MECA2195 Reactional flows.

[30h+15h exercises] 4 credits

This course is taught in the 1st semester

Teacher(s): Miltiadis Papalexandris
Language: French
Level: Second cycle

Aims

Advanced study of the thermodynamical aspects and the numerical simulation of reacting flows with emphasis on combustion processes.

Main themes

Fundamentals of chemical reactions, thermodynamics of combustion.
Theoretical study of laminar flames and deflagrations.
Introduction to turbulent flames.
Introduction to detonations.
Numerical methods for the simulation of turbulent flames.
Numerical methods for the simulation of detonations and explosions.

Content and teaching methods

- The fundamentals: Thermodynamics of combustion. Chemical kinetics of combustion, velocity of an elementary reaction, chain reactions. Conservation equations for mass, momentum, and energy. Species diffusion and heat conduction.
- Basics of flame modeling: diffusion flames, premixed flames. Turbulent flames and flame-turbulence interaction. The concept of flamelettes. The pdf approach for turbulent flame analysis. Analysis of detonations and explosions. Two-phase reacting flows.
- Numerical methods: Direct Numerical Simulations (DNS) and its requirements. The approach of Reynolds-Averaged Navier-Stokes equations (RANS). Introduction to Large Eddy Simulation methods (LES). Analysis of the capabilities and limitations of each method via the study of specific cases selected from the literature.
- Other types of flows: Examples of extending the various numerical methods to other types of reacting flows (without combustion)
- Practical studies: Exercises related to Part 2, employment of a numerical method covered in Part 3 for a simple problem of a turbulent flame and/or discussion on recently published papers.
A significant part of this course is based on the research activities of the holder of the course. The detailed contents of this course may vary according to these activities.

Other information (prerequisite, evaluation (assessment methods), course materials recommended readings, ...)

-Prerequisites: Fluid Mechanics I (MECA2321). Additionally, the students must have taken or take at the same time Fluid Mechanics II (MECA2322).
- Exam : Written, with open books and notes. The practical studies count for the 30% of the total grade, if the results of the written exam is 20/40 or higher.

Other credits in programs

ELME23/E	Troisième année du programme conduisant au grade d'ingénieur civil électro-mécanicien (énergie)	(4 credits)