

AAE390 Thermal Sciences

Fall 2013

(Outline)

Instructor: Haifeng Wang

Description: A fundamental course covering a wide range of topics selected from disciplines of engineering thermodynamics, fluid mechanics, heat transfer and combustion. This is an entry level course to prepare students for advanced thermal analysis of propulsion and energy systems.

Prerequisites: ME 200 Thermodynamics I (prerequisite)
AAE 333 or ME 310 Fluid mechanics (co-requisite/prerequisite)

Textbooks: *TBD – possibly one of the following*

- ✓ Frank W. Schmidt, Robert E. Henderson, Carl H. Wolgemuth, Introduction to thermal science, Wiley, 1993
- ✓ Deborah A. Kaminski, Michael K. Jensen, Introduction to Thermal and Fluids Engineering, Wiley, 2005
- ✓ Yunus S. Cengel, Robert H. Turner, John M. Cimbala, Fundamentals of Thermal-Fluid Sciences, McGraw Hill, 2008
- ✓ Michael J. Moran, Howard N. Shapiro, Bruce R. Munson, David P. DeWitt, Introduction to Thermal Systems Engineering
- ✓ Stephen Turns, Thermal-fluid sciences: An integrated approach, Cambridge, 2006

Objectives: Upon completion of this course, students are expected to be able to apply fundamental principles to perform thermodynamic analysis for problems involving fluid flow, heat transfer and chemical reaction.

Course Info: 3 credits;
3 lectures a week;
Regular grading option;

Table of Contents (Tentative)

1	Overview (1 week).....	3
2	Thermodynamics (3 weeks).....	3
2.1	Concepts and definitions.....	3
2.2	Energy and 1 st law of thermodynamics	3
2.3	Evaluating properties, equation of state, mixture.....	3
2.4	2 nd law of thermodynamics and entropy	3
2.5	Thermodynamic analysis of propulsion systems	3
3	Fluid Mechanics (4 weeks)	3
3.1	Concepts and definitions.....	3
3.2	Control volume analysis.....	3
3.3	Differential forms of fluid equations	3
3.4	Introduction to computational fluid dynamics	3
3.5	Incompressible flow.....	4
3.5.1	Viscous internal flows.....	4
3.6	Compressible flow	4
3.6.1	Preliminaries	4
3.6.2	Isentropic one-dimensional flow in nozzles and diffusers	4
3.6.3	One-dimensional flow with heat exchange and friction.....	4
3.6.4	Normal shocks	4
4	Heat Transfer (4 weeks).....	4
4.1	Introduction.....	4
4.2	Conduction heat transfer.....	4
4.3	Convection heat transfer	4
4.4	Radiation heat transfer	4
5	Combustion (4 weeks)	5
5.1	Combustion and thermochemistry	5
5.2	Chemical equilibrium.....	5
5.3	Mass transfer.....	5
5.4	Chemical kinetics.....	5
5.5	Analysis of thermal/chemical systems	5
5.6	Laminar flames	5
5.7	Droplet combustion.....	5