# San José State University
# Mechanical Engineering Department
# ME 147-01 Dynamic Systems Vibrations and Control, Fall 2019

**Course and Contact Information**

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|---|---|
| **Instructor** | Dr. Feruza Amirkulova |
| **Office Location** | Engineering Building, Room 310J |
| **Telephone** | (408) 924-2045 |
| **Email** | feruza.amirkulova@sjsu.edu |
| **Office Hours** | Monday, Wednesday 3:15pm – 4:15 pm in E310J |
| **Class Days/Time** | Monday, Wednesday 12:00pm – 1:15pm |
| **Classroom** | E339 |
| **Prerequisites** | Grade of "C-" or better grade 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**
Copies of the course materials including the syllabus, homework solutions, slides, and MATLAB codes will be available on course webpage at Canvas. Class participation and attendance are strongly encouraged. Students are encouraged to attend all classes and take class notes to support their reading assignments.

**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 a vibratory system transient and steady-state responses.
3. design a vibratory system for reduced amplitude of vibration and/or reduced transmitted forces.
4. analyze multi-degree of freedom systems to determine eigen values and vectors.
5. develop a mathematical model of a mechanical, hydraulic, or electrical system.
6. to analyze a control system to determine transfer function and its characteristics equation.
7. to predict system performance including stability.
8. design controllers to meet control system goals.
9. determine control system's relative stability gain and phase margins.

**Required Text/Readings**

**Textbook (required)**
**Dynamic Systems Vibration and Controls** *by F. Barez*, Fall 2018, available at Maple Press

**Other**
1) **Mechanical Vibration: Analysis, Uncertainties, and Control** *by Haym Benaroya, Mark Nagurka, Seon Han. 4th Edition. CRC Press, 2017, 579 Pages, ISBN 9781498752947,* electronic book is available at our SJSU library.
2) **Engineering Vibrations**, *William J. Bottega, Second Edition, CRC Press/Taylor & Francis Group, 2015,* electronic book is available at our SJSU library.
3) **Textbook Of Mechanical Vibrations**, *Rao V. Dukkipati and J. Srinivas, (Kindle pdf version).*
4) **Schaum's Outline of Theory and Problems of Mechanical Vibration,** *S. G. Kelly, McGraw-Hill, 1996*
5) **Automatic Control Systems**, *Farid Golnaraghi, Benjamin C. Kuo. 2017 Tenth Edition. ISBN: 9781259643835.*

**Course Requirements and Assignments**
Homework will be assigned weekly as a set and is due on the Wednesday of each week following the week assigned.

**Final Examination or Evaluation**
The final exam will be comprehensive, covering all material presented in class. There will be no make-up quiz. 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. The lowest quiz grade will be dropped.

**Grading Information**
Course grade will be based on homework assignments, exams.

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|---|---|---|
| Homework | 10% | Due on Wednesday before lecture |
| Quizzes | 15% | on Wednesdays, look at the Course Schedule/Outline for dates |
| Class participation | 5% | class discussions, participation, iClicker quizzes |
| Test 1 | 20% | 09/25/19, Wednesday |
| Test 2 | 20% | 11/06/2019, Wednesday |
| Final Exam | 30% | 12/16/2019 at 09.45 - 12.00 |

**Determination of Grades**
There will be no curving of grades. Final grades will be assigned as follows:

| | | | | | |
|---|---|---|---|---|---|
| A | >94 | A- | 90-93 | | |
| B+ | 85-89 | B | 80-84 | B- | 76-79 |
| C+ | 72-75 | C | 69-71 | C- | 65-68 |
| D+ | 62-64 | D | 59-61 | D- | 56-58 |
| F | <55 | | | | |

**Examinations**
Five 20-minute quizzes, two 75-minute exams and one 2-1/4 hour final examination.

**Class Protocol**
Class participation and attendance are strongly encouraged. Use of cell-phones is not allowed except during taking quizzes using iClicker (see https://www.iclicker.com/students for instructions). Laptop computers and tablet are allowed for taking lecture notes on the front row 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/**"**

**iClicker Cloud**

I will be using iClicker Cloud this semester to conduct polls, quizzes, and/or attendance in class. This will help me understand what you know and give everyone a chance to participate in class. This will also give you feedback on how well you are comprehending course concepts, help you master the challenging material in this class, and allow you to review material after class.

You are required to bring a device to participate in my iClicker sessions during class. I will be allowing the use of iClicker Reef on a smartphone, tablet or laptop OR iClicker remotes.

It is your responsibility to properly register your iClicker Reef device and/or iClicker remote in a timely fashion. It is also your responsibility to regularly check your iClicker grades for any discrepancies and bring them to my attention quickly.

**Registration Instructions:**

Regardless of which device you use in class, you must create an iClicker Reef account–or use your existing Reef account if you already have one–to ensure that your grades sync to my iClicker gradebook. You can do this by downloading the mobile app via the App Store or Google Play, or by visiting iclicker.com.

