CE 527: Structural Dynamics, Spring 2013

INSTRUCTOR: Dr. Abhinav Gupta
413 Mann Hall
Phone: 515-1385;
email: agupta1@ncsu.edu

CLASS TIMING: T, H: 11:45 am – 1:00 pm, 406 Mn Hall

OFFICE HOURS: Walk-ins and by appointments. Mostly available in mornings for communication by email except when I am on travel.

PREREQUISITES: CE 425/525 (Matrix Structural Analysis) or equivalent

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.

TEXTBOOK: Strongly Recommended but NOT required. *Dynamics of Structures, 2nd ed.*, J. L. Humar, A. A. Balkema Publishers, 2002.

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 and SAP2000 will be used for numerical solutions.

GRADING:

Homework	10%
2 Tests (**Thursday, Feb. 21 and Thursday, April 11**)	50%
Final exam (Thursday **May 9, 8:00 – 11:00 am**)	40%

A-: 90-92.9; A: 93-96.9; A+ 97-100; etc.

HOMEWORK: Assigned each week and collected the following Thursday at the beginning of class. Solutions will be provided / emailed soon after. ***Homework will be NOT be graded. It will simply be checked for completeness***, i.e. whether you have completed and submitted all the problems or not. You would then use the solutions to check your own homework. If you submit all homework problems, you will get full points – irrespective of the correctness of your work. 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 by me. You may ask homework related questions to the TA or me. It would be good to copy both if you are emailing your question. I will provide the TA information in a few days.

EXAMS: The exams will be closed book and closed notes, but equations may be provided as necessary.

ATTENDANCE: University's attendance policy can be viewed at http://www.ncsu.edu/policies/academic_affairs/courses_undergrad/REG02.20.3.php

ACADEMIC INTEGRITY:

Students are expected to adhere to the guidelines for academic integrity as outlined in the NC State University Code of Student Conduct (http://www.ncsu.edu/policies/student_services/student_discipline/POL11.35.1.php)

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 1900 Student Health Center, Campus Box 7509, 515-7653. For more information on NC State's policy on working with students with disabilities, please see http://www.ncsu.edu/policies/academic_affairs/courses_undergrad/REG02.20.1.php

TENTATIVE SCHEDULE: # Lectures

- Introduction, Chap. 1 1
- SDOF systems 12
  - Equations of motion & Virtual Work, Chap. 2
  - Free vibration response, Chap. 5
  - Forced harmonic vibrations, Chap. 6
  - General dynamic loading, Chap. 7
  - Numerical analysis, Chap. 8
- MDOF systems 12
  - Equations of motion, Chap. 3
  - Free vibration response, Chap. 10
  - Numerical analysis for eigenvalue analysis, Chap. 11
  - Forced vibration response, Chap. 12
  - Numerical analysis for response analysis, Chap. 13
- Uniform Building Code and Response Spectrum Concepts... 2

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:

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

for single degree of freedom systems. Note that Humar uses the abbreviated notion $\frac{d^2u}{dt^2} = \ddot{u}; \quad \frac{du}{dt} = \dot{u}$. 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.