MAE 3303  Aerodynamics of Compressible Flow

Spring 2010  MWF  9.00 –9.50 am  WH 221

Instructor:  U. S. Satyanand, Ph.D.
Office:  WH 323H
Office Hours: MWF 11.20-11.50 am or by appointment
Phone:  817-897-1269  email:  uss41@uta.edu

Course Website URL:  http://www-woolf.uta.edu
username:  mae3303  password:  mod73lid08

Textbook:

Course Learning Goals/Objectives:
To study both the fundamentals and calculations of compressible flow.

Course Description:
Topics: Fundamentals of physical and mathematical gas dynamics; adiabatic and isentropic flows; normal shock waves; oblique shock and expansion waves; compressible flow through nozzles, diffusers, and wind tunnels; thin-airfoil and small perturbation theory.

Course Prerequisites:
MAE 3302 and MAE 3309 or 3310

Tentative Lecture/Topic Schedule (course content):

Chapters 7-12 of the text book.

1) Introduction to compressible flow
   a) Flow regimes
   b) A brief review of thermodynamics
   c) Governing equations for inviscid flows

2) One-dimensional flow and normal shock waves
   a) One-dimensional flow equations
   b) Speed of sound and Mach number
   c) Stagnation and sonic reference properties
   d) Normal shock relations
e) Moving normal shock waves

3) Oblique shock and expansion waves
   a) Oblique shock wave relations
   b) Supersonic flow over wedges and cones
   c) Shock interactions and reflections
   d) Detached shock wave
   e) Prandtl-Meyer expansion waves
   f) Shock-expansion theory: applications to supersonic airfoils
   g) Shock-wave/boundary-layer interaction

4) Compressible flow through nozzles, diffusers and wind tunnels
   a) Governing equations for quasi-one-dimensional flow
   b) Area-velocity relation
   c) Nozzle flows
   d) Diffusers
   e) Supersonic wind tunnel

5) Subsonic compressible flow over airfoils: linear theory
   a) Rotational and irrotational flows
   b) Velocity potential equation
   c) Linearized velocity potential equation
   d) Linearized subsonic flow and compressibility corrections
   e) Critical Mach number, drag-divergence Mach, sound barrier, area rule, supercritical airfoils

6) Linearized supersonic flow
   a) Linearized supersonic pressure coefficient
   b) Wave drag
   c) Application to supersonic airfoil

7) Method of characteristics
   a) Equations of characteristics for two-dimensional flow
b) Supersonic nozzle design

**Attendance and Drop Policy:**
Attendance required. Drop policy as specified in the UTA catalog.
If a student misses a class, it is his/her responsibility to make up the missed class (i.e. get the course notes, assignments, or announcements from other students).

**Homework:**
Homework problems from the text book are assigned. See the course website.
Late and tardy home works are not accepted.
Solve the homework problems **independently** to get better trained for tests and exam.

**Tests and exam: Closed book**
2 tests and a final exam (comprehensive-selective chapters), and **no make-up tests**.

**Key Assignment:**
To assess students’ ability to identify, formulate and solve engineering problems, a design project will be designated as the key assignment this semester. In order to pass this class, students must submit and pass the key assignment. If any key assignment is not submitted and passed, the student will not pass the class even if he/she scores perfectly on all exams and other assignments.

**Grading:**
10% for home work, 10% for the key assignment, 40% for tests, and 40% for final exam.
Bonus points (2 for each) shall be awarded in the class for the following:
(i) right answers to the questions (selected by the instructor) in the class,
(ii) highly challenging questions to the instructor, and
(ii) pointing out serious mistakes in the lectures.

**Other Information:**
Students are expected to read assignments before class, answer questions in class, and participate in class discussions.

**Final Review Week**
A period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week unless specified in the class syllabi. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week.

**Special requirements for preparing and submitting homework assignments:**

**Paper:** Use 8-1/2” x 11” paper. Write on one side only. Draw margin lines on all four sides. Draw four boxes at top for course number, date, your name (last name first) and page number, respectively.
Writing: Type or hand letter (legibly). Write problem number and text page number. Write problem statement followed by a line across page between margins. Sketch neatly using straight and circular edges. Freehand sketches are not acceptable. Write solution in logical sequence showing all steps. Write equation in symbols first before substituting in numbers. Define symbols or write equation number from text. Box-in your final answers.

Americans with Disabilities Act:
The University of Texas at Arlington is on record as being committed to both the spirit and letter of federal equal opportunity legislation; reference Public Law 93112-The Rehabilitation Act of 1973 as amended. With the passage of new federal legislation entitled Americans with Disabilities Act (ADA), pursuant to section 504 of The Rehabilitation Act, here is renewed focus on providing this population with the same opportunities enjoyed by all citizens. As a faculty member, I am required by law to provide reasonable accommodation to students with disabilities, so as not to discriminate on the basis of that disability. Student responsibility primarily rests with informing faculty at the beginning of the semester and in providing authorized documentation through designated administrative channels.

Academic Dishonesty:
It is the philosophy of The University of Texas at Arlington that academic dishonesty is a completely unacceptable mode of conduct and will not be tolerated in any form. All persons involved in academic dishonesty will be disciplined in accordance with University regulations and procedures. Discipline may include suspensions or expulsion from the University. Scholastic dishonesty includes but is not limited to cheating, plagiarism collusion, the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts. (Regents Rules and Regulations, Part One, Chapter VI, Section 3, Subsection 3.2, Subdivision 3.22) “University Authorized Absences” and “Observance of Religious Holidays” are as stated in the UTA Catalog. “Statement on Ethics, Professionalism and Conduct of Engineering Students” (attached) applies to all engineering students. “Cheating: Definitions and Consequences” is published by the Undergraduate Assembly, Student Congress and Research and Evaluation Office/Student Affairs. See also Regents Rules and Regulations, Part One, Chapter VI, Section 3, Subsection 3.2, Subdivision 3.22.

Student Support Services Available
The University of Texas at Arlington supports a variety of student success programs to help you connect with the University and achieve academic success. These programs include learning assistance, developmental education, advising and mentoring, admission and transition, and federally funded programs. Students requiring assistance academically, personally, or socially should contact the Office of Student Success Programs at 817-272-6107 for more information and appropriate referrals.

For assistance with your library needs in this course, please consult the appropriate subject librarian.