of software depending on the targeted problem, link with hardware (High-Performance Computing, cloud resources) etc.

Practical projects using software based on different methods studied in courses (BEM, F. etc) are proposed to students with the use of commercial software or software developed in Ecole Centrale de Nantes. In other lab work students will have to implement their own simple numerical model.

Course contents

Lesson 1 - Knowledge and understanding of potential flow solvers
Potential flow methods (BEM), Integral methods solving, Surface meshing, Hydrodynamic loading calculation

Lesson 2 - Numerical methods for free surface flows
Volume discretization methods (FD, FV), Time integration and stability, Turbulence models (RANS, LES)

Lesson 3 - Navier-Stokes equations solution techniques
Pressure-velocity coupling, Linear system solving, Volume meshing
Hydrodynamic loading calculation, Interface methods (VoF, LS)

Course material

- H. Lomax et al., Fundamentals of Computational Fluid Dynamics, Springer, 2011
- B. Andersson et al., Computational Fluid Dynamics for engineers, Cambridge Univ. Press, 2011
- J.H. Ferziger, M. Peric, Computational Methods for Fluid Dynamics, Springer, 1997
- J.F. Wendt, Computational Fluid Dynamics, an introduction, Springer, 2009
- R.H. Nichols, Turbulence Models and Their Application to Complex Flows, Univ. Alabama, 2012
- V. Bertram, Practical Ship Hydrodynamics, Elsevier, 2012

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LABO	PROJECT	EXAM
English	5	12 hrs	6 hrs	14 hrs	0 hrs	2 hrs

WAVE-STRUCTURE INTERACTIONS AND MOORINGS

MARINE TECHNOLOGY - HYDRODYNAMICS FOR OCEAN ENGINEERING
YEAR 2 - AUTUMN SEMESTER

LEAD PROFESSOR: Pierre FERRANT

Objectives

The objective of the first part of the course is to give a complete presentation of the available models for the determination of marine structure response in a seaway, emphasizing the advantages and drawbacks of each approach. A complete presentation of the linearized theory of wave-body interactions, treated in a deterministic sense, is first given. Both frequency domain and time domain approaches are described. Fundamental relations between both solutions are systematically emphasized. High and low frequency second order effects are explained and illustrated. Then, an overview of the available nonlinear theories and numerical models for wavestructure interactions is given. Different levels of approximation are described, from the simple addition of nonlinear hydrostatics to fully nonlinear time domain models.

The second part addresses the modelling of mooring systems. Different options in terms of mooring systems and arrangements are presented in order to give students the main information necessary for undertaking a mooring design process.

For both parts, lectures and seminars are completed by practical exercises based on state-of-theart software for wave-structure interaction and mooring modelling.

Course contents

Lesson 1 - Objectives, theoretical framework
Lesson 2 - Short review of linear systems theory
Lesson 3 - Formulation of the boundary value problem. Linearization
Lesson 4 - Frequency domain approach

- Definition of diffraction and radiation sub-problems
- Hydrodynamic loads: added mass and damping
- Calculation of motions
- Relations between elementary solutions

Lesson 5 - Time domain approach
Forced motion of a floating body
Formulation of the diffraction problem in the time domain
Equations of motion
Relation to frequency domain response

Lesson 6 - Second order effects
Drift forces
Low and high frequency loading in irregular waves

Lesson 7 - Introduction to nonlinear models

- Nonlinear hydrostatics and Froude-Krylov loading
- Weak scattered hypothesis

- Fully nonlinear models

Lesson 8 - Moorings for marine structure

- Some examples in Oil and Gas energy
- Different types of mooring systems
- Offloading operations
- Some examples in Marine Renewable energy
- Mooring main functions
- Mooring arrangement
- Mooring components
- Environmental conditions
- Mooring Design basis

Course material

- J.N. Newman (1977) Marine Hydrodynamics, MIT Press.
- O.M. Faltinsen (1990) Sea Loads on Ships and Offshore Structures, Cambridge University Press.
- Adrian Biran (2003) Ship Hydrostatics and Stability, Butterworth-Heinemann.
- API recommended Practice 2SK (2005) Design and analysis of Station-keeping Systems for Floating Structures.
- Vryhof anchors (2010) Anchor Manual, The Guide to Anchoring.

