AE 434 Rocket Propulsion and Rocketry

Last modified: 2-7-14

Basic principles of chemical rocket propulsion and performance, propellants and their influence on design of rockets, combustion processes, design of components, and flight performance.

Classes: MWF 10am, 101 Transportation Bldg.

Instructor: Prof Joanna Austin
311 Talbot
jmaustin@illinois.edu
x 33739
Office hour: Wednesdays 12-1pm
Location: 311 Talbot

TA: Andrew Knisley
aknisely@illinois.edu
Office hours: Tuesdays and Thursdays 4- 5 pm
Location: 319 H Talbot (may move if large attendance)

Prerequisites: AE312 or equivalent undergraduate course in compressible flows
AE433 or equivalent introductory propulsion
Ability to use department/campus workstations

Text: Sutton, G.P. and O. Biblarz, Rocket Propulsion Elements, 8th ed. Wiley, NY 2010

Credit: 3 or 4 hours. Students may register for an optional 1 hour independent study topic with consent of instructor. This unit will involve submission of extra homework problems, or a research paper and possibly presentation on a special topic directly related to the course, depending on numbers.

Assessment:
Problem sets (30 %)
Midterm exam (30 %)
Final exam (40 %)
Research projects and presentations

Problem sets: approximately every second week Due at beginning of class unless otherwise stated

Midterm: Wednesday March 12th, in class
Final (scheduled by campus): 8-11am, Monday, May 12th

Notes:
1) If you need accommodations for a learning or physical disability, please make an appointment to discuss these with me during the first two weeks of the semester.

2) Requests for grade corrections should be made within one week after return of the assignment or exam.

Course Outline

- Classification of propulsion systems and overview of mission requirements

- What makes a rocket work?
  Conservation equations, control volumes, application to steady and unsteady propulsion systems

- Performance parameters: specific thrust, thrust coefficient

- Flight dynamics: trajectory, staging

- Nozzles: ideal performance - quasi-1D, compressible flow, non-ideal performance

- Combustion:
  basic processes, reaction rates, nonequilibrium, instabilities, hazards

- Equilibrium code (Gordon-McBride method):
  calculation of thermodynamic properties and chemical composition

- Liquid propellants: storage, pumping, injection

- Solid propellants: combustion and burning rate, grain design, chamber operating pressure

- Heat transfer: concepts and analysis of conductive, convective, and radiative energy transfer

- Special topic (eg. microrockets, pulsed detonation engine, …)