**Department of Mechanical and Aeronautical Engineering**
**Clarkson University**

# AE/ME 455: Mechanical Vibrations and Control
**Spring Semester 2005**

**2004 Catalog Data for ME 455/AE 455 Credits: (3)**. Fundamentals, free vibration, harmonically excited vibration, transient vibration, multi-degree freedom systems, vibration measurements, introduction to control theory, linear feedback control, vibration control, adaptive and optimal control, numerical methods.

**Prerequisite**: ES 223 Rigid Body Dynamics

**Textbook**: S. S. Rao, Mechanical Vibrations, 4th Edition, 2004, Pearson/Prentice Hall, Upper Saddle River, NJ, ISBN: 0-13-048987-5

**Instructor:** Dr. J. C. Moosbrugger, Dept. of Mech. and Aero. Eng., CAMP 259, moose @clarkson.edu, 268-4429/6586
**Office Hours**: Monday 2:00 – 3:00pm, Tuesday 9:30am-11:00am, Wed. 1:00pm-2:00am, Thursday 9:30am-11:00am

**Classroom**: CAMP 178; **Class Hours**: Tuesday, Thursday, 8:00 – 9:15am

**Course Website:** http://clarkson.edu/class/ae-me455/

**Course Learning Objective:** The objective of this course is to provide students with conceptual and analytical skills to model and analyze vibrating mechanical systems for design, maintenance and testing. This objective supports ME and AE program objectives stated in the MAE Student Handbook.

**Course Learning Outcomes:** [assessment method] (ME program outcomes supported)
1. Students will learn how to develop linear vibration models for mechanical systems using mass, elastic stiffness and damping of mechanical systems. [1,2] ( 1,2)

2. Students will gain experience in developing governing equations (equations of motion) from conservation of momentum and energy principles. [1,2] ( 1,2)

3. Students will model vibrating mechanical systems, and develop and solve their governing equations in order to obtain the response of the system under various excitations. [1,2] ( 1,2)

4. Focusing on analytical solutions, students will learn how to interpret system responses, including frequency response, mode shapes, free vibration response character and effect of system parameters, etc. [1,2] ( 1,2)

**Assessments**

| | |
|---|---|
| 1. Timed Examinations | 70% |
| 2. Homework and Computer Projects | 30% |

**Topical Course Outline:** Text Chapter [approximate number of class periods]

| | | |
|---|---|---|
| 1. Introduction to Mechanical Vibrations | Chapter 1 | [3 classes] |
| 2. Free Vibration of Single Degree of Freedom Linear Systems | Chapter 2 | [6 classes] |
| 3. Harmonically Excited Vibration of Single Degree of Freedom Linear Systems | Chapter 3 | [7 classes] |
| 4. Vibration of Single Degree of Freedom Systems under Periodic Excitations and/or General Excitations | Chapter 4 | [6 classes] |
| 5. Vibration of Two degree of Freedom and Multiple Degree of Freedom Lumped Mass Systems | Chapters 5 and 6 | [12 classes] |
| 6. Continuous Systems | Chapter 8 | [6 classes] |

**Course Grading:**

| | |
|---|---|
| Homework | 15% |
| Matlab/Simulink Projects | 15% |
| Exam I | 20% |
| Exam II | 20% |
| Final Exam | 30% |

**Important Dates:**

| | |
|---|---|
| Exam I (tentative) | Tuesday, February 8, 2005 |
| February Recess | Monday, February 14 – Tuesday, February 15 |
| Spring Recess | Monday, March 14 – Friday, March 18 |
| Exam II (tentative) | Tuesday, March 29, 2005 |
| Final Exam | TBA – week of April 25-29, 2005 |
| Last Day to Drop a Class (with notation on transcript) | Friday, April 22, 2005 |

Unless otherwise noted, homework will be collected and graded. Once collected, homework/project solutions will be made available on the class web site listed above; therefore, no late homework/projects will be accepted without prior consent of the instructor. Exams will be cumulative and given on the tentative schedule given above. Grades will be assigned on the basis of A(92% or better), B+(86% or better), B(80% or better), C+(76% or better), C(70% or better), D+(65% or better), D(58% or better), and F(below 58%). Depending on the performance

of the class as a whole, bonus points will normally be awarded to EVERYONE when the final scores are computed, but the scores will NOT be scaled down. Thus, if you score in one of the above ranges without bonus points, you are guaranteed the corresponding letter grade with the possibility that it could be better.

**Homework Assignments:** Homework and Matlab projects will be assigned and announced periodically in class and on the course website.

**General:** Attendance is required, so that you are responsible for all announcements made, material discussed and work assigned during class. I will not provide class notes to students with unexcused absences.

Exams must be taken during the scheduled periods. If an exam, other than the final exam, is missed (instructor approved absences only, the reason for which must be verified by the Dean of Students) then that exam percentage will be added to the final exam percentage. Valid reasons for missing an exam include incapacitating illness or death in the family, provided notice is given. Student-athletes with conflicting varsity athletic events can have their exam proctored by the team coach provided arrangements are scheduled at least one week in advance of the scheduled exam period. All students must take the final exam during the scheduled period to pass the course.

***Requests for re-grading***: Requests for re-grading of problems on homework, exams or Matlab projects must be made *in writing* to receive consideration. The request should include the date, the problem number, and the exam or assignment title. It should clearly state the reason for the request for re-grade, and must it be signed by the student.

**Academic Integrity:**
Students are encouraged to share their thoughts and experiences with the class throughout the semester. Each student must, however, submit his/her own work on homework, projects and exams. Violations of the University's academic integrity policies will dealt with according to the *Clarkson Regulations*.