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LABO	PROJECT	**EXAM**
English	**4**	**18 hrs**	**2 hrs**	**12 hrs**	**0 hrs**	**2 hrs**

General Concepts of Hydrodynamics

MARINE TECHNOLOGY - HYDRODYNAMICS FOR OCEAN ENGINEERING
YEAR 2 - AUTUMN SEMESTER

LEAD PROFESSOR: Lionel GENTAZ

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, numerical simulation in Hydrodynamics, hydrostatic and stability of floating structures. This global overview will be then detailed in other courses of the Master programme.

Course contents

Lesson 1 - Industrial, R&D and research activities connected to free surface hydrodynamics and ocean engineering
An overview of the problems in engineering or applied research where the use of Hydrodynamics is required.

Lesson 2 - Different classes of approximation used in Hydrodynamics
Presentation of different mathematical models which can be used in Hydrodynamics to describe free surface incompressible free surface flows (Navier-Stokes equations, Euler equations, Laminar and turbulent boundary layer equations, Potential flow model) and the main problems of free surface Hydrodynamics for which each model is adapted.

Lesson 3 - Introduction to Numerical Simulation

- Methodology for numerical simulation of a physical problem
- Implementation of a numerical method
- Pre- and post-treatment
- High-performance computing

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
- 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

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LABO	PROJECT	EXAM
English	4	20 hrs	6 hrs	6 hrs	0 hrs	2 hrs

EXPERIMENTAL HYDRODYNAMICS

MARINE TECHNOLOGY - HYDRODYNAMICS FOR OCEAN ENGINEERING
YEAR 2 - AUTUMN SEMESTER

LEAD PROFESSOR: Félicien BONNEFOY

Objectives

To provide students with state-of-the-art knowledge on experimental fluid dynamics in the field of Offshore renewable energy. Despite the development of numerical modelling, the experimental approach remains a major source of knowledge development in ship hydrodynamics and marine renewable energy. The contribution to the selection of adequate hypotheses and to the validation of analytical or numerical models is of primary importance. In numerous situations, the experimental approach remains the most reliable, economical and fastest way to validate new designs. Specific instrumentation and facilities are presented in this course and used in lab work.

Course contents

Lesson 1 - Introduction to experimental hydrodynamics
The students find the main topics in MRE experiments.

Lesson 2 - Experimental ocean engineering
Experimental tests in offshore basins.

Lesson 3 - Resistance
Ship resistance and experiments in towing tanks. Reynolds and Froude similitude; extrapolation at full scale.

Lesson 4 - Ship manoeuvrability
Mathematical formulation, experimental determination of hydrodynamic coefficients. Modelling of towed structures.

Lesson 5 - Measurements and signal processing
Sensors and transducers, sampling theory. Signal processing, Fourier analysis.

Course material

- S.A. Hughes, Physical Models and Laboratory Techniques in Coastal Engineering
- N. Newman, Marine Hydrodynamics
- O.M. Faltinsen, Sea loads on ships and offshore structures
- V. Bertram, Practical Hydrodynamics
- S. Chakrabarti, Offshore structure modelling

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LABO	PROJECT	**EXAM**
English	**4**	**12 hrs**	**0 hrs**	**20 hrs**	**0 hrs**	**2 hrs**

NAVAL ENGINEERING

MARINE TECHNOLOGY - HYDRODYNAMICS FOR OCEAN ENGINEERING
YEAR 2 - AUTUMN SEMESTER

LEAD PROFESSOR: Lionel GENTAZ

Objectives

In manoeuvrability, the students learn how to use the mathematical formulation and the analytical resolution of the linearized problem in simple examples such as turning circles. Realistic configurations are then studied by means of numerical simulations of the nonlinear problem.

In optimization, the multi-objective approach is used through various examples in naval applications. Different algorithms are presented (gradient, genetic etc) and the Mode-Frontier software is applied to optimize the bulb of a ship in order to minimize the wave resistance.

In CFD, the knowledge covered in the Numerical hydrodynamics course is applied to the simulation of a ship with forward speed.

Course contents

Lesson 1 - Manoeuvrability, an introduction
The students discover the basics of manoeuvrability: hydrodynamic loads on the hull, propeller loads, rudder action etc. The mathematical framework is presented to express the problem in the ship reference frame.

Lesson 2 - Experimental manoeuvrability
Experimental tests at seas (full scale) and in tanks (model scale).

