CENTRALE NANTES

MASTER OF SCIENCE, TECHNOLOGY AND HEALTH

2021-2022

YEAR 1

MARINE TECHNOLOGY

ATLANTIC MASTER ON SHIP OPERATION AND NAVAL ENGINEERING (AMASONE)

PROGRAMME SUPERVISOR(S):
Antoine DUCOIN

YEAR 1 - Autumn Semester

CORE COURSES

Course code	Title	ECTS Credits
ACOUS	Acoustics	4
ALEMO	Algorithmics for Engineering Modeling	4
FLUM1	Fluid Mechanics 1	5
KNFLU	Knowledge of Maritime Environment - Acoustics	5
MAENV	Maritime Initiation and Leadership	4
NUMME	Numerical Methods	4

LANGUAGE COURSES

Course code	Title	ECTS Credits
CCE1	Cultural and Communication English	4
ESP1	Spanish Language	4
FLE1	French Language	4

YEAR 1 - Spring Semester

CORE COURSES

Course code	Title	ECTS Credits
ENERG	Energetics	5
FLUII	Fluid Mechanics 2	5
HYDRO	Hydrodynamics	5
HYDROEN	Hydrodynamics (basics)	3
PROPEL	Electric Propulsion	2
PROPUL	Propulsion	5
TROSH	Training on Ship	2

LANGUAGE COURSES

Course code	Title	ECTS Credits
CCE2	Cultural and Communication English	4
ESP2	Spanish Language	4
FLE2	French Language	4

Acoustics [ACOUS]

LEAD PROFESSOR(S): Antoine DUCOIN

Objectives

This course has two main objectives:
1) to understand the senses of a ship: how the sailors can evaluate the ship environment remotely.
It covers all the sensors (optical, radio, radar, sonar) all sensors are faced to extracting a useful information (signal) spoiled by spurious information (noise).
2) After a description of the ocean and the seafloor, a deep study of underwater acoustics and sonar systems is achieved in order to show how they can be used for evaluation the underwater environment.

Course contents

1) Senses of a ship, a unified approach: optical, electromagnetic (radar, communication) & acoustical sensing: (3 h)
2) Arrays, antenna, beamforming and Fourier transform (3 h)
3) Understanding the Ocean: overview of oceanography and marine geosciences (2 h)
4) Ocean variability and its influence on acoustical propagation (3 h)
5) Sonar Systems (4 h)
6) An example of sonar systems: sidescan sonar (3 h)
7) Sonar transducers (2 h)
8) Acoustic propagation in the Ocean (4 h)
9) Characteristic of noises at sea (2 h)
10) Active sonar equation and active systems analysis (6 h)
11) Conventional signal processing schemes (4 h)
12) Hands on: side scan sonar, training at sea (3 h)

Course material

Principles of underwater sounds by R. J. Urick, Paninsula Publishing 2013
Principles of Radar and Sonar Signal Processing, by François le Chevalier, Artech House Publishers 2002.

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	0 hrs	40 hrs	0 hrs	0 hrs	0 hrs

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 Matlab/Octave
- Use standard libraries for scientific computing in Matlab/Octave

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
- An Introduction to Programming and Numerical Methods in MATLAB

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	10 hrs	0 hrs	20 hrs	0 hrs	2 hrs

Fluid Mechanics 1 [FLUM1]

LEAD PROFESSOR(S): Guillaume DUCROZET

Objectives

At the end of the course (30 hours + personal work) the 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

This course aims to present the foundations and general principles of fluid mechanics. 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 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	5	14 hrs	12 hrs	4 hrs	0 hrs	2 hrs

Knowledge of Maritime Environment - Acoustics [KNFLU]

LEAD PROFESSOR(S): Antoine DUCOIN / Jean-Yves BILLARD

Objectives

This course has two main objectives:
1) to gain a better knowledge of the physics of the ocean, of marine geosciences, and of underwater acoustics,
2) to understand the principles of the systems that provide information on the ocean and on the seafloor

Course contents

1) Overview of oceanography and marine geosciences (2 h)
2) Overview of acoustics and underwater acoustics, sonar equation, underwater acoustics propagation (5h)
3) Tools and methodology for seafloor observation. Principles of bathymetry (3h)
4) Principles of multibeam echosounders and side scan sonar, including training at sea (3h)
5) Bathymetry with processing of real data (3h)
6) Analysis of various underwater acoustics systems (5h)
7) Evaluation, prevention and control of exposure to noise at the workplace.

