

## ME 449: Mechanical Vibration

<i>Course description:</i>	Vibrating systems and noise producing mechanisms; design for noise and vibration control. Cooperative course taught jointly by WSU and UI (ME 472).
<i>Number of credits:</i>	3
<i>Course Coordinator:</i>	C. Pezeshki
<i>Prerequisites by course:</i>	ME 348
<i>Prerequisites by topic:</i>	<ol style="list-style-type: none"><li>1. Differentiation and integration</li><li>2. Ordinary differential equations</li><li>3. Concepts of velocity, acceleration, force and energy</li><li>4. Newton's laws of motion</li><li>5. Matrix algebra</li></ol>
<i>Postrequisites:</i>	None
<i>Textbooks/other required materials:</i>	<ol style="list-style-type: none"><li>1. Rao. <i>Mechanical Vibrations</i>. Pearson Prentice Hall, 2010, 5/e.</li></ol>
<i>Course objectives:</i>	<ol style="list-style-type: none"><li>1. Applying the laws of motion to oscillating systems.</li><li>2. Deriving differential equations of motion using free body diagrams.</li><li>3. Examining the effects of energy-removal mechanisms; i.e. damping.</li><li>4. Applying energy methods to dynamic systems.</li><li>5. Examining the concept of natural modes of vibration in terms of system physical parameters.</li><li>6. Identification of system vibration characteristics using analytical methods and numerical methods – numerical integration and finite element method.</li><li>7. Design of structures based on specified vibration constraints.</li><li>8. Use of experimental methods to determine vibration characteristics.</li></ol>
<i>Topics covered:</i>	<ol style="list-style-type: none"><li>1. Undamped free vibration.</li><li>2. Viscous damping.</li><li>3. Energy methods.</li><li>4. Forced vibration with harmonic excitation.</li><li>5. Rotating imbalance; instrumentation for vibration analysis.</li><li>6. Nonharmonic forcing functions.</li><li>7. Modal analysis for multi-degree of freedom systems.</li><li>8. Vibration isolation and absorption.</li><li>9. Vibration of continuous systems.</li><li>10. Vibration analysis using the finite element method.</li></ol>
<i>Expected student outcomes:</i>	<ol style="list-style-type: none"><li>1. Ability to derive system equations using first principles.</li><li>2. Ability to modify, in a design scenario, the system parameters to alter vibration response.</li><li>3. Ability to calculate natural frequencies and mode shape(s).</li><li>4. Ability to measure vibration characteristics and infer model parameters from the measured data.</li><li>5. Ability to apply modern computational techniques (i.e. MATLAB and ANSYS to vibration analysis).</li><li>6. Ability to recognize when the material covered in this course is not sufficient for analysis of more complicated problems.</li></ol>

*Class schedule:* Three 50-minute lecture sessions per week or two 75-minute lecture sessions per week for one semester.

*Laboratory schedule:* None.

*Contribution to meeting the professional component* Engineering Topics

*Relationship of course to program objectives:* Meets:  
1. School of MME ME educational objectives: 1  
2. School of MME ME program outcomes: 1, 7  
3. ABET EC2019, Criterion 3 program outcomes: 1, 7

*Prepared by:* Andrea Butcherite and C. Pezeshki

*Date:* May 30, 2018

## **POLICIES**

A. **Reasonable Accommodation** (the nature of the particular course determines which one applies):

- **Pullman Campus.** Reasonable accommodations are available for students with a documented disability. If you have a disability and need accommodations to fully participate in this class, please either visit or call the Access Center (Washington Building 217; 509-335-3417) to schedule an appointment with an Access Advisor. All accommodations MUST be approved through the Access Center.
- **WSU Online Course.** Reasonable accommodations are available in online classes for students with a documented disability. All accommodations must be approved through your WSU Disability Services office. If you have a disability and need accommodations, we recommend you begin the process as soon as possible. For more information contact a Disability Specialist on your home campus: Pullman or WSU Online (<http://accesscenter.wsu.edu>), Spokane (<http://spokane.wsu.edu/students/current/studentaffairs/disability/>), Tri-Cities (<http://www.tricity.wsu.edu/disability>), Vancouver (<http://studentaffairs.vancouver.wsu.edu/student-resource-center/disability-services>).

## **B. Academic Integrity**

WSU expects all students to behave in a manner consistent with its high standards of scholarship and conduct. Students are expected to uphold these standards both on and off campus and acknowledge the university's authority to take disciplinary action. The Standards of Conduct for Students can be found at <http://conduct.wsu.edu>.

## **C. WSU Safety**

WSU is committed to maintaining a safe environment for its faculty, staff, and students. Safety is the responsibility of every member of the campus community and individuals should know the appropriate actions to take when an emergency arises. In support of our commitment to the safety of the campus community the University has developed a Campus Safety Plan, <http://safetyplan.wsu.edu>. It is highly recommended that you visit this web site as well as the University emergency management web site at <http://oem.wsu.edu/> to become familiar with the information provided.