Modeling of Air and Pollutant Flows in Buildings
CE 397 Spring 2013

The University of Texas at Austin
Department of Civil, Architectural, and Environmental Engineering

Course Numbers and credits: 15820 3 credits

Course Website: http://www.ce.utexas.edu/prof/Novoselac/classes/ARE372

Classroom and Time: ECJ 9.236, Tuesday and Thursday 9:30 AM - 11:00 AM

Prerequisites: Graduate standing students. Undergraduate students need permission of instructor.

Instructor: Dr. Atila Novoselac
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Office Hours: Tuesday and Thursday, 11:00 AM - 12:00 PM or by appointment. I have an open door policy – if my office door is open, I will see students without an appointment. If I am busy, we will schedule a convenient time for both of us.

Course Catalog Description: Fundamentals of indoor airflow modeling, use of Computational Fluid Dynamics (CFD) for air quality and thermal comfort analyses, application of CFD for analysis of air velocity, temperature, humidity, and contaminant distributions with different ventilation systems.

Course Objectives:

1) Recognize the physics behind various numerical tools used for solving airflow problems.
2) Employ basic numerical methods for solving Navier-Stokes Equations.
3) Apply CFD for airflow simulations in buildings and use this tool in various design and/or research problems.
4) Evaluate thermal comfort and indoor air quality (IAQ) with different ventilation systems.
5) Assess transport of different pollutants in indoor environments.
6) Critically analyze and evaluate CFD simulation results.

Textbook:
Versteeg, H.K. and Malalasekera, W. 2007. *An Introduction to Computational Fluid Dynamics, The Finite Volume Method*, Prentice Hall, ISBN: 0131274988

References: (optional – on 2 hour reserve at Engineering Library)

Anderson 1995. *Computational Fluid Dynamics –The Basics With Applications*, McGraw-Hill
Wilcox, D.C. 1998. *Turbulence Modeling for CFD*, DCW Industries, Inc.

Topics:

1. Course Introduction and Background	1 wk
2. Fundamentals of fluid dynamics	2 wks
3. Turbulence and turbulence models	1.5 wks
4. Numerical methods and parameters	2 wks
5. CFD modeling parameters	1.5 wks
6. Introduction to CFD software	1 wk
7. Application of CFD for building airflows	1 wk
8. Simulation of IAQ parameters	1 wk
9. Simulation of thermal comfort parameters	1 wk
10. Modeling of aerosols	1 wk
11. Air and pollutant flows in the vicinity of occupants	1 wk
12. Accuracy and validation of building airflow simulations	1 wk
Total	15 wks

Grading:

Midterm Test	25%
Classroom Participation	5%
Homework Assignments	30%
Midterm Project	10%
Final Project & Presentation	30%
	100%

Course Letter Grades: (Numerical Grades for graduate and undergraduate students)

90-93; 94-100	A-, A
80-83; 84-86; 87-89	B-, B, B+
70-73; 74-76; 77-79	C-, C, C+
60-63; 64-66; 67-69	D-, D, D+
< 60	F

Personal Problems:
If you have illness or personal problems that will affect your performance during the course of the semester, please let me know as soon as possible. "After the fact" provides little protection unless there are extreme circumstances. I have an answering machine and an e-mail address if you need to get in touch with me after hours. Do not hesitate to use them.

Academic Honesty:
Students who violate University rules on scholastic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and/or dismissal from the University. Since such dishonesty harms the individual, all students, and the integrity of the University, policies on scholastic dishonesty will be strictly enforced. For further information, visit the Student Judicial Services web site http://www.utexas.edu/depts/dos/sjs/.

Privacy – Web Based Class Sites:
Web-based, password-protected class sites may be associated with all academic courses taught at the University. Syllabi, handouts, assignments and other resources are types of information that may be available within these sites. Site activities could include exchanging email, engaging in class discussions and chats, and exchanging files. In addition, electronic class rosters will be a component of the sites. Students who do not want their names included in these electronic class rosters must restrict their directory information in the Office of the Registrar, Main Building, Room 1. For information on restricting directory information, see: http://www.utexas.edu/student/registrar/catalogs/gi00-01/app/appc09.html.

Students with Disabilities:
The University of Texas at Austin provides, upon request, appropriate academic adjustments for qualified students with disabilities. Any student with a documented disability (physical or cognitive) who requires academic accommodations should contact the Services for Students with Disabilities area of the Office of the Dean of Students at 471-6259 as soon as possible to request an official letter outlining authorized accommodations. For more information, contact that Office, or TTY at 471-4641, or the College of Engineering Director of Students with Disabilities at 471-4321.

Dropping the Course:
From the 1st through the 12th class day, an undergraduate student can drop a course via the web and receive a refund, if eligible. From the 13th through the university's academic drop deadline, a student may Q drop a course with approval from the Dean, and departmental advisor. After the academic drop deadline has passed, a student may drop a course only with Dean's approval, and only for urgent, substantiated, non-academic reasons.

Course Evaluations:
Each student will be given the opportunity to evaluate the course using the standard course/instructor evaluation form at the end of semester.

Computer Usage:
Basic knowledge of any programming language (Fortran, C, Matlab, Matcad, etc.) is beneficial. Some homework assignments and the term projects will require extensive use of computers. The students will use the energy simulation software Fluent-Airpak or Star CCM+ for projects and homework assignments.

Projects:
There will be two projects assigned. The midterm projects will account for 10% and final for 30% of your final grade. The final project will include student project presentations during the final week of classes. Exact time and place for the project presentations will be determined later in the semester.

Important Dates:
Test: tentative on March 28
Midterm Project Due: April 4
Final Project Due: May 2

TENTATIVE COURSE SCHEDULE

Date	Topics	Due date for
01/15	Course introduction and terminology	
01/17	Fluid dynamics review	HW0
01/22	Conservation Equations	
01/24	Turbulence	
01/29	No class (ASHRAE Conference) - make-up will be the midterm test	
01/31	Modeling of turbulence	
02/05	Reynolds-averaged Navier-Stokes equations	
02/07	k-ε turbulence models	
02/12	Finite volume method	HW1
02/14	Domain discretization	
02/19	Discretization methods	
02/21	Equation solver	
02/26	System of equations - SIMPLE Algorithm	HW2
02/28	Relaxation and Numerical stability	
03/05	Introduction to CFD software - Airpak (FLUENT) and Star CCM+	
03/07	Midterm project	
03/19	Boundary conditions	HW3
03/21	Wall functions	
03/26	Review	
03/28	Thermal comfort parameters (out of class Midterm test)	Midterm test
04/02	IAQ parameters	
04/04	Final Project Assignment	Midterm Proj.
04/9	Unsteady-state flow	
04/11	Meshing	
04/16	Particles	
04/18	Largrangian modeling of particles	FP prelim. Res.
04/23	Final project review	
04/25	Evaluation of CFD results	
04/30	Course Review	
05/02	Project presentations	Final Project