



MARYLAND APPLIED GRADUATE ENGINEERING

ENPM 670-- Advanced Energy Audit, Modeling, and Management of Building Systems

Note: This course will be taught in the future under a new title– De-carbonization of Building Systems through Energy Audit, Renewable Energy, and Electrification

Prof. Michael Ohadi Syllabus, ENPM 670- Fall 2022 Last updated: 08/27/2022

Fall 2022, Thursday 4:00-6:40 PM

Instructors:

Dr. Andres Sarmiento (AS); Email: aspc@umd.edu
Dr. Roxana Family (RF); Email rfamily@umd.edu;
Dr. Michael Ohadi (MO); E-mail:ohadi@umd.edu; phone: X55263; Lead
advising instructor and course coordinator

Course Objectives:

- a) Understanding of socio-economics impacts on energy consumption
- b) Understanding of building energy consumption and its major contributing sources
- c) Understanding of utility rate schedules and energy consumption costs
- d) Ability to model and analyze the energy consumption of buildings
- e) Understanding of technologies for renewable energy production and utilization f) Gain experience in energy auditing and analysis of residential and commercial buildings g) Understanding of fundamentals and technologies for electrification of buildings
- h) Learn the latest development technologies for building envelop, heating/cooling equipment, lighting, and automation technologies
- i) Apply your knowledge to the design of net-zero carbon emission buildings and communities

Office Hours: There will be no formal office hours. However, questions by e-mail are welcome and will be responded to as quickly as possible. Phone calls or web-based meetings will be scheduled as needed when requested in advance.

Textbook: There is no required textbook for the course. Recommended reference books are given below. Powerpoint lecture notes will be provided and uploaded the day before the lecture day to have the opportunity to review the lecture materials ahead of our classroom time.

Recommended

Reference Text Book [Energy Audit of Building Systems: An Engineering Approach](#), Second



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Recommended

Reference Book Guide to Energy Management 7 Ed. by
Capehart, Barney L., Wayne C.
Turner, and William J. Kennedy.
CRC Press, Inc.,
2011.



Course Prerequisites:

Students are expected to have prior knowledge of undergraduate basic thermodynamics and heat transfer.

Course Description:

This course is designed to provide students with fundamentals and applications of the de-carbonization of building systems for energy sustainability through energy audit and efficiency measures, renewable energy, and electrification. Topics covered include societal and economic motivations for de-carbonization of buildings; building energy auditing and energy consumption analysis; lighting systems and controls; heating/cooling and ventilation systems; integrated building automation systems; fundamentals of renewable energy for building applications; fundamentals of building electrification and energy storage devices; emerging technologies for building energy sustainability.

Topics & Lecture Dates:

The tentative lecture and exam dates are given in the course lecture schedule (below). The scheduled lecture may change subject to weather and other circumstances. However, any changes in the exam dates will be announced at least three days in advance.

Grading Policy:

Final grades will be based on the following breakdown
Two Quizzes & the Mid Term 50% (25% + 25%)
Course Project(s) 50% (20% + 30%)
Final Exam Will be devoted to project presentations

Tentative Grading Scale:

A+: 100-96 A: 95-91 A-: 90-89

B+: 88-86 B: 85-82 B-: 81-78

C+: 77-76 C: 75-71 C-: 70-68

D+: 67-65 D: 64-62 D-: 60-61

F: below 60

Note: The above grading scale is meant to serve as a guideline.

Homework:

Homework will be assigned but will not be collected. Solutions to homework will be posted on

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the course website per the schedule listed on the syllabus. You are urged to work on the problems yourself before looking at the solutions.

Project(s)

One residential building will be assigned for energy audit and will require the submission of a powerpoint presentation report. This can include the student's own residence. A simplified commercial building will be assigned for the commercial energy audit problem. Project 1 will have 20% and project II 30% of your grade, or total of 50% of the course grade.

Quiz:

Quiz is normally designed for a duration of 30 minutes. It may include both statements type as well as problems to solve type questions. Thus, you need to have your calculator with you. You need to clearly show your work. This is important for all quizzes, exams, projects, and other assignments to avoid losing points that otherwise are deserved. Grading errors due to lack of clarity of the paper will be strictly your responsibility.

Midterm and Final Exams:

Midterm and final exams typically consist of two parts: the first part will focus on statement-type questions and the 2nd part on problems to solve. Necessary tables are provided or you are asked ahead of time to bring them with you to the exam. You need to have your calculator with you. The Final Exam will be cumulative and test the knowledge gained in the entire course. Mid-term will be an hour exam (60 minutes duration). The final exam will also be a 60-minute duration.

