NORTHEASTERN UNIVERSITY HONORS PROGRAM
CIVIL & ENVIRONMENTAL ENGINEERING

HONR 3309A or CIVE 4777 – Climate Change: Resilient Cities and Ecosystems
Summer 2 – 2023

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Course description: This course, which will be offered in India and Nepal, combines the science, engineering, economic, social, and policy aspects of how cities and megaregions can prepare themselves for climate change and natural hazards. Weather extremes have been highlighted as a global risk of highest concern by the recent Global Risk Report of the World Economic Forum, which has also ranked failure of climate adaptation and mitigation as the among the highest risks. Climate change impacts are expected to be felt in both coastal and inland cities from Mumbai to New York and New Delhi to Phoenix. Among the relatively near-term impacts will be melting of glaciers in the mountains as well as sea and land ice in the poles. The Himalayas (literal meaning: abode of snow) glaciers, which feed among the largest rivers in the world in some of the most densely populated regions of the global including the Indian subcontinent and China, are in danger of receding owing to climate change. Meanwhile, climate induced changes in the patterns of the Indian and South Asian monsoons, among the most challenging of climate phenomenon to understand the model, are hard to pin down but are likely to cause significant changes in the space-time distribution of rainfall. The impacts on water resources, food, and energy, infrastructures, ecology, and biodiversity, are expected to be enormous. We will learn about these concepts at four locations: the national capital region of India, specifically, Delhi and Agra, which includes the "teardrop in the cheek of Time" aka the Taj Mahal of Agra, the coastlines of "God's own country" of Kerala, as well as the Tibetan Buddhist enclave of Leh in Ladakh often called "Little Tibet" within the Himalayas, as well as Kathmandu, the national capital of the Himalayan country of Nepal.

Students will learn about the science of (what has sometimes been called) "global weirding": this refers to the possibility of unprecedented changes in weather and hydrological extremes or regional climate patterns caused by global warming and natural climate variability. The physical science basis of climate, and computer models of the earth system, will be introduced together with their uncertainties. Statistical and machine learning (or AI) tools for the analysis of climate model and remote sensor data will be presented. The concept of urban resilience will be introduced and developed, with a focus on the ability to prevent natural hazards from turning into catastrophic disasters in densely populated and vulnerable regions. The ability to prevent the disruption of critical functions, and recover these functions should they get disrupted, will be discussed. The multi-faceted aspect of resilience will be examined, and will include governance, emergency response, infrastructural, informational, social, and policy aspects. Decision support tools will be introduced.

Students will be working in groups to produce integrated reports and presentations discussing the science, engineering, and policy challenges in transforming vulnerable urban and coastal regions to climate resilient cities. Students will be divided into groups for the war-games. These groups will represent sectors such as Water Resources, Climate and Landuse, Infrastructures, Policy and Behavioral science, and Resilient City Enterprises. Inter-sector discussions and negotiations will be moderated.

The reports will closely examine whether and how societies can learn from each other by comparing, for example, various parts of the US with the regions we are visiting. This course requires enthusiasm to explore and research another culture, and an interest in interdisciplinary learning that can contribute to providing solutions for urgent national and global priorities. The course will formally meet daily during the first half, when fundamental principles will be introduced in a classroom setting, and weekly assignments. The second half will be devoted to projects in small groups, some of which may involve students and faculty or other invited guests, and to the development of reports and presentations. While the course will formally meet twice during the week in this second phase, informal discussions with the instructor and supporting teaching assistants, as well as with interested guests, will be encouraged and expected. A two-part report is required, where the first should be on a topic of general interest, and the second on first-hand experiences of Northeastern students in India, and their understanding of how cities such as Boston and are similar or different and may learn from each other, understanding climate extremes and developing adaptation measures.

At the conclusion of this course students will be able to:

1. Develop a basic understand of the science of climate change and natural hazards.
2. Understand the concept of resilience as this applies in urban or coastal settings.
3. Learn introductory concepts and tools for pertinent analysis and decision making.

