ME 510
GAS DYNAMICS

Course Outcomes

1. Introduce the student to the fundamentals of compressible fluid flow.
2. Master solution methods for one dimensional flow.
3. Obtain a general understanding of the principles of multi-dimensional flow.

Fundamental Concepts (2 wks)
1. Concept of a continuum
2. Perfect fluids and equations of state
3. Acoustic speed and Mach number
4. Governing equations

One Dimensional Flow (5 wks)
1. Isentropic flow with area change
2. Flow with friction: the Fanno Line
3. Flow with heat transfer: the Rayleigh Line
4. Flow with mass addition
5. Generalized 1-D flow
6. Normal shock waves
7. Oblique shock waves
8. Expansion waves
9. Supersonic wind tunnels and diffusers

Multi-Dimensional Flow (4 wks)
1. Vorticity and circulation
2. Potential and stream functions
3. Kelvin’s theorem
4. Crocco’s theorem
5. Linearized flow equations
6. Thin airfoil theory

Advanced Topics (4 wks)
1. Method of characteristics
2. Supersonic nozzle design
3. Unsteady 1-D flow
4. Shock tubes

Revision Date: 2/12/2013
1. COURSE NUMBER AND TITLE: ME 51000 Gas Dynamics

2. CREDITS AND CONTACT HOURS: 3 credits
   a. Lecture – 3 days per week at 50 minutes for 16 weeks

3. COURSE COORDINATOR OR INSTRUCTOR:
   C. Wassgren & N. Key

4. TEXTBOOK:

5. SPECIFIC COURSE INFORMATION:
   a. Catalog Description: Flow of compressible fluids. One-dimensional flows, including basic concepts, isentropic flow, normal and oblique shock waves. Rayleigh line, Fanno line, and simple waves. Multidimensional flows, including general concepts, small perturbation theory for linearized flows, and method of characteristics for nonlinear flows. Typically offered in spring (alternating years).
   b. Prerequisites:
      ME 30900 – Fluid Mechanics
      AAE 33400 – Aerodynamics
   c. Status: Elective

6. SPECIFIC GOALS FOR THE COURSE
   a. Course Outcomes:
      1. Introduce the student to the fundamentals of compressible fluid flow.
      2. Master solution methods for one dimensional flow.
      3. Obtain a general understanding of the principles of multidimensional flow.
   b. Related ME Program Outcomes:
      A1. Engineering Fundamentals;   B3. Prof/Ethical Responsibility;
      A3. Experimental Skills;        B5. Life-Long Learning;
      A4. Modern Engr Tools;          C1. Leadership,
      A5. Design Skills;              C2. Global Engineering Skills;
      A6. Impact of Engr Solns;       C3. Innovation;
      B1. Communication Skills;       C4. Entrepreneurship
      B2. Teamwork Skills

7. LIST OF TOPICS: See following page.

PREPARED BY: N. Key

REVISION DATE: February 12, 2013