

BCN 6584C

## **Building Energy Modeling**

Fall 2016; 3 Credit Hours

**INSTRUCTOR:** Ravi S. Srinivasan PhD, CEM, LEED AP, GGP  
M.E. Rinker, Sr. School of Construction Management  
University of Florida

**OFFICE:** Rinker 316

**OFFICE HOURS:** Wednesdays: 11:00 AM to 2:00 PM; and by  
appointment + by appointment

**CONTACT:** For email messages to instructor, use: [sravi@ufl.edu](mailto:sravi@ufl.edu)  
For phone messages to instructor, use: 352.273.1164

**CLASS SESSIONS:** Wednesdays, 1:55-4:55 (Periods 7,8,9)

**ROOM:** Rinker 215 BCN Computer Lab

**COURSE WEBSITE:** <http://lss.at.ufl.edu>

### **PURPOSE OF COURSE**

As energy is becoming more precious, it is crucial for building sector to proactively design and operate high performance buildings. To achieve higher standards in building design and operation, a solid foundation of energy engineering and sustainability principles is essential. This course builds essential knowledge of building energy and sustainability, and provides necessary background to use building energy simulation software tools. The goal of this course is to use building performance modeling as an investigative tool to improve overall energy efficiency of the building.

### **COURSE OBJECTIVES FOR STUDENTS**

- To recognize various building energy simulation tools, types and capabilities.
- To learn underlying concepts, modeling inputs and analysis methods of building components such as envelope, lighting, occupants, equipment, process loads, HVAC and service hot water systems.
- To model building performance using energy simulation software.
- To interpret simulation results and troubleshoot errors.
- To use measured building energy data to calibrate simulation model.
- To evaluate EEMs and perform parametric analysis to identify optimal solutions.

### **READING MATERIAL**

There are no text books for this course. However, the instructor will provide electronic copies of technical articles including course related conference proceedings and journal manuscripts; book chapters; and handouts. These can be accessed in the Resources folder of the e-learning website for the course -- they are organized by modules. The course also uses video recordings of software simulation.

Assigned readings and video viewings must be completed prior to class. For some sessions, students must post comments regarding these readings prior to class using the website's Discussion board. You will also be notified when you must complete a short quiz on the reading material before class session.

eQUEST v3.64 building energy modeling software will be used in the course. Download instructions available here: <http://doe2.com/equest/>

## CLASS ATTENDANCE AND PARTICIPATION

Class sessions consist of brief lectures/presentations by the instructor, class discussions, student presentations, other hands-on work, and guest speakers. You are expected to attend all classes and participate fully. The instructor will not summarize the required readings, but we will use them as a platform for discussion and critique. Your course evaluation includes attendance and participation. In order to participate fully, read all the required readings before these sessions.

The schedule of course topics is at the end of this syllabus. These dates are subject to change depending upon guest lecturer rescheduling.

Attendance is required. Arriving late to class or leaving early may be counted as an absence. Missed class sessions result in grade deductions unless there is an acceptable reason for absence according to university policies. These include: illness, serious family emergencies, special curricular requirements, military obligation, severe weather conditions, religious holidays, participation in official university activities, and court-imposed legal obligations (e.g., jury duty or subpoena). To be excused, absences must be properly documented and a make-up determined. The number of excused absences for the semester is limited. Grade deductions begin after a student has missed 3 sessions.

Participation in class discussion and online discussion is expected and counts towards your grade. To minimize distractions, all cell/smart phones must be turned off during class sessions. Please bring laptops to class so that you can refer to reading, and video material during class sessions. Otherwise, laptops must be turned off during class.

## QUIZZES, EXAMS, PROJECT AND GRADING POLICY

There will be two quizzes (5 points each); a mid-term exam (20 points); a final exam (30 points); and a final project (40 points). Final project grade will be assigned based on the following (EEMs & Results: 80%; Innovation: 10%; and Presentation: 10%).

Quizzes and exams will be held in class, while the project will be submitted electronically to the instructor via the course website. The final project is considered late if it arrives a minute past the due date. Final submissions after the stated deadline will be deducted 10% for every day late.