Make Up Policy:

No makeup will be given for quizzes. If you miss a Quiz and your excuse is accepted then the weight of that Quiz will be distributed on the remaining Quizzes. Make-up for midterm or final examinations will only be given in exceptional cases when the individual can demonstrate with proper documentation that the emergency involved was beyond his/her control. In case of any religious observance, the student must personally hand over a written notification of the projected absence in the first week of the semester.

Academic Honesty:

All students are expected to uphold the highest ethical and professional of academic honesty (see the University of Maryland Code of Academic Integrity). A violation of the UMD Code of Academic Integrity includes (but is not limited to) intentionally using or attempting to use unauthorized materials, information, or study aids in any academic exercise. Please be advised that a failure to accept and exhibit the fundamental value of academic honesty may result in a

course grade of 'XF'

Course Website:

We will use ELMS (<https://elms.umd.edu>) as the primary site to archive lecture notes and course related materials and share information. If you are unfamiliar with ELMS Learning System, it would be a good idea to familiarize yourself with its features now. In case of any technical difficulty, please send an email to elms@umd.edu. Should you prefer assistance over the phone, you can call the OIT Help Desk at 301-405-1400. You are required to check the course website on a regular basis.

Path to Success in ENME 670:

The key factors for success in this course are to stay focused and fulfill your responsibilities. The course material is inherently cumulative such that the material learned in one session will be used in the following sessions. If you lose your focus for a day or two, it will be extremely hard for you to come back to track. Please feel free to send your questions by e-mail at any time. We will be happy to assist you as necessary.

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Course Schedule:

The following is a tentative course schedule. It may change during the semester as circumstances arise. Consult the course website for updated versions. Any changes in Quiz and/or Exams dates will be announced at least three days in advance.

Week	Date	Topics Covered/Instructor
1	9/1/22	Introduction of the course and significance of building energy consumption/ MO
	9/1/22	Societal and economic motivations for de-carbonization of buildings/ MO
2	9/8/22	Utility Rate Schedules--Understanding Energy consumption costs; HW No 1 assigned/AS
	9/8/22	Energy Audit Procedures and Energy Benchmarking/ Energy Use Intensity (EUI)/ AS
3	9/15/22	Emerging technologies for energy sustainability in buildings—Net Zero Energy Buildings/ AS
	9/15/22	Residential Energy Audit; HW No 1. Solutions posted; HW No 2 assigned/AS
4	9/22/22	Residential Energy Audits (Cont.); Residential Audit Project Assigned/AS
	9/22/22	Lighting System Audit, HW No 2 solutions posted/RF
5	9/29/22	Building Envelope Audit, I; RF
	9/29/22	Building Envelope Audit II; Also QUIZ I /RF
6	10/6/22	HVAC Audit I; RF
	10/6/22	HVAC Audit II/ RF
7	10/13/22	Energy Economics Analysis; HW No 3 Assigned/AS

	10/13/22	LEED and Energy Star Standards; Also, problem-solving session; Res. Audit Reports Due; AS
8	10/20/22	Leeds & Energy Star (Cont.); Also, ASHRAE Energy Efficiency Standards; Commercial Audit Project Assigned; HW No 3 solutions posted. AS
	10/20/22	Boiler/steam systems principles & energy saving techs AS
9	10/27/22	Building energy systems—Processing of air and related HVAC equipment; Also, Commercial audit project discussions; HW No 4 Assigned AS
	10/27/22	MID-TERM AS/RF
10	11/3/22	Building Automation and Control Systems/ RF
		Commercial audit project walkthrough/site visit, Bldg. 223, Energy Research Facility
11	11/10/22	Site visit, Kim Engineering building AS/RF/MO
	11/10/22	Renewable energy and its applications in buildings AS
12	11/17/22	Renewable energy and its applications in buildings (Cont); HW No 4 assigned. AS
	11/17/22	Renewable energy and its applications in buildings (Cont.), AS
13	11/24/22	Thanksgiving
	11/24/22	Thanksgiving
14	12/1/22	Fundamentals of Building Electrification. HW No 4 solutions posted RF
	12/1/22	Fundamentals of Building Electrification (Cont). RF
15	12/8/22	Fundamentals of Building Electrification (Cont). Commercial Audit Reports Due; RF
	12/8/22	Emerging technologies for energy sustainability in buildings—Thermal management of Data Centers; Also Quiz 2/RF
Final Exam	Per University schedules	Commercial Audit project Presentations AS/RF