1. ME 5446, Introduction to Combustion

2. 4 credits, 4 contact hours.

3. Instructors: W. Northrop, S. Yang

4. Textbook: An Introduction to Combustion by S.Turns; 2017 (Required)
   a. Combustion by Glassman, Yetter, and Glumac; 2014 (Reference)

5. Specific course information:
   b. Prerequisites: ME 3331, ME 3332, ME concurrent, CSE upper division or grad student.
   c. Elective course for ME students.

6. Course outcomes (related ABET student outcomes indicated in square brackets):
   a. An ability to compute energy release and temperature during combustion. [1]
   b. An ability to utilize computer codes to determine species distribution under various pressure, temperature, and volume combustion conditions. [1]
   c. An ability to mathematically describe the rate of species formation based on an arbitrary set of reactions and equilibrium constants. [1]
   d. An ability to model simple mass and heat transfer problems involving multiple species and phase change. [1]
   e. An ability to estimate flame speeds under a variety of conditions. [1]
   f. An ability to identify the environmental impact of combustion processes [4]
   g. An ability to compute quenching distances for the safe design of burners. [1]
   h. An ability to compute minimum ignition energies. [1]
   i. An ability to compute droplet burning rates. [1]
   j. A qualitative understanding of the role of turbulence in combustion. [1]
   k. An ability to apply course material to a computer model of a combustion system. [1,2]
   l. An ability to analyze and describe an open-ended combustion problem through a technical report. [3,7]
7. Course topics:
   a. Review of thermodynamics, adiabatic flame temperatures, chemical equilibrium.
   b. Computer calculation of equilibrium species distribution and adiabatic temperatures.
   d. Chemical kinetics: rate laws, elementary reactions, rate constants from simple kinetic theory.
   e. Chain reaction mechanisms.
   f. H\textsubscript{2}/O\textsubscript{2}, CO and hydrocarbon combustion mechanisms.
   g. Combustors, reactors: batch, plug flow and perfectly stirred reactors.
   h. Computer simulation of reactors.
   i. Statement of mass, momentum, species and energy conservation.
   j. Premixed laminar flames: flame speed, propagation, ignition, and extinction; flame stabilization.
   k. Droplet and spray flames: heat and mass transfer effects, \(d^2\) law.
   l. Introduction to NOx and soot formation in combustion.