Policy for assigning grade points to letter grades will follow UF grading policies, which can be found at: [catalog.ufl.edu/ugrad/current/regulations/info/grades](http://catalog.ufl.edu/ugrad/current/regulations/info/grades).

Letter Grade	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	E
Numeric Grade	93-100	90-92	87-89	83-86	80-82	77-79	73-76	70-72	67-69	63-66	60-62	0-59

## MAKE-UP POLICY

There is no make-up policy for missing quizzes or exams with the exception of medical and religious reasons.

## GETTING HELP

For issues with technical difficulties for e-learning in Sakai, please contact the UF Help Desk at:

- [Learning-support@ufl.edu](mailto:Learning-support@ufl.edu)
- (352) 392-HELP - select option 2
- <https://lss.at.ufl.edu/help.shtml>

Should the final project submission occur after the due date solely as a result of technical issues, a request to the instructor for consideration **must** be accompanied by the ticket number received from LSS when the problem

was reported to them. The ticket number will document the time and date of the problem. You must e-mail your instructor within 24 hours of the technical difficulty.

Other resources are available at <http://www.distance.ufl.edu/getting-help> for:

- Counseling and Wellness resources
- Disability resources
- Resources for handling student concerns and complaints
- Library Help Desk support

Should you have any complaints with your experience in this course please visit <http://www.distance.ufl.edu/student-complaints> to submit a complaint.

## UF AND GENERAL POLICIES

**University policy on accommodating students with disabilities.** Students requesting accommodation for disabilities must first register with the Dean of Students Office (<http://www.dso.ufl.edu/drc/>). The Dean of Students Office will provide documentation to the student who must then provide this documentation to the instructor when requesting accommodation. You must submit this documentation prior to submitting final project or taking the quizzes or exams. Accommodations are not retroactive, therefore, students should contact the office as soon as possible in the term for which they are seeking accommodations.

**University policy on academic misconduct.** Academic honesty and integrity are fundamental values of the University community. Students should be sure that they understand the UF Student Honor Code at <http://www.dso.ufl.edu/students.php>.

**Course evaluations.** Students are expected to provide feedback on the quality of instruction in this course based on ten criteria. These evaluations are conducted online at <https://evaluations.ufl.edu>. Evaluations are typically open during the last two or three weeks of the semester; but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu>.

**Netiquette: communication courtesy.** All members of the class are expected to follow rules of common courtesy in all email messages, threaded discussions and chats. Please refer to: <http://teach.ufl.edu/docs/NetiquetteGuideforOnlineCourses.pdf>

**Religious observances.** Please inform the instructor of any religious holidays or other days of special religious significance that may interfere with your participation in this class so that she can accommodate these events.

**Special consideration.** The principle of equal treatment of all students is a fundamental guide in responding to requests for special consideration. No student shall be given an opportunity to improve a grade that is not made available to all members of the class. This policy is not intended to exclude reasonable accommodation of verified student disability or the completion of work missed due to religious observance, verified illness, or absence due to circumstances beyond your control. Reconsideration of subjective judgments of an individual student's work will be done only if all students in the class can be and are given the same consideration.

**Sexual harassment.** Sexual harassment is reprehensible and will not be tolerated by the University. It subverts its mission and threatens the careers, educational experience, and well being of students, faculty, and staff. The University will not tolerate behavior between or among members of the university community that creates an unacceptable working environment.

**Stress.** The academic year presents many opportunities as well as challenges, sometimes resulting in increased stress. If at any time you feel anxious or stressful, please contact the instructor or the university's Counseling + Wellness Center at <http://www.counseling.ufl.edu/cwc/Default.aspx>.

