

San Jose State University
Department of Mechanical Engineering
ME 154-Mechanical Engineering Design, Spring 2023

Course and Contact Information

Class No and Section:	22429, Section 02
Class Days/Time:	TuTh 16:30-18:10 (4:30 pm – 6:10 pm)
Classroom:	DH 135 (Duncan Hall)
Pre-requisites:	ME 20, MatE 25, ME 101, CE 112; all with a C- or better
Co-requisite:	TECH/ME 41
Instructor:	Dr. Keith Yi
Office Hours:	TuTh 20:00-21:00 (8:00 pm – 9:00 pm)
Office Location:	Zoom Link
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Grader:	Naga Sai Rahul Garneni (nagasairahul.garneni@sjsu.edu)

Course Format

This is a mixed-mode class, with both in-person and online components. Online components require the use of the Canvas learning management system, accessed via <https://sjsu.instructure.com/>. Successful completion of course requirements necessitates accessing the course website frequently, typically at least twice a week on a regular basis. Technical support for Canvas is available at <http://www.sjsu.edu/at/ec/canvas/>. Important communications regarding this class may be sent via Canvas or to email addresses listed above, and thus each student is expected to maintain up-to-date contact information in both systems.

Course Description

Introduction to the design and analysis of mechanisms and machine elements. Linkage synthesis. Kinematic and dynamic analysis of mechanisms. Application of statics, dynamics, strength of materials, static failure theories and fatigue theories to the design of machine components. Threaded fasteners. Group design project.

Learning Outcomes

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

1. Apply the concept of kinematics pairs (joints) and 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 to 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 motion or function generation task.
5. Perform a kinematics 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 location of the maximum stress (principal stresses, 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 under pressure and to select proper interference fits for press or shrink fits.
10. Design and analyze ductile and brittle machine components under static loads using appropriate failure criterion.
11. Estimate the value of stress concentration factor.
12. Design and analyze machine components under cyclic loads to guard against fatigue failure.
13. Design bolted joints in tension and shear.
14. Work as a team to accomplish a project goal.

Required Textbooks

1. Design of Machinery, 6th ed., R. L. Norton, McGraw-Hill, 2020. ISBN 9780077421717 (with software), 9780073529356 (no software), or 9781121466852 (custom for ME 154, via Spartan Bookstore).
2. Machine Design: An Integrated Approach, 6th ed., R. L. Norton, Prentice Hall, 2019.

Supplementary Textbooks

1. Budynas and Nisbett: Shigley's Mechanical Engineering Design, 11th ed., McGraw-Hill, 2020.
2. Waldron, Kinzel, and Agrawal: Kinematics, Dynamics, and Design of Machinery, 3rd ed., Wiley, 2016.
3. Juvinall and Marshek: Fundamentals of Machine Component Design, 5th ed., Wiley, 2012.

Course Requirements and Assignments

SJSU classes are designed such that in order to be successful, it is expected that students will spend a minimum of forty-five hours for each unit of credit (normally three hours per unit per week), including preparing for class, participating in course activities, completing assignments, and so on. More details about student workload can be found in University Policy S12-3 at <http://www.sjsu.edu/senate/docs/S12-3.pdf>.

- Design Project: A major (and hopefully enjoyable!) part of this course is the Design Project. Students are responsible for working in a team to design a mechanism (both synthesis and analysis) and to build a prototype that demonstrates its functionality. Details are provided via separate documentation.
- Exams: There are one midterm exam and one final exam. All students are expected to complete exams as scheduled. There are no make-up exams, but for truly unavoidable and extenuating circumstances with firm documentation, a student may petition to have weight redistributed to the final exam. Disability accommodations must be coordinated through the Accessible Education Center <http://www.sjsu.edu/aec/>.
- Homework: Homework problems will be assigned corresponding to lecture topics. Late submission receives zero credit. See "Exceptions" below regarding petition for extenuating circumstances. For any questions about homework (e.g. your grade, late submissions, feedback, ...) directly contact the grader.
- Classwork: Classwork problems will be assigned corresponding to lecture topics. Students are expected to submit their work during class time. Late/no submission receives zero credit with no exceptions, but the two lowest grades will be dropped for everyone.

Grading Policy

The course grade will be weighted as follows:

10% for Homework
10% for Classwork
20% for Midterm Exam
25% for Design Project
35% for Final Exam

The overall course grade is calculated from a weighted sum of all graded components. Graded percentage points correspond to letter grade as follows:

93 ≤ → A

90 ≤ < 93	→ A-
87 ≤ < 90	→ B+
83 ≤ < 87	→ B
80 ≤ < 83	→ B
77 ≤ < 80	→ C+
73 ≤ < 77	→ C
70 ≤ < 73	→ C-
67 ≤ < 70	→ D+
63 ≤ < 67	→ D
60 ≤ < 63	→ D-
< 60	→ F

Exceptions: Any grading appeals or late petitions must be petitioned promptly in writing (or email). Exceptions will normally be evaluated at the very end of the semester in context with semester track record and all other exceptions class wide. Special consideration for truly unavoidable and extenuating circumstances will depend on timing and strength of supporting documentation (e.g., doctor's note, jury summons, military orders).

