

SAN JOSE STATE UNIVERSITY  
Mechanical Engineering Department

**ME 154 - Mechanical Engineering Design**

**Fall 2021**

Instructor: Dr. Ken Youssefi

**Office: E-116B**

Class room: **Online via Zoom (synchronous)**

**Office hrs: MW 5:45-6:45 (on zoom after the class)**

Class time: Lecture - MW 4:00 - 5:40

**email : kyoussefi@aol.com**

Class code: 42078 (section 2)

**Final Exam: TBA**

**Course website: Canvas**

**COURSE OBJECTIVE:**

Introduction to Mechanisms design and analysis. Graphical and analytical synthesis of mechanisms, path, motion, and function generation mechanisms. Complex polar notation and closed loop vector equations to analyze mechanisms. Position, velocity, acceleration and force analyses. Application of statics, dynamics, strength of materials, static failure theories and fatigue failure theory to the design of machine components. Threaded fasteners and the design of bolted joints. The course will include a term project that involves the design and prototype fabrication of a mechanical device. Lecture 4 hours.

**Success in this course is based on the expectation that students will spend, for each unit of credit, a minimum of forty-five hours over the length of the course (normally 3 hours per unit per week with 1 of the hours used for lecture for instruction or preparation/studying or course related activities including but not limited to internships, labs, clinical practical. Other course structures will have equivalent workload expectations as described in the syllabus.**

**Prerequisites:** ME20, C- or better in ME101 and CE112, CAD knowledge is strongly recommended. **You must turn in an unofficial transcript with the prerequisites highlighted by the second class period, or you will be dropped from the class.**

**Required Text:** R.L. Norton, "Machine Design", 5<sup>th</sup> or 6<sup>th</sup> edition, Prentice Hall, (MD)

**Recommended Text:** R. L. Norton, "Design of Machinery; Introduction to Synthesis and Analysis of Mechanisms" 5<sup>th</sup> edition, McGraw-Hill Inc. 2012 (DOM) or the custom version available at the bookstore.

**Group design project** - see handout for details

**Grading: Homework 10%, Project 25%, Midterm Exams 20% each, Final Exam 25%**

Final course grade is determined using a normal distribution curve ( $\pm$  grades will be assigned):

Grade distribution	Grade A	average plus one standard deviation and higher
	Grade B	average plus $\frac{1}{2}$ standard deviation
	Grade C+	average
	Grade C-	average minus $\frac{1}{2}$ standard deviation
	Grade F	average minus one standard deviation and lower

**Academic Integrity:** Your commitment, as a student, to learning is evidenced by your enrollment at San Jose State University. The [University Academic Integrity Policy S07-2](http://www.sjsu.edu/senate/docs/S07-2.pdf) at <http://www.sjsu.edu/senate/docs/S07-2.pdf> requires you to be honest in all your academic course work. Faculty members are required to report all infractions to the office of Student Conduct and Ethical Development. The [Student Conduct and Ethical Development website](http://www.sjsu.edu/studentconduct/) is available at <http://www.sjsu.edu/studentconduct/>.

**Campus policy in compliance with the Americans with Disabilities Act:** If you need course adaptations or accommodations because of a disability, or if you need to make special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. [Presidential Directive 97-03](http://www.sjsu.edu/president/docs/directives/PD_1997-03.pdf) at [http://www.sjsu.edu/president/docs/directives/PD\\_1997-03.pdf](http://www.sjsu.edu/president/docs/directives/PD_1997-03.pdf) requires that students with disabilities requesting accommodations must register with the [Accessible Education Center](http://www.sjsu.edu/aec) (AEC) at <http://www.sjsu.edu/aec> to establish a record of their disability.

## **Dropping and Adding**

Students are responsible for understanding the policies and procedures about add/drop, grade forgiveness, etc. Refer to the current semester's [Catalog Policies](http://info.sjsu.edu/static/catalog/policies.html) section at <http://info.sjsu.edu/static/catalog/policies.html>. Add/drop deadlines can be found on the current academic year calendars document on the [Academic Calendars webpage](http://www.sjsu.edu/provost/services/academic_calendars/) at [http://www.sjsu.edu/provost/services/academic\\_calendars/](http://www.sjsu.edu/provost/services/academic_calendars/). The [Late Drop Policy](http://www.sjsu.edu/aars/policies/latedrops/policy/) is available at <http://www.sjsu.edu/aars/policies/latedrops/policy/>. Students should be aware of the current deadlines and penalties for dropping classes.

## **Course Goals**

1. To design a mechanism to perform a desired task using different techniques.
2. To learn failure criterion to design components guarding against yielding, fracture and fatigue failures
3. To learn to work as a team to design and simulate a mechanical device using CAD.