## COURSE TOPICS AND SCHEDULE

*Topics/dates subject to change upon availability of guest speakers*

<p>Introduction to Building Energy Modeling, Tools &amp; Capabilities, Energy Standards, Protocols, and Rating Systems</p>	<p>Energy Crisis, Codes &amp; Milestones</p> <ul style="list-style-type: none"> <li>• Global trends, “Peak Oil 2020,” building energy use &amp; challenges</li> <li>• History &amp; definitions of energy standards, codes and protocols</li> <li>• Energy policies EPCA &amp; EPAct</li> </ul> <p>Need for Building Energy Evaluation</p> <ul style="list-style-type: none"> <li>• Importance of energy evaluation</li> <li>• Terminology &amp; metrics</li> <li>• Approach to new &amp; existing buildings</li> </ul> <p>Weather &amp; Climate Characteristics</p> <ul style="list-style-type: none"> <li>• Terminology</li> <li>• Earth: orbit, rotation, sun’s radiation</li> <li>• Climate zone characteristics</li> </ul> <p>Building Energy Analysis (BEA)</p> <ul style="list-style-type: none"> <li>• Introduction to Building Energy Analysis</li> <li>• BEA as a tool for decision-making</li> <li>• BEA as a process-oriented approach</li> </ul>
	<p>Building Energy Analysis Tools, Types &amp; Capabilities</p> <ul style="list-style-type: none"> <li>• System sizing tools &amp; system performance evaluation tools</li> <li>• Macroscopic &amp; Microscopic analysis tools</li> <li>• Calculation methodologies</li> <li>• BES tools availability &amp; capability</li> <li>• BES tools approved by US Dept. of Energy</li> <li>• Emerging Technologies: BIM, gbXML, Predictive Model Controls, Component-based Modeling</li> </ul> <p>Building Energy Standards, Protocols &amp; Rating Systems</p> <ul style="list-style-type: none"> <li>• ASHRAE Building Energy Quotient Program</li> <li>• ASHRAE Fundamentals 2009</li> <li>• ANSI/ASHRAE/IESNA 90.1-2010; 100-2006</li> <li>• ANSI/ASHRAE 62.1-2010; 55.1-2004</li> <li>• ANSI/ASHRAE/USGBC/IES Standard 189.1-2009</li> <li>• State Energy Codes</li> <li>• Greenhouse Gas Emission &amp; Carbon Neutrality</li> <li>• CIBSE Applications Manual 10</li> <li>• ENERGYSTAR Portfolio Manager</li> <li>• COMNET Modeling Guidelines</li> <li>• International Performance Measurement &amp; Verification Protocol</li> <li>• IRS Tax Deduction</li> <li>• Net Zero Energy Buildings</li> <li>• Building Rating Systems (LEED, BREEAM, GGP, GREENSTAR, GREEMARK)</li> </ul>

Introduction to eQUEST: Hands-on Session	<p><b>Quiz #1</b> (will cover Aug 26 and Sept 2 lectures; time allotted: 30 mins)</p> <p>The following topics will be covered in-depth under each section (related to eQUEST energy modeling software):</p> <ul style="list-style-type: none"> <li>• Building Envelope</li> <li>• Operating Schedules</li> <li>• Lighting &amp; Daylighting Integration</li> <li>• Occupants, Equipment &amp; Process</li> <li>• HVAC Systems &amp; Controls</li> <li>• Domestic Hot Water Systems</li> </ul>
Energy Modeling – Rinker Hall Hands-on Session	Thermal zoning criteria, schedules, and assumptions
	Building Envelope: construction (roof, walls, slab-on-grade, windows, skylights)
	Internal Loads: occupants, lighting / daylighting, infiltration, misc. electrical loads.
	<b>Mid-term Exam</b> (will cover all prior lectures, and will include software simulation)
	HVAC: system and plant specification inputs
	Results interpretation and validation, calibration with existing measured data; and Energy Efficiency Measures (EEMs)
	<p><b>Quiz #2</b> (will cover Oct 14 and Oct 21 lectures; time allotted: 30 minutes)</p> <p>The following topics will be covered in-depth:</p> <ul style="list-style-type: none"> <li>• Troubleshooting errors</li> <li>• Analyzing and proposing additional EEMs</li> <li>• Complying with ASHRAE 90.1 Appendix G requirements</li> </ul>
Energy Modeling – Rinker Hall (Final Project) Hands-on Session	Students work on final project in class
	<i>Holiday</i>
	Students work on final project in class
	<i>Holiday</i>
	Students work on final project in class
	<b>Final Exam</b> (comprehensive exam and will include software simulation)
	<b>Final project:</b> project report due date and project presentation by students