Lesson 3 - Computational manoeuvrability
Presentation of an overvies in terms of numerical computations of manoeuvring performance of ships. Numerical modelling of turning circle problem

Lesson 4 - Optimization – basics.
Presentation of two typical optimization methods: the geometrical method and the gradient-based method. The students learn how to use the software ModeFrontier with some simple examples.

Lesson 5 - Optimization – advanced
Presentation of the genetic optimization method. The students will use ModeFrontier to optimize the shape of the bulbous bow in order to minimize the resistance exerted on the ship.

Course material

- V. Bertram, 2000, Practical Ship Hydrodynamics, Butterworth Heinemann
- T.I. Fossen, 2011, Handbook of marine craft hydrodynamics and motion control, Wiley
- N. Newman, Marine Hydrodynamics
- O.M. Faltinsen, Sea loads on ships and offshore structures
- J.H. Ferziger, M. Peric, Computational Methods for Fluid Dynamics, Springer

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LABO	PROJECT	**EXAM**
English	5	10 hrs	4 hrs	18 hrs	0 hrs	2 hrs

HYDRODYNAMICS R&D

MARINE TECHNOLOGY - HYDRODYNAMICS FOR OCEAN ENGINEERING
YEAR 2 - AUTUMN SEMESTER

LEAD PROFESSOR: Antoine DUCOIN

Objectives

To provide students an overview of the current research in numerical methods for hydrodynamics.

Course contents

Lesson 1 - LBM (lattice Boltzmann method)
Over the last two decades, the lattice Boltzmann method (LBM) has emerged as a promising numerical tool for simulating, and not limited to, various types of fluid flows in nature as well as in engineering applications. It has been recently demonstrated that the LBM can be systematically derived from the Boltzmann equation (kinetic theory). This inherent feature allows the LBM to solve fluid dynamic problems with a large range of scales. This course consists of four hours of lectures and four hours of programming lab work. The theoretical basis of the LBM is first presented in the lecture, such as the derivation from the Boltzmann equation using Hermite polynomial expansion, the relation with the Navier-Stokes equation via the Chapman-Enskog analysis. The second part of the lecture is devoted to the presentation of the numerical aspects of the LBM, such as the collision and streaming steps, the boundary condition treatment. In the lab work, the students will learn how to write an LBM program using Matlab in order to simulate some academic test-cases, e.g. Poiseuille flow, lid driven cavity. The objective of the lab work is to make the students better understand this numerical method and experience its simplicity of implementation.

Lesson 2 - FSI (Fluid Structure Interaction)
An overview of Fluid Structure Interactions (FSI) for hydrodynamic applications is presented in this class. The first part concerns the basic equations for fluid structure interaction problems, followed by a non-dimensional analysis to extract the different class of fluid structure interactions. The class will then focus on the particular case of flow induced vibration. Two simple FSI problems are then studied: the free motion of a 2D cylinder under unsteady, periodic flow, and the static deformation of a 2D hydrofoil under stationary flow. In the third part, an overview of the numerical methods for fluid structure interaction problems is presented. In the computer lab work, students will study a free oscillating cylinder submitted to hydrodynamic flow, using Direct Numerical Simulation (DNS).

Lesson 3 - PWAVE (Pseudo-spectral methods for water WAVE simulation)
This course aims to give the students an introduction to the theory and applications of pseudospectral methods for the simulation of nonlinear free surface flows, upon the hypothesis of potential flow. After a presentation of the theory, the course is completed by a practical computer exercise in which students (in groups of 2) have to develop and evaluate their own implementation of the theory, solving a variety of free surface flow problems: standing or propagating waves, generation and absorption of gravity waves, etc.

Lesson 4 - SPH (Smoothed Particle Hydrodynamics)
The Smoothed Particle Hydrodynamics method is of growing interest for complex free surface flows, mainly when characteristic times are short (impact, slamming, sloshing, spray, etc.). The course covers the various aspects of the method theory and application to marine engineering.

First are highlighted the different reasons why this method is well suited to these complex free surface problems (advantages), and why it is also mainly limited to them (drawbacks). The method theory is then developed and compared to standard mesh-based methods in terms of: schemes of approximation of the differential operators, convergence and accuracy, explicit solving of Navier-Stokes equations, weak-compressibility assumption, quasi-Lagrangian description, etc. Implementation is also discussed, especially in the context of High Performance Computing. Finally, it is shown how this method is applied to industrial marine engineering problems, and it is discussed what are its current trends of development: improvement of convergence, particle refinement, easy Fluid-Structure Interaction, coupling to Finite Volumes.

