SHAKE THE FUTURE.

CENTRALE NANTES

ENGINEERING PROGRAMME

SPECIALISATION

OCEAN: HYDRODYNAMICS AND MARINE ENGINEERING

SPRING SEMESTER

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

GROUPE **CENTRALE**

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Marine Renewable Energies

Ocean: Hydrodynamics and Marine Engineering, Engineering programme specialisation

Spring Semester

Professor: Guillaume DUCROZET

Objectives

This course presents different aspects relative to marine renewable energies (MRE: tidal, offshore wind, wave etc). Physical and technical issues specific to this field will be presented through several conferences with industry specialists. Particular attention will be paid to the modelling of physical phenomena which are specific to MREs (energy conversion, farm effects etc).

Course contents

- Modelling of wave energy devices
- Tidal wave energy and technologies
- Offshore windmills
- Ocean Thermal Energy Conversion
- Farm effects
- Project methodology

Course material

Keywords

Wave energy, Tidal energy, Ocean Thermal Energy conversion, Offshore windmills, Farm effects

Links with other programmes

Marine environment and hydrodynamic loads
Seakeeping and moorings of marine structures
Numerical hydrodynamics part 1
Lifting bodies and propulsion
Marine fluid-structure interactions

LANGUAGE	ECTS CREDITS	LECTURES	TUTORIALS	LABO	PROJECT
French	3	18 hrs	0 hrs	14 hrs	0 hrs

OFFSHORE OIL AND GAS

OCEAN: HYDRODYNAMICS AND MARINE ENGINEERING, ENGINEERING PROGRAMME SPECIALISATION

SPRING SEMESTER

Professor: Pierre FERRANT

Objectives

The purpose of this course is to examine in detail the oil and gas offshore industry.

Course contents

- introduction
- hydrodynamics for offshore
- drilling, risers and flowlines
- production supports
- (platform, FPSO unit: Floating Production Storage and Offloading unit etc)
- offshore operations (installation, offloading)
- design and standards

Course material

Keywords

Links with other programmes

Marine environment and hydrodynamic loads
Seakeeping and moorings of marine structures
Numerical hydrodynamics part 1
Marine fluid-structure interactions

LANGUAGE	ECTS CREDITS	LECTURES	TUTORIALS	LABO	PROJECT
French	3	24 hrs	0 hrs	8 hrs	0 hrs

SHIPBUILDING AND MARITIME ECONOMY

OCEAN: HYDRODYNAMICS AND MARINE ENGINEERING, ENGINEERING PROGRAMME SPECIALISATION

SPRING SEMESTER

Professor: Félicien BONNEFOY

Objectives

The fundamentals on managing ship projects, ship propulsion (definitions, main categories of propulsors) and ship structures are presented. In lab work students have to complete a short design loop.
A conference on world maritime economy as well as shipyards visits are also proposed in this course.

Course contents

Part 1 - Shipbuilding:

- management of ship projects
  - categories of ships
  - ship design loop
  - elements of building of ships

- energy on board
  - production of energy and examples

- ship propulsion
  - decomposition of ship resistance
  - usual propulsion by propeller
  - other propulsors used in shipbuilding

- ship structure
  - definitions
  - resistance of materials
  - calculation of needed structures based on local and global stresses

Part 2 - Maritime transportation

- maritime transport's role in the world economy
- organisation of maritime transportation
- present and future issues

Course material

Keywords

ship project, ship design loop, ship structures, ship propulsion, maritime transportation in the economy

Links with other programmes

Ship stability and manoeuvrability
Experimental hydrodynamics
Lifting bodies and propulsion

LANGUAGE	ECTS CREDITS	LECTURES	TUTORIALS	LABO	PROJECT
French	3	16 hrs	0 hrs	6 hrs	8 hrs

PROJECT: PART 2

OCEAN: HYDRODYNAMICS AND MARINE ENGINEERING, ENGINEERING PROGRAMME SPECIALISATION

SPRING SEMESTER

Professor: Lionel GENTAZ

Objectives

The purpose of this course is to use the skills acquired during the Ocean specialisation for practical projects proposed and supervised by Centrale Nantes professors and researchers or engineers from companies.

