CETS8AF COMPUTATIONAL FLUID DYNAMICS

CETS8AF Computational fluid mechanics	ECTS Credits : 2 Duration : 21 hours	Semester : S8

Person in charge :

Jean-Pierre BELLOT, Professor, jean-pierre.bellot@mines.nancy.univ-lorraine.fr

Keywords : Fluid mechanics, numerical simulation, coupled transfers

Prerequisites :

Goal : Concepts for the development and the practice of Computational Fluid Dynamics commercial codes.

Program and contents :

Teaching goal :

This elective course gives the necessary basics for developing and using codes for computational fluid dynamics (CFD). Today, this tool is indispensable for an engineer to understand and optimize industrial installations, where turbulent flows coupled with heat and mass transfer play an important role. CFD cover a vast sector of activities, including most particularly Energy, Aeronautics, Process Engineering, Materials Processing, the Environment Engineering, etc. The program is designed so that students can understand the main features of numerical methods, use a commercial code, analyze and make the most of the numerical results. There is an emphasis on modeling turbulence and combustion. FLUENT, which has been chosen for all the coursework, is the most commercially widespread code throughout the world today.

Practical work is carried out through a simulation project that will be developed step by step during class sessions.

Contents- Program

1. CFD codes, architectures, state of the market… In-class presentation in of the Fluent code – usual controls

Class work: Flow around an airplane wing – hands-on use of software

2. Review of transonic flows, and the resulting pressure and friction forces

Class work: Flow around an airplane wing – Calculation of a characteristic curve of an airplane wing Cz=f(Cx))

3. Structured and unstructured meshes – Basics of the finite volume method

Class work: 2D Mesh of an injector

4. Solving Navier-Stokes equations – SIMPLE algorithms – Coupled convectodiffusive transfers

Class work: Flow in an injector in laminar regime – Mixture of two chemical species in laminar regime

5. Representation of turbulent flows – From a mixing length model to Direct Numerical Simulation. Closure –Reynolds stresses – Simulation of turbulence - RANS Models (k/epsilon)

Class work: Flow in an injector – Mixture of two chemical species in turbulent regime.

6. Simulation of turbulence – Wall functions and advanced treatments. Modelling of combustion.

Class work: Adaptation of a mesh. Turbulent mixing and combustion.

7. Modelling of combustion (following). Caracteristics of a flame.

Class work: Flows in an injector - Turbulent mixing and combustion.

Abilities :

Levels	Description and operational vocabulary
Know	
Understand	
Apply	
Analyse	
Summarise	

Assess				
Evaluation :				
☑ Written test	☑ Continuous Control	☐ Oral report	☑ Project	☑ Written report