

UUT 621E “Advanced Problems in Compressible Flow”
Fall Semester 2005
COURSE OUTLINE

The assumption is made that all students have had an introductory course dealing with the fundamentals of inviscid compressible flows such as the topics in section A below. This material will be reviewed at the beginning of the semester but at a rapid pace. Since this material is critical for the development of the other topics, you must make sure early on that you have a thorough understanding of it.

In this course we will take this basic material and build on it, focusing largely on the areas listed below. The objectives are 1) to give you a firm understanding of the physical processes in these aspects of high speed flows and, 2) an understanding of the theory governing these phenomena, the assumption behind it, and the ensuing limitations. The course will be a balance between the theory and applications.

- A) Review material
 - basic thermodynamics, 1st and 2nd Laws
 - 1-D conservation equations
 - steady isentropic flow
 - stationary normal and oblique shock waves
 - Prandtl-Meyer expansion
 - 1-D flow with heat addition and friction
- B) Applications of Isentropic Flow/Shocks/Expansions
 - converging-diverging nozzles, on and off-design conditions
 - continuous and blowdown wind tunnel design, start-up and operations
 - intersection of shocks with solid surfaces, shocks with shocks, shocks with free boundaries, shocks with expansion
 - supersonic aircraft inlets
- C) Conical Shock Waves
 - physical aspects of conical flow
 - Taylor-Maccoll theory
 - numerical procedure
- D) Physics of Shock Waves
 - dissipative mechanics in shocks
 - estimation of shock thickness
- E) Unsteady Wave Motion
 - moving normal shock waves
 - reflected shock waves
 - shock tubes, explosions
 - fundamental of acoustic theory
 - finite waves
 - unsteady expansion waves
- F) Method of Characteristics
 - introduction and general philosophy
 - characteristic lines
 - compatibility equations
 - supersonic nozzle design