During the project, students work in teams of 2 or 3 people.

Course contents

Teams of students can work on their project and interact with their supervisors during sessions which are planned in the timetable.

A final project presentation is organized at the end of March.

Course material

All documents and books proposed by the lecturers in the different courses of the Ocean specialisation.

Keywords

project; team work; hydrodynamics

Links with other programmes

All courses of the specialisation.

LANGUAGE	ECTS CREDITS	LECTURES	TUTORIALS	LABO	PROJECT
French	2	0 hrs	0 hrs	0 hrs	48 hrs

FLUID-STRUCTURE INTERACTION

OCEAN: HYDRODYNAMICS AND MARINE ENGINEERING, ENGINEERING PROGRAMME SPECIALISATION

SPRING SEMESTER

Professor: Antoine DUCOIN

Objectives

Part 1- Fundamentals of fluid structure interaction.

The purpose is to present fundamental aspects for modelling and solving problems of fluid-structure interactions in marine engineering. The different parts cover:

a) Outline of the different types of fluid structure interaction phenomena:

- Theory: equilibrium at the fluid structure interface, effect of added mass and stiffness and damping, scaling of a fluid structure interaction problem
- Study of flow induced vibration problems through simple models:
  - flow around a flexible cylinder (forced and free motions), resonance phenomenon
  - flexible lifting profile: study of static divergence and flutter with potential flow theory
  - numerical methods in fluid structure interaction: coupling algorithm (space/time, staggered/monolithic etc), algoritms used to deform the mesh, ALE formulation.

b) Lab work: simulation of a blade deformation using STARCCM+, structural instability analysis

Part 2 - Ship vibrations

The objective of these lectures is to provide the fundamentals for an engineer to calculate the vibratory response of a ship.

Course contents

Part I.
Lecture 1: Introduction and non dimensional analysis
Lecture 2: Flow induced vibration
Lecture 3: Numerical methods

Part 2:
Lecture 1: Ship vibration

Course material

Keywords

Fluid structure coupling, ship vibration, hydroelasticity, structural instability

Links with other programmes

Lifting bodies and propulsion
Numerical hydrodynamics part 1
Numerical hydrodynamics part 2

LANGUAGE	ECTS CREDITS	LECTURES	TUTORIALS	LABO	PROJECT
French	**3**	**18 hrs**	**4 hrs**	**4 hrs**	**4 hrs**

ADVANCED HYDRODYNAMICS

OCEAN: HYDRODYNAMICS AND MARINE ENGINEERING, ENGINEERING PROGRAMME SPECIALISATION

SPRING SEMESTER

Professor: Lionel GENTAZ

Objectives

This course is delivered in three parts:

Part 1 - Multi-objective optimization with a lab work dedicated to a ship optimization

Part 2 - Introduction to innovative numerical methods in hydrodynamics (among others: meshless methods like Smooth Particles in Hydrodynamics)

Part 3 - Introduction to naval architecture

Course contents

Part 1 Optimization:

- presentation of different algorithms for optimization (gradient, genetic etc)
- Lab work with use of optimization software: tests of efficiency of the optimization algorithms for a known function. Practical case consisting in the optimization of a ship bulbous bow in order to reduce ship resistance.

Part 2 - Introduction to innovative numerical methods:

- Smooth Particles in Hydrodynamics (SPH) Lagrangian method
- High order methods
- Cartesian finite volumes
- Finite elements
- Lattice-Boltzmann methods (LBM)
- During lab work use of SPH software for a case of violent free surface flow (with high flow dynamics)

Part 3 - Introduction to naval architecture:

- review of loads acting on a sailing boat and study of its equilibrium
- basics of naval architecture
- specificities of the ship project for sailing boats
- visit of a repair shipyard

Course material

Keywords

multi-objective optimization, introduction to naval architecture, meshless numerical methods for hydrodynamics, Smooth Particles in Hydrodynamics

Links with other programmes

Ship stability and manoeuvrability
Numerical methods for hydrodynamics part 1
Numerical methods for hydrodynamics part 2

LANGUAGE	ECTS CREDITS	LECTURES	TUTORIALS	LABO	PROJECT
French	3	16 hrs	0 hrs	11 hrs	5 hrs