It is your responsibility to make sure your account is in working order, and to regularly check your grades for any discrepancies and bring them to my attention immediately. If you already have a Reef account, simply add my course to it. **Do not create a duplicate account.**

**Grading Information**

Class attendance/polls will be worth X% of your final grade. You will earn X points for each correct question you answer.

**Academic Integrity Information**
iClicker activities fall under the provisions of our campus's academic honesty policy. Students must not engage in academic dishonesty while participating in iClicker activities. This includes but is not limited to answering polling questions while not physically in class, looking at other students' devices while answering live questions, or using more than one iClicker remote or account at a time. Any student found to be in violation of these rules will lose polling points for the entire term and may be reported to the Dean of Student Discipline.

**Need Help?**
You can contact eCampus or check their website for more information. Contact information: Email= ecampus@sjsu.edu Phone= (408)924-2337 Building/Room= IRC206
Website= www.sjsu.edu/ecampus

You may also find the answers to many of your questions by visiting iclicker.com/support.

# ME 147 Dynamic Systems Vibration and Control
# Fall 2018 Course Schedule/Outline

| Week | Date | Lecture Topics | Quizzes and Exams |
|---|---|---|---|
| 1 | 8/21 | Course organization. Principles of Mechanics. Intro to Vibrations. Degree of Freedom | |
| 2 | 8/26 | Equation of Motion. Natural Circular Frequency. Period of Oscillations. Free Vibrations | |
| 2 | 8/28 | Free Vibrations of Single Degree of Freedom System (SDFS). Unamped Systems | |
| 3 | 9/2 | **No Class, Labor Day Holiday** | |
| 3 | 9/4 | Energy Method. Unamped Systems | |
| 4 | 9/9 | Free Vibrations of Damped Systems | |
| 4 | 9/11 | Forced Vibrations. Undamped and Damped Vibration. Transmissibility | Quiz-1 (20 min) |
| 5 | 9/16 | Forced Vibrations. Undamped and Damped Vibration. Transmissibility | |
| 5 | 9/18 | Multi-degree of Freedom System. Free Vibrations. Eigenvalues and Eigenvectors | |
| 6 | 9/23 | Multi-degree of Freedom System. Free Vibrations. Eigenvalues and Eigenvectors | |
| 6 | 9/25 | **Test No.1 in class** | **Test No.1 (75 min)** |
| 7 | 9/30 | Multi-degree of Freedom System. Forced Vibrations. | |
| 7 | 10/2 | Vibration Isolation. Vibration Absorbers | |
| 8 | 10/7 | Vibration Isolation. Vibration Absorbers | |
| 8 | 10/9 | Design for Vibration Control | Quiz-2 (20 min) |
| 9 | 10/14 | Distributed Mass Systems. Wave equation. Longitudinal & Transverse Vibrations | |
| 9 | 10/16 | Wave equation. Longitudinal & Transverse Vibrations. Flow-Induced Vibrations | |
| 10 | 10/21 | Intro to Control Systems. Open-loop and Closed-loop system transfer systems | |
| 10 | 10/23 | Open-loop and Closed-loop system transfer systems. Transfer Function | Quiz-3 (20 min) |
| 11 | 10/28 | Mathematical Modeling of Physical Systems. Mechanical, Hydraulic, Electrical. | |
| 11 | 10/30 | Transfer Function and System Response. S-Plane. Pole and Zero. System Stability Analysis. | |
| 12 | 11/4 | S-Plane. Pole and Zero. System Stability Analysis. | |
| 12 | 11/6 | **Test No.2 in class** | **Test No.2 (75 min)** |

| Week | Date | Lecture Topics | Quizzes and Exams |
|---|---|---|---|
| 13 | 11/11 | **No Class, Veteran's Day Holiday** | |
| 13 | 11/13 | Time Domain Analysis. Transient and Steady-State Responses | |
| 14 | 11/18 | Time Domain Analysis. Transient and Steady-State Responses. | |
| 14 | 11/20 | State-Variable Method. Controller Types and Control Laws. Controller Design | Quiz-4 (20 min) |
| 15 | 11/25 | State-Variable Method. Controller Types and Control Laws. Controller Design | |
| 15 | 11/27 | **No Class on campus, due to upcoming Thanksgiving Holidays** | |
| 16 | 12/2 | Frequency Analysis. Nyquist plots | |
| 16 | 12/4 | Frequency Analysis. Nyquist plots. Bode Diagrams, and Gain and Phase Margins | Quiz-5 (20 min) |
| 17 | 12/09 | Bode Diagrams, and Gain and Phase Margins | |
| **Final Exam** | 12/16 | **In class** at **09.45 - 12.00** | **Final Exam** (2 hours and 15 min) |

***NOTE: This is not a firm list. There may be additions or deletions during the semester***