Course material

Lecture 1 (LBM):

- Shan, X., Yuan, X.F., Chen, H. Kinetic theory representation of hydrodynamics: a way beyond the Navier-Stokes equation. Journal of Fluid Mechanics 550: 413-441, 2006.
- Guo, Z., Zheng, C., Shi, B. Discrete lattice effects on the forcing term in the lattice Boltzmann method. Physical Review E 65: 046308, 2002.
- Succi, S. The lattice Boltzmann equation: for fluid dynamics and beyond. Oxford University Press. 2001

Lecture 2 (FSI)

- M.P. Païdoussis. Fluid-Structure Interaction: Slender Structures and Axial Flow. Academic Press, 2004
- J.F. Sigrist, Fluid-Structure Interaction: An Introduction to Finite Element Coupling, Wiley, 2015

Lecture 3 (PWAVE)

- P. Ferrant, D. Le Touzé: Simulation of Sloshing Waves in a 3D Tank Based on a Pseudo-Spectral Method, Proc. 16th International Workshop on Water Waves and Floating Bodies, Hiroshima, April 2001.
- F Bonnefoy, D. Le Touzé, P. Ferrant: A Fully Spectral 3D Time-Domain Model for Second-Order Simulation of Wavetank Experiments. Part A: Formulation, Implementation and Numerical Properties, Applied Ocean Research, Vol. 28 (1), pp33–43, 2006.
- F. Bonnefoy, G. Ducrozet, D. Le Touzé, P. Ferrant: Time Domain Simulation of Non-Linear Water Waves using Spectral Methods, Chapter in: 'Advances in Numerical Simulation of Nonlinear Water Waves', Advances in Coastal and Ocean Engineering, Vol. 11, Q.W. Ma Editor, World Scientific Publishers, 700p, ISBN: 978-981-283-649-6, 2010.

Lecture 4 (SPH):

- D. Le Touzé, 'Smoothed Particle Hydrodynamics, fact checking: from theory to applications', Keynote lecture at the 2017 SPHERIC international workshop, http://spheric-sph.org//files/SPHERIC_Beijing_Keynote_pdf.pdf
- G.R. Liu, M.B. Liu, 'Smoothed Particle Hydrodynamics, a meshfree particle method', World Scientific Pub Co Inc

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LABO	PROJECT	**EXAM**
English	**5**	**18 hrs**	**0 hrs**	**14 hrs**	**0 hrs**	**2 hrs**

Marine Renewable Energy

MARINE TECHNOLOGY - HYDRODYNAMICS FOR OCEAN ENGINEERING
YEAR 2 - AUTUMN SEMESTER

LEAD PROFESSOR: Sandrine AUBRUN

Objectives

To provide students with (i) a good understanding of the fundamentals of wind turbines, tidal turbines and wave energy converter performance and (ii) a first experience with the assessment of the performance of these technologies.

Course contents

Lesson 1 - Fundamentals of turbine performance
This course is an introduction to the "offshore wind turbines" and "current turbine" classes. The objective is to understand the fundamentals of turbine performance, with a focus on marine applications. We will focus on the main operating principle of turbines, followed by the understanding of flow physics and performance of turbine blades operating in the marine environment.

Lesson 2 - Current turbines
This part of the course will describe, the resource, market and advanced technologies of current turbines. Experimental and numerical methods for studying current turbines will be outlined. An overview of current activities in the field of current turbines will be given. Numerical exercises will aim to calculate the performance of a current turbine in different operating conditions.

Lesson 3 - Offshore wind turbines
Firstly, this part of the course will describe the wind resource at sea. Then, the components of a wind turbine will be detailed. Rotor technologies, drive-train and generators, control as well as bottom fixed and floating foundations will be addressed. Experimental methods will be outlined as well as park effects. Numerical exercises will be carried out in order to investigate the dynamic behaviour of floating offshore wind turbines.

