CIV_ENV 295 Section 23

Climate Action:

Mitigation, Adaptation & Geoengineering

Lectures: MWF 10:00 – 10:50 am, Tech XXXX

Canvas website: https://canvas.northwestern.edu

Instructors: Robert Dalrymple and Kimberly Gray

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Course description: Societies are dealing with the impacts of a rapidly changing climate as they struggle with rising sea levels and worsening heat waves, floods, droughts and wildfires. The role of engineers, particularly civil and environmental engineers, is critical in tackling these challenges and transitioning to a carbon balanced (negative?) economy. The goal of this course is to explore the many strategies that lead to an adaptive and resilient future where people live, work, move, and build in an ecologically sound, economically viable and social just manner.

Prerequisites: CHEM 131/151/171 or equivalent, MATH 224

Readings: Posted on Canvas

Evaluation methods: Progress in the course will be monitored by a series of problem sets, class activities and exams. The grades will be weighted in the following manner:

Activity	% of Total
Class Project (+ Group Evaluation)	35%
Homework Assignments	25%
Examinations (2)	2 @ 20 = 40%

Late assignments will not be accepted without prior approval from the professor or teaching assistant.

Tentative Schedule:

Week 1:
1/6 – Course Introduction
1/8 – Climate Drivers (Physics of solar radiation, earth's black body T, role of atmosphere, GHGs, albedo, solar energy units)
1/10 – Climate Drivers (Carbon cycle & budget; Evidence of anthropogenic climate change)

Week 2:
1/13 – Climate Drivers (Climate models (GCM), Ocean acidification and implications, clouds, permafrost extinctions, GHG warming potentials; weather≠climate)
1/15 – Climate Drivers & Tipping Points (Case Study: The Arctic)
1/17 - Extreme Events (Heat waves, Floods, Droughts, Wildfires)

Week 3:
1/20 - MLK HOLIDAY
1/22 – Extreme Events (Economic, public health, refugees/migration)
1/24 – Coastal Hazards (Global Sea Level Rise, Relative Sea Level Rise, Hot spots; THC slowing)

Week 4:
1/27 - Natural Hazard (Hurricanes/ typhoons & Storm Surge; Case Study – New Orleans & Lousiana Coast)
1/29 - Storm Surge & RSLR (Case Studies: NYC & Miaml)
1/31 - Introduction to Climate Action tool box (Major sources of C-emissions; Energy use today)

Week 5
2/03 - Mitigation (Conservation & efficiency in building, transportation, lighting, etc)
2/05 - Deep Decarbonization (renewable energy; cement, steel & freight)
2/07 - Deep Decarbonization & Carbon Capture & Storage (large scale energy v small scale; coupled systems)

Week 6
2/10 - Adaptation: Coastal Engineering; Harden, Soften Coastlines
2/12 - Adaptation – Retreat; Case studies, The Netherlands
2/14 – EXAM 1

Week 7
2/17 - Other Adaptation Examples (Heat/cooling, flooding (GI, floating buildings), drought (H2O storage, grey water, reduced demand, pricing)
2/19 - Other Adaptation Examples (migratory corridors, seed banks, wetlands & coastal marshes
2/21 – Resilience (Define, don't tip; how is this different from adaptation)

Week 8
2/24 - Design for Resilience

2/26 – Geoengineering (BECCS; TEA & limits)
2/28 – Geoengineering (Enhanced weathering - TEA and limits

Week 9
3/02 – Geoengineering (Afforestation & Reforestation; TEA and limits)
3/04 – Geoengineering (Solar Radiation Management & other extreme engineering (glaciers, mirrors in space, etc.))
3/06 - Cities as ground zero for climate action

Week 10
3/09 - Cities as ground zero for climate action
3/11 – Class project presentations
3/13 - Class project presentations

3/16 – Exam 2

Course goals

By the end of the course the students should be able to:

1. Research information in the scientific peer-reviewed literature
2. Assemble and synthesize information & data to answer research questions
3. Clearly communication information in written and oral formats
4. Identify the major technological, economic, social & political issues associated with climate change.
5. Identify and describe possible engineering solutions to climate change; identify costs, benefits, tradeoffs
6. Perform fundamental mathematical calculations of climate-related data, unit conversions, scaling.

Collaborations and Academic Ethics

Discussion is encouraged between class participants however assignments turned in for grades should be the work of the individual. Sources of information for all work should be carefully cited. Violations of the principles of academic integrity can result in severe penalties, including expulsion from the University. All students should review College guidelines on Academic Integrity.

Disability Accommodations

Any student with a documented disability needing accommodations is requested to speak directly to the Office of Services for Students with Disabilities (SSD) (847-467-5530) and the instructor as early as possible in the quarter (preferably within the first two weeks of class). All discussions will remain confidential.