University Policy F13-1 at <http://www.sjsu.edu/senate/docs/F13-1.pdf> states: “All students have the right, within a reasonable time, to know their academic scores, to review their grade-dependent work, and to be provided with explanations for the determination of their course grades.”

General Expectations, Rights and Responsibilities of the Student

As members of the academic community, students accept both the rights and responsibilities incumbent upon all members of the institution. Students are encouraged to familiarize themselves with SJSU’s policies and practices pertaining to the procedures to follow if and when questions or concerns about a class arises. See University Policy S90-5 at <http://www.sjsu.edu/senate/docs/S90-5.pdf>. More detailed information on a variety of related topics is available in the SJSU catalog, at <http://info.sjsu.edu/web-dbgen/narr/catalog/>. In general, it is recommended that students begin by seeking clarification or discussing concerns with their instructor. If such conversation is not possible, or if it does not serve to address the issue, it is recommended that the student contact the Department Chair as a next step.

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 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 at http://www.sjsu.edu/provost/services/academic_calendars/. The Late Drop 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.

Information about the latest changes and news is available at the Advising Hub at <http://www.sjsu.edu/advising/>.

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 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 is available at <http://www.sjsu.edu/studentconduct/>.

Campus Policy in Compliance with the American 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 inform me in writing as soon as possible (email acceptable). Presidential Directive 97-03 at 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 (AEC) at <http://www.sjsu.edu/aec> to establish a record of their disability.

Student Technology Resources

Computer labs for student use are available in the Academic Success Center at <http://www.sjsu.edu/at/asc/> located on the 1st floor of Clark Hall and in the Associated Students Lab on the 2nd floor of the Student Union. Additional computer labs may be available in your department/college. Computers are also available in the Martin Luther King Library. A wide variety of audio-visual equipment is available for student checkout from Media Services located in IRC 112. These items include DV and HD digital camcorders; digital still cameras; video, slide and overhead projectors; DVD, CD, and audiotape players; sound systems, wireless microphones, projection screens and monitors.

SJSU Writing Center

The SJSU Writing Center is located in Clark Hall, Suite 126. All Writing Specialists have gone through a rigorous hiring process, and they are well trained to assist all students at all levels within all disciplines to become better writers. In addition to one-on-one tutoring services, the Writing Center also offers workshops every semester on a variety of writing topics. To make an appointment or to refer to the numerous online resources offered through the Writing Center, please see <http://www.sjsu.edu/writingcenter>.

Tentative Course Schedule

Week	Topics
1	Course organization; design project discussion; introduction to linkages; degrees of freedom; kinematic pairs; 4-bar mechanisms (Ch 2 in DoM*).
2	Types of joints; mechanism classification; Kutzbach's equation; linkage transformation; Grashof condition; inversion (Ch 2 in DoM). Toggle positions; transmission angle; linkage output types (Ch 3 in DoM).
3	Graphical synthesis: two-position and three-position problems; adding dyad; coupler curves; dwell mechanism (Ch 3 in DoM).
4	Vectors, coordinate systems, and complex notation (Ch 4 in DoM). Analytical synthesis (Ch 5 in DoM).
5	Analytical analysis: position and velocity (Ch 4 & 6 in DoM).
6	Analytical analysis: acceleration and force (Ch 7 & 11 in DoM).
7	Analytical analysis: force (Ch 11 in DoM). Review of stress (Ch 4 in MD**).
8	Midterm Exam
9	Review of stress under combined loads, principal stresses (Ch 4 in MD**).
10	Stress concentration; strain and deflection; column design (Ch 4 in MD). Failure theories for static loads (Ch 5 in MD).
11	Failure theories for static loads (Ch 5 in MD). Design of cylinders; press and shrink fits; material selection for design (Ch 2 & 4 in MD).
12	Failure under cyclic loads; low-cycle and high-cycle fatigue; Marin factors (Ch 6 in MD).
13	Effect of stress concentration on fatigue; effect of mean stress on fatigue life; combined stresses for cyclic loading case (Ch 6 in MD).
14	Bolted joint design (Ch 15 in MD).
15	Design Project presentation and demonstration; course review.

Final Exam: Thursday, May 18, 14:45-17:00 (2:45 pm – 5:00 pm), DH 135

* Design of Machinery textbook

** Machine Design textbook