COLUMBIA UNIVERSITY
School of Professional Studies

Master of Science in Sustainability Management

SUMA PS5135 Analysis for Energy Efficiency
Scheduled Meeting Times: TBD
Number of Credits (3)
Elective

Instructor: Tom Sahagian, ts3449@columbia.edu
Office Hours: By appointment, date and time TBD, or after class or via Zoom.
Response Policy: Please send me an email with questions or to set up an appointment.
I will respond within 24 hours with an answer or to set up a meeting time.

Facilitator/Teaching Assistant: TBD
Office Hours: TBD
Response Policy: TBD

Course Overview

This Physical Dimensions/Quantitative Analytics course will provide real-world information about energy management. Through lectures, problem sets, and readings, students will learn about energy audits, analyze the energy performance of various technologies, and evaluate the energy use and financial impacts of upgrades and operational improvements to building systems. Pending permission from various NYC job sites, we will also make a handful of field trips to view various energy-consuming technologies in vivo.

Learning objectives

Energy management is the cornerstone of any sustainability initiative. How energy is used -- and frequently, wasted -- has a significant impact on an organization's cash flow and profitability, not to mention the impact on the environment.

All sustainability managers should be able to distinguish between sustainability projects that are worth pursuing and those that are not.

This Physical Dimensions/Quantitative Analytics course will provide real-world information about energy management and about how energy-consuming systems, especially residential and commercial building systems, operate, and how they can be made to operate more efficiently.

This class requires at least a passing familiarity with Microsoft Excel. Although there are no course prerequisites, some basic math will be necessary to complete the coursework.

If you prefer not to work with technical information and perform calculations, this class is not for you.

Readings

Most weeks students are assigned readings in Courseworks to be completed before each class. The readings are intended to prepare students for the material covered during class and serve as reference material for assignments.

Course Books:

Sustainable Energy — Without the Hot Air, by David J.C. MacKay. The book is available for free in electronic form at https://www.withouthotair.com/order.html, but I *strongly recommend* buying the paperback edition as well. I've asked the CU bookstore to order copies.

Guide to Energy Management (a/k/a GEM), by Barney L. Capehart, Wayne C. Turner and William J. Kennedy Eighth Edition, ISBN: 0-88173-765-8 or ISBN: 978-1-4987-5933-5

Note: The previous edition of this book is available electronically and is suitable for use in the course.

Assignments and Assessments

Problem Sets:

Problem sets will assess the ability of each student to:

1. Follow the analysis method at issue as presented in the lectures (partial credit will be given for partial success) and;
2. Derive the answer to the problem based on the information provided.

Generally, credit for methodology is 50% and credit for the answer is 50%. However, this may vary somewhat depending on the individual homework problem.

You may directly email the instructor or the CA; please cc: both.

Submit assignments in Excel unless otherwise directed; assignments submitted in other than Excel format will receive no credit. Late assignments will lose points as outlined below under Course Policies unless there are extenuating circumstances (to be decided at the sole discretion of the instructor). The chances of receiving an extension will be inversely proportional to the proximity to the due date a student brings the issue to the instructor's attention. Last-minute and after-due-date requests are unlikely to be approved except under the most unusual circumstances.

Presentations

Depending on the size of the class, each student or small group of students may be required to make a brief presentation to the class on a technical topic.

Midterm and Final Exams:

The two exams will be take-home assignments. The midterm will include problems designed to ensure understanding of the key concepts covered in class up to that point. The final will be similar, except that it will address all the material covered during the semester.

Exams are not group assignments. Students who collaborate or receive outside help on an exam will receive a zero for that exam.

As with the problem sets, the exams will be graded on the ability of each student to:

1. Follow the analysis method at issue as presented in the lectures (partial credit will be given for partial success) and;
2. Derive the answer to the problem based on the information provided.

The midterm exam will be posted on TBD between 9:00 pm and 10:00 pm and will be due on TBD by 6:00 pm. Please note that questions about the exam should be submitted before TBD at 6:00 pm. Questions submitted after that time may not be addressed.

