CE 397 Building Energy Management Systems

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

Course Numbers and Credits: CE 397(15695) 3 credits

Course Website: http://www.ce.utexas.edu/prof/Novoselac/classes/CE397b

Classroom and Time: Tuesday and Thursday ECJ 9.236, from 12:30 p.m.-2:00 p.m.

Prerequisites: Graduate students in CAEE, or other engineering fields. Student should have at least one Fluid Dynamics course and at least one Thermodynamics course. HVAC Design course is desired but not necessary. Undergraduate students interested in this course will need permission from the instructor.

Instructor: Dr. Atila Novoselac
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Office Hours Tuesday and Thursday from 11:00 am to noon. 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:

This course examines the underlying thermodynamic principles of advanced building heating, ventilation, and air-conditioning (HVAC) systems, studies integration of power production systems with building environmental control systems, and provides design principles of centralized heating and cooling systems.

Course Objectives:

1) Learn about advanced building energy and environmental control systems.
2) Obtain knowledge about district cooling and heating systems.
3) Gain the skills and tools necessary to evaluate integration of sustainable energy production systems to a given building site.
4) Study application of combined heat and power systems in a specific building or group of buildings.
5) Conduct thermal, hydraulic and economic modeling of integrated building energy systems for planning and design.

Textbook:
There will not be a required textbook for this course. Instructor will provide students with hard or electronic copies of reading materials.

References: (optional - available at Engineering Library)
Kuehn, T.H.; Ramsey, J.W.; Threlkeld, J.L. 1998. *Thermal Environmental Engineering (3rd Edition)* Prentice Hall ISBN: 0139172203.

Taylor, S., P. Dupont, B. Jones, T. Hartman and M. Hydeman. 2000. *Chilled water plant design guide*. San Francisco: Pacific Gas & Electric Company.

ASHRAE. 2007. *ASHRAE Handbook--2007 HVAC Systems and Equipment*. Atlanta: American Society of Heating, Refrigerating, and Air-Conditioning Engineers.

ASHRAE Handbook--2009 Fundamentals. Atlanta: American Society of Heating, Refrigerating, and Air-Conditioning Engineers.

Course Topics:

1. Class intro and HVAC systems review	2 wks
2. Building ventilation heat recovery systems	2 wks
3. Thermal (solar and waste heat) powered desiccant systems	1 wk
4. Centralized (compressor and sorption based) cooling systems	3 wks
5. Centralized heating systems	1 wk
6. District heating and cooling distribution systems	1 wk
7. Geothermal buildings systems	1 wk
8. Combined heat and power systems	2 wks
9. Systems integration and control	1 wk
	Total 14 wks

Grading:	Exam	30%
	Classroom Participation	5%
	Homework Assignments	35%
	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://deanofstudents.utexas.edu/conduct/.

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://catalog.utexas.edu/general-information/appendices/appendix-c/educational-records/.

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 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. **Students with 20-hr/week GRA/TA appointment or a fellowship may not drop below 9 hours.**

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:
Some homework assignments and the final project will require extensive use of computers. Basic knowledge of data processing and programing (in Matlab, Mathcad or other equation solver tool) is expected.

Project:

There will be one project accounting for 30% of the course final grade. It will include thermal, hydraulic and economic modeling of integrated building energy systems for planning and design. Each student 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, so that each student will have the same final project work load. The project will include student project presentations during the final week of classes.

Written Exam:
This course will have one exam at the second half of April. The exam will cover principles of building energy systems and advanced HVAC components covered in the course.

Date	Topics	Due date /comment
01/17	Course introduction and examples	
01/19	Review Cooling Cycles	
01/24	No class	Visit to DTU (make-up: filed trip)
01/26	Review Psychometrics & Mixtures	
01/31	No class	ASHRAE meeting (make-up: out of class exam)
02/02	Absorption Cooling systems	HW1
02/07	Mixture and Cooling cycles	
02/09	Absorption Cooling Cycle Analyses	
02/14	H2O-NH3 Systems	
02/16	H2O-NH3 vs. Li-Br - Systems	
02/21	Power generation and CHP	HW2
02/23	Boilers	
02/28	Boilers and Energy storage systems	
03/02	Thermal storage systems	
03/07	Hydronic Distribution Systems	
03/09	Distribution Systems and pumps	
03/21	Pumps	HW3
03/23	Modeling of pumps and plumbing systems	
03/28	Chillers	
03/30	Cooling tower and chiller modeling	
04/04	Chilled water storage tank	
04/06	Ice, PCM and other thermal store systems	
04/11	District systems	HW4
04/13	District heating vs. district cooling	Out of class Exam
04/18	Heat Recovery and Dehumidification	
04/20	Desiccant Systems	
04/25	Low Temperature Systems	
04/27	Geothermal systems	
05/02	Control and optimization	
05/04	Course summary (project presentations)	Project