Assignments and Grading:

(1) Homework Assignments: There will be three homework assignments covering the three broad topics: climate science, urban resilience, and tools or methods. The completed assignments will need to be submitted individually and may entail a combination of standard problem sets and questions that require out of the box and innovative ideas.
The three homework assignments will be weighed equally and will comprise 45% of your final Grade.

(2) Written Report and Oral Presentation: The written report will comprise two parts as described earlier, and end with a group presentation. The contribution of each student in the group project will be carefully monitored, and the final grades will be based on both the overall team performance and the contributions of individuals within the group.
The written report is worth 30% of your final Grade. I will be grading you on content, organization, participation, and overall presentation. Attendance, participation, and enthusiasm will account for 15% of the Grade.

Note: Non-Honors students can take this course and will get credits for CIVE 4777

TEXTBOOKS and REFERENCES:

1. Critical Infrastructures Resilience: Policy and Engineering Principles: By Auroop Ratan Ganguly, Udit Bhatia and Stephen E Flynn. Routledge (Taylor & Francis). 132 pages. March 2018.
2. What we know about climate change: By Kerry Emanuel. Second Edition. MIT Press.
3. UCCRN ARC3 2011: "Climate Change and Cities: First Assessment Report of the Urban Climate Change Research Network (ARC3)", 2011: Downloadable from http://uccrn.org/publications/
4. IPCC SREX 2012: "Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX)" a Special Report by the Intergovernmental Panel on Climate Change (IPCC), 2012: Downloadable from http://ipcc-wg2.gov/SREX/

BACKGROUND NEWS ARTICLES:

1. A quote from a March 2012 news report in USA Today on the IPCC SREX titled "Global warming linked to deadly, costly weather disasters": http://usatoday30.usatoday.com/weather/climate/globalwarming/story/2012-03-28/climate-change-global-warming-weather-disasters-floods-droughts-storms/53826590/1
   "The greatest danger from extreme weather is in highly populated, poor regions of the world, the report warns, but no corner of the globe — from Mumbai to Miami — is immune ... The 594-page report blames the scale of recent and future disasters on a combination of man-made climate change, population shifts and poverty."
2. A November 2012 report in the NY Times titled "Protecting the City, Before Next Time" on hurricane preparedness post Sandy: http://www.nytimes.com/2012/11/04/nyregion/protecting-new-york-city-before-next-time.html

BACKGROUND OP-EDs (Note: Relevant for both CIVE 4777 and CIVE 4778):

1. ***Newsweek*** on Global Weirding: https://www.newsweek.com/climate-change-causing-climate-chaos-weather-extreme-events-1739426
2. ***New York Times*** on Rebuilding after Hurricanes: https://www.nytimes.com/2022/10/03/climate/hurricane-ian-rebuilding.html
3. https://www.cnn.com/2017/08/29/opinions/dutch-america-storms-opinion-ghitis/index.html
4. https://in.reuters.com/article/analysis-cyclone-phailin-odisha/analysis-how-a-prepared-india-saved-lives-during-monster-storm-phailin-idINDEE99D04T20131014
5. http://www.millenniumpost.in/opinion/confronting-weather-extremes-260245
6. http://www.millenniumpost.in/opinion/gearing-up-for-natures-wrath-262846
7. http://www.millenniumpost.in/opinion/opinion-251528
8. http://www.millenniumpost.in/opinion/water-water-everywhere-269919
9. http://www.millenniumpost.in/opinion/urban-sustainability-and-resilience-255286
10. http://www.millenniumpost.in/climate-change-democracy-overrated-179299

NOTE: The background and references in CIVE 4778 are relevant for CIVE 4777 as well

NUpath Attributes: This course (HONR 3309-A or CIVE 4777), together with the companion course (HONR 3309-B or CIVE 4778) for this Dialogue, may collectively satisfy three NUpath attributes: **ND** (*Engaging with the Natural and Designed World*), **AD** (*Analyzing and Using Data*), and **IC** (*Interpreting Culture*).