The final exam will be posted on TBD between 9:00 pm and 10:00 pm and will be due on TBD by TBD. Please note that questions about the exam should be submitted before TBD at 6:00 pm. Questions submitted after that time may not be addressed.

Questions about either exam must be limited to clarifying the language of the problems. Questions about methodology or whether or not your approach is on the right track will not be answered.

Evaluation and Grading

The final grade will be calculated as described below, based upon a standard A-F scale:

FINAL GRADING SCALE

Grade	Percentage
A+	98–100 %
A	93–97.9 %
A-	90–92.9 %
B+	87–89.9 %
B	83–86.9 %
B-	80–82.9 %
C+	77–79.9 %
C	73–76.9 %
C-	70–72.9 %
D	60–69.9 %
F	59.9% and below

Final grades are calculated by assigning the following weights:

Assignment/Assessment	% Weight	Individual or Group/Team Grade
Class Participation/Class Presentation	10%	Indiv/Group
Problem Sets	40%	Individual
Midterm	25%	Individual
Final Exam	25%	Individual

Midterm exams submitted late will receive a letter grade deduction (10 points off) for each day or part of a day they are late, for up to 5 days; after 5 days the exam grade will be zero. Final exams submitted late will be treated the same way.

It is every student's responsibility to confirm they have successfully submitted their homework and exams into Courseworks prior to the relevant deadline. Excuses along the lines of "I thought I submitted it but then after the deadline, I discovered I hadn't" will not be accepted.

If you encounter a problem submitting an assignment or exam into Courseworks, please immediately contact CUIT or the Instructor for support.

Expectations

We cover a lot of material in this class. To make the most of our collective time, and to keep from needlessly having points deducted from your final grade, please take care to:

- Check your CU email at least once a day. Some class announcements will be made via Courseworks, but others will be via email. If you receive an email from either the instructor or the CA, and it asks you to confirm receipt, please do so asap.

- It is the student's responsibility to secure the instructor's prompt and timely approval for their presentation topic. If the instructor has for some reason not responded to a student's proposal, the student must actively follow up with the instructor.
- Attend every class, and arrive on time. If you plan to skip class, for whatever reason, please inform the instructor in advance.
- Leave your phone off and in your bag or backpack during class
- I'd prefer it if you took notes on paper instead of your laptop, but it's up to you. Studies show that more information is retained when students write notes longhand.
- Read all the assigned material before the relevant class
- Include your name or initials in your Excel homework files and filenames
- Use commas in numbers greater than 999
- Avoid excessive decimal places in your homework answers

Course Schedule/Course Calendar (field trip dates are tentative)

Note: Readings should be completed before the relevant class. Each week will include readings in addition to the course book sections shown below. A homework (HW) assignment due date will generally be the day before the following class.

Date	Topics and Activities	Course Book Readings	Assignments
Week 1	Course Intro; Intro to Building Systems	GEM Chapter 5 except Sec. 5.15 (read before the first class session)	HW
Week 2	Energy Audits & Modeling	GEM Chapter 2; Sec 11.3 Mackay pp viii-34, Sec. A	HW
Week 3	Energy Benchmarking and Consumption Measurement	GEM Sec. 1.6.3.1 Mackay Sec. 5-10, Sec. C	HW
Week 4	Utility Rates and Billing; Lighting	GEM Chapters 3 and 6; Sec. 8.10.5 Mackay Sec. 11-17, Sec. F, G, H	HW
Week 5	Ventilation; Properties of Air; Stack Effect; Air Handling	GEM Sec. 8.1-8.3; 8.6-8.8; 8.11 Mackay Sec. 18-20	HW
Week 6	Building Envelope and Heat Transfer	GEM Sec. 8.10; Chapter 13 Mackay Sec. 21-24; Sec. E pp. 289-300	HW Field Trip 1
Week 7	Review for midterm		Midterm
Week 8	Space Heating and Domestic Hot Water	GEM Chapter 9-	HW Field Trip 2
Week 9	Space Cooling; Heat Pumps	GEM Sec. 8.4, 8.5, 8.9, 15.7.2 Mackay Sec. 25-27, Sec. E pp. 300-306	HW Field Trip 3
Week 10	TBD		TBD
Week 11	Controls; Electrification	GEM Sec. 8.14, 11.1, 11.2, Chapter 17 Mackay Sec. 28-32	HW; Field Trip 4
Week 12	Passive House, Solar Photovoltaics, Wind Power	GEM Sec. 15.2--15.5 Mackay Sec. B, D	HW; Field Trip 5
Week 13	Time Value of Money	GEM Chapter 4	HW
Week 14	Guest Lecture – Carbon Capture		HW
Week 15	Optional Final Exam Review Session. Final Exam Due TBD, by TBD pm.		

