Georgia Tech

School of Civil and Environmental Engineering

CEE 4160: Smart and Sustainable Cities | Fall 2019

SYLLABUS

NOTE: This syllabus is subject to change. Any changes will be communicated in advance.

COURSE:	Smart and Sustainable Cities | 3 Credits Location t.b.d. Canvas | http://canvas.gatech.edu
INSTRUCTOR:	John E. Taylor, PhD Frederick Law Olmsted Professor, Civil & Envir. Eng. Mason 4140C | jet@gatech.edu | www.ndl.gatech.edu Office Hours: t.b.d.

COURSE OVERVIEW:

Over half of the world's nearly 7.5 billion people live in cities, which have experienced unprecedented urban growth over the past several decades. This number is predicted to increase to 70% by 2050, with much of this growth occurring in less developed countries. However, urban population growth is posing numerous challenges, which spurred the United Nations to develop the "New Urban Agenda" as a roadmap for building cities that are engines of prosperity and culturally rich centers of social engagement, while still protecting the environment. This course will be taught in three parts. In Part I "City Infrastructure Systems," the course will focus on providing a broad overview of how cities function by examining the various city infrastructure systems (e.g., transportation infrastructure, power supply, water distribution, buildings, etc.) and their interdependencies in relation to one another and to human and natural systems. This will be explored in the context of the role city infrastructure systems play in understanding and achieving urban sustainability. Part II "Sustainability Challenges" will examine the key challenges urban environments face adopting the United Nations Sustainable Development Goals. Finally, in Part III of the course on "Smart Solutions," will explore emerging solutions in place or under development to address such challenges. In this final course module, students will form into teams to conceptualize solutions to a selected challenge through a team semester project. Final project teams will identify and explore interdisciplinary solutions, which may be analytical (data-driven) or theoretical (focused on modeling and design).

COURSE LEARNING OBJECTIVES:

Upon successful completion of this course, students should be able to:

- Recognize and classify urban infrastructure systems.
- Identify sustainability challenges in cities.
- Describe and critique ongoing research and practical solutions to address sustainability challenges.
- Propose smart city solutions to sustainability challenges.
- Communicate effectively with urban stakeholders about smart solutions to sustainability challenges.
- Collaborate effectively in an interdisciplinary team environment.

COURSE PREREQUISITES:

Engineering Economics, or its equivalent, must be taken prior to taking this course. This can be met by having taken Civil Engineering Systems (CEE 3000) or Engineering Economy (ISYE 3025).

COURSE AFFILIATIONS:

This course serves as an approved elective (3hrs) for engineering undergraduates pursuing a *Leadership Studies* minor with a focus on *Global Engineering Leadership* at the School of Civil and Environmental Engineering. This course is also part of Georgia Tech's Serve-Learn-Sustain (SLS) initiative, which provides students with opportunities to combine their academic and career interests with their desire to make worthwhile contributions to the world and build sustainable communities where people and nature thrive, in Georgia, the United States, and around the globe. More information about SLS can be found at www.serve-learn-sustain.gatech.edu. Visit the website to sign up for the SLS Email List, view the full list of affiliated courses, and find links to Facebook, Instagram and Twitter.

LEADERSHIP DEVELOPMENT COURSE COMPONENT:

As noted, this course is an approved elective in the *Global Engineering Leadership Minor*. As such, it incorporates a leadership development component. In this course that component is communication—both written and oral. The leadership development component is integrated into the course instruction and deliverables, so even students who are not part of the leadership minor will participate in these activities. The deliverables—presentations and reports—will not look radically different than deliverables in other engineering courses. However, because of the leadership development component, there will be a significant emphasis placed on communication instruction. Dr. Lisa Rosenstein, Director of the Engineering Communications Program in CEE, will guest lecture and prepare course materials for the leadership development component.

COURSE MATERIALS:

Textbook: There is a required textbook for this course, Urban Engineering for Sustainability by Dr. Sybil Derrible. Smart and sustainable cities is a relatively new concept insofar as courses go, hence, we are using this draft textbook which will soon be published by MIT Press.

Other required readings: Additional case study readings required over the duration of the semester will be provided (or links provided) on Canvas.

CASE STUDIES:

Case Studies are intended to allow you to consider urban sustainability challenges and smart solutions in place to address sustainability challenges in cities. These assignments must be submitted by the start of class on the day they are due. These should be completed *individually* or *in pairs* (as noted in the assignment). Case Study discussion questions will be posted on T-Square in advance of the due date (see course schedule for exact dates). These write-ups should be one (1) page maximum in length.

HOMEWORK:

Homework assignments are intended to evaluate your understanding of various city infrastructure systems, sustainability challenges, and smart solutions. These are *individual* assignments and must be submitted as assigned (see the course schedule for exact dates).

MIDTERM EXAM:

The midterm exam will take place as described in the detailed course schedule in the regular classroom. The exam will be on the material covered up to that point on city infrastructures systems and city sustainability challenges (see the course schedule for exact dates).

TEAM PROJECT:

Students will form into 10 comparably sized teams (teams will have a minimum of 3 and maximum of 5 students per team, although we expect teams to typically include 4 team members) to complete a semester project. Student teams will work together throughout the semester to conceptualize an engineering solution to a sustainability challenge. The purpose of this project is to give you an opportunity to increase your understanding of urban sustainability challenges with an emphasis on engineering smart solutions for such challenges. The project requires a written report, a set of milestone deliverables, and oral presentations.

Team project reports should be a maximum of 15 pages (including all appendices). Reports should be double-spaced, should have 1" margins, and use a 12-point font size. In addition to the correctness, insightfulness, referencing, and thoroughness of your analysis, you will be evaluated on the professionalism of your written presentation. Team members are expected to contribute equally to this project. In cases where specific members of the team do not contribute their share of the work, the written report should contain a statement to this effect. Please include a section in the project report about how you managed collaboration or communication with your team as well as other city stakeholders (market testing). Written team project reports are due as noted in the course schedule at the end of this syllabus.

