

AE 5327/MAE 4301: Introduction to Computational Fluid Dynamics

Fall 2009

Course Syllabus

Instructor(s): Dr. Brian H Dennis

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Office Hours: MW 5:20 – 6:00

Time and Place of Class Meetings: NH 112, MW 4 – 5:20

Description of Course Content:

Computational fluids dynamics is a numerical tool that can be applied effectively to the analysis of many fluid and heat transfer problems. This course is intended to provide a thorough introduction to the basic ideas employed in the derivation and application of numerical techniques to fluid flow and heat transfer problems. The focus will be on methods of finite difference, though more modern methods such as finite volume and finite element will be introduced. Mastery of the material provided in this course will enable the student to more intelligently use commercially available software for fluid flow and heat transfer analysis.

Requirements:

Programming skills in C, JAVA, MATLAB, or FORTRAN. Undergraduate courses in fluid mechanics or heat transfer. One course involving partial/ordinary differential equations and linear algebra. Consent of instructor.

Recommended Textbooks and Other Course Materials:

Computational Fluid Mechanics and Heat Transfer, Tannehill et al. , 1997

Computational Fluid Dynamics: The basics with applications, Anderson, J., 1995

Grading Policy:

Grades will be determined according to scores obtained on homework and project assignments.

Homework: 70%

Final Project: 30%

Attendance Policy: Students are expected to attend all class meetings and to arrive on time.

Tentative Lecture/Topic Schedule (course content):

- History and philosophy of computational methods for fluid dynamics and heat transfer
- Governing differential equations of fluid flow and heat conduction – derivation and mathematical behavior
- Aspects of discretization with finite difference methods for spatial derivatives
- Discretization of time derivatives and time marching methods, methods for ODE's
- Fourier stability analysis of time marching methods in 1-D
- Steady-state and transient heat conduction solutions in 1-D
- Proper numerical treatment of convection dominated equations

- Solution to banded systems of equations
- Approximate factorizations
- Steady-state heat conduction solutions in 2-D
- Coordinate transformations for boundary fitted structured meshes
- Basic mesh generation in 2-D
- Overview of Finite Volume and Finite Element methods
- Treatment of incompressible viscous flows with simple techniques
- Treatment of compressible Euler equations with simple techniques
- Steady-state flow solutions in 2-D
- Overview of advanced topics

Drop Policy: Students may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. Undeclared students must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is the student's responsibility to officially withdraw if they do not plan to attend after registering.

Students will not be automatically dropped for non-attendance. Repayment of certain types of financial aid administered through the University may be required as the result of dropping classes or withdrawing. Contact the Financial Aid Office for more information.

Americans with Disabilities Act: The University of Texas at Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including the *Americans with Disabilities Act (ADA)*. All instructors at UT Arlington are required by law to provide "reasonable accommodations" to students with disabilities, so as not to discriminate on the basis of that disability. Any student requiring an accommodation for this course must provide the instructor with official documentation in the form of a letter certified by the staff in the Office for Students with Disabilities, University Hall 102. Only those students who have officially documented a need for an accommodation will have their request honored. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at www.uta.edu/disability or by calling the Office for Students with Disabilities at (817) 272-3364.

Academic Integrity: 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 suspension or expulsion from the University. According to the UT System Regents' Rule 50101, §2.2, "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."

Student Support Services Available: The University of Texas at Arlington has established a variety of programs to help students meet the challenges of college life. Support to students includes advising, counseling, mentoring, tutoring, supplemental instruction, and writing assistance. For a complete list of academic support services, visit the Academic Assistance resource page of the Office of Student Success Programs, www.uta.edu/uac/studentsuccess/academic-assistance. To help students address personal, academic and career concerns, individual counseling is also available. For more information, students are encouraged to contact Counseling Services www.counseling.uta.edu at (817) 272-3671 or visit a counselor in 216 Davis Hall.

Electronic Communication Policy: The University of Texas at Arlington has adopted the University "MavMail" address as the sole official means of communication with students. MavMail is used to remind students of important deadlines, advertise events and activities, and permit the University to

conduct official transactions exclusively by electronic means. For example, important information concerning registration, financial aid, payment of bills, and graduation are now sent to students through the MavMail system. All students are assigned a MavMail account. **Students are responsible for checking their MavMail regularly.** Information about activating and using MavMail is available at <http://www.uta.edu/oit/email/>. There is no additional charge to students for using this account, and it remains active even after they graduate from UT Arlington.

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 syllabus. 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. Classes are held as scheduled during this week and lectures and presentations may be given.