Course Policies

Participation and Attendance: You are expected to complete all assigned readings, attend all class sessions, and engage with others in class discussions. Your participation will require that you answer questions, defend your point of view, and challenge the point of view of others. If you need to miss a class for any reason, please discuss the absence with the instructor in advance.

Late Work: Homework other than exams that is not submitted on the relevant due date without advance notice and permission from the instructor will have 5 points deducted for every day or part of a day it is late.

Citation & Submission: All written assignments must use APA, cite sources, and be submitted to the course website via the assignments link (not via email, unless arranged specifically).

School and University Policies and Resources

Copyright Policy
Please note—Due to copyright restrictions, online access to this material is limited to instructors and students currently registered for this course. Please be advised that by clicking the link to the electronic materials in this course, you have read and accept the following:

> The copyright law of the United States (Title 17, United States Code) governs the making of photocopies or other reproductions of copyrighted materials. Under certain conditions specified in the law, libraries and archives are authorized to furnish a photocopy or other reproduction. One of these specified conditions is that the photocopy or reproduction is not to be "used for any purpose other than private study, scholarship, or research." If a user makes a request for, or later uses, a photocopy or reproduction for purposes in excess of "fair use," that user may be liable for copyright infringement.

Academic Integrity
Columbia University expects its students to act with honesty and propriety at all times and to respect the rights of others. It is fundamental University policy that academic dishonesty in any guise or personal conduct of any sort that disrupts the life of the University or denigrates or endangers members of the University community is unacceptable and will be dealt with severely. It is essential to the academic integrity and vitality of this community that individuals do their own work and properly acknowledge the circumstances, ideas, sources, and assistance upon which that work is based. Academic honesty in class assignments and exams is expected of all students at all times.

SPS holds each member of its community responsible for understanding and abiding by the SPS Academic Integrity and Community Standards posted at https://sps.columbia.edu/students/student-support/academic-integrity-community-standards. You are required to read these standards within the first few days of class. Ignorance of the School's policy concerning academic dishonesty shall not be a defense in any disciplinary proceedings.

Diversity Statement
It is our intent that students from all diverse backgrounds and perspectives be well-served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that the students bring to this class be viewed as a resource, strength and benefit. It is our intent to present materials and activities that are respectful of diversity: gender identity, sexuality, disability, age, socioeconomic status, ethnicity, race, nationality, religion, and culture.

Accessibility
Columbia is committed to providing equal access to qualified students with documented disabilities. A student's disability status and reasonable accommodations are individually determined based upon disability documentation and related information gathered through the intake process. For more information regarding this service, please visit the University's Health Services website: https://health.columbia.edu/content/disability-services.

School Policies and Expectations:
Accessibility Statement – I want you to succeed in this course. Contact disability@columbia.edu<mailto:disability@columbia.edu> for learning accommodations.

Names/Pronouns
You deserve to be addressed in a manner that reflects your identity. You are welcome to tell me your pronoun(s)and/or name (if different from University records) at any time, either in person or via email.

Discrimination
We embrace the diversity of gender, gender identity & expression, sex, sexual orientation, race, ethnicity, national origin, age, religion, disability status, family status, socioeconomic background, and other visible and non-visible identities. Columbia University does not tolerate unlawful discrimination, discriminatory harassment, sexual assault, domestic violence, dating violence, stalking, or sexual exploitation and all such conduct is forbidden by Columbia University Policy.

