

AME 513b

Fundamentals and Applications of Combustion Spring 2025, KAP 167, MW 2:00 pm - 3:50 pm

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Office Hours: Anytime by appointment

References:

1. Notes and class presentations will be distributed.
2. Combustion Physics, by C.K. Law, 1st Edition, Cambridge University Press, 2006 (required).
3. Combustion, by Irvin Glassman and Richard A. Yetter, 4th Edition, Elsevier, 2008 (recommended).
4. Combustion, by Jürgen Warnatz, Ulrich Maas, and Robert Dibble, 4th Edition, Springer, 2006 (recommended).
5. An Introduction to Combustion to Turbulent Reacting Flows, by R.S. Cant and E. Mastorakos, Imperial College Press, 2008.
6. Combustion Theory, by Forman A Williams, 2nd Edition, Addison-Wesley, 1985 (recommended).
7. Combustion, Flames, and Explosions of Gases, by Bernard Lewis and Guenther von Elbe, 3rd Edition, Academic Press, 1987(recommended).

Prerequisite: AME 513 (Principles of Combustion) or equivalent

Topics:

- 1. Review of Principles of Combustion:**
 - Chemical Thermodynamics
 - Chemical Kinetics
 - Transport Phenomena
 - Conservation Equations
 - Fundamentals of Non-Premixed Flames
 - Fundamentals of Premixed Flames
- 2. Aerodynamics of Laminar Flames**
 - General Concepts
 - The Stretch Rate
 - Flame Stretch: Phenomenology
 - Flame Stretch, Heat Loss, and Lewis Number
 - Examples of Stretched Flames
 - Flame Instabilities
- 3. Detonations**
 - General Concepts
 - Detonation Phenomena and Theory
 - Structure of Detonation Waves
 - Detonations in Non-Gaseous Media

4. Ignition

- General Concepts
- Chain Spontaneous Ignition
- Thermal Spontaneous Ignition
- Forced Ignition
- Other Ignition Concepts

5. Low-Temperature Ignition and Engine Knock

- Fundamental Phenomena in Otto Engines
- Oxidation at Intermediate Temperatures
- Low-Temperature Oxidation
- Ignition Processes in Reciprocating Engines

6. Turbulent Reacting Flows

- General Concepts
- Turbulence Models
- Turbulent Non-Premixed Flames
- Turbulent Premixed Flames

7. Combustion of Non-Volatile Fuels

- General Concepts
- Metal Combustion
- Diffusional vs. Kinetically Controlled Combustion Limits

8. Environmental Combustion Considerations

- General Concepts
- The Photochemical Smog
- Formation and Reduction of Nitrogen Oxides
- SO_x Emissions
- Particle Formation
- Stratospheric Ozone

Grading:	Midterm Exam	March 12, 2025 (W)	(2:15 pm-3:45 pm)	30%
	Final Exam	May 12, 2025 (M)	(2:00 pm-4:00 pm)	30%
	Homework Assignments			40%

Note:

1. Depending on the class preferences, the Final Exam may be replaced by a computational project. This will be decided during the first few lectures.
2. The use of laptops or cell phones to access the internet or e-mail during class and/or exams is not allowed. Such devices are allowed only to access class material.