EFS9AB COMBUSTION APPLIED TO TURBOJET ENGINES

EFS9AB **Combustion applied to turbojet engines**	**ECTS Credits : 4** **Duration : 42 hours**	**Semester : S9**

Person(s) in charge :

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Keywords : Combustion, flames, turbojet engines, internal combustion engines, pollutant

Prerequisites : Fluid mechanics, thermal sciences, thermodynamics

Objective:

Acquire knowledge on combustion and its industrial applications

This course gives an overview on combustion. It also aims at acquiring knowledge on certain aspects of specific industrial interest and practices that come with turbojet engines. It also includes an introduction to compressible highly energetic flows.

The program of the module is as follows :
1. C1 - GC. Combustion thermodynamics : reminder on mixtures of chemical species and chemical balance ; composition at chemical balance ; rich/poor combustion ; composition of combustion gas ; adiabatic flame temperature ; Lower and Upper Heating Values
2. C1 - GC. Chemical kinetics of combustion reactions : reaction's degree of advancement ; stakes of reducing combustion kinetics sketches
3. C2,3,4 - GC. Laminar combustion :

- Laminar pre mixing flames : examples, one dimension equations, propagation speed ; flame stabilising
- Laminar diffusion flames : examples, elements on passive scalar mixing, structure of a diffusion flame

4. Practical works - GC. Measure of the speed of propagation of a propane/air mixture ; stability of laminar flames partially pre-mixed ; case study : Bensen burner ; limits of use

5. C5 - GC. Combustion in two phase flow : modelling the combustion of an isolated drop ; different types of combustion in smog.

6. C6 - GC. Initial concepts of compressible flows : one dimension equations, example of flows : isentropic, Rayleigh and straight shock waves.

7. C7 - GC. Combustion waves : explosions, structure of an explosion, speed of a Chapman-Jouguet explosion

8. C8 - OP. Turbulent flow : Phenomenological approach and conservation equations Reynolds-Average Navier-Stokes. Closed-form expression for the average advancement rate. Solving chemical kinetics by table reading or reduced schematics.

9. C9,10 - OP. Turbulent diffusion pre-mixing flames : most common models, including those based on Probability Density Functions ; overview on RANS numeric methods, Large Eddy Simulation, Direct Numerical Simulations ; case study - turbojet engines

10. C11 - OP. Pollutant effluents from turbojet engines chambers :modelling the formation of NOX, CO, UHC and particles pollutants ; impact of the fuel's finer composition ; Low NOX chambers future technology

11. C12 - OP. Environmental aspects on air quality and glass effect, Well to Wing CO2 balance ; stakes of "drop in" alternative fuels : impact on ultra-small particles ; measure of pollutants.

The evaluation of the module is essentially done through a test at towards mid-course and a final test. Practical works, that lead to a report, also come into account.

Abilities :

Levels	Description and operational verbs
Know	
Understand	
Apply	
Analyse	
Summarise	
Asses	

Evaluation :

☑ Written test	☐ Continuous Control	☐ Oral report	☐ Project	☐ Written report