Course material

X. Lurton, An introduction to underwater acoustics, 2nd edition, Springer, 2010.
F. Jensen, W. Kuperman, M. Porter, H. Schmidt, Computational Ocean Acoustics, 2nd edition, Springer, 2011
K. Pickering and R. Hiscott, Deep Marine Systems: Processes, Deposits, Environments, Tectonics and Sedimentation, Ed.: Wiley-blackwell - 2015

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	5	0 hrs	40 hrs	0 hrs	0 hrs	0 hrs

Maritime Initiation and Leadership [MAENV]

LEAD PROFESSOR(S): Antoine DUCOIN / Lionel GENTAZ

Objectives

This course is given in Ecole Navale partner of Centrale Nantes in the AMASONE programme

The aim of the practical leadership training is to introduce the students to 'leadership' from a military perspective in both the land and maritime environments. The focus is action centered putting the students in command situations requiring them to develop a plan of action and brief their intentions in a coherent and structured manner.

Course contents

The course will start with classroom theory, giving the students time to understand the foundations to leadership in a military domain; it will also include question and answer time.
The course has a secondary focus on team work and cohesion as a key to effective output; and as such the course will include various activities which will highlight their necessity and relevance. The students will take command of a team for a mission in the land and maritime environments. By the end of the course the students should be able to deliver a briefing following the basic NATO structure of orders and also take charge of a team understanding the importance of different leadership styles and techniques to get the most out of their team.
- Leadership
- Physical Training
- Ethics
- Maritime History
- Geopolitics
- Maritime English
- 1 day on a boat (Goelette)

Course material

Adair. J (2002) Inspiring Leadership. London: Thorogood
Northhouse P.G. (2009) Leadership Theory and Practice. London: Sage Publications
Yukl. G. (2002) Leadership in Organisations, 5th edn. New Jersey: Prentice Hall.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	0 hrs	60 hrs	0 hrs	0 hrs	0 hrs

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 PDEs (elliptic, parabolic, hyperbolic)
- Solve simple elliptic problems by means of finite differences or finite elements
- Assess the accuracy of the schemes they use
- Program finite differences and finite elements in both 1D and 2D

Course contents

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

- Classification of PDEs
- Classification of boundary conditions, well-posedness
- 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 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	14 hrs	6 hrs	10 hrs	0 hrs	2 hrs

Cultural and Communication English [CCE1]

LEAD PROFESSOR(S): Spencer HAWKRIDGE

Objectives

Introduction to Cultural and Communicational English:

- Understand the general concepts of communication English (different levels of language, etc.)
- Build a communicational project
- Develop strategies for enhanced interaction
- Organize, lead and participate in discussions, interviews and meetings
- Behavioral skills in an inter-cultural environment:
- Strengthen engagement and level of conviction
- Develop a capacity to explain and argue
- Acquire notions of corporate culture and values
- Enhance team work

Course contents

Cultural and Communicational English: exercises to explore in practice the areas of culture and communication
Inter-cultural project (for example, documentary project, publishing project: construct a work of fiction or of educational value and experience the complete publishing process)
VEC (Virtual Environmental Challenge) Challenge - international competition to design an Eco-campus with participants from French and foreign universities.

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).
Our own eZoomBook template for the Intercultural project.
VEC padlet and PMooc ('The stories we live by' - Professor Arran Stibbe lecturing on Ecolinguistics)

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	0 hrs	64 hrs	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
English	4	0 hrs	64 hrs	0 hrs	0 hrs	0 hrs

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 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	0 hrs	64 hrs	0 hrs	0 hrs	0 hrs

Energetics [ENERG]

LEAD PROFESSOR(S): Jean-François HETET

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 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	5	16 hrs	14 hrs	0 hrs	0 hrs	2 hrs

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 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	5	8 hrs	10 hrs	12 hrs	0 hrs	2 hrs

Hydrodynamics [HYDRO]

LEAD PROFESSOR(S): Antoine DUCOIN

Objectives

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

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

Wave theory:
- Explain hypotheses leading to the derivation of the Airy wave model
- Use this model to estimate wave characteristics
- Understand the limits of the model and have a qualitative knowledge of the influence of higher order effects

