

AE5301/ME5390 Finite Element Method in Fluid Mechanics and Heat Transfer
Spring 2018

Course Syllabus

Instructor(s): Dr. Brian H Dennis

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Office Hours: MW 4:00 – 4:30

Time and Place of Class Meetings: WH 308, MW 2:30 – 3:50

Description of Course Content:

The finite element method is a numerical tool that can be applied effectively to the analysis of many fluid and heat transfer problems. The method's firm mathematical background and its applicability to complex geometric domains make it an attractive alternative to the more traditional finite difference and finite volume methods. This course is intended to provide a thorough introduction to the basic ideas employed in the application of finite element techniques to fluid flow and heat transfer problems. A student who successfully completes this course will have the foundation required to develop or modify finite element analysis software. Additionally, mastery of the material provided in this course will enable the student to more intelligently use commercially available finite element analysis 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:

1. The Finite Element Method for Engineers by K. Huebner et al.
2. The Finite Element Method in Heat Transfer and Fluid Dynamics by D. Gartling and J.N. Reddy

Grading Policy:

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

Late homework will penalized by 5% per day.

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

Tentative Lecture/Topic Schedule (course content):

- Introduction to the finite element method for fluid flow and heat transfer
- Element interpolation functions for popular 1-D,2-D, and 3-D elements
- Basic unstructured mesh generation
- Numerical integration and isoparametric elements
- Variational Principles and the Method of Weighted Residuals
- Solutions to ideal incompressible and compressible fluid flows
- Steady-state and transient heat conduction solutions

- Treatment of Navier-Stokes equations for analysis of steady incompressible viscous flows
- Coupled heat transfer/flow problems including natural/forced convection
- Introduction to advanced topics such as Least-Squares, Petrov-Galerkin, and reduced order model approaches

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.