The structure of your report will look similar to the structure outlined below. You do not have to follow this format exactly.

Title: Using X to Solve Y

Executive Summary
Table of Contents
List of Figures and Tables
1.0 Introduction
    Problem Description
    Research Objective
2.0 Current Approaches
3.0 Proposed Solution
4.0 Impacts
5.0 Market Test
6.0 Limitations
7.0 Conclusion and Recommendations
8.0 References

The graphics that you include must meet standard practices and standards of excellence for data displays. Additionally, all graphical elements must be appropriately integrated into the written document and cited if taken from another source. Use ASCE or IEEE documentation format.

Team solution presentations should be a maximum of 10 minutes. In addition to the correctness and thoroughness of your presentations, you will be evaluated on the professionalism of your oral presentation. Your classmates will also prepare a peer evaluation of your presentation, which will influence the presentation grades. Dr. Rosenstein will lecture on the two different types of presentations—pitch and final presentation—you will be required to deliver. She will then post lecture materials and instructions on the course website.

STUDENT EVALUATION/GRADING:

Grade components will be weighted as follows in computation of the final course grade:

CASE STUDIES	**12%**	
HOMEWORKS	**10%**	
MIDTERM EXAM	**35%**	
TEAM PROJECT	**38%**	
PARTICIPATION	**5%**	**[In-Class Assignment Submissions]**

POLICIES:

Honor Code: Academic Integrity is expected of all students at all times. The Georgia Tech Academic Honor Code applies to all work in this class. Any student suspected of cheating or plagiarizing on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations. For any questions involving these or any other Academic Honor Code issues, please the instructors or www.honor.gatech.edu. For information on Georgia Tech's Academic Honor Code, please visit http://www.catalog.gatech.edu/policies/honor-code/ or http://www.catalog.gatech.edu/rules/18/.

Accommodations for Students with Disabilities: If you are a student requiring special accommodation, contact the Office of Disability Services at (404) 894-2563 or http://disabilityservices.gatech.edu/, as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Assignments: Assignments are due as assigned in the detailed course schedule, unless otherwise indicated. Assignments will NOT be accepted for credit or graded if late unless an excused absence occurs on the day the assignment is due. Assignments must be well organized to get full credit. All necessary materials and assignments will be posted on the course website (Canvas | http://canvas.gatech.edu). Students are expected to regularly log in to the Canvas website and check for updated announcements, course materials and assignments.

Class Participation: Class participation points are given to encourage your active class participation and discussion. You will be rewarded with a perfect score as long as you frequently come to class and actively contribute to the class discussion during recitations and lectures. Many class sessions have individual and group in-class exercises which are to be submitted and will be used to calculate class participation scores. You may track your class participation grade by visiting and reviewing the participation scores on the course website (Canvas | http://canvas.gatech.edu).

Office Hours: Students are encouraged to make use of Instructor office hours as needed. Please keep two general principles in mind: **(1) make sure you have read the material and attempted the work prior to seeking assistance** and **(2) it is better to ask for help earlier than later**.

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DETAILED COURSE SCHEDULE

NOTE: This course schedule is subject to change. Any changes will be communicated in advance.

WEEK	DAY/DATE	TOPIC: FOCUS	DELIVERABLE	
			Assignment	
1		Intro to Course		
		Intro to CIS Module: Humans, Infrastructure, & Technology		
2		CIS: Buildings		
		CIS: Mobility	HW #1: Buildings	
3		CIS: Energy		
		CIS: Water	HW #2: Mobility	
4		CIS: Module Conclusion (CIS Integration)	Case #1: CIS in your City	
		Intro to SC Module	HW #3: Energy	
5		SC: UN Sustainable Development Goals I		
		SC: UN Sustainable Development Goals II	HW #4: Water	
6		SC: UN Sustainable Development Goals RCE Atlanta	Case #2: UN SDGs in your City	
		SC: Module Conclusion → Pitch Fest	HW #5: Integrated CIS	
7		Communications (Writing & Presentation) –Guest Lecture: Lisa Rosenstein		
		Project Overview & Team Formation/Building	Project Milestone #1: Submit Team SC & Roles	
8		NO CLASS (Fall Student Recess)		
		Midterm Exam Review		
9		Midterm Exam		
		SS: Into to SS Module: Smart vs. Sustainable Cities		
10		SS: Comparative Analysis of Smart Solutions	Case #3: Smart Solution Comparative Analysis	
		SS: Envisaging Smart Sustainable Cities	Case #4: Future Challenge/Technology Vision	
11		SS: Sensing & Data –Lecture/Activity	Project Milestone #2: Sensing & Data	
		SS: Modeling & Visualization –Lecture/Activity	Project Milestone #3: Modeling & Visualization	
12		SS: Simulation & Analytics –Lecture/Activity	Project Milestone #4: Simulation & Analytics	
		SS: Workshop + Past Projects	Project Milestone #5: Workshop Results	
13		SS: Smart Solutions –Integrating Technological Solutions	Case #5: Smart Solution Critical Analysis	
		SS: Module Conclusion → Solution Presentations A		
14		SS: Module Conclusion → Solution Presentations B		
		NO CLASS (Thanksgiving)		
15		Starting a "Smart" Solution Venture	Case #6: Podcast 1, 2 & 3	
		Communications (Rehearsing Your Pitches) –Guest Lecture: Lisa Rosenstein		
16		Panel-Judged Elevator Pitches		

CIS: City Infrastructure System
SC: Sustainability Challenge
SS: Smart Solution