ME 449: Mechanical Vibration

Course description: Vibrating systems and noise producing mechanisms; design for noise and vibration control. Cooperative course taught jointly by WSU and UI (ME 472).

Number of credits: 3

Course Coordinator: C. Pezeshki

Prerequisites by course: ME 348

Prerequisites by topic:

1. Differentiation and integration
2. Ordinary differential equations
3. Concepts of velocity, acceleration, force and energy
4. Newton's laws of motion
5. Matrix algebra

Postrequisites: None

Textbooks/other required materials: Rao. *Mechanical Vibrations.* Pearson Prentice Hall, 2010, 5/e.

Course objectives:

1. Applying the laws of motion to oscillating systems.
2. Deriving differential equations of motion using free body diagrams.
3. Examining the effects of energy-removal mechanisms; i.e. damping.
4. Applying energy methods to dynamic systems.
5. Examining the concept of natural modes of vibration in terms of system physical parameters.
6. Identification of system vibration characteristics using analytical methods and numerical methods – numerical integration and finite element method.
7. Design of structures based on specified vibration constraints.
8. Use of experimental methods to determine vibration characteristics.

Topics covered:

1. Undamped free vibration.
2. Viscous damping.
3. Energy methods.
4. Forced vibration with harmonic excitation.
5. Rotating imbalance; instrumentation for vibration analysis.
6. Nonharmonic forcing functions.
7. Modal analysis for multi-degree of freedom systems.
8. Vibration isolation and absorption.
9. Vibration of continuous systems.
10. Vibration analysis using the finite element method.

Expected learning outcomes:

1. Ability to derive system equations using first principles.
2. Ability to modify, in a design scenario, the system parameters to alter vibration response.
3. Ability to calculate natural frequencies and mode shape(s).
4. Ability to measure vibration characteristics and infer model parameters from the measured data.
5. Ability to apply modern computational techniques (i.e. MATLAB and ANSYS to vibration analysis).
6. Ability to recognize when the material covered in this course is not sufficient for analysis of more complicated problems.

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 student outcomes:
3 strongly supported; 2 supported; 1 minimally supported

Student Outcomes Pre-Fall 2018 (ABET EC2000)

a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
3								1		

Student Outcomes Fall 2018 forward (ABET EC2019)

1	**2**	**3**	**4**	**5**	**6**	**7**
3						1

Prepared by: Andrea Butcherite and C. Pezeshki *Date:* May 30, 2018