

***Mechanical Vibrations II (2003)***  
***20-263-662***

***Class Location:***

*Lecture Room: 422D Reiveschel Hall*

*Laboratory Room: 584C Rhodes Hall*

***Instructor:***

*Randall Allemang, PhD*  
*Professor of Mechanical Engineering*

*Room 593 Rhodes Hall*  
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***Text:***

*Theory of Vibrations with Applications*  
*Fourth Edition (1993) or Fifth Edition (1998)*  
*William T. Thomson*  
*Prentice Hall*

*Mechanical Vibrations*  
*Second Edition (1978)*  
*Tse, Morse, Hinkle*  
*Marcel Dekker, Inc.*

*Analytical and Experimental Modal Analysis*  
*UC-SDRL-CN-20-263-662*  
*Allemang, et al*  
*(<http://www.sdrl.uc.edu/ucme662/ucme662.html>)*

**Grading:**

*Grading will be based upon the following weighting of the quizzes, tests and final exam.*

Quizzes	25%
Test Number 1	25%
Test Number 2	25%
Final Exam (or Project)	25%

**Quizzes:**

*All quizzes will be closed book, closed notes. Quizzes will be given at the start of each Thursday lecture classes to be certain that the reading material and work is being kept up. Quizzes will last no more than ten (10) minutes. If you are late to class, you will not be given extra time. Quizzes will not be given the Week 1, Week 4 and Week 8 of the quarter. Homework that has been assigned for over one week may be collected as a quiz.*

**Homework:**

*Homework is assigned for the benefit of the student to emphasize areas of importance in the material. Some questions on the tests will be similar to assigned homework. Homework may be requested instead of a quiz or instead of test problem(s).*

**Tests:**

*Tests will be given during the Thursday class period during Week 4 and Week 8. All tests will be closed book, closed notes. Test questions of a numerical nature will be similar to homework assignments or classroom discussions. Other test questions will be conceptual in nature requiring short written or numerical work. These questions will utilize the reading assignments but will primarily be taken from material presented or discussed in the class lectures.*

## **Course Goals:**

*The text and material to be covered have been selected to give the student a classical background in mechanical vibrations of multiple degree of freedom systems, particularly as it applies to experimental data. Specific goals of this course are:*

- *Develop theoretical equations of motion (linear and/or nonlinear) using Newton's Method (Dynamic/Static Force Balance).*
- *Develop theoretical equations of motion (linear and/or nonlinear) using the Lagrange Method (Energy Method).*
- *Solve linear, second order matrix differential equations resulting from Newton's or Lagrange's Methods.*
- *Understand the solutions of the matrix differential equations as eigensolutions (eigenvalues, eigenvectors) as well as modal parameters (frequencies, damping, modal shapes, modal scaling).*
- *Understand the relationships between mass, stiffness and damping matrices and frequency and impulse response functions.*
- *Understand the relationships between degrees of freedom and measurement degrees of freedom.*
- *Prepare the student for experimental work required in later experimental course (Mechanical Vibrations III).*

## **Pertinent Course Dates:**

Week 1	January 6-10 (No Quiz)
Week 2	January 13-17
Week 3	January 20-24 (No Class: Monday January 20)
Week 4	January 27-31 (RJA Out of Town, Jan. 29 - Feb. 6)(Test Number 1)
Week 5	February 3-7
Week 6	February 10-14
Week 7	February 17-21 (Engineering Week)
Week 8	February 24-28 (Test Number 2)
Week 9	March 3-7 (RJA Out of Town)
Week 10	March 10-14
Week 11	March 17-21 (Exam Week)

<i>Vibrations II Course Outline:</i>			
<i>Date</i>	<i>Topic</i>	<i>Reading Reference</i>	
<i>Week 1</i>	<i>Review Vibrations I Review Math Review/Learn MATLAB</i>	<i>Thomson</i>	<i>Chapters 1-4 Appendix C</i>
<i>Week 2</i>	<i>Newton's Method (MDOF)</i>	<i>Thomson</i>	<i>Chapter 5</i>
<i>Week 3</i>	<i>System Properties (MDOF)</i>	<i>Thomson</i>	<i>Chapter 6</i>
<i>Week 4</i>	<i>Lagrange Method (MDOF)</i>  <i>Test Number 1 (Chapters 5 and 6)</i>	<i>Thomson</i>	<i>Chapter 7 Appendix E</i>
<i>Week 5</i>	<i>Lagrange Method (MDOF)</i>	<i>Thomson</i>	<i>Chapter 7 Appendix E</i>
<i>Week 6</i>	<i>Experimental Modal Analysis</i>	<i>Course Notes</i>	<i>Sections 1-3</i>
<i>Week 7</i>	<i>Experimental Modal Analysis</i>	<i>Course Notes</i>	<i>Sections 1-3</i>
<i>Week 8</i>	<i>Experimental Modal Analysis</i>  <i>Test Number 2 (Chapter 7 + ??)</i>	<i>Course Notes</i>	<i>Section 4</i>
<i>Week 9</i>	<i>Experimental Modal Analysis</i>	<i>Course Notes</i>	<i>Sections 5-6</i>
<i>Week 10</i>	<i>Experimental Modal Analysis</i>	<i>Course Notes</i>	<i>Sections 7-9</i>
<i>Week 11</i>	<i>Exam Week Final Exam, Final Project or Take-Home Exam</i>		

<i>Vibrations II Course Schedule</i>	
<i>Date</i>	<i>Homework Assignment</i>
<i>Week 1</i>	<i>MATLAB Assignment Number 1</i>
<i>Week 2</i>	<i>5-2,5-3,5-4 Handout: 4-5a, 4-5d, 4-5e, 4-5j (Newton's Method) 5-15,5-16, 5-18  MATLAB Assignment Number 2</i>
<i>Week 3</i>	<i>5-55,5-62,6-15,6-19,6-24  MATLAB Assignment Number 3</i>
<i>Week 4</i>	<i>5-55,5-62 (Lagrange's Method) Handout: 4-5a, 4-5d, 4-5e, 4-5j (Lagrange's Method)  MATLAB Assignment Number 4</i>
<i>Week 5</i>	
<i>Week 6</i>	<i>MATLAB Assignment Number 5</i>
<i>Week 7</i>	<i>MATLAB Assignment Number 6</i>
<i>Week 8</i>	<i>MATLAB Assignment Number 7 MATLAB Assignment Number 8</i>
<i>Week 9</i>	<i>MATLAB Assignment Number 9 MATLAB Assignment Number 10 (Design Problem ?)</i>
<i>Week 10</i>	<i>Final Project ??</i>