

TEXAS TECH UNIVERSITY
Department of Civil, Environmental & Construction Engineering

CE 5331-005: Performance-Based Engineering
DD/DD HH:MM-HH:MM pm @ location
Semester YYYY – instructor_name

Instructor

instructor.name, credentials

Assistant Professor

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Welcome to Performance-Based Engineering (PBE): This new TTU class provides an opportunity for advanced graduate students to utilize the framework of performance-based engineering to aid decision making. Performance-based engineering estimates the hazard at the site and system of interest, in order to assess system response, predict damage extent, and evaluate system performance in terms of expected loss or other metrics. Successfully implemented in earthquake engineering during the past decade and recently adopted in other fields, PBE has demonstrated a growing influence in research and practice.

Upon mastering the PBE framework which is probabilistic in nature, students will be able to transfer PBE concepts to useful applications. The course evolves from the general framework to specific applications and potential extensions which welcome student inputs from various disciplines. General topics include: hazard, response, damage and loss analyses; synthesis of recent advancement in research and practice with case studies; emphasis on the impact of earthquakes on buildings, with extensions to other hazards (e.g., sea-level rise, tsunamis, storm surges, hurricanes, tornadoes, volcanoes, droughts, and floods) and systems (e.g., ports, off-shore structures, bridges, dams, aviation, communication, water, and energy). Students will be able to develop component skills, integrating skills, and transfer the knowledge gained to applicable settings and problems.

One unique opportunity this year is a workshop “Advancing Infrastructure Resilience: Mastering Extremes in Complex Environments” - featuring TED talks and World Café - hosted by TTU in collaboration with [Fraunhofer EMI](#) (Europe's leading application-oriented research organization) as part of German-US Year @ McKenzie-Merket Alumni Center on October 9, 2018.

Learning Objectives

This course is designed to introduce graduate students to concepts and applications of performance-based engineering. Upon completion of this course, students will be able to:

- Describe, explain, and debate the framework of performance-based engineering to aid decision making.
- Define domain-specific intensity measures, engineering demand parameters, damage measures, and decision variables.

- Implement performance-based engineering through hazard, response, damage and loss analyses.
- Become familiar with recent research and practice in performance-based engineering, and translate this knowledge into your own research and practice.
 - Be able to locate and evaluate/assess recent research literature and practice in performance-based engineering
 - Be able to integrate interesting findings into your own project
- Evaluate the impact of earthquakes on buildings through performance-based engineering, and be able to apply the framework to other hazards and systems.

Readings, Materials, and Resources

There is no required textbook for this course. Related readings, materials and resources will be posted on Blackboard. Example references include, but are not limited to:

Fajfar, Peter and Krawinkler, Helmut. (2004). *Performance-Based Seismic Design: Concepts and Implementation*, Pacific Earthquake Engineering Research Center, Berkeley, CA, USA. https://peer.berkeley.edu/sites/default/files/0405_edited_by_p._fajfar_and_h._krawinkler.pdf. (Publicly available for free at Berkeley)

Woo, Gordon. (2014) *Calculating Catastrophe*, Imperial College Press, London, UK. ProQuest Ebook Central, <https://ebookcentral.proquest.com/lib/ttu/detail.action?docID=840546>. (TTU: unlimited access)

Prerequisites

Required: This course will assume

- Basic knowledge of **probability and statistics**, e.g., descriptions of random variables, probability distributions, functions of random variables, estimation of model parameters, model selection and verification, covered by CE 5331-109 Applied Statistics or equivalent (e.g., IE 3341 Engineering Statistics, ISQS 5346 Statistics for Data Science, MATH 4342/4343 Mathematical Statistics, POLS 5382 Data Analysis, STAT 5302/5303 Applied Statistics, or STAT 5384/5385 Statistics for Engineers and Scientists).
- **Linear algebra**, e.g., systems of equations, matrix operations, transformations.
- **Calculus and differential equations**, e.g., differentiation, integration, ordinary and partial differential equations.

Preferred: Basic programming using Matlab or equivalent programs.

Students with any questions regarding these prerequisites should talk to Prof. Lin immediately.

Assessment

You will be evaluated on your ability to explain the course concepts and perform calculations using the techniques presented. Grades will be computed using the following weighting scheme:

- Class participation/quizzes/workshop: **20%**
- Homework assignments: **30%**
- Final project: **50%**

Students are expected to actively participate in class discussions and contribute to the community of scholars. Homework assignments will typically consist of questions that develop further understanding of the materials presented in class. The final project will provide students an opportunity to apply the concepts learned in this course to their applications of interest.

