CIV_ENV 201 Engineering possibilities: Decision Science in the Age of Smart Technologies

Instructor: Amanda Stathopoulos; Department of Civil and Environmental Engineering

- **Credits**: 1 Unit credit; Three 50-minute lectures/week
- **Instructor**: Amanda Stathopoulos, PhD
- **Schedule**: Monday, Wednesday, and Friday at 10-10.50am
- **Textbook**: No Formal Textbook, readings are assigned on Canvas
- **Location**: Tech MG28
- **Office hours**: 11.00-12.00 Wednesdays in the instructor's Office: Tech A312
- **E-mail**: a-stathopoulos@northwestern.edu
- **TA/Grader**: Gretchen Bella
- **Prerequisites**: none, the class is designed as a gateway class for CEE students
- **Course requirement**: elective part of Civil Engineering Major Requirements: Basic Courses (for both civil and environmental majors)

Catalog Description

This undergraduate course guides students through the many challenging questions related to reshaping cities to become more efficient, sustainable, and equitable, by using smart interventions and data-driven solutions. Students will learn about theories, tools, and perspectives needed to understand smart city interventions from a broader societal perspective. Students will gain insights and skills on how to critically evaluate 'smart city' interventions designed to improve life in cities, including infrastructure design, and digital, behavioral, and technological measures.

Specific Course Goals

1. Identify leading theories of urban systems and smart city interventions from literature and case-studies
2. Build knowledge of visualization and quantitative approaches
3. Evaluate smart city solutions in a holistic way
4. Cultivate critical thinking skills
5. Cultivate ethical problem solving
6. Work effectively in teams to identify research approaches and produce reports and presentations
7. Clearly communicate information in written and oral formats

Specific Course Outcomes

1. Students will demonstrate **knowledge** of the basic theories and facts of urban systems and the role of 'smart' technologies, digitization, and connectivity, covering the benefits/challenges of cities, and how innovation originates in, and impacts, cities, and communities.
2. Ability to **quantify and visualize** data about important urban issues and challenges (e.g., transportation access, air quality, waste management, energy consumption, food access). Students will demonstrate deeper knowledge of a chosen domain, including domain-specific data collection, curation, management, and visualization.
3. Students will demonstrate the ability to **design an evaluation framework** that considers multiple alternatives, and multiple decision factors and examines tradeoffs, as well as identifies impacts between different parts of the system, or different groups in society.
4. Students display **critical thinking skills**. In this course this is centered on: a) consideration of different perspectives, stakeholders, and trade-offs; b) consideration of the problem/technology implementation context; and c) ability to incorporate both qualitative and quantitative aspects, d) understanding the limitations/pitfalls of technological solutions.
5. **Ethical problem solving**: Ability to articulate, measure and understand the broader context and impact of engineering innovation. Show the ability to promote transparency, equity, and incorporate multiple perspectives in projects. Show awareness that innovation occurs in contexts where some communities have been impacted negatively or marginalized.

6. **Teamwork**. Students will show the ability to work effectively in teams. This is centered on demonstrating: a) participation in group decision-making and coordination, b) prioritizing team project plans, schedules, and equitable management of people.
7. **Communication**: Students will demonstrate skills of effective skills in audience-specific written, graphic/visual, oral, and interpersonal communication Students will be communicating both about technology and engineering concepts, and show an understanding of the broader impacts and innovation context.

ABET student learning outcomes addressed by the course

Table 1. Goals and assessment overview

Course goals	Program ABET outcomes	Criteria met via [1]	Performance indicator	Assessment	Proposed Action
1 - **knowledge**	7	Quiz, Individual Report	Quiz #1 Q1-7 Quiz #2 Q1-11 IR #1	100 > 80% 97 > 80% 80 > 80%	2, 4
2 - **quantify and visualize**	6	Individual Report	IR #2 IR#3 Quiz #1 Q2,Q5,Q6	94 > 80% 97 > 80% 97 > 80%	2
3 - **design evaluation**	2	Team Report	Team Report #1 Team Report #2	100 > 80% 100 > 80%	
4 - **critical thinking**	2	OP; Quiz; Team Report	Team OP #2 Quiz #2 Q7, Q8 IR #2	100 > 80% 86 > 80% 100 > 80%	2
5 - **ethical**	4	Quiz 2 Individual Report	Quiz #2 Q3, Q10 IR #3	80 > 80% 97 > 80%	2, 3
6 – **teamwork**	5	OP, Team Report	Team OP #1 Team OP #2 Team Report #1 Team Report #2	100 > 80% 100 > 80% 100 > 80% 100 > 80%	
7 - **Communication**	3	Individual Report, OP	IR #1 IR #2 Team OP #1 Team OP #2 Team Report #1 Team Report #2	80 > 80% 94 > 80% 100 > 80% 100 > 80% 100 > 80% 100 > 80%	4

Notes: [1] IR = Individual Report, OP=Oral presentation.

Proposed action: **2.** This year, I split a longer quiz into two shorter ones: a mid-term and final quiz, and also added additional in-class practice quizzes. This has helped increase background knowledge and ability to do ethics reasoning. **3**. This year I added a newly designed lecture activity on ethics in the smart city era, as well as a new report assignment (IR #3) to specifically delve in to ethics reasoning and promote student creativity in this area. This has resulted in improved skills in the class. **4**. I will add new online material on written and oral communication to provide support for students in preparing written reports, and oral presentations. The first report IR#1 would benefit from more background on correct scientific writing, citations, and constructing an argument from literature.

Evaluation methods

Progress in the course will be monitored by a series of class activities, canvas discussions, quizzes, reports and oral presentations. The grades will be weighted in the following manner:

- Class participation 15%
- 3 Individual reports 45%
- 2 team reports 20%
- 2 team presentations Exams 20%

The grading will align with the following expectations for performance.

A = 93-100; A- = 90-92.9; B+ = 83-89.9, B = 75-82.9; B- = 68-83 C+ = 58-68, C = 50-57.9; C- = 43-39.9; D = 25-42.9 F < 25