ASEN 5022: Dynamics of Aerospace Structures

Spring 2018

Class meetings: Tue/Thu 09:30 AM - 10:45 AM in FLMG - 104

Instructor:

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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.

Logistics:

A. Office hours

11:00 AM - 12:30 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 in D2L, subject to change.

D. Website

Course materials are available on D2L.

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.

F. Grades

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

(a) Homework assignments: 30%

Homework will be due on Fridays at 8 PM and should be submitted to D2L. Please put all files (code, text documents, scanned files) into one zip file with the naming scheme (last- name)HW(homework 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 6
- **Mid-term Exam 2:** Thursday, April 19
- **Final Project Presentations:** Monday, May 7, 4:30 PM - 7:00 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) Hamiltons 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 www.colorado.edu/disabilityservices/students. Contact Disability Services at 303-492-8671 or

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 and discuss your needs with your professor.

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, you should make arrangements with the instructors at least two weeks in advance, so that appropriate accommodations can be made. See the campus policy regarding religious observances for full details.

Classroom and On-Campus 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, veteran status, political affiliation or political philosophy. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. For more information, see the policies on classroom behavior and the Student Code of Conduct.

Discrimination and Harassment - The University of Colorado Boulder (CU Boulder) is committed to maintaining a positive learning, working, and living environment. CU Boulder will not tolerate acts of sexual misconduct, discrimination, harassment or related retaliation against or by any employee or student. CUs Sexual Misconduct Policy prohibits sexual assault, sexual exploitation, sexual harassment, intimate partner abuse (dating or domestic violence), stalking or related retaliation. CU Boulders Discrimination and Harassment Policy prohibits discrimination, harassment or related retaliation based on race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. Individuals who believe they have been subject to misconduct under either policy should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127. Information about the OIEC, the above referenced policies, and the campus resources available to assist individuals regarding sexual misconduct, discrimination, harassment or related retaliation can be found at the OIEC website.

The University of Colorado policy on Sexual Harassment and the University of Colorado policy on Amorous Relationships applies to all students, staff and faculty. Any student, staff or faculty member who believes s/he has been the subject of discrimination or harassment based upon race, color, national origin, sex, age, disability, religion, sexual orientation, or veteran status should contact the Office of Discrimination and Harassment (ODH) at 303-492-2127 or the Office of Judicial Affairs at 303-492-5550. Information about the ODH and the campus resources available to assist individuals regarding discrimination or harassment can be obtained at http://www.colorado.edu/odh and http://www.colorado.edu/policies/discrimination.html.

Honor Code - All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the academic integrity policy. Violations of the policy may include: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, resubmission, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code Council (honor@colorado.edu; 303-735-2273). Students who are found responsible for violating the academic integrity policy will be subject to non-academic sanctions from the Honor Code Council as well as academic sanctions from the faculty member. Additional information regarding the academic integrity policy can be found at the Honor Code Office website.