Lesson 4 - Wave energy converters
The objective of this part of the course is (i) to give to the student a good understanding of the current status of wave energy conversion technologies in terms of potential and actual performance. Thus, it will address first the wave energy resource and market. A historical perspective of wave energy conversion will be given and an overview of the technology will be described. Fundamentals of wave energy conversion and energy performance will be highlighted. The energy performance of current technologies will be discussed as well as project development methodologies.

Course material

- J. Falnes (2002) Ocean Waves and Oscillating Systems: Linear Interactions Including Wave-Energy Extraction. Cambridge University Press.
- J. Cruz (2008) Ocean Wave Energy: Current Status and Future Perspectives. Springer.
- B. Multon (2011) Marine Renewable Energy Handbook. Wiley.
- J.J. Newman; Marine Hydrodynamics, MIT press, 1977.
- I.H. Abbott, A.E.Von Doenhoff, Theory of wing section, Courier Corporation, 1959.

- J.F. Manwell, J.G. MCGowan & A.L. Rogers (2009) Wind energy explained – Theory, Design and Application. Wiley.
- M. C. Brower (2012) Wind resource assessment – A practical guide to developing a wind project. Wiley.

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LABO	PROJECT	**EXAM**
English	**5**	**16 hrs**	**0 hrs**	**16 hrs**	**0 hrs**	**2 hrs**

CULTURAL AND COMMUNICATION ENGLISH

MARINE TECHNOLOGY - HYDRODYNAMICS FOR OCEAN ENGINEERING
YEAR 2 - AUTUMN SEMESTER

LEAD PROFESSOR: Spencer HAWKRIDGE

Objectives

Team-building and Communicational English:

- Understand the general concepts of team-building
- Build a team-building project
- Understand and nurture the creative process
- Enhance self-belief and self-empowerment

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
Field-related or inter-cultural project (for example, construct content for inter-cultural teambuilding activities; example WIOBOX website 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).

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LABO	PROJECT	**EXAM**
English	**4**	**0 hrs**	**32 hrs**	**0 hrs**	**0 hrs**	**0 hrs**

French Language

MARINE TECHNOLOGY - HYDRODYNAMICS FOR OCEAN ENGINEERING
YEAR 2 - Autumn Semester

LEAD PROFESSOR: 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. Those who already completed the first year of the French course will be prepared for working in a French business environment.

Course contents

Two different tracks are proposed: track 1 for students newly arrived at Centrale Nantes and track 2 for students who have completed the first year of the French course.

Track 1:
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. 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.)

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

Track 2:
This track follows on directly from the first-year French course, developing and completing the concepts studied thus far. The main themes are: housing, health and work. These topics will help prepare students for their future work environment. For example, housing is explored in the form of a search for accommodation upon arrival in a new city.

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).

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LABO	PROJECT	**EXAM**
French	**4**	**0 hrs**	**32 hrs**	**0 hrs**	**0 hrs**	**0 hrs**

YEAR 2 - SPRING SEMESTER

Master Thesis / Internship

MASTER THESIS / INTERNSHIP

MARINE TECHNOLOGY - HYDRODYNAMICS FOR OCEAN ENGINEERING
YEAR 2 - SPRING SEMESTER

LEAD PROFESSOR: Guillaume DUCROZET

Objectives

- Be exposed to and adapt to an industrial or research environment
- Put in practice the scientific and technical skills acquired in the previous semesters
- Strengthen interpersonal and communication skills
- Be part of or manage a project
- Organize tasks, analyze results and build deliverables

Course contents

Students should be pro-active and career-oriented in the search for their thesis/internship. The topics are validated by the program supervisor to ensure an adequate Master level. The thesis/internship is evaluated through the submission of a written report and an oral defense.

Course material

- Turabian Kate Larimore, Booth Wayne Clayton, Colomb Gregory G., Williams Joseph M., & University of Chicago press. (2013). A manual for writers of research papers, theses, and dissertations: Chicago style for students and researchers (8th edition.). Chicago (Ill.) London: University of Chicago Press.
- Bui Yvonne N. How to Write a Master's Thesis. 2nd ed. Thousand Oaks, Calif: Sage, 2014.
- Evans David G., Gruba Paul, et Zobel Justin. How to Write a Better Thesis. 3rd edition. Carlton South, Vic: Melbourne University Press, 2011.

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LABO	PROJECT	EXAM
English	30	0 hrs	0 hrs	0 hrs	0 hrs	0 hrs