## **Student Learning Objectives**

1. Apply the concept of kinematic pairs (joints) and to determine the number of degrees of freedom for a given mechanism.
2. Identify the different types of four-bar mechanisms and their classifications.
3. Identify the toggle positions and determine the minimum transmission angle and mechanical advantage of a given mechanism.
4. Synthesize a four-bar mechanism using graphical and analytical methods for a given path, motion, or function generation task.
5. Perform a kinematic analysis of a mechanism to determine position, velocity, and acceleration of all members.
6. Perform a kinetic analysis of a mechanism to determine the forces on all joints and the torque required to drive the mechanism.
7. Determine the magnitude and the location of the maximum stress (principal stress, maximum shear stress, and von Mises stress) on a component.
8. Design and analyze short and long columns.
9. Design and analyze thin and thick-walled cylinders, proper interference fits for press and shrink fits.
10. Design and analyze ductile and brittle machine components under static loads using appropriate failure criterion.
11. Identify the type of discontinuity in a cross sectional area of a machine component and estimate the appropriate value for the stress concentration factor.
12. Design and analyze machine components under cyclic loading to guard against fatigue failure.
13. Design bolted joints in tension and shear.
14. Work as a member of a design team to achieve the project goals
15. Learn how to perform motion analysis using CAD

## **References:**

1. [Journal of Mechanical Design](#), Transaction of ASME
2. Shigley and Uicker, [Theory of Machines and Mechanisms](#), McGraw-Hill, 2015
3. A.G. Erdman and G.N. Sander, [Mechanism Design; Analysis and Synthesis](#), Prentice-Hall, V1, 2015
4. B. Paul, [Kinematics and Dynamics of Planar Machinery](#), Prentice Hall, 2008
5. Beggs, J. S., [Mechanism](#), McGraw-Hill, 1955, TJ175.B34 (WLN)
6. Juvinal, [Fundamentals of Machine Components Design](#), Wiley, 2014.
7. Roark, [Formulas for Stress and Strain](#), McGraw Hill, 2014.

## COURSE SCHEDULE

Week/Date (MW)	Subject	Reading Assign.(ch.)	Homework Assign.
1 8/19 (Th)	No lecture		
2 8/23	Enrollment, course organization and design project discussion		
	Introduction to mechanisms, linkages, degree of freedom, (1,2) DOM		
8/25	Kinematics pairs, 4-Bar mechanism and classification (2) DOM		<b>List of group members due date</b>
3 8/30	Graphical synthesis: Mechanical advantage, toggle positions, (3) DOM		Homework #1
	Motion generation mechanism (2 and 3 positions), adding Dyad		Degrees of freedom
	Graphical synthesis; Path generation mechanism (3 position)		Due Wed. Sept. 1
	Synthesis (path gen. mech.) with prescribed timing, design of a Quick-return mechanism		
9/1	Analytical synthesis; Complex polar notation, Closed loop vector eq.		
4 9/6	<b>Holiday – Labor Day</b>		
9/8	Motion generation mechanisms (two to five position), Introduction to CAD animation and motion analysis	(4,5) DOM	
5 9/13	Analytical synthesis; Function & path generation mech.	(4,5) DOM	Home work #2
9/15	Analytical analysis; Position, Velocity. Example problems. <b>Project proposal due date (9/15)</b>	(6,7) DOM	Graphical synthesis Due Wed. Sept. 15
6 9/20	Analytical analysis: acceleration	(6,7) DOM	Homework #3
9/22	Forces on mechanisms; Matrix method Example problems <b>Project specification due date (9/22)</b>		Analytical Synthesis Due Wed. Sept 22
7 9/27	Force analysis: Graphical method Project discussion	(11) DOM	Homework #4 Analytical analysis
9/29	Review of stress & strain, Principal stresses. Exam review <b>Design review</b>	(4) MD	Due Wed. Sept. 29
8 10/4	Exam review, review of combined stresses; axial, bending, torsion and column design. (4) MD		
10/6	<b>Exam 1, Mon. Oct. 6, covers materials on mechanism design and synthesis (DOM)</b>		
9 10/11	Design of thin & thick walled cylinders.	(4) MD	Homework #5
10/13	Material selection for design Most commonly materials used <b>Design project review</b>	(2, notes)	Explode & collapse video of HW#2, due Wed.10/13
10 10/18	Failure theories for static loads; Maximum shear stress theory, The distortion-energy theory.	(5) MD	Homework #6 Force analysis
10/20	Modified Coulomb-Mohr theory (brittle materials).		Due Wed. Oct. 20
11 10/25	The concept of stress concentration	(4,6) MD	Homework #7
10/27	Failure theory for cyclic loads - Fatigue High cycle fatigue; S-N curve.		Static failure, cylinder Due Wed. Oct. 27
12 11/1	Effect of mean stress on fatigue life (Modified Goodman Diagram) (6) MD		
11/3	Combined stresses, Fatigue problems		
13 11/8	Fatigue examples, Bolted joints design: thread standards, static and fatigue analysis, (15) MD bolted joints in tensile and shear loads, preload and torque		Homework #8 Due Wed. Nov. 10
11/10	<b>Design project review</b>		Fatigue failure
14 11/15	Fatigue problems, design project		
11/17	Fatigue problems, <b>Exam Review</b>		
15 11/22	<b>Exam 2, Mon. Nov. 23 – Topics; stress analysis, column, cylinder, yielding and fatigue (MD)</b>		
12/24	<b>Holiday - Thanksgiving</b> Wed. (11/25), Th. (11/26) and Friday (11/27)		
16 11/29	Design project presentation – Groups 1 – 3 and <b>Final Exam review</b>		
12/1	Design project presentations: groups 4 – 7		
17 12/6	Monday - <b>Design project demo 4:00-5:40, project report due date 12/6, upload to Canvas</b> Last day of the semester		<b>by 11:59. No late report will be accepted</b> ky

