CEE 6445 Geotechnical Earthquake Engineering
Spring 2021

Instructor: Prof. Jorge Macedo, Ph.D., P.E
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Time and Place: TR 9:30 am – 10:45 am (Remote Synchronously).

Office Hours: Tuesday 3:00 pm – 5:00 pm.

Course Objective:

The course objective is to familiarize graduate students with the field of geotechnical earthquake engineering. Lectures will focus on describing earthquake hazards and developing methods used for seismic analysis and design of geotechnical engineering systems. The assignments and project will focus on reinforcing essential concepts. The canvas website will be used to share information in this course.

Course Textbook:

- Kramer, S.L. (1996) Geotechnical Earthquake Engineering, Prentice Hall, NJ.
- Several other publications will be cited during the course. The most important of these publications will be available in the "Files" folder at the Canvas course website.

Supplemental Materials:

- Chopra, A. (2005). Earthquake Dynamics of Structures: A Primer, Monograph No. MNO-11, Earthquake Engineering Research Institute, Oakland, California, 150 pp.
- Ishihara, K. (1996). Soil Behaviour in Earthquake Geotechnics. Oxford University Press, New York, 350 pp.
- McGuire, R.K. (2004). Seismic Hazard and Risk Analysis, Monograph No. MNO-10, Earthquake Engineering Research Institute, Oakland, California, 240 pp.
- Reiter, L. (1991). Earthquake Hazard Analysis. Columbia University Press, New York, 254 pp.
- Idriss, I.M. and Boulanger, R.W. (2008). Soil Liquefaction During Earthquakes, Monograph No. MNO-12, Earthquake Engineering Research Institute, Oakland, California, 262 pp.
- The PEER ground motion database at: https://ngawest2.berkeley.edu/

Assignments:

Assignments are mandatory – all assignments must be handed in to receive a grade. Assignments are due at the start of class on the due date. Late assignments will be docked 15% the first week and 10% every subsequent week. Assignments will be graded on content, clarity, and neatness.

Readings:

Reading assignments will be given throughout the semester. Please check the course website regularly for updates.

Project:
A project will be assigned and due during the last day of class. The projects will be presented during the last week of classes. More details about the project will be disseminated during Week 3

Grading: Assignments: 20%, Exams 60%, Project 15% Participation/Quizzes 5%

COURSE OUTLINE

The course will break down roughly into the following content modules.

I. Introduction

II. Earthquakes and seismic design concepts

- Fundamentals of vibration
- Earthquake fundamentals and engineering seismology
- Ground motion parameters; response spectra
- Ground motion prediction models
- Probabilistic seismic hazard assessment
- Deterministic seismic hazard assessment
- Ground motion time histories for seismic design (general concepts/procedures)
- Performance-based design philosophy in earthquake engineering

III. Site/spatial effects on ground shaking characteristics

- Recorded ground motions and local site effects
- Near fault ground motions
- Site-dependent design motions
- Dynamic soil properties, laboratory and in Situ Measurements
- 1-D site response, site amplification/deamplification, equivalent linear site response analysis
- Advanced site response analyses
- soil-structure interaction

IV. Soil liquefaction

- Soil liquefaction effects on infrastructure
- Liquefaction Behavior of Soils
- Pore water pressure generation during cyclic loading
- Laboratory tests and their limitations
- Evaluation of field data
- Critical state soil mechanics and soil liquefaction
- Procedures for evaluating liquefaction triggering
- Procedures for evaluating the effects of liquefaction, including soil-structure interaction
- Design and remediation considerations

V. Seismic performance of slopes and earth structures

- Pseudostatic analyses and the seismic coefficient
- Seismically induced permanent displacements
- Deterministic, pseudo-probabilistic and fully probabilistic procedures
- Seismic design of earth embankments, heap leach pads and solid-waste landfills
- Seismic design of earth retaining systems

VI. Advanced topics

- Overview of numerical modeling in geotechnical earthquake engineering (FEM, FDM, MPM)
- Overview of seismic risk assessment
- Reliability applications

VI. Course Summary and Review

Collaboration policy

For all assignments, students may collaborate through discussion, but all calculations, coding (when needed), and writing should be done individually. Students who submit unattributed material will be found in violation of the Honor code (see Academic Integrity below).

Academic Integrity:

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. 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/19/.

Accommodations for Individuals with Disabilities

If you are a student with learning needs that require 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.