Fluides et Energie
FLUIDS AND ENERGY

Introduction

This course unit reviews the key concepts and the modeling tools required to study flow problems and heat transfer applications. The conservation laws associated with various levels of approximation are described. The theoretical lectures are complemented with numerous hands-on activities : introductory experiment, physical and numerical experiments, thematic project performed as a group on a panel of 31 test-rigs. The concepts and tools presented in the course are of use in most of the industrial domains hiring engineers : environment, energy, car industry, aerospace, health and biology

Semester

S05

S06

Programme

FLE tc1 : Introduction and theoretical bases
FLE tc2 : Experimental and numerical techniques
FLE tc3 : Thematic project

Learning Outcomes

- Be able to describe the fundamental laws of fluid flows and heat transfers and their various levels of approximation
- Be able to identify the main flow features and flow regimes
- Be able to perform a dimensional analysis and an order of magnitude analysis for a boundary problem
- Know the basics of continuous flux systems and head balances

Employment Sectors

Environment, energy, car industry, aerospace, health and biology

Requirements

Concept of velocity, temperature, pressure, density, viscosity, stress.
Partial differential equations

Assesment

Weighted average : 60% tc1 + 15% tc2 + 25% tc3

Option Website

Additional Information

FLUIDES ET ENERGIE - CONCEPTS ET APPLICATIONS

FLUIDS AND ENERGY - CONCEPTS AND APPLICATIONS

Lecturers: Pierre DUQUESNE

| Lecturers : 22.0 | TC : 16.0 | PW : 4.0 | Autonomy : 8.0 | Study : 0.0 | Project : 0.0 | Language : MI

Objectives

This teaching component (AF) introduces the whole FLE (Fluids & Energy) teaching unit (UE) through a hands-on exploration of flow physics and presents next the key concepts of fluid mechanics and heat transfers

Keywords : Discovery of fluid mechanics, fundamental governing equations, simplifying frameworks

Programme

- Kinematics and fundamental laws
- Newtonian viscous fluid
- Reynolds number
- Flow regimes and flow features as a function of the Reynolds number
- Turbulent flows
- Energy, thermodynamics and compressible flows
- Vorticity and introduction to aerodynamics
- Heat transfer Mixtures

Learning outcomes

- Be able to describe the fundamental laws of fluid flows and heat transfers and their various levels of approximation.
- Be able to identify the main flow features and flow regimes.
- Be able to perform a dimensional analysis and an order of magnitude analysis for a boundary problem.
- Know the basics of continuous flux systems and head balances.

Independent study

Objectifs :

Méhodes :

Core texts

E. Guyon, J.-P. Hulin, L. Petit., *HYDRODYNAMIQUE PHYSIQUE.* , CNRS Editions, EDP Sciences., 2012
G. K. Batchelor *AN INTRODUCTION TO FLUID DYNAMICS.* , Cambridge University Press, 1967
C. Bailly & G. Comte-Bellot*TURBULENCE.*, Springer, 2015

Assessment

Final mark = 60% Knowledge + 40% Know-how (Knowledge = 100% final exam / Know-how = 100% continuous assessment).

FLUIDES ET ENERGIE - MÉTHODES EXPÉRIMENTALES ET NUMÉRIQUES

FLUIDS AND ENERGY - EXPERIMENTAL AND NUMERICAL METHODS

Lecturers: Andrea MAFFIOLI, Didier DRAGNA

| Lecturers : 0.0 | TC : 0.0 | PW : 8.0 | Autonomy : 4.0 | Study : 6.0 | Project : 0.0 | Language : FR

Objectives

This teaching activity presents experimental and numerical methods in fluid mechanics, and the approach to be adopted for their practical implementation.

Keywords : Experimental protocal, Measurement techniques, Numerical simulation, Comparison model/experiment, Uncertainties

Programme

- Practical work on flow speed measurement in a jet
- Practical work on Bernoulli or Air treatment
- 4 BE sessions on a practical introduction to numerical simulation in fluid mechanics

Learning outcomes

- Know how to make use of experimental and numerical methods in fluid mechanics and energetics.
- Know how to design an experimental protocol to characterize a phenomenon.
- Know how to present the results of simulations or experiments.
- Know how to compare a model and measurements.

Independent study

Objectifs : Getting started with a numerical simulation software in fluid mechanics.
Exploitation of results from numerical simulation.

Méhodes : Use of the commercial software FLUENT.
Simulations performed under supervision during the three first BE and autonomously in the last BE.

Core texts

Assessment

Know-how mark based on two reports and on participation during the activities: Note = 33% Expérience + 67% Synthèse + Présence

FLUIDES ET ENERGIE - ETUDES THÉMATIQUES

FLUIDS AND ENERGY - PROJECT LABS

Lecturers: Alexis GIAUQUE, Michel GERON

| Lecturers : 0.0 | TC : 0.0 | PW : 9.0 | Autonomy : 7.0 | Study : 6.0 | Project : 0.0 | Language : FR

Objectives

This module aims at applying all the knowledge and know-how acquired throughout the whole "Fluid Mechanics and Energy" course. From the choice of a topic and the set-up of the relevant practical work sessions, to the presentation of the results, going through performing and interpreting the experiments, the students will have to illustrate a scientific theme (head losses, similarity, heat transfer, hydraulic networks, ...) in order to deliver both an oral presentation to fellow students and a written report.

Keywords : Experiments and numerical simulations. Team work and project mode

Programme

- Defining the project and setting-up of the practical work sessions
- Performing the experiments
- Post-processing and analysing the results
- Oral and written reporting

Learning outcomes

- Be able to identify key flow features and flow regimes
- Be able to perform a dimensional and an order of magnitude analysis
- Be able to apply fundamental tools on flow analysis : flux balance, head loss analysis
- Be able to apply experimental and numerical techniques

Independent study

Objectifs : Performing the measurements, post-processing and analysing the results

Méhodes : 1h during each practical work session.
2h devoted to post-processing and analysis.

Core texts

Assessment

N1 = individual involvement in practical works / N2 = deliverables grade (1/3 oral, 2/3 written report) / Module (know-how) grade = 0,3 x N1 + 0,7 x N2