## Technology Requirements

Students are required to have an electronic device (laptop, desktop or tablet) with a camera and built-in microphone. SJSU has a free equipment loan program available for students: <https://www.sjsu.edu/learnanywhere/equipment/index.php>

Students are responsible for ensuring that they have access to reliable Wi-Fi during tests. If students are unable to have reliable Wi-Fi, they must inform the instructor, as soon as possible or at the latest one week before the test date to determine an alternative. See Learn Anywhere website for current Wi-Fi options on campus.

<https://www.sjsu.edu/learnanywhere/equipment/index.php>

## Zoom Classroom Etiquette

- **Mute Your Microphone:** To help keep background noise to a minimum, make sure you mute your microphone when you are not speaking.
- **Be Mindful of Background Noise and Distractions:** Find a quiet place to “attend” class, to the greatest extent possible.
  - Avoid video setups where people may be walking behind you, people talking/making noise, etc.
  - Avoid activities that could create additional noise, such as shuffling papers, listening to music in the background, etc.
- **Position Your Camera Properly:** Be sure your webcam is in a stable position and focused at eye level.
- **Limit Your Distractions/Avoid Multitasking:** You can make it easier to focus on the meeting by turning off notifications, closing or minimizing running apps, and putting your smartphone away (unless you are using it to access Zoom).
- **Use Appropriate Virtual Backgrounds:** If using a virtual background, it should be appropriate and professional and should NOT suggest or include content that is objectively offensive or demeaning. Make sure your name and your picture is displayed.

## Recording of Zoom Classes

All lectures will be recorded and posted on Canvas. Students are permitted to only view the recordings, not to download the videos.

You must obtain permission in advance to record any course materials. Such permission allows the recordings to be used for a student’s private, study purposes only. Students will not be permitted to share any class recordings with someone who isn’t enrolled in the class or without permission. The recordings are protected by instructor’s copyright.

Any student that needs accommodations or assistive technology due to a disability should work with the Accessible Education Center (AEC), and the instructor.

This course or portions of this course (i.e., lectures, discussions, student presentations) will be recorded for instructional or educational purposes. The recordings will only be shared with students enrolled in the class through Canvas. The recordings will be deleted at the end of the semester. If, however, you would prefer to remain anonymous during these recordings, then please speak with the instructor about possible accommodations (e.g., temporarily turning off identifying information from the Zoom session, including student name and picture, prior to recording). Students are not allowed to record without instructor permission. Students are prohibited from recording class activities (including class lectures, office hours, advising sessions, etc.), distributing class recordings, or posting class recordings. Materials created by the instructor for the course (syllabi, lectures and lecture notes, presentations, etc.) are copyrighted by the instructor. This university policy (S12-7) is in place to protect the privacy of students in the course, as well as to maintain academic integrity through reducing the instances of cheating. Students who record, distribute, or post these materials will be referred to the Student

Conduct and Ethical Development office. Unauthorized recording may violate university and state law. It is the responsibility of students that require special accommodations or assistive technology due to a disability to notify the instructor.

### Technical difficulties

**Internet connection issues:** Canvas autosaves responses a few times per minute as long as there is an internet connection. If your internet connection is lost, Canvas will warn you but allow you to continue working on your exam. A brief loss of internet connection is unlikely to cause you to lose your work. However, a longer loss of connectivity or weak/unstable connection may jeopardize your exam.

**Other technical difficulties:** Immediately email the instructor a current copy of the state of your work/exam and explain the problem you are facing. Your instructor may not be able to respond immediately or provide technical.

**Contact the SJSU technical support for Canvas:**

Technical Support for Canvas Email: [ecampus@sjsu.edu](mailto:ecampus@sjsu.edu) Phone: (408) 924-2337 <https://www.sjsu.edu/ecampus/support/>

### Academic Dishonesty

Students who are suspected of cheating will be referred to the Student Conduct and Ethical Development office and depending on the severity of the conduct, will receive a zero on the assignment or a grade of F in the course. Grade Forgiveness does not apply to courses for which the original grade was the result of a finding of academic dishonesty.