CEE 289: Random Vibrations

Course website

This course will be facilitated online through Canvas (`canvas.stanford.edu`). We will use Ed Discussion for Q&A and discussions, and will use GradeScope for homework submission and grading. Both of these tools are accessible via links from the Canvas site.

Meeting time and location:

Mon, Wed, Fri 8:30 - 9:30 am, Shriram 104

Teaching team

Instructor
Jack Baker (he/him)
Office hours: M/W/F 11:30 - 12:30

Course Assistant:
Rodrigo Silva-Lopez
Building 540, Room 209
Office hours: Tu/Th 1:30 - 3:00 pm

Office hours are the most productive and enjoyable way to engage with you. We hope you will attend regularly!

We prefer that electronic correspondence take place on the Ed Discussion tool, so that the entire teaching team can see your inquiries, and so that all students can see questions and respond with ideas. Please write us there if you have any questions or requests. You can use Anonymous posts if you prefer to hide your name from other students, or private posts for issues unique to you. For items that should be kept confidential with Prof. Baker only, feel free to e-mail.

Introduction and Prerequisites

This course is designed to introduce advanced graduate students to concepts of random vibrations for dynamic analysis of structural and mechanical systems subjected to stochastic loading. CEE 203 and CEE 283, or their approved equivalents, are required prerequisites. This course is more theoretical in nature than CEE 203 and is intended for PhD students, but interested MS students with the necessary prerequisites are welcome to enroll.

Learning objectives

Students taking this course will learn to apply tools from probabilistic modeling to analyze dynamic systems while accounting for variability and uncertainties that are inevitably present in real engineered systems. By the end of this class, you will be able to:

- Classify random excitations as stationary or non-stationary
- Discuss important properties of random processes
- Define and compute power spectral density functions

- Compute auto-and cross-correlation functions, and relate them to power spectral density functions
- Describe the dynamic response of a multi-degree-of-freedom system to a stochastic excitation
- Quantify the distributions of peak loads and peak responses from a system subject to stochastic excitation

Textbook

Loren D. Lutes and Shahram Sarkani (2004) *Random Vibrations: Analysis of Structural and Mechanical Systems*, Elsevier Butterworth-Heineman.

Chopra, Anil K. (2016). *Dynamics of Structures*. Prentice Hall, Upper Saddle River, N.J.

The Lutes and Sarkani textbook is available electronically from within the Stanford campus: `http://www.sciencedirect.com/science/book/9780750677653`. The textbook is required, because I will be assigning homework problems from it. It should be useful for those of you looking for an alternate presentation of the course material, and will serve as a valuable reference book in the future.

The Chopra book (or another graduate structural dynamics book) will be helpful in reviewing some concepts from structural dynamics, but is not required.

Evaluation

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

Homework	30%
In-class exam	30%
Project presentation	10%
Project report	30%

Homework assignments will consist of calculations and derivations related to the material presented in class. The exam will be similar to the homework in content and format. The course will conclude with a project where students (optionally working with a partner) will apply course concepts to a research topic or application that they identify.

Homework policy

- Homework assignments are to be submitted on GradeScope by midnight on the due date listed on each assignment.
- Late assignments will be penalized at a rate of 10% per day late. Homework submitted after the solutions have been provided will not be accepted. Exceptions to this policy may be arranged with Prof. Baker for special situations such as a serious illness.

- Some homework assignments will require computer calculations. We suggest that these computations be done using Matlab. I will provide some example code for it, and we will be able to assist with it a bit. Matlab is free for students at `https://www.mathworks.com/academia/tah-portal/stanford-university-30569029.html`. Make sure to install the *Statistics and Machine Learning*, *Symbolic Math*, and *Optimization* toolboxes when you install Matlab. You are free to use other computer programs if you prefer, as long as you clearly document your work.

Honor code

It is expected that Stanford's Honor code will be followed in all matters relating to this course. You are permitted to meet and exchange ideas with your classmates while studying and working on homework assignments, but you are individually responsible for your own work and for understanding the material. You are not permitted to copy or otherwise reference another student's homework or computer code. If you have any questions regarding this policy, feel free to contact Prof. Baker.

Course material copyrights

The materials provided to you for this course are copyrighted or licensed to Stanford University. Stanford grants you a limited license to use the materials solely in connection with the course for your own personal educational purposes. Any use of the materials outside of the course may be in violation of copyright law. You agree that you will not post, share or copy the materials.

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Respect for Diversity

It is my intent that students from diverse backgrounds, perspectives, and situations be well served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength, and benefit. It is my intent to present materials and activities that are respectful of diversity in gender, sexuality, disability, age, socioeconomic status, ethnicity, race, religion, political affiliation, and culture. I acknowledge that there is likely to be a diversity of access to resources among students and aim to support all of you as best as I can. Please let me know ways to improve the effectiveness of the course for you personally or for other students or student groups. In addition, if any of our class meetings conflict with your religious events, please let me know so that we can make arrangements for you.

All people have the right to be addressed and referred to in accordance with their personal identity. Please indicate the name that you prefer to be called and, if you choose, identify pronouns with which you would like to be addressed. I will do my best to address you accordingly and support classmates in doing the same.

Students with disabilities

Students with Documented Disabilities who may need an academic accommodation based on the impact of a disability must initiate the request with the Office of Accessible Education (OAE). Professional staff will evaluate the request with required documentation, recommend accommodations, and prepare an Accommodation Letter for faculty. Students should contact the OAE as soon as possible since timely notice is needed to coordinate accommodations (650-723-1066, `https://oae.stanford.edu/`).

Schedule:

`https://docs.google.com/spreadsheets/d/1AuyqBzBh_wv_ms3HwzHZ6CaUZTTsD656n4gGVKRSO2s`