

# ASEN 5022: Dynamics of Aerospace Structures

Spring 2020

**Class meetings:** Tue/Thu 1:00 PM - 2:15 PM in AERO - 232

## Instructor:

Prof. Sanghamitra Neogi

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## Course Objectives:

The Dynamics of Aerospace Structures encompasses the application of concepts covered in undergraduate dynamics, structures, and mathematics to analyze the dynamics of aerospace structural components. The course incorporates methods of dynamic analysis, vibrational characteristics, vibration measurements, and dynamic stability.

Additionally, this course has a major project component through which the student will get to

1. Apply theoretical concepts learnt during the course on a specific example,
2. Practice developing models with increased complexity,
3. Learn to distinguish models according to their strengths and weaknesses, and
4. Critically analyze predictions from models incorporating different levels of approximations.

## Logistics:

### A. Office hours

2:30 PM - 4:00 PM Tue and Thu, otherwise by appointment.

### B. Prerequisites

ASEN 5012, 5227 or equivalent. Recommended: MATH 313. Students are expected to be familiar with energy methods from an undergraduate dynamics course.

### C. Class Time

There are two 75-mins meetings per week. The time will include formal lecturing and group work presentations. You are responsible for all material discussed in class, whether you attended or not. Class schedule is posted on Canvas, subject to change.

### D. Website

Course materials are available on Canvas.

### E. Reading Material

The textbook for the course will be *Mechanical Vibrations: Theory And Application To Structural Dynamics*, M. Géradin and D. Rixen, 3rd edition. The following book may be useful for reference:

- *Principles and Techniques of Vibrations*, L. Meirovitch and
- *Fundamentals of Structural Dynamics*, R. R. Craig and A. J. Kurdila, 2nd Edition.

## F. Grades

Homework (30%), two in-class mid-term exams (40%), and project (30%).

(a) Homework assignments: 30%

Homework will be due at 8 PM and should be submitted to Canvas. Please put all files (code, text documents, scanned files) into one zip file with the naming scheme (last- name)HW(homeework number).zip. For example, neogiHW4.zip. Homework submitted by midnight of the day it is due will be penalized 25%. Homework submitted by 8 AM the day after it is due will be penalized 50%. Homework submitted after that time will result in a grade of zero.

(b) Project presentations and reports: 30%

Details will be provided in class. The deadline policies will be similar to homework submission policies.

Any grading disputes will be handled by the instructor. Any request for a grade change should be made to the instructor, in writing, within one week after the graded work is returned. Your entire submission will be subject to regrading. Students are advised to read and adhere to the Honor Code at the University of Colorado at Boulder.

(c) Exam dates (tentative):

- **Mid-term Exam 1:** Tuesday, March 10
- **Mid-term Exam 2:** Thursday, April 16
- **Final Project Presentations:** Saturday, May 2, 1:30 PM - 4:00 PM or before.

## Course content:

1. Review of dynamics of single-degree-of-freedom systems
2. Analytical dynamics of discrete systems
  - (a) Principle of virtual work
  - (b) Hamilton's principle for conservative systems
  - (c) Lagrange equations of motion
3. Undamped vibration of n-degree-of-freedom systems
  - (a) Linear vibration about an equilibrium configuration
  - (b) Normal modes of vibration
  - (c) Free vibration and analysis under forced harmonic and external loadings
4. Damped vibration of n-degree-of-freedom systems
  - (a) Normal eigensolutions
  - (b) Forced harmonic response for lightly-damped systems
  - (c) State-space formulation of viscously damped systems
5. Dynamics of continuous systems
  - (a) Formulation of 1D continuous systems
  - (b) Continuous eigenproblem
6. Numerical methods in dynamical systems
  - (a) Displacement, Rayleigh-Ritz, and Finite Element methods

- (b) Direct time integration methods
- (c) Numerical solution of eigenvalue problems

## Some Aerospace Engineering Sciences & University Policies:

**Accommodation For Disabilities** - If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the [Disability Services website](#). Contact Disability Services at 303-492-8671 or [dsinfo@colorado.edu](mailto:dsinfo@colorado.edu) for further assistance. If you have a temporary medical condition or injury, see [Temporary Medical Conditions](#) under the Students tab on the Disability Services website.

**Classroom Behavior** - Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteranstatus, political affiliation or political philosophy. For more information, see the policies on [classroom behavior](#) and the [Student Code of Conduct](#).

**Preferred Student Names and Pronouns** - CU Boulder recognizes that students' legal information doesn't always align with how they identify. Students may update their preferred names and pronouns via the student portal; those preferred names and pronouns are listed on instructors' class rosters. In the absence of such updates, the name that appears on the class roster is the student's legal name.

**Honor Code** - All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code. Violations of the policy may include: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code ([honor@colorado.edu](mailto:honor@colorado.edu)); 303-492-5550). Students found responsible for violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code as well as academic sanctions from the faculty member. Additional information regarding the Honor Code academic integrity policy can be found at the [Honor Code Office website](#).

**Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation** - The University of Colorado Boulder (CU Boulder) is committed to fostering a positive and welcoming learning, working, and living environment. CU Boulder will not tolerate acts of sexual misconduct, intimate partner abuse (including dating or domestic violence), stalking, or protected-class discrimination or harassment by members of our community. Individuals who believe they have been subject to misconduct or retaliatory actions for reporting a concern should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127 or [cureport@colorado.edu](mailto:cureport@colorado.edu). Information about the OIEC, university policies, [anonymous reporting](#), and the campus resources can be found on the [OIEC website](#).

Please know that faculty and instructors have a responsibility to inform OIEC when made aware of incidents of sexual misconduct, discrimination, harassment and/or related retaliation, to ensure that individuals impacted receive information about options for reporting and support resources.

**Religious Holidays** - Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, Faculty: insert your procedures here. please submit your request to your faculty member beginning of the semester so that your needs can be addressed.

See the [campus policy regarding religious observances](#) for full details.

You can access the policy documents directly here: [required syllabus statements/student version](#).