Duty to Report
You deserve a University community free from discrimination, harassment, and gender-based misconduct including sexual harassment, sexual assault, domestic and dating violence, stalking, and sexual exploitation. It is therefore University policy to require Columbia faculty and staff to report to EOAA any instance or allegation of prohibited conduct involving any undergraduate or any graduate student that is disclosed to, observed by, or otherwise known to that employee. This requirement to report is in place to help ensure that students are provided appropriate resources and to allow the University to mitigate harm to our community.

Confidential Resources
There are confidential resources on campus who do not have a Duty to Report, including:
* Sexual Violence Response & Rape Crisis/Anti-Violence Support Center (SVR)
* Ombuds Office
* Medical Services
* University Counseling and Psychological Services
* University Pastoral Counseling
* Columbia Office of Disability Services
University employees working in a confidential capacity will not report information shared with them.

Inclusion
In the M.S. in Sustainability Management program, faculty and staff are committed to the creation and maintenance of "inclusive learning" spaces – classrooms and other places of learning where you will be treated with respect and dignity, and where all individuals are provided an equitable opportunity to participate, contribute, and succeed. All students are welcome regardless of race/ethnicity, gender identities, gender expressions, sexual orientation, socio-economic status, age, disabilities, religion, regional background, Veteran status, citizenship status, nationality and other diverse identities that we each bring to class.

Class Recordings
All or portions of the class may be recorded at the discretion of the Instructor to support your learning. At any point, the Instructor has the right to discontinue the recording if it is deemed to be obstructive to the learning process.

If the recording is posted, it is confidential and it is prohibited to share the recording outside of the class.

SPS Academic Resources
The Division of Student Affairs provides students with academic counseling and support services such as online tutoring and career coaching: https://sps.columbia.edu/students/student-support/student-support-resources.

Columbia University Information Technology
Columbia University Information Technology (CUIT) provides Columbia University students, faculty and staff with central computing and communications services. Students, faculty and staff may access University-provided and discounted software downloads.

Columbia University Library
Columbia's extensive library system ranks in the top five academic libraries in the nation, with many of its services and resources available online.

The Writing Center
The Writing Center provides writing support to undergraduate and graduate students through one-on-one consultations and workshops. They provide support at every stage of your writing, from brainstorming to final drafts. If you would like writing support, please visit the following site to learn about services offered and steps for scheduling an appointment. This resource is open to Columbia graduate students at no additional charge. Visit http://www.college.columbia.edu/core/uwp/writing-center.

Career Design Lab
The Career Design Lab supports current students and alumni with individualized career coaching including career assessment, resume & cover letter writing, agile internship job search strategy, personal branding, interview skills, career transitions, salary negotiations, and much more. Wherever you are in your career journey, the Career Design Lab team is here to support you. Link to https://careerdesignlab.sps.columbia.edu/

Netiquette
{Only applies to courses using online platforms}

Online sessions in this course will be offered through Zoom, accessible through Canvas. A reliable Internet connection and functioning webcam and microphone are required. It is your responsibility to resolve any known technical issues prior to class. Your webcam should remain turned on for the duration of each class, and you should expect to be present the entire time. Avoid distractions and maintain professional etiquette.

Please note: Instructors may use Canvas or Zoom analytics in evaluating your online participation.

More guidance can be found at https://jolt.merlot.org/vol6no1/mintu-wimsatt_0310.htm

Netiquette is a way of defining professionalism for collaborations and communication that take place in online environments. Here are some Student Guidelines for this class:

- Avoid using offensive language or language that is not appropriate for a professional setting.
- Do not criticize or mock someone's abilities or skills.
- Communicate in a way that is clear, accurate and easy for others to understand.
- Balance collegiality with academic honesty.
- Keep an open-mind and be willing to express your opinion.
- Reflect on your statements and how they might impact others.
- Do not hesitate to ask for feedback.
- When in doubt, always check with your instructor for clarification.