



Cornell University

MAE 5430 – Combustion Processes
Syllabus – Fall 2021

MAE 5430 – Combustion Processes

Instruction Mode: On campus

Credits: 3 credits, Letter grade

Class Meeting Time: Tues/Thurs 1:00-2:15pm (see page 5 for detailed schedule)

Location: Upton 202

Expected Supplemental Hours: 90 hours

Instructor: Sadaf Sobhani

Office location: Upton 371

E-mail: sobhani@cornell.edu

Phone: (607) 255-7450

Office hours: Thurs 2:15-3:15 pm

Teaching Assistant: N/A

COURSE DESCRIPTION

Combustion is an interdisciplinary field that combines chemistry, fluid mechanics, thermodynamics and heat transfer. This course is an introduction to combustion science, beginning with a review of thermodynamics, its application to combustion system analysis, and concepts of chemical kinetics. We will then discuss the nonequilibrium diffusive transport of heat, mass and momentum and introduce the general conservation equations for chemically reacting flows. The transport laws and governing equations are then applied to several flame configurations. Finally, the basic structure of premixed and non-premixed flames is analyzed, and practical applications of these principles in transportation, propulsion, power generation, and industrial processes are discussed.

Prerequisites: Graduate standing or instructor approval.

COURSE OBJECTIVES

At the end of the course, students will be able to identify flame regimes of practical combustion systems as well as compute the corresponding reaction rates and thermodynamic state of combustion products corresponding to various fuels.

CLASS FORMAT

Instruction of this class will be via lectures, including PowerPoint slides, in-class derivations and problem solving.

TEXT AND MATERIALS/COURSE READING

Class notes can be downloaded from Canvas.

Optional supplementary texts: [Combustion](#) I. Glassman, [Combustion Physics](#) C.K. Law

ASSIGNMENTS, QUIZZES, EXAMS, AND PROJECTS (LEARNING ACTIVITIES)

Problem sets: There are 4 problem sets for the semester. These should be submitted on Gradescope by **5pm** on the due date indicated in the course schedule. One late extension in the semester, without penalty, of up to 3 days will be granted if you inform the instructors one day before the due date.

Quiz: 7-10 mins oral quiz (date indicated on course schedule and times will be scheduled individually).

Prelim: Oral exam ~15-20 mins (date indicated on course schedule and times will be scheduled individually).

Final project: You will be asked to apply your combustion knowledge and Cantera skills to analyze a combustion system not yet explored in the class. The final project will include an in-class presentation and final report.

LEARNING OUTCOMES

The student learning outcomes for this class are:

- identify basic flame structure in existing practical combustion systems (gas turbine engine, internal combustion engines, etc.)
- identify regimes of subsonic and supersonic flame propagation in premixtures
- compare and apply different models for predicting thermochemical data
- distinguish reaction mechanisms corresponding to different fuels
- calculate reaction rates
- calculate analytically and numerically (using open-source software Cantera) the energy released during combustion and the thermodynamic state of the combustion products

GRADING POLICIES/RUBRIC

In case of a legitimate situation or emergency that arises during the semester that is going to hinder your ability to complete work on time, consult with me as soon as possible and we will work out a solution.

Problem Sets: 30%

Quiz: 5%

Prelim exam: 25%

Final project: 35%

In class participation/polls: 5%

Letter grades will be based on the weighted average specified above and assigned as follows:

A+ = 97-100%

A = 94-96%

A- = 90-93%

B+ = 87-89%

B = 84-86%

B- = 80-83%

C+ = 76-79%

C = 74-76%

C- = 70-73%

D+ = 67-69%

D = 64-66%

D- = 61-63%

F < 61%

COURSE EXPECTATIONS

PERSONAL CONDUCT

Cornell MAE expects students to be respectful and professional in all participation and communication. You are expected to maintain professional conduct and speech in all aspects of this course. Professional behavior demands you have a responsible and mature attitude in person and online. Disrespectful, unethical, and/or unprofessional behaviors will not be tolerated and can result in course failure and/or dismissal from the program.

CLASS PARTICIPATION

Students are expected to actively participate in class, including answering poll questions to gauge learning during lecture. Participation accounts for 5% of the grade.

ATTENDANCE POLICY

Active in-class participation necessitates attendance.

ACADEMIC STANDARDS

Each student is expected to abide by the Cornell University Code of Academic Integrity (<https://theuniversityfaculty.cornell.edu/dean/academic-integrity/code-of-academic-integrity/>).

Work submitted by students for academic credit must be a student's own.

Exclusively for the problem sets, discussion of the concepts related to the problems with your classmates is encouraged but submitted solutions should represent your own individual efforts. No collaboration is permitted for quizzes and exams.

Violations of the Code of Academic Integrity, especially plagiarism, may result in a failing grade in the course.

Students are urged to read and complete the exercises on “Recognizing and Avoiding Plagiarism” at: <https://plagiarism.arts.cornell.edu/tutorial/index.cfm>

INCLUSIVE LEARNING ENVIRONMENT

Cornell supports an inclusive learning environment where diversity and individual differences are understood, respected, appreciated, and recognized as a source of strength. It is expected that students in this class will respect differences and demonstrate diligence in understanding how other peoples' perspectives, behaviors, and worldviews may be different from their own.

ACCOMODATIONS FOR STUDENTS WITH DISABILITIES

Your access in this course is important to me. Services and reasonable accommodations are available to persons with temporary and permanent disabilities when conditions cause barriers to equal educational opportunity. Student Disability Services (SDS) determines the eligibility of students to receive accommodations and works collaboratively with the student and university faculty and staff to recommend appropriate accommodations. Please request your accommodation letter early in the semester, or as soon as you become registered with SDS. If you are approved for exam accommodations, please consult with me at least two weeks before the scheduled exam date to confirm the testing arrangements. If you experience any access barriers in this course or any communication barriers; reach out to me and your SDS counselor right away. sds_cu@cornell.edu, 607-254-4545, sds.cornell.edu.

ATTESTATION

By registering for this class and accessing course materials through Canvas, students agree to abide by University, College, Department, and Course policies.