

## ME 348: Dynamics Systems

<i>Course description:</i>	Fundamentals of vibration analysis, control systems, system modeling and dynamics analysis.
<i>Number of credits:</i>	3
<i>Course Coordinator:</i>	J Swensen
<i>Prerequisites by course:</i>	ME 212; ME 313; certified major in Mechanical Engineering
<i>Prerequisites by topic:</i>	<ol style="list-style-type: none"><li>1. Dynamics</li><li>2. Differential Equations</li><li>3. Linear Algebra</li></ol>
<i>Postrequisites:</i>	ME 401, ME 416, ME 449, ME 470, ME 475, ME 481
<i>Textbooks/other required materials:</i>	<ol style="list-style-type: none"><li>1. Ogata, K. <i>System Dynamics</i>. Pearson Prentice Hall, 2004, 4/e.</li></ol>
<i>Course objectives:</i>	<ol style="list-style-type: none"><li>1. To provide students with a review of dynamics.</li><li>2. To instruct students in the use of modeling mechanical, electrical, thermal, and fluid engineering systems.</li><li>3. To introduce students to the analysis of linear dynamical systems, vibrations, and control systems.</li></ol>
<i>Topics covered:</i>	<ol style="list-style-type: none"><li>1. Dynamics (review)<ol style="list-style-type: none"><li>a. Newtonian Mechanics, Translation, Rotation</li></ol></li><li>2. Modeling Engineering Systems<ol style="list-style-type: none"><li>a. Laplace Transforms and Block Diagrams</li><li>b. Mechanical, electrical, thermal, and fluid systems</li></ol></li><li>3. Analysis of Linear Dynamical Systems<ol style="list-style-type: none"><li>a. Equilibrium solutions</li><li>b. Linearization of nonlinear systems</li><li>c. Solution of linear differential equations</li><li>d. State space systems</li><li>e. n-th order Input-Output ODEs</li><li>f. Free response</li><li>g. Forced response</li><li>h. Eigenvalues and stability</li><li>i. Eigenvectors, diagonalization, state transition matrix</li></ol></li><li>4. Introduction to Vibrations<ol style="list-style-type: none"><li>a. Free vibrations</li><li>b. Forced vibrations</li><li>c. Frequency response (Sinusoidal inputs)</li></ol></li><li>5. Introduction to Control Systems<ol style="list-style-type: none"><li>a. Feedback control systems</li><li>b. PID control</li><li>c. Transient response specifications</li></ol></li></ol>
<i>Expected student outcomes:</i>	<ol style="list-style-type: none"><li>1. Develop differential equations models for mechanical, electrical, and hydraulic systems.</li><li>2. Determine equilibrium solutions for nonlinear systems.</li><li>3. Develop linearized ODE models describing the motion of a dynamic system near equilibrium.</li><li>4. Solve the linearized ODE models for both free and forced responses.</li></ol>

5. Determine natural frequencies and mode shapes for  $n$  degree-of-freedom undamped vibrations.
6. Design simple feedback control systems to meet various performance specifications.

*Class schedule:* Three 50-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
2. School of MME ME program outcomes: 1
3. ABET EC2019, Criterion 3 program outcomes: 1

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*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.