DEPARTMENT OF AERONAUTICS AND ASTRONAUTICS

AA 400 GAS DYNAMICS

WINTER QUARTER

CREDIT AND CONTACT HOURS: 3 credits, Three 50 minutes lectures per week.

COORDINATOR: Robert Breidenthal, Professor of Aeronautics and Astronautics

TEXTBOOK: Elements of Gasdynamics, Liepmann & Roshko 2002

SUPPLEMENTAL MATERIAL: Introduction to Physical Gas Dynamics, Vincenti & Kruger,
The Feynman Lectures on Physics, Feynman, Leighton, and Sands,

CATALOG DATA: GAS DYNAMICS, Selected Elective
Introduction to kinetic theory and free molecule flow. Review of thermodynamics. One-dimensional gasdynamics, one-dimensional wave motion. Combustion waves. I deal and real gas application. Prerequisites: ChemE/Engr 260, or permission of instructor.

PREREQUISITES BY TOPIC:
1) Thermodynamics
2) Introductory compressible aerodynamics

OUTCOMES:
1) Understand pressure, temperature, internal storage, mean free path and transport properties from a molecular point-of-view.
2) Be able to calculate aerodynamics of bodies in free-molecular flow.
3) Be able to apply the law of mass action.
4) Be able to calculate and contrast 1-D ideal and real gas flows.
5) Understand non-steady waves and be able to predict performance of test devices that operate with non-steady 1D gas dynamics.
6) Be able to calculate combustion waves.

RELATIONSHIP TO STUDENT OUTCOMES:
a) An ability to apply knowledge of mathematics, science, and engineering
e) An ability to identify, formulate, and solve engineering problems
k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

TOPICS:
1) Kinetic theory: model, wall collisions, temperature and equation of state, mean free path, transport properties. (5 lectures)
2) Free molecule flow: model, surface collisions, forces and heat transfer. (3 lectures)
3) Thermodynamics: law of mass action, applications, thermo-dynamics of air. (4 lectures)
4) One-dimensional flow: review steady 1-D flow, real gas flows, re-entry flow (5 lectures)
5) One-dimensional wave motion: propagating waves, Riemann Invariants, applications, explosion waves. (5 lectures)
6) Additional applications: nozzles and diffusers, hypersonic flow. (2 lectures)