# San José State University
# Mechanical Engineering Department
# ME 147 Dynamic Systems Vibrations and Control, Fall 2018

**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** | Mondays 3:15pm to 4:15 pm in E310J<br>Tuesdays 10:00am to 10:55 am in E310J |
| **Class Days/Time** | M W 16:30 – 17:45 |
| **Classroom** | E341 |
| **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, and slides will be available on course webpage at 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 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**
Rao V. Dukkipati and J. Srinivas, Textbook Of Mechanical Vibrations (Kindle pdf version).
Dorf R.C., Bishop R.H. 'Modern Control systems', Pearson Prentice Hall
Kelly, S. G., 'Fundamentals of Mechanical Vibrations'
Nise, N. S., 'Control Systems Engineering'

**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 | 15% | Due on Wednesday before lecture |
| Quizzes | 15% | on Wednesdays, look at the Course Schedule/Outline for dates |
| Test 1 | 20% | 10/03/18, Wednesday |
| Test 2 | 20% | 11/14/2018, Wednesday |
| Final Exam | 30% | 12/13/2018 at 14.45 – 17.00 |

**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. 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/**"**

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

| Week | Date | Lecture Topics | Quizzes and Exams |
|---|---|---|---|
| 1 | 8/22 | Course organization. Principles of Mechanics. Intro to Vibrations | |
| 2 | 8/27 | Equation of Motion. Free Vibrations | |
| 2 | 8/29 | Natural Circular Frequency. Period of Oscillations | |
| 3 | 9/3 | **No Class, Labor Day Holiday** | |
| 3 | 9/5 | Energy Method. Damped Systems | |
| 4 | 9/10 | Forced Vibrations. Undamped and Damped Vibration. Transmissibility | Quiz-1 (20 min) |
| 4 | 9/12 | Forced Vibrations. Undamped and Damped Vibration. Transmissibility | |
| 5 | 9/17 | Multi-degree of Freedom System | |
| 5 | 9/19 | Eigenvalues and Eigenvector | Quiz-2 (20 min) |
| 6 | 9/24 | Vibration Isolation. Vibration Absorbers | |
| 6 | 9/26 | Vibration Isolation. Vibration Absorbers | |
| 7 | 10/1 | Design for Vibration Control | |
| 7 | 10/3 | **Test No.1 in class** | **Test No.1 (75 min)** |
| 8 | 10/8 | Distributed Mass Systems | |
| 8 | 10/10 | Wave equation. Longitudinal & Transverse | |
| 9 | 10/15 | Vibrations, Flow-Induced Vibrations | |
| 9 | 10/17 | Vibrations, Flow-Induced Vibrations | Quiz-3 (20 min) |
| 10 | 10/22 | Intro to Control Systems. Open-loop and Closed-loop system transfer systems | |
| 10 | 10/24 | Open-loop and Closed-loop system transfer systems. Transfer Function | |
| 11 | 10/29 | Mathematical Modeling of Physical Systems. Mechanical, Hydraulic, Electrical, S-Plane | |
| 11 | 10/31 | Pole and Zero. System Stability Analysis. Routh-Hurwitz Criterion | Quiz-4 (20 min) |
| 12 | 11/5 | Time Domain Analysis. Transient and Steady-State Responses. Root Locus | |
| 12 | 11/7 | Time Domain Analysis. Transient and Steady-State Responses. Root Locus | |

| Week | Date | Lecture Topics | Quizzes and Exams |
|---|---|---|---|
| 13 | 11/12 | **No Class, Veteran's Day Holiday** | |
| 13 | 11/14 | **Test No.2 in class** | **Test No.2 (75 min)** |
| 14 | 11/19 | State-Variable Method. Controller Types and Control Laws. Controller Design | |
| 14 | 11/21 | **No Class on campus, due to upcoming Thanksgiving Holidays** | |
| 15 | 11/26 | State-Variable Method. Controller Types and Control Laws. Controller Design | |
| 15 | 11/28 | Frequency Analysis. Nyquist Stability Analysis | |
| 16 | 12/3 | Frequency Analysis. Nyquist Stability Analysis | |
| 16 | 12/5 | Bode Diagrams and Gain and Phase Margins | Quiz-5 (20 min) |
| 17 | 12/10 | Bode Diagrams and Gain and Phase Margins | |
| **Final Exam** | 12/13 | **In class** at **14.45 – 17.00** | **Final Exam** (2 hours and 15 min) |

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