

M.E. 8207 Vibration Analysis

Term: Fall 2006
Instructor: Dr. "Nat" C. Nataraj
Classes: T 6:00-8:45, CEER 312
Office: Tolentine 111B, 610-519-4994
Office Hours: Mondays, 1-3, or by appointment
E-mail: nataraj@villanova.edu
Web page: <http://www.homepage.villanova.edu/c.nataraj/>

Course Description

Objectives:

The main objective of this course is to provide an understanding of vibration theory and to establish its direct relation to real physical systems. The emphasis will be on development of mathematical modeling techniques, and the formulation of differential equations of motion for various systems.

The course will start with a review of elementary vibration concepts and will cover general methods for practical systems under various forcing conditions. Specific concepts that will be studied include rotating machinery, force transmission, natural frequencies and normal modes. The course will also include an introduction to nonlinear aspects of real systems and to continuous system modeling. The emphasis throughout will be on computer solution techniques to reflect current industrial practices.

Prerequisites:

The students are expected to have had some exposure to vibration in undergraduate education (or equivalent industrial experience). It is also expected that the students have an adequate background in basic mathematics including differential equations and matrix theory. In addition, the assignments will require basic computer programming skills.

Attendance Policy:

Attendance is required at all examinations which will be announced in advance. Make-up tests for excused absences from examinations must be arranged before the scheduled examination time. It is strongly recommended that the students attend all the class sessions. It is imperative that the students participate actively in the class sessions by asking and answering questions.

Grading:

Homework will be assigned every week and should be submitted promptly for grading and subsequent discussion. Solutions will be posted in the library. An individual term project will be required of each student. The project topic may be either selected by the student, with approval, or be specified by the instructor. It is initiated at the mid-term date and is due in the last class week. Each student is required to make an oral presentation on the term project in addition to submitting a written report.

The semester grade is based on the following relative weights:

Homework	20%
Tests (two)	30%
Term Project	20%
Final Exam (comprehensive)	30%

Grades:

F < 65% C- < 70% < C < 75% < C+ < 80% < B- < 82% < B < 85% < B+ < 87% < A- < 90% < A

Primary Text:

Meirovitch, L., 1997, *Analytical Methods in Vibrations*, Prentice Hall.

Supplementary reading material:

Technical papers and texts as appropriate will be placed online and will be required reading for the course.

Computer Software:

All students are required to learn to use MATLAB, an interactive scientific software which can be used for numerical analysis, matrix computation, and graphics.

Syllabus:

- Review of elementary vibration of single and two degree of freedom systems
- Multiple degree of freedom systems
- The eigenvalue problem
- General methods of response analysis
- Computational techniques
- Continuous system modeling and analysis - strings, rods, beams and plates
- Discretization procedures and variational methods
- Introduction to FEM
- Topics in nonlinear vibration analysis

The following sections will be covered (in addition to other material based on handouts):
1-1, 1-2, 1-3, 1-8, 1-9; 2-1 to 2-9; 3-1 to 3-5; 4-1 to 4-5, 4-9 to 4-12; 5-1 to 5-14; 6-1 to 6-4;
7-1 to 7-14; 10-1 to 10-5.