

School of Environmental, Civil, Agricultural, and Mechanical Engineering
College of Engineering

MCHE 4530/6530 Combustion and Flames
Spring 2024

Instructor:	Professor Brandon Rotavera College of Engineering Department of Chemistry Office: STEM-I Building (Room 3040A) Phone: 706 /542.1801 Email: rotavera@uga.edu Website: rotavera.uga.edu Office hours: by appointment (schedule via email)
Topical Outline:	Introduction and analysis of hydrocarbon fuels; Review of thermodynamics; Basic principles of combustion; Mass transfer; Basics of chemical kinetics; Analysis of reacting systems; Conservation equations for reacting flows; Laminar premixed flames; Laminar diffusion flames; Detonations; Analysis of combustion systems (turbines and internal combustion engines);
Description:	Fundamentals of thermodynamics, fluid dynamics, and mass transfer in laminar and turbulent flames in combustion systems. Introduction to chemical kinetics, explosions, supersonic combustion, deflagration and detonation, and ignition dynamics. Introduction to combustion in stationary gas turbines for power generation, internal combustion engines, and combustion systems in jet engines.
Credit Hours:	3 (lecture)
Prerequisites:	ENGR 3150 – Heat Transfer ENGR 3160 – Fluid Mechanics
Lecture Times:	Tuesday/Thursday 11:10 A – 12:25 P
Lecture Location:	Driftmier Engineering Center, Room 1453
Website:	eLC
Required Text:	<i>An Introduction to Combustion: Concepts and Applications</i> (3 rd Edition) Author: Stephen R. Turns ISBN: 978-0073380193

Grading*:	Exam 1	25%
	Exam 2	25%
	Quizzes (4 – 6)	20% (final score assigned from top three scores)
	Final Exam	30% (see Homework section below)

*The listed grading scale is for MCHE 4530 (undergraduate level). The overall grade is based on two topical exams, 4 – 6 quizzes, and a homework-based final exam. The course project requirement for MCHE 6530 students (listed below) accounts for 20% of the final grade, and the scale above will be adjusted to include the grade earned. Grading will be relative but, in general, the minimum scale will be based on A = 90 – 100%, B = 80 – 89%, C = 70 – 79%, etc. Pluses and minuses (+ / –) are given with discretion.

Departmental Grading Policy Regarding Communication Skills: 30% of the grade on all written assignments is based on the quality of communication. In the context of exams and homework there are several key aspects that define quality, including clear organization of the solution procedure, written interpretation of assumptions used for a particular problem, and commentary as to the implications of the numerical result and/or connection to the assumptions.

Homework: Working homework problems is a necessity for practicing and learning the material, and is a tool that leads to developing a deeper understanding beyond the lecture content. Homework is assigned on an approximately bi-weekly basis (approximately 5 – 10 problems) but will not be collected or graded for a homework grade. Discussion of the solutions to selected problems will take place in lecture, time permitting, or during problem-solving sessions. The final exam grade is based on the grading of one of the homework sets, selected at the end of the term. Diligently working through the assignments and presenting the results in an organized, professional format is strongly encouraged. The grade will be based on the rigor of the methodology applied (i.e. application of assumptions, equations), reaching the correct solution, analysis and interpretation of the result(s), and organizational merits. An important component of the solution is writing comments on the context/meaning of the result.

Academic Honesty: Ethical behavior and academic honesty are expected and required of students and even more so of engineers and scientists. Evidence of cheating during an exam or other assignment for credit may result in failure of the entire course for the student(s) in question. The University of Georgia requires academic honesty and personal integrity among students and other members of the University Community. A policy on academic honesty has been developed to serve these goals. All members of the academic community are responsible for knowing the policy and procedures on academic honesty. The document for academic honesty may be found at the [website](#) for The University of Georgia Office of Senior Vice President for Academic Affairs and Provost. All academic work must meet the standards contained in "[A Culture of Honesty](#)". Students are responsible for informing themselves about the standards before performing any academic work.

Americans with Disabilities Act (ADA) Policy Statement:

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Resource Center, in Clark Howell Hall, call 706-542-8719, or email at dsinfo@uga.edu. For additional information visit drc.uga.edu.

Course Objectives and Expected Learning Outcomes: By the end of the course, students will have, at a minimum, developed the ability to (a) apply fundamental principles of mass conservation and momentum to reacting flows, (b) interpret underlying physics of practical combustion systems, (c) apply emissions quantification procedures and understand environmental effects of pollution, (d) understand the strengths and weaknesses of current and future engine designs and what current technological needs are for increasing engine efficiency and reducing emissions, (e) identify characteristics of explosions, including the chemical reactions responsible and implications on combustion engines, (f) distinguish between laminar and turbulent flames, (g) understand the structure of and principal characteristics of detonation waves and calculation of detonation velocities.

Additional Requirements for Graduate Students (MCHE 6530): In addition to the above requirements, graduate students must prepare a 15-min. presentation at the end of the semester based on an assigned topic.

Course Schedule (Table 1): The exam dates are subject to change upon prior notice with at least one week in advance.

Table 1. Course schedule: January 9 – May 7, 2024.

<i>Week</i>	<i>Tuesday</i>	<i>Thursday</i>	<i>Notes</i>
1	1/9	1/11	
2	1/16	1/18	Problem Set 1 Assigned
3	1/23	1/25	Problem Set 2 Assigned
4	1/30	2/1	<i>Problem-Solving Session</i>
5	2/6	2/8	Problem Set 3 Assigned
6	2/13	2/15	Problem Set 4 Assigned
7	2/20	2/22	<i>Problem-Solving Session</i>
8	2/27	2/29	Exam 1, 2/29
9	3/5	3/9	Spring Break
10	3/12	3/14	Problem Set 5 Assigned
11	3/19	3/21	<i>Problem-Solving Session</i>
12	3/26	3/28	
13	4/2	4/6	Problem Set 6 Assigned
14	4/9	4/11	
15	4/16	4/18	<i>Problem-Solving Session</i>
16	4/23	4/25	Exam 2, 4/25; submit all assignments on 4/25;
17			6530 presentations, 5/7, 12 P;