SAN JOSE STATE UNIVERSITY
Mechanical Engineering Department

ME 154 - Mechanical Engineering Design **Spring 2023**

Instructor:	Prof. Ken Youssefi	**Office: E 247**	
Class room:	E 339	**Office hrs: by appointment**	
Class time:	Lecture - MW 3:00 - 4:40	***email : kyoussefi@aol.com***	
Class code:	2565 (section 1)		
Final Exam:	**Thursday May 18, 12:15 - 2:30**	**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 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", 5th or 6th edition, Prentice Hall, (MD)
Recommended Text: R. L. Norton, "Design of Machinery; Introduction to Synthesis and Analysis of Mechanisms" 6th edition, McGraw-Hill Inc. 2020 (DOM) or the custom version available at the bookstore.

Group design project - see project description for details

Grading: Homework 15%, Project 20%, Midterm Exams 20% each, Final Exam 25%
Final course grade is determined using a normal distribution curve (± grades will be assigned):

Grade distribution	Grade A	average plus one standard deviation and higher
	Grade B	average plus ½ standard deviation
	Grade C+	average
	Grade C-	average minus ½ 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 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 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 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.

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.

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. Juvinall, Fundamentals of Machine Components Design, Wiley, 2014.
7. Roark, Formulas for Stress and Strain, McGraw Hill, 2017.

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COURSE SCHEDULE

Week/Date		Subject	Reading Assign.(ch.)	Homework Assign.
1	Wed. 1/25	Enrollment, course organization and design project discussion Introduction to mechanisms		
2	1/30	Introduction to mechanisms, linkages, degree of freedom,	(1,2) DOM	
	2/1	Kinematics pairs, 4-Bar mechanism and classification (2) DOM **List of group members due date**		
3	2/6	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. 2/8
		Synthesis (path gen. mech.) with prescribed timing, design of a Quick-return mechanism		
	2/8	Analytical synthesis; Complex polar notation, Closed loop vector eq.		
4	2/13	Analytical synthesis - examples		Homework #2
	2/15	Motion generation mechanisms (two to five position),	(4,5) DOM	Graphical synthesis
		Introduction to CAD animation and motion analysis		Due Wed. 2/15
5	2/20	Analytical synthesis; Function & path generation mech.	(4,5) DOM	HW #3 - animation
	2/22	Analytical analysis; Position, Velocity	(6,7) DOM	explode & collapse, of
		Example problems. **Project proposal due date 2/24**		hw2, Due Wed. 2/22
6	2/27	Analytical analysis: acceleration	(6,7) DOM	HW # 4 - Analytical
	3/1	Forces on mechanisms; Graphical method		Synthesis, Due W 3/1
		Example problems **Project specification due date (3/3)**		
7	3/6	Force analysis: Matrix method	(11) DOM	HW #5 – animation of
	Project discussion			hw4 mechanism
	3/8	**Examples – analytical analysis**		Due Wed. 3/8
8	3/13	Review of stress & strain, Principal stresses. Exam review	(4) MD	Homework #6
	3/15	Design of thin & thick walled cylinders.	(6,7) MD	Analytical analysis
		Design project review on Zoom		Due Wed. March 3/15
9	3/22	Exam 1 review – homework and example problems		HW #7-Motion analysis
	3/22	**Exam 1, Wed. 3/22, topics; DOF, mechanism synthesis & analysis graphical and analytical**		(CAD) of hw6 mech. Due Friday 3/24
10	**3/27 – 3/31**	***Spring Recess***		
11	4/3	Failure theories for static loads;	(5) MD	
		Maximum shear stress theory, The distortion-energy theory.		
	4/5	Modified Coulomb-Mohr theory (brittle materials).		
12	4/12	The concept of stress concentration	(4,6) MD	Homework #8
	4/14	Failure theory for cyclic loads - Fatigue		Force analysis
		High cycle fatigue; S-N curve.		Due Wed. April 14
13	4/17	Effect of mean stress on fatigue life (Modified Goodman Diagram)	(6) MD	Homework #9
	4/19	Combined stresses, Fatigue problems		Static failure, cylinder, due Wed. April 19
14	4/24	Fatigue examples, Bolted joints design: thread standards, static and fatigue analysis,	(15) MD	
		bolted joints in tensile and shear loads		
		preload and torque		**Design project review (Zoom)**
	4/26	Problems, design project		Homework #10 Due Wed. April 26
15	5/1	Fatigue problems, **Exam2 and Final Exam Review**		
	5/3	**Exam 2, Wed. May 3 – Topics; stress analysis, yielding and fatigue failures (MD)**		
16	5/8	Design project presentations: groups 1, 2, 3, 4, 5		
	5/10	Design project presentations: groups 6, 7, 8, 9, 10		
17	5/15	**Monday - Design project demo 3:00-5:00 pm, project report due date 5/15, upload to Canvas by 11:59. No late report will be accepted**		
		Monday is the last day of the instruction		ky