

# USC Viterbi

School of Engineering  
*Sonny Astani Department  
of Civil and Environmental  
Engineering*

## Tentative

Please see Course Info on D2L for the latest version of the syllabus

**CE 541: Dynamics Of Structures**

**Units: 4**

**Fall 2022:**

- **Tuesday, 6:00 PM - 9:20 PM**

**Location: Online/OHE 100D**

**Instructor:** Professor A. Niazy, Ph.D., P.E.

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## **Course Description**

Free and Forced vibration of discrete and distributed systems; energy methods; analytical dynamics; computational techniques; approximate methods; random vibration concepts; nonstationary response; structural control; nonlinear system response.

## **Learning Objectives and Outcomes**

To achieve fundamental understanding of the subject of dynamics of structures and apply it to diverse problems in Aerospace, Civil, and Mechanical Engineering.

1. Single-Degree-of-Freedom Systems
2. Systems with Several Degrees-of-Freedom
3. Energy Methods
4. Elements of Analytical Dynamics
5. Vibration of Continuous Systems (Exact Methods)
6. Vibration of Continuous Systems (Approximate Methods)
7. Random Vibration Concepts: Response of Continuous Systems to Random Excitation
8. Nonlinear Systems: Geometric Theory; Approximate Methods
9. Computational Techniques

## **Prerequisite(s)**

Prerequisite:

CE 525b “Engineering Analysis” or equivalent.

MATLAB Software.

## **Recommended Preparation**

Good command of undergraduate Mathematics, Engineering Mechanics, Statics, and dynamics.

## **Course related Materials**

Course related materials on DEN website. Login is needed:

<https://courses.uscden.net/d2l/login>

## **Required Textbook**

L. Meirovitch, “**Fundamentals of Vibrations.**” Waveland Press.

## **Reference Materials**

- 1) J.P. Den Hartog, “Mechanical Vibrations.”
- 2) A.K. Chopra, “Dynamics of Structures.”
- 3) B.K. Donaldson, “Introduction to Structural Dynamics.”
- 4) D.L. Logan, “A First Course in the Finite Element Method,” CL-Engineering.
- 5) K-J. Bathe, “Finite Element Procedures,” Prentice-Hall, Englewood Cliffs.
- 6) H. Ataei, and M. Mamaghani, “Finite Element Analysis, Applications and Solved Problems using Abaqus.”

## Description and Assessment of Assignments

### Homework:

Homework (HW) assignment and delivery will be per the class schedule, unless otherwise instructed. The homework delivery will be due at the start of the designated class on the specified delivery day depicted on the class schedule, unless otherwise instructed. Students are to work independently on the HW assignments. No late HW is accepted. However, exceptions might be considered in situation-established emergency reasons; credit for such late cases is at the absolute discretion of the instructor. HW assignments may involve a varying number of problems; however, in the end, the HW assignments are counted equally in computing the final HW grade.

### Project:

The project typically requires the student to do all the following tasks:

1. Study, go through, and prepare a set of step-by-step MATLAB programs (\*.m) for dynamics problems.
2. Solve the assigned set of dynamics problems using MATLAB.
3. Write a comprehensive report summarizing the solutions of the assigned set of dynamics problems. The project report should include a description of the problem, the classical formulations, associated MATLAB solution results, and comments on the accuracy of the results.
4. Submit the project report, the associated MATLAB files (\*.m files), and any relevant files by the due date as required.

There is no required presentations of the project results. The project delivery is due per the class schedule, at the start of the class meeting, unless otherwise instructed. No late project is accepted. No exceptions except in situation-established emergency reasons; credit for such late project is at the discretion of the instructor.

### Exams:

There will be two exams: One midterm exam and one final exam.

- Closed book.
- Only one sheet of 8.5" x 11" paper (two pages) of formulae allowed.
- Calculator.
- No make-up on any examinations.

## Grading Score Breakdown

A weighted average grading score will be calculated as follows:

Homework	20%
Midterm Exam	25%
Project	20%
Final Exam	35%
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Total	100%

## Grading Scale

Students will be graded based on their total scores (possibly relative to the overall class performance). The following is a rough guideline and may be subject to revision depending on the overall class performance.

- A 95-100
- A- 90-94
- B+ 87-89
- B 83-86
- B- 80-82
- C+ 77-79
- C 73-76
- C- 70-72
- D+ 67-69
- D 63-66
- D- 60-62
- F 59 and below

## Assignment Submission Policy

- Late Student Work: Completed assignments (HW/Project) are due per class schedule at the beginning of class. If the student work cannot be turned in at the beginning of class on the due date, prior permission from the instructor to change the due date is necessary. Credit for such late work is at the discretion of the instructor. Without permission, the student work will not be graded and zero will be given for the associated work assignment.
- Answers should be clearly and fully justified as well as organized. If the answers/steps are not clear, not justified, not organized, points will be deducted, even if the final answer is correct.
- Reasonable collaboration in solving homework problems is allowed. Exchanging solutions, finding solutions on the web or elsewhere, and/or blindly copying previous years' solutions are not allowed. Violations result in losing the credit for the entire problem(s) in which the violation occurred and to be reported to the University's academic integrity office.

