ME 309: Structural Mechanics – Spring 2023

Professor Douglas P. Holmes – *dpholmes@bu.edu*

Lecture - Four Credits
PSY B55 (64-86 Cummington Mall)
Tuesday & Thursday
9:00a.m. – 10:45a.m.

Office: 730 Commonwealth Ave., EMA 213
Phone: (617) 358-1294
Office Hours: Tues. 11:00a.m.– 1:00p.m.
Thurs. 11:00a.m.– 1:00p.m.

Goal: To be able to identify, design, analyze, and understand how structures respond to loads.

Course Description: Structures are all around us. They are both naturally occurring and engineered to bear loads and contain fluids. The goal of this course is to provide students with the intuition and technical ability to describe and predict on how structures behave. In this course, we will learn: why egg shells are stiff, how origami helps build space structures, why wet hair clumps together, why airplane windows are round, and how studying fingerprints helps build flexible electronics. All of these concepts can be understood by breaking down these complex structures into basic building blocks, like beams, plates, and shells, and considering how these respond to forces and moments.

Expectations:

1. **Be Engaged** – Come to class prepared.
2. **Reflect** – Keep a journal of the interesting structures you encounter.
3. **Contribute** – Seek out and share interesting and relevant publications, podcast episodes, YouTube videos, Tweets, articles.
4. **Explore** – Design, build, analyze a structure and rationalize its behavior.

Assessment:

1. **Participation Self–Assessment**: Assignments may include listening to a podcast episode or watching a YouTube video or reading a longform essay about a structural failure. We will discuss these assignments, and the questions they raise, in class and so engagement with the material is essential. I will ask you to submit a grade to me, **every other week**, evaluating your preparedness, engagement, and participation (broadly defined).
2. **Portfolio**: On your own, or in a team of two to three, you will build a portfolio of contributions and explorations over the course of the semester. Students are free to choose how they want to demonstrate their learning, and you welcome to take a broad and creative approach to building your portfolio. Examples include, but are not limited to: design-build-analyze a new **toy**, **musical instrument**, or **soft robot**; record interviews with practicing structural engineers and produce a mini-**podcast**; use ideas from **origami** or **kirigami** to create a structure that performs a task; study how the structure of **food** you bake or cook changes with the recipe; compare the structural response of novel **airfoil** designs that you build with simulations, study how different weaves, knits, and textile properties give **garments** different looks and movements; create a **YouTube** explainer video on a structural mechanics concept or structural engineering success or failure; build an **app** or game that reinforces learning concepts from class; examine and model the structural mechanics in various **sporting** equipment; use **ChatGPT** to write structural mechanics code and evaluate its accuracy and explanations; interview the **architects** of the new BU Computing & Data Sciences building and write up an article for the press.

You will be given a **Rubric** well in advance to help guide you as you build your portfolio over the course of the semester. To ensure steady progress towards building your portfolio, you will be expected to meet with the GTF every other week, and with Prof. Holmes at least twice before the portfolio is due.

Important Notes & Dates:

– *GTF*: Meet with GTF every other week for guidance and to discuss concepts, questions, and evaluate portfolio progress.
– *February 9th*: Meet with Prof. Holmes by this date to discuss your plan.
– *March 16th*: Meet with Prof. Holmes by this date to discuss your progress.
– *April 7th*: Portfolio due.
– *May 5th*: Portfolio refinement (optional) and showcase.

Resources:

Class Notes & Digital Content - *D.P. Holmes*
Notes and code available on the course website: https://www.bu.edu/moss/courses/
Playlist of lectures on YouTube: https://youtube.com/playlist?list=PLM1ijNJVxGFmMnalL4JO9DvvUsDeRYjPDl

Technical Reference
Advanced Mechanics of Materials and Applied Elasticity, A.C. Ugural, S.K. Fenster
Elasticity and Geometry: From hair curls to the nonlinear response of shells, B. Audoly, Y. Pomeau

Casual Reading
Hidden Wonders: The Subtle Dialogue Between Physics and Elegance, E. Reyssat, B. Roman, J. Bico, E. Guyon
Structures: Or Why Things Don't Fall Down, J.E. Gordon
History of Strength and Materials, S.P. Timoshenko

Academic Conduct & Student Performance:

1. **Academic Honesty:** In engineering, just as in humanities, science, and social science disciplines, plagiarism is unacceptable. Original thought is highly valued in engineering and is expected from students in this course in preparing and completing all course assignments. Students must follow the COE Academic Conduct Code: www.bu.edu/academics/eng/policies/academic-conduct/. Any violation of this conduct code will be reported to the COE Academic Conduct Committee.
2. **Working Together:** Students are permitted to consult with each other regarding approaches to solving problems in these assignments. If you consult with another person or webpage, please write "Consulted with <person's name> in preparing this assignment."
3. **COVID 19 & BU Community Health Expectations:** All students are expected to follow all university guidelines with respect to daily symptom checks, testing, social distancing, and mask wearing when they leave their dorm or home. For a detailed description of official, up-to-date BU policies regarding COVID, please visit: https://www.bu.edu/shs/covid-19/
4. **Mental Health:** Diminished mental health, including significant stress, mood changes, excessive worry, or problems with eating and/or sleeping can interfere with optimal academic performance. The source of symptoms might be strictly related to your course work; if so, please speak with me. However, problems with relationships, family worries, loss, or a personal struggle or crisis can also contribute to decreased academic performance. BU provides mental health services to support the academic success of students. Getting help is a smart and courageous thing to do – for yourself *and* for those who care about you.
5. **Inclusion & Belonging:** I consider this classroom to be a place where you will be treated with respect, and I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability – and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class.
6. **Financial Security:** Any student who has difficulty affording groceries or accessing sufficient food to eat every day, or who lacks a safe and stable place to live, and believes this may affect their performance in the course, is urged to contact the Dean of Students for support. Please notify the professor if you are comfortable in doing so. This will enable me to provide any resources that I may possess.
7. **Accommodations for Students with Documented Disabilities:** If you are a student with a disability or believe you might have a disability that requires accommodations, requests for accommodations must be made in a timely fashion to Disability & Access Services, 25 Buick St, Suite 300, Boston, MA 02215; 617-353-3658 (Voice/TTY). Students seeking academic accommodations must submit appropriate medical documentation and comply with the established policies and procedures http://www.bu.edu/disability/accommodations/