Course contents

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 the blades occurring in the marine environment and of the resulting performance. The methods will focus on potential flow theory to calculate the flow around a lifting profile, and to calculate the performance.
- Basics and applications
- Flow physics – hydrodynamics: characterization of flow regimes, performance analysis, flow control
- Methods and theory: Conformal mapping, thin profiles theory, lifting line theory
- Tutorial: calculate the performance of a NACA section using the thin profile theory
- Lab sessions: code the lifting line theory using Matlab to analyze the effect of various blade geometries and of the aspect ratio on hydrodynamic performance

Wave theory:
The main objective of the course is to give students access to basic knowledge on the main characteristics of water waves. The derivation of the classical linearized Airy wave model through the method of separation of variables is detailed. The related important physical properties of water waves are then examined:
- Dispersion effects
- Phase velocity, group velocity
- Energy density
- Energy flux
- Asymptotic limits in shallow and deep water
- Notion of wave power spectrum
- Qualitative influence of higher order effects

In addition, a review of ongoing research related to ocean waves and their interaction with structures is given, addressing both numerical and experimental approaches.

As an applicative exercise, students are asked to build Matlab programmes based on Airy theory with targets such as particle trajectories, drift motion in waves, estimation of hydrodynamic loads based on simplified load models, etc. These exercises

are prepared in groups of 2 students, who are asked to prepare a short report on which the evaluation is based.

Course material

- Abott, Theory of wing section, Dover publication, 1947
- Newman, Marine Hydrodynamics, The MIT Press, 1977
- Glauert H. Airplane propellers. In: Durand WF, editor. Aerodynamic theory. New York: Dover Publications; 1963
- Campbell Flake C. Manufacturing Processes for Advanced Composites. New York: Elsevier, 2004
- R.G. Dean, R.A. Dalrymple, Water Wave Mechanics for Engineers and Scientists: World Scientific, 1984

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	5	16 hrs	14 hrs	0 hrs	0 hrs	2 hrs

Hydrodynamics (basics) [HYDROEN]

LEAD PROFESSOR(S): Antoine DUCOIN / Jean-Yves BILLARD

Objectives

The purpose of this course is to provide clear connections between modern naval engineering and classic hydrodynamics by developing theoretical and practical skills.

Course contents

Organized into four sections, the course insist on exercising a specific skill-set related to each section as described next.
Section 1: A practical exercise based on DelftShip [A] animates the discussion to understand hull geometry : ship dimensions, form coefficients, ship lines [1] and its uses from an engineering point of view by simultaneously describing empirical procedures for preliminary estimations of the powering requirements of a vessel [2]. The section concludes with a seminar during which students present their work on using Delftship and their bibliographical research (orchestrated by specific reading material) to demonstrate design particularities related to hull geometry of certain vessel categories: tankers-containers, service vessels, high-speed vessels and special categories and conclude with powering estimations of a vessel of their category.
Section 2: Having related hull's geometry and resistance from a global point of view the need of calculating fluid stress on the hull's surface to evaluate resistance is our principal motivation for introducing the incompressible Navier-Stokes equations in a modern tensorial formulation [3]. The section concludes with a seminar during which students present their work (orchestrated by specific reading material) on using the tensorial framework to formulate classic solutions of the Navier-Stokes [4]: Hagen-Poiseuille flow, Couette flow, 1st and 2nd Stokes problem, 1D linear wave theory and Blasius solution for boundary layers, and use them as a motivating mean to describe hydrodynamics concepts [5]: vortical patterns for different Reynolds numbers, transition concepts, ship-generated waves, viscous components of resistance.
Section 3: The need for numerical estimations for engineering problems is naturally introduced by understanding the underlying difficulties of solving the Navier-Stokes even for problems of simple geometries. Classic numerical approximation methods are introduced for lift-generating flows: D'Alambert paradox, Magnus effect, relating vorticity/lift, to eventually generalize these concepts to simple panel methods for 2D hydrofoils and Prandtl's lifting line [6]. Using the developed concepts the students use OpenProp [B] to understand propeller geometry and performance coefficients.
Section 4: Bibliographical research is conducted by the students to collect material related to naval hydrodynamics so that they can assess the modern world of naval engineering and research related to industrial needs. The students present their work during the course's last seminar. The students begin by revisiting the research work of LHEEA and IRENAV (experimental and numerical) to clarify the connections between the participating institutions of AMASONE and modern developments in naval engineering.

