AAE690 Computational Combustion

(Tentative)

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Course Information

Spring, 2013, 3 credits
Lectures: days and time (tbd)
Computer Lab: days and time (tbd)
Class location (tbd)
Course webpage: tbd

Course Description:

Fundamentals of thermochemistry. Chemical equilibrium and its calculation. Chemical kinetics and auto-ignition. Laminar non-premixed flames and the computation of an opposed jet flame. Laminar premixed flames and the calculation of the laminar flame speed. Models for turbulent combustion (the flamelet model and the transported probability density function model). Turbulent non-premixed combustion and the modeling and simulation of a turbulent free jet flame. Turbulent partial premixed combustion and the modeling and simulation of a turbulent lifted jet flame.

The course consists of lectures and computer labs.

Prerequisites:

Sufficient knowledge on fundamentals of combustion theory (ME525 or equivalent), turbulence (ME611, AAE626, or equivalent), computational fluid dynamics (AAE412, AAE512, or equivalent), and at least one modern programming language (MATLAB, FORTRAN, C/C++ etc.). Students who do not meet the prerequisites should get the instructor's permission to be enrolled.

Course Goals:

Students are expected to learn the fundamentals and skills for performing combustion modeling and simulations, as well as the status of the frontier turbulent combustion research.

Learning Objectives:

- Calculate chemical equilibrium;
- Calculate rate of chemical reaction and compute auto-ignition process;
- Compute opposed jet flames and understand characteristics of non-premixed combustion;

- Compute laminar flame speed and understand characteristics of premixed combustion;
- Understand turbulent combustion problems and the advanced modeling approaches;
- Choose appropriate models for turbulent combustion problems and perform turbulent combustion simulations.

Course Requirements:

Students are required to attend all the lectures and computer labs. There are six computer projects in this course. Students are required to do these project assignments and submit written reports. The final grade is based on the submitted project report (80%) and attendance and class engagement (20%).