## **Grading Timeline**

- Homework assignments are intended to be graded and returned usually within one week after their due dates.
- Midterm exams are intended to be graded and returned usually within one week after the exam date.
- Final exam will be graded. Only the student's score in the final exam will be communicated. The student's score in the final exam is intended to be communicated usually within one week after the exam date.
- Letter grade of the student in the class is intended to be posted to the school grading system (GRS) usually within one week after the exam date.

## Tentative Course Lecture/Schedule: A Weekly Breakdown

Week	Tuesday	Topics	Textbook Reading Assignments	Assignment	Delivery
1	8/23	Introduction; Single-Degree-of-Freedom Systems	Chapter 1, 2	HW1	
2	8/30	Single-Degree-of-Freedom Systems	Chapter 3.1-3.3, 3.5-3.11, 4.1-4.9, 4.12-13	HW2	
3	9/6	Systems with Two Degrees-of-Freedom, Numerical Techniques	Chapter 5	HW3	HW1
4	9/13	Systems with Several Degrees-of-Freedom, Numerical Techniques	Chapter 7.1-10	<b>Project</b>	HW2
5	9/20	Systems with Several Degrees-of-Freedom, Numerical Techniques	Chapter 7.11-21	HW4	HW3
6	9/27	Energy Methods, Elements of Analytical Dynamics	Chapter 6.1-3		
<b>7</b>	<b>10/04</b>	<b>Midterm Exam</b>	<b>7:00 PM – 9:00 PM</b>		HW4
8	10/11	Elements of Analytical Dynamics	Chapter 6.4-6	HW5	
9	10/11	Continuous Systems: Exact Methods	Chapter 8	HW6	
10	10/25	Continuous Systems: Approximate Methods	Chapter 9.1, 9.5, 9.11-12	HW7	HW5
11	11/01	Random Vibration: Concepts, Response of Continuous Systems to MDOF Systems	Chapter 12		HW6
12	11/08	Random Vibration: Response of Continuous Systems to Random Excitation	Chapter 12	HW8	HW7
13	11/15	Nonlinear Systems: Introduction, Geometric Theory; Approximate Methods	Chapter 11	HW9	<b>Project</b>
14	11/22	Nonlinear Systems: Geometric Theory; Approximate Methods	Chapter 11		HW8
15	11/29	Computational Techniques			HW9
16	12/06	No Class. Study Days: Saturday Dec. 3 – Thursday Dec. 6.			
<b>17</b>	<b>12/13</b>	<b>Final Exam</b>	<b>7:00 PM – 9:00 PM</b>		

# Statement on Academic Conduct and Support Systems

## Academic Conduct:

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, “Behavior Violating University Standards” [policy.usc.edu/scampus-part-b](http://policy.usc.edu/scampus-part-b). Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, [policy.usc.edu/scientific-misconduct](http://policy.usc.edu/scientific-misconduct).

## Support Systems:

*Counseling and Mental Health - (213) 740-9355 – 24/7 on call*  
[studenthealth.usc.edu/counseling](http://studenthealth.usc.edu/counseling)

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

*National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call*  
[suicidepreventionlifeline.org](http://suicidepreventionlifeline.org)

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

*Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL), press “0” after hours – 24/7 on call*

[studenthealth.usc.edu/sexual-assault](http://studenthealth.usc.edu/sexual-assault)

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

*Office of Equity and Diversity (OED) - (213) 740-5086 | Title IX – (213) 821-8298*  
[equity.usc.edu](http://equity.usc.edu), [titleix.usc.edu](http://titleix.usc.edu)

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

*Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298*  
[usc-advocate.symplicity.com/care\\_report](http://usc-advocate.symplicity.com/care_report)

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity | Title IX for appropriate investigation, supportive measures, and response.

*The Office of Disability Services and Programs - (213) 740-0776*  
[dsp.usc.edu](http://dsp.usc.edu)

Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

*USC Campus Support and Intervention - (213) 821-4710*  
[campussupport.usc.edu](http://campussupport.usc.edu)

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

*Diversity at USC - (213) 740-2101*  
[diversity.usc.edu](http://diversity.usc.edu)

Information on events, programs and training, the Provost’s Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

*USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call*  
[dps.usc.edu](http://dps.usc.edu), [emergency.usc.edu](http://emergency.usc.edu)

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

*USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call*  
[dps.usc.edu](http://dps.usc.edu)

Non-emergency assistance or information.