STATEMENTS

ADA (as per OP 34.22)

Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor's office hours. Please note instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, you may contact the Student Disability Services office at 335 West Hall or 806-742-2405.

Academic Integrity (as per OP 34.12)

Academic integrity is taking responsibility for one's own class and/or course work, being individually accountable, and demonstrating intellectual honesty and ethical behavior. Academic integrity is a personal choice to abide by the standards of intellectual honesty and responsibility. Because education is a shared effort to achieve learning through the exchange of ideas, students, faculty, and staff have the collective responsibility to build mutual trust and respect. Ethical behavior and independent thought are essential for the highest level of academic achievement, which then must be measured. Academic achievement includes scholarship, teaching, and learning, all of which are shared endeavors. Grades are a device used to quantify the successful accumulation of knowledge through learning. Adhering to the standards of academic integrity ensures grades are earned honestly. Academic integrity is the foundation upon which students, faculty, and staff build their educational and professional careers. [Texas Tech University ("university") quality enhancement plan, academic integrity task force, 2010]

Religious Holy Day:

"Religious holy day" means a holy day observed by a religion whose places of worship are exempt from property taxation under Texas tax code §11.20. A student who intends to observe a religious holy day should make that intention known in writing to the instructor prior to the absence. A student who is absent from classes for the observance of a religious holy day shall be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence. A student who is excused under section 2 may not be penalized for the absence; however, the instructor may respond appropriately if the student fails to complete the assignment satisfactorily.

Discrimination, Harassment, and Sexual Violence Statement:

Texas Tech University is committed to providing and strengthening an educational, working, and living environment where students, faculty, staff, and visitors are free from gender and/or sex discrimination of any kind. Sexual assault, discrimination, harassment, and other Title IX violations are not tolerated by the university. Report any incidents to the office for student rights & resolution, (806)-742-safe (7233) or file a report online at titleix.ttu.edu/students. Faculty and staff members at TTU are committed to connecting you to resources on campus. Some of these available resources are: TTU student counseling center, 806-742-3674, <https://www.depts.ttu.edu/scc/> (provides confidential support on campus.) TTU 24-hour crisis helpline, 806-742-5555, (assists students who are experiencing a mental health or interpersonal violence crisis. If you call the helpline, you will speak with a mental health counselor.) Voice of

hope Lubbock rape crisis center, 806-763-7273, voiceofhopelubbock.org (24-hour hotline that provides support for survivors of sexual violence.) The risk, intervention, safety and education (RISE) office, 806-742-2110, <https://www.depts.ttu.edu/rise/> (provides a range of resources and support options focused on prevention education and student wellness.) Texas Tech police department, 806-742-3931, <http://www.depts.ttu.edu/ttppd/> (to report criminal activity that occurs on or near Texas Tech campus.)

Civility in the Classroom:

Texas Tech University is a community of faculty, students, and staff that enjoys an expectation of cooperation, professionalism, and civility during the conduct of all forms of university business, including the conduct of student–student and student–faculty interactions in and out of the classroom. Further, the classroom is a setting in which an exchange of ideas and creative thinking should be encouraged and where intellectual growth and development are fostered. Students who disrupt this classroom mission by rude, sarcastic, threatening, abusive or obscene language and/or behavior will be subject to appropriate sanctions according to university policy. Likewise, faculty members are expected to maintain the highest standards of professionalism in all interactions with all constituents of the university (www.depts.ttu.edu/ethics/matadorchallenge/ethicalprinciples.php).

LGBTQIA Support:

Office of LGBTQIA, student union building room 201, www.lgbtqia.ttu.edu, 806.742.5433 within the center for campus life, the office serves the Texas Tech community through facilitation and leadership of programming and advocacy efforts. This work is aimed at strengthening the lesbian, gay, bisexual, transgender, queer, intersex, and asexual (LGBTQIA) community and sustaining an inclusive campus that welcomes people of all sexual orientations, gender identities, and gender expressions.

Student Grade Appeals (as per OP 34.03)

The student will have the right to appeal the receipt of a failing grade in a course through the established grade appeal procedure. The student may not appeal a failing grade given for a class assignment or exam.

Military Personnel Ordered to Active Duty (as per OP 34.13)

Please see instructor.

Operational Procedures (OP)

The University's Operational Procedures can be viewed/downloaded from <http://www.depts.ttu.edu/opmanual/>

Revision to Syllabus:

Topics and/or dates may be changed during the semester at the instructor's discretion because of scheduling issues, developments in the discipline, or other contingencies.