Course material

[1] Letcher (2009), The Principles of Naval Architecture Series: The Geometry of Ships, SNAME.
[2] Larsson & Raven (2010), The Principles of Naval Architecture Series: Ship Resistance and Flow (ch.10), SNAME.
[3] Hjelmstad (2005), Fundamentals of Structural Mechanics, Springer.
[4] Panton (2005), Incompressible Flow (3rd ed.), Wiley.
[5] Newman (1999), Marine Hydrodynamics (9th ed.), MIT Press.
[6] Katz, J., & Plotkin, A. (2010). Low-Speed Aerodynamics (2nd ed.). Cambridge University Press.
Online resources
[A] https://www.delftship.net/DELFTwp/
[B] https://engineering.dartmouth.edu/openprop/

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	3	0 hrs	40 hrs	0 hrs	0 hrs	0 hrs

Electric Propulsion [PROPEL]

LEAD PROFESSOR(S): Antoine DUCOIN

Objectives

To give a knowledge of the possible architectures of all electric ship or hybrid electric ship
To give a knowledge of the pros and cons of electrical propulsions
To give a knowledge of the architecture and the behavior of the most common systems used in electrical and hybrid-electric propulsion systems for ships.
To give some elements on electrical embedded networks for ships.
To give an overview of the future solutions

Course contents

1) Interest of Electric or Hybrid Systems for Ship Propulsion Application
2) Variable speed propulsion systems
    2-1) Systems based on Rectifiers with DC motors (old historical solution)
    2-2) Systems based on CSI and synchronous AC motors
    2-3) Systems based on VSI and AC Motors
    2-4) Evolution of variable speed propulsion systems
3) Power electronics and networks
    3-1) Harmonics in AC Grid
    3-2) DC Networks
4) Future solutions

Course material

- Damir Radan : Power Electronic Converters For Ship Propulsion Electric Motors, Tech. Report, Department of Marine Technology, project: Energy-Efficient All Electric Ship, NTNU, Trondheim, Norway, 2004
- IEEE Guide for the Design and Application of Power Electronics in Electrical Power Systems on Ships, IEEE-2008
- Alf Kåre Ådnanes : Maritime Electrical Installations And Diesel Electric Propulsion –Report ABB 2003

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	2	0 hrs	20 hrs	0 hrs	0 hrs	0 hrs

Propulsion [PROPUL]

LEAD PROFESSOR(S): Xavier TAUZIA

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 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	5	16 hrs	14 hrs	0 hrs	0 hrs	2 hrs

Training on Ship [TROSH]

LEAD PROFESSOR(S): Antoine DUCOIN / Lionel GENTAZ

Objectives

This course is given in Ecole Navale partner of Centrale Nantes in the AMASONE programme.

The purpose is to discover navigation, maneuver life onboard, its constraints and characteristics and then to develop its seamanship through sailing.

Course contents

Prerequisite for sailing (maritime vocabulary, seamanship, safety)
Basic maritime knowledge (maritime environment, meteorology)
Navigation fundamentals (maritime chart, buoyage)
Introduction to sailing (sailboat dynamics, sailboat control)
Navigation aboard sailing ships (embarkation on board of a sailboat 2,5 days)

Course material

Code Vagnon permis de plaisance par A. Nemeta (Ed. Vagnon)
Traité Vagnon de navigation par C. Lorieux (Ed. Vagnon)
Rade de Brest Baie de Crozon Morgat par A. Daoulas (Ed. Le Piment Graphique)
Guide de manœuvre de l'Ecole navale (impr. Ecole navale)
Traité de manœuvre par H. Baudu (Ed. InfoMer)
Le dictionnaire de la plaisance (bilingue) par Centre nautique des Glénans (Ed. Seuil)

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	2	0 hrs	40 hrs	0 hrs	0 hrs	0 hrs

Cultural and Communication English [CCE2]

LEAD PROFESSOR(S): Spencer HAWKRIDGE

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).
Our own eZoomBook template for the Intercultural project.

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

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

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
English	4	0 hrs	32 hrs	0 hrs	0 hrs	0 hrs

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:

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

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 1.0)

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