

ME 7442-B/Q Vibration of Continuous Systems

Fall 2026

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Office hours: TBD (or by email appointment if you need another time) – for Zoom/Teams connection just send me an email so we can arrange

HW grader: TBD

Pre-requisites

ME 6442 or equivalent, or with the consent of the instructor

Required course materials

There is no required textbook. I use multiple references, a few of the relevant books are below:

- Meirovitch, L., 1997, *Principles and Techniques of Vibrations*, Prentice Hall.
- Meirovitch, L., 2001, *Fundamentals of Vibrations*, McGraw-Hill.
- Shames, I. H. and Dym, C. L., 1985, *Energy and Finite Element Methods in Structural Mechanics*, Hemisphere Publishing.
- Dym, C. L. and Shames, I. H., 1973, *Solid Mechanics: A Variational Approach*, McGraw-Hill.

Course description (per catalog)

- Equations of motion and oscillatory response of dynamic systems modeled as continuous media.

Course objectives

Develop an ability to model and analyze continuous system vibrations through the following topics:

- **Review of the Elements of Analytical Dynamics**
 - Generalized coordinates; the principle of virtual work; d'Alembert's principle; Hamilton's principle; Euler-Lagrange equations; brief review of MDOF system vibration
- **Vibration of 1D and 2D Continuous Systems:** *Transverse vibration of strings; longitudinal vibration of bars; torsional vibration of circular shafts; transverse vibration of Euler-Bernoulli and Timoshenko beams; vibration of membranes; transverse vibration of Kirchhoff-Love and Mindlin-Reissner plates*
 - Boundary-value problem formulation (Newtonian and Lagrangian)
 - Exact solutions (free vibration and differential eigenvalue problem, forced vibration)
 - Approximate methods (Rayleigh's quotient, Rayleigh-Ritz method, assumed-modes method, Galerkin's method, etc.)
 - Example problems (natural/geometric/mixed boundary conditions, segmented structures, varying cross-section, etc.)
- **Special Topics (TBD)**
 - Will be based on a select topic or two if time permits: e. g. Experimental modal analysis of continuous systems; use of smart materials/structures for modal testing (sensing and actuation) of continuous systems; novel applications of continuous system vibration (energy harvesting, bio-inspired resonant actuation, etc.); electromechanical continuous systems; metamaterial-based continuous systems, passive and active vibration attenuation, etc.

In-class exams

- There will be two in-class exams (closed books, open lecture notes).
- No computers or communication devices should be in use.
- You may need a pocket calculator.
- If you miss an exam without a valid and documented excuse, no make-up exam will be given.

Take-home final

- The final exam will be a take-home exam with an experimental vibration testing component.
- You (those in section B – not required for Section Q) will participate in the experiment with your peers and take frequency response data of a continuous system in the lab to become familiar with modal testing procedures and equipment. You will not be graded for your experimental skills.

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- All students will eventually be provided the same experimental frequency response functions (MATLAB data) for the take-home exam. Contact me if you have no background to plot the magnitude and phase of an array of complex numbers in MATLAB so I can help you.
- You will be given 3 weeks to analyze (by yourself) the experimental continuous system using the exact and approximate methods learned in this course. The goal is to predict the natural frequencies, mode shapes, and frequency response functions of the cantilever for multiple vibration modes by using exact and approximate methods. You may use the computer software you prefer (MATLAB, Mathematica, etc.) to simulate your theoretical derivations.
- You will be expected to prepare a neat solution report (your own work) for the continuous system you will have analyzed theoretically and experimentally by addressing the final-exam questions.
- There will be no separate in-class final exam.

Homework

- Homework assignments and solutions will be posted via Canvas.
- Homework solutions must be submitted in pdf format as a single file (make sure it is legible). Please combine your solution, computer codes, and plotted outputs into a single pdf file.
- Do not attempt to submit multiple pdf files for a single homework assignment. Submissions in other formats (jpeg etc.) or as multiple files will not be graded.
- Please use the following file naming convention for consistency in your submissions:
hw#_lastname_firstname.pdf
- You are allowed to collaborate on homework assignments, discuss and exchange ideas with other students, but you must turn in your own work.
- Complete solutions and neatness are expected in your homework papers. Lack of neatness may negatively affect your homework grade.
- Use of a computer package (e.g. MATLAB) will be required in most/all homework assignments (for time series or frequency response plotting, eigenvalue problem solution, etc.).

Grading policy and weighting

- Exam 1: 25% TBD – within a week for Section Q
- Exam 2: 25% TBD – within a week for Section Q
- Final (take home): TBD
- Homework: 25%
- The following letter grades are *guaranteed*: $x \geq 90\%$ is an A; $90 \geq x \geq 80\%$ is a B; $80 \geq x \geq 70\%$ is a C; $70 \geq x \geq 60\%$ is a D (I usually help if you are near the limits, and I do not “curve” unless it is to your advantage).

Canvas

- Assignments and announcements will be posted via Canvas. It is your responsibility to check Canvas and your e-mails regularly for the assignments, announcements, and updates.
- Homework and exam solutions will also be posted via Canvas.

Distance learning (DL): Section Q

- Recorded lectures (non-synchronous DL) will be posted by GTPE within 48 hours of the live class (will be made available to all sections).
- The due dates for homework assignments of DL students (Section Q) will be one week later than the date for students who are on campus (Section B). Likewise, the exam dates for DL students will be one week later than the date for on-campus students (except for the take-home final).
- You can nominate in-person proctor or use Honorlock or show up in person with Section B in class for the exams.

Attendance policy

- I highly encourage you to attend the lectures and to participate. Usually there is a dramatic difference in the exam performance between students who regularly attend class and those who do not.

Academic integrity

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- 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. Review [Georgia Tech's Honor Code](#) and the student [Code of Conduct](#).
- Any student suspected of cheating or plagiarism on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Student-faculty expectations agreement

- At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. The [Student-Faculty Expectations](#) articulate some basic expectations that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

Extensions, late assignments, and re-scheduled/missed exams

- Late homework will be penalized accordingly. Make-up exams are given for illness, approved Institute activities or religious observances.

Accommodations for students with disabilities

- If you are a student with learning needs that require special accommodation, contact the [Office of Disability Services](#) (404-894-2563) as soon as possible to make an appointment to discuss your special needs and to obtain an accommodations letter. Let me know how I can help.