Energy Simulation in Building Design
CE 397, ARE 371 Fall 2016

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

Course Unique Numbers: 15895 (CE 397) 15185 (ARE 371)

Course Website: http://www.ce.utexas.edu/prof/Novoselac/classes/ARE383/

Classroom and Time: ECJ 3.104 Tuesday and Thursday 9:30 AM - 11:00 AM

Prerequisites: Graduate student. For undergraduate students: ARE 346N or consent of instructor.

Instructor: Dr. Atila Novoselac
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Phone: Office 475-8175
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http://www.ce.utexas.edu/prof/Novoselac

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 building energy simulations including basic analytical models for heat & mass transfer in building elements and general numerical methods for solving system of equations. Use of energy simulations tools for building design analyses including parametric studies of various design solutions for different operational and environmental parameters.

Course Objectives:
1. Identify basic building elements which affect building energy consumption and analyze the performance of these elements using energy and mass conservation models.
2. Understand the physics behind various numerical tools used for solving different heat and moisture transfer problems in building elements.
3. Use basic numerical methods for solving systems of linear and nonlinear equations.
4. Conduct building energy and mass transfer analyses using comprehensive computer simulation tools.
5. Evaluate the performance of building envelope and environmental systems considering energy consumption in buildings.
6. Perform parametric analyses to evaluate the effects of design choices and operational strategies of building systems on building energy use.
7. Use energy simulations in life-cycle cost analyses for selection of building components.

Textbook:
There are no required textbooks for this class. Students are required to read provided papers and handouts. Some textbooks that you might find useful are in the reference list below:

References: (optional)

J A Clarke, 2002, *Energy Simulation in Building Design (2nd Edn)*, Butterworth-Heinemann, ISBN 0 7506 5082.

2001 ASHRAE Handbook: Fundamentals. IP or SI edition, hard copy or CD.

S V Patankar, 1980, *Numerical Heat Transfer and Fluid Flow*, ISBN: 0891165223.

John A. Duffie, William A. Beckman, 1991, *Solar Engineering of Thermal Processes*, ISBN: 0471510564.

Topics:

1. Course introduction and background	0.5 wk
2. Fundamentals of energy mass transfer	1.5 wks
3. Thermal analysis of building components	2 wk
4. Numerical methods	1 wk
5. Fundamentals of moisture transfer	1 wk
6. Energy and moisture simulation tools	1 wk
7. Introduction to modeling software	1 wk
8. Building envelope analyses	2 wks
9. HVAC system analyses	2 wks
10. Parametric analyses	2 wks
	14 wks

Grading:

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

Course Letter Grades (for graduate and undergraduate students):

90-93, >93	A-, A
80-83, >83-86, >86-90	B-, B, B+
70-73, >73-76, >76-80	C-, C, C+
60-63, >63-66, >66-70	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.

Honor Code:

The core values of The University of Texas at Austin are learning, discovery, freedom, leadership, individual opportunity, and responsibility. Each member of the university is expected to uphold these values through integrity, honesty, thrust, fairness, and respect towards peers and community.

Policy of Scholastic Dishonesty:

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://deanofstudents.utexas.edu/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.

Accommodations (Disability Statement):
The University of Texas at Austin provides, upon request, appropriate academic accommodations for qualified students with disabilities. For more information, contact the Division of Diversity and Community Engagement, Services for Students with Disabilities, 471-6259 (voice) or 232-2937 (video phone) or http://www.utexas.edu/diversity/ddce/ssd.

Dropping the Course:
Undergraduate Students: 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 5th through the university's academic drop deadline, a student may Q drop a course with approval from the Dean, and departmental advisor.
Graduate Students: From the 1st through the 4th class day, graduate students can drop a course via the web and receive a refund. During the 5th through 12th class day, graduate students must initiate drops in the department that offers the course and receive a refund. After the 12th class day, no refund is given. No class can be added after the 12th class day. From the 13th through the 20th class day, an automatic Q is assigned with approval from the graduate advisor and the Graduate Dean. From the 21st class day through the last class day, graduate students can drop a class with permission from the instructor, graduate advisor, and the Graduate Dean.

Attendance Policy:
Regular attendance and participation are essential and expected. Random attendance will be taken throughout the semester by various means and it can affect your grade up to 5% (participation grade). "A student who is absent from a class or examination for the observance of a religious holy day may complete the work issued within a reasonable time after the absence, if proper notice has been given". The deadline for notification of such an absence is 14 days prior to the class absence.

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

Computer Usage:
Some homework assignments and the term projects will require extensive use of computers. The students will use the energy and moisture simulation software eQUEST, EnergyPlus, WUFI, etc. for projects and homework assignments. The software will be installed on computers in ECJ building, but the eQUEST and EnergyPlus software can be downloaded to personal computers for free at: http://www.doe2.com/equest/ and http://apps1.eere.energy.gov/buildings/energyplus/. Also, basic knowledge of any programming language (Matlab, Fortran, C, etc.) is beneficial.

Final Exam:
This course will not have a final exam. The final project and the final project presentation will replace the final exam.

Projects:
There will be two projects assigned. The midterm projects will count for 10% and final for 30% of your final grade. Midterm project will be an individual project.

Final Project Description:
It will be a group project where students have a choice to select their project topic in the area of building energy analysis. Each group will prepare a two page proposal to define the project objectives, scope, methodology, and deliverables. Students are welcome to propose problems from their current research or future career. Based on these proposals the course instructor will refine the final project scope and deliverables for each group, so that each student will have the same final project work load. Each group member will have the same project grade.

Important Dates:
Test: October 27 (will be confirmed)
Midterm project due: November 1
Preliminary results for the final project due: November 15
Final project due: December 5

Due Dates Policy:
All assignments are due at the end of the day and those turned in late will count off 10% per day.

TENTATIVE COURSE SCHEDULE

Date	Topics	Due date for
08/25	Course introduction and terminology	
08/30	Heat transfer review	HW0
09/01	Heat transfer review	
09/06	Heat transfer review	
09/08	Solar radiation	
09/13	Weather boundary conditions	HW1a
09/15	Thermal processes in building elements	
09/20	Thermal modeling of basic building elements	HW1b
09/22	Unsteady-state heat transfer	
09/27	System of equations for the building systems	
09/29	Numerical methods for solving system of equations	HW2
10/04	Internal and external heating/cooling load	
10/06	Design condition vs. typical weather conditions – TMY data	
10/11	Simplified and detailed simulation techniques and programs	HW3
10/13	Moisture transfer – fundamentals	
10/18	Control of moisture transfer	
10/20	Midterm project assignment	HW4
10/25	Review, for midterm test	
10/27	Test	Test
11/01	Introduction to parametric analysis	Midterm project
11/03	Final project assignment	
11/08	Primary and secondary HVAC systems	
11/10	HVAC and automatic control	
11/15	Modeling the HVAC systems and equation solving	Final project - prel. results
11/17	Interaction of building envelope and HVAC system	
11/22	Building simulation as requirement for the LEED certification	
11/29	Detailed energy simulations - Energy Plus and other tools	
12/01	Energy modeling and life cycle cost analysis	Final project