San José State University
Mechanical Engineering Department
ME 147-03: Dynamic Systems Vibration and Control, Spring 2020

Course and Contact Information

Instructor	Professor Long Lu
Email Address	Long.Lu@sjsu.edu
Office Location	ENG 303 and ENG 164C
Office Hours	Tuesday and Thursday 8:00 am-9:00 am at ENG 303 Tuesday and Thursday 12:00 pm-1:00 pm at ENG 164C
Class Days/Time	Tuesday and Thursday 9:00 am-10:15 am
Classroom	ENG 303
Prerequisites	A grade of "C-" or better in ME 130 (undergraduate students only)

Course Format
The course relies on lecture materials presented in class, and students are strongly encouraged to attend.

Course Materials
Course materials such as the syllabus, homework assignments, and solutions will be available on Canvas.

Course Description
Mathematical representation of dynamic systems. Damped and undamped free and forced vibrations of single and multi-degree of freedom systems. Vibration control and isolation. Dynamic analysis of control systems. Transient response, frequency response and the stability criteria. State-variables approach. Feedback and feed forward compensation. Emphasis on engineering problems involving analysis and design.

Course Learning Outcomes
Upon successful completion of this course, students will be able to:

1. model and analyze simple vibratory systems.
2. calculate transient and steady-state responses for a vibratory system.
3. design a vibratory system to reduce amplitude of vibration and/or transmitted forces.
4. analyze multi-degree of freedom systems to determine eigenvalues and eigenvectors.
5. develop a mathematical model of a mechanical, hydraulic, or electrical system.
6. analyze a control system to determine its transfer function and characteristic equation.
7. predict system performance including stability.
8. design controllers to meet control system goals.
9. determine the relative stability gain and phase margins of a control system.

Textbooks and Additional References

Required Textbook
Dynamic Systems Vibration and Control by Dr. Fred Barez. Spring 2020. Available at Maple Press, which is located at 330 S. 10th Street, San Jose, CA 95112.

Additional References
[1] Kelly, S. G. *Fundamentals of Mechanical Vibrations*. McGraw-Hill.
[2] Rao, S. S. *Mechanical Vibrations*. Prentice Hall.
[3] Dorf, R. C. and Bishop, R. H. *Modern Control Systems*. Prentice Hall.
[4] Nise, N. S. *Control Systems Engineering*. John Wiley & Sons, Inc.
[5] Ogata, K. *Modern Control Engineering*. Pearson.

Homework Assignments
Homework assignments are individual effort assignments. Students are encouraged to have intellectual discussions about the homework problems. However, all students must prepare and submit their own solutions to the homework problems which reflect their understanding and problem-solving methodologies. Any form of cheating or plagiarism will not be tolerated. Homework is typically assigned as a set and due to Canvas in one week. No late homework submissions will be accepted.

Examinations
There will be two 75-minute midterm exams and one 135-minute final exam. The final exam will be comprehensive, covering all material presented in class. Please consult the class schedule for the exam dates and times. There will be no make-ups for missed exams, except for medical or other reasons outside the student's control, and such must be documented with a written notice and proof.

Grading Information
Course grade will be out of 1000 points total.

Homework	300 points
Midterm Exam 1	200 points
Midterm Exam 2	200 points
Final Exam	300 points
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Total points	1000 points

Determination of Grades
There will be no curving of grades. Final grades will be based on the total points and assigned as follows:

- Total points $\geq$ 970 points: A+
- 940 points $\leq$ Total points $<$ 970 points: A
- 900 points $\leq$ Total points $<$ 940 points: A-
- 850 points $\leq$ Total points $<$ 900 points: B+
- 800 points $\leq$ Total points $<$ 850 points: B
- 760 points $\leq$ Total points $<$ 800 points: B-
- 720 points $\leq$ Total points $<$ 760 points: C+
- 690 points $\leq$ Total points $<$ 720 points: C
- 650 points $\leq$ Total points $<$ 690 points: C-
- 620 points $\leq$ Total points $<$ 650 points: D+
- 590 points $\leq$ Total points $<$ 620 points: D
- 550 points $\leq$ Total points $<$ 590 points: D-
- Total points $<$ 550 points: F

Class Protocol
Class participation and attendance are strongly encouraged. Use of cell-phones is not allowed. Laptop computers and tablets are allowed for taking lecture notes in a non-distracting manner only.

University Policies
Per University Policy S16-9, university-wide policy information relevant to all courses, such as academic integrity, accommodations, etc. will be available on Office of Graduate and Undergraduate Programs' Syllabus Information web page at <http://www.sjsu.edu/gup/syllabusinfo/>.

ME 147 Dynamic Systems Vibration and Control
Spring 2020 Tentative Course Schedule/Outline

Week/Dates	Discussions Topics/Class Activities
Week 1 Th 01/23	Welcome to ME 147
Week 2 T 01/28 & Th 01/30	Principles of Newtonian Mechanics, Introduction to Vibrations, Degrees of Freedom, Equations of Motion, Free Vibrations
Week 3 T 02/04 & Th 02/06	Natural Circular Frequency, Period of Oscillations, Energy Method, Damped Systems
Week 4 T 02/11 & Th 02/13	Forced Vibrations, Undamped and Damped Vibration, Transmissibility
Week 5 T 02/18 & Th 02/20	Multi Degree of Freedom Systems, Eigenvalues and Eigenvectors
Week 6 **T 02/25 & Th 02/27**	**Review for Midterm Exam 1 on Tue 02/25** **In-Class Midterm Exam 1 on Thu 02/27 9:00 am-10:15 am**
Week 7 T 03/03 & Th 03/05	Vibration Isolation, Vibration Absorbers, Design for Vibration Control
Week 8 T 03/10 & Th 03/12	Distributed Parameter Systems, Wave Equations, Solutions to Wave Equations
Week 9 T 03/17 & Th 03/19	Flow-Induced Vibrations
Week 10 T 03/24 & Th 03/26	Introduction to Control, Mathematical Modeling of Physical Systems, Open-Loop and Closed-Loop Systems, Transfer Functions
Week 11 **T 03/31 & Th 04/02**	**Spring Recess**
Week 12 **T 04/07 & Th 04/09**	**Review for Midterm Exam 2 on Tue 04/07** **In-Class Midterm Exam 2 on Thu 04/09 9:00 am-10:15 am**
Week 13 T 04/14 & Th 04/16	Pole and Zero, System Stability Analysis, Routh-Hurwitz Criterion, Time Domain Analysis, Transient and Steady-State Responses
Week 14 T 04/21 & Th 04/23	Controller Types, Controller Design, State-Variable Method, General Form of the State Variable Equations, Solution of State Equations
Week 15 T 04/28 & Th 04/30	Frequency Analysis, Nyquist Stability Analysis
Week 16 T 05/05 & **Th 05/07**	Bode Diagrams, Gain and Phase Margins, Bandwidth, Root Locus **Review for Final Exam on Thu 05/07**
Final Exam Week **T 05/19**	**Final exam is scheduled on Tue 05/19 7:15 am-9:30 am at ENG 303.**