

CE 527: Structural Dynamics, Spring 2026

INSTRUCTOR: Dr. Abhinav Gupta
email: agupta1@ncsu.edu

CLASS TIMING: Monday and Wednesday, 10:15 am – 11:30 am. Room 02220, Engineering Building 3

OFFICE HOURS: Walk-ins are welcome if I am in the office or reachable by email. I will then send an appropriate time for either an in-person meeting or via Zoom.

TA INFORMATION: Aditya Nayak (anayak6@ncsu.edu). Office hours to be emailed later.

STUDENT LEARNING OBJECTIVES:

By the end of the course, you will be able to:

1. formulate equations of motion for single and multiple-degree-of-freedom structures subjected to various dynamic loads,
2. solve these equations using analytical and computational methods,
3. model continuous structural systems using the Finite Element Method, and
4. use and evaluate commercial dynamic analysis software (SAP2000) and Generative Artificial Intelligence (GenAI) tools (Gemini and Copilot).

TEXTBOOK: Strongly Recommended but NOT required. *Dynamics of Structures, 3rd ed.*, J. L. Humar, CRC Press, 2012. Note that you may be able to find the 2nd edition, which is less expensive and sufficient. The eBook is available at the [NCSU libraries](#).

You MUST read “a textbook” on Structural Dynamics for a good understanding of the course material. The discussion in most books is quite similar for the topics to be covered.

COMPUTING: MATLAB, SAP2000, and GenAI tools will be used for numerical solutions.

GRADING:

Homework.....	10%
Final Project	15%
2 Tests (Wednesday, Feb 25 and Wednesday, April 8)	40%
(First Test grade 20%, Second Test grade 20%)	
Final exam (Wednesday, May 6th, 8:30 – 11:00 am)	35%

A+: 97-10; A: 93-96.9;
A-: 90-92.9; etc.

HOMEWORK: Assigned each week and collected the following Wednesday at the beginning of the class. Solutions will be emailed. **All Homework MIGHT NOT be graded. It may simply be checked for completeness**, i.e. whether you have completed and submitted all the problems or not. **Selected homework or selected problems will be graded for correctness.** You would then use the solutions to check your own homework. The responsibility of checking the correctness of solution lies with each student individually. It is also intended to make all of you go through your homework solution one more time. Just don't check the final answer – go through the entire solution provided.

EXAMS: The exams will be closed-book and closed-notes.

CALENDAR: January 19th (MLK Holiday), March 16 – 20 (Spring Break), April 28th (Last day of Class)

ACADEMIC INTEGRITY:

Students are expected to adhere to the guidelines for academic integrity as outlined in the NC State University Code of Student Conduct <https://policies.ncsu.edu/policy/pol-11-35-01>

STUDENTS WITH DISABILITY:

Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with Disability Services for Students at Holmes Hall, Suite 304, 2751 Cates Ave, Raleigh, NC, Phone: 515-7653. For more information on NC State's policy on working with students with disabilities, please see: <https://policies.ncsu.edu/regulation/reg-02-20-01>

TENTATIVE SCHEDULE:

	<u># Lectures</u>
Introduction, Chap. 1	1
SDOF systems.....	10
Equations of motion & Virtual Work, Chap. 2	
Free vibration response, Chap. 5	
Forced harmonic vibrations, Chap. 6	
Excel Solver-Based Identification	
Numerical analysis, Chap. 8	
MDOF systems	10
Equations of motion, Chap. 3	
Free vibration response, Chap. 10	
Numerical analysis for eigenvalue analysis, Chap. 11	
Forced vibration response, Chap. 12	
Numerical solution for response, Chap. 13	
Response Spectrum and Design Spectrum Concepts.....	2
Design Example for SDOF structure.....	1
Building Code	1
Real Life Application Examples	1

AI TOOLS:

Gemini Chat, Google's generative artificial intelligence chatbot, is available to NC State students, faculty, and staff. To use Gemini, visit gemini.google.com and log in with your NC State account.

Microsoft Copilot is a conversational artificial intelligence chat interface that is available to NC State students, faculty, and staff. To use Microsoft Copilot, log in to your [Microsoft 365 account](#) with your NC State account. Includes **GPT** models similar to **ChatGPT**.

THINGS YOU SHOULD KNOW:

Although we will cover all of these topics in class to some degree, it is expected that you will have some familiarity with them before they are covered in class.

1. Discrete systems are made up of particles or rigid bodies with hinges and/or springs. Continuous systems are made up of truss, beam, or frame elements. The element stiffness matrices for these continuous systems can be formulated from either elementary concepts of solid mechanics or the Finite Element Method. For all of these types of structures, you should be able to formulate the matrix equations of equilibrium for structures subjected to static loading, although we will be concentrating on discrete systems, including shear buildings.
2. It will be useful if you review your undergraduate course on differential equations (DE). The equations we will be using all have the following form:

$$m \frac{d^2u}{dt^2} + c \frac{du}{dt} + ku = p(t); \quad \frac{du}{dt}(0) \& u(0) \text{ given}$$

for single degree of freedom systems. Note that Humar uses the abbreviated notation $\frac{d^2u}{dt^2} = \ddot{u}$; $\frac{du}{dt} = \dot{u}$; . For multi DOF systems, m , c and k will be square matrices, and the loading, acceleration, velocity, displacement, and initial conditions will be vector functions of time. For the SDOF case, recall that the solution is made up of two parts: a complementary solution for the homogeneous part of the DE, and a particular solution for the non-homogeneous part.