San José State University
Department of Mechanical Engineering
ME182-Thermal Systems Design, Section 01, #41467, Fall 2022

Instructor:	Dr. Ernest M. Thurlow
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Office Hours:	Tuesday/Thursday/3:00pm-4:15pm and 4:15-4:45pm In Class, or Eng 348!
Class Days/Time:	Eng 340 Tues and Thurs 3:00pm-4:15pm
Classroom:	Eng 340
Prerequisites:	ME111, Fluid Mechanics, C- or better ME114, Heat Transfer, C- or better (Hardcopy of Unofficial Transcript Required)
GE/SJSU Studies Category:	Three (3) semester units of engineering science topics

Faculty Web Page and MYSJSU Messaging

CANVAS: https://sjsu.instructure.com/courses/1489888

Course Description

Design of power systems and cooling/heating systems by engineering groups/teams using course information, class examples, and computer software. Designs will be discussed in written team reports for each of the three projected designs. The final project, the "alternative fuel design", will be presented to the class.

Course Time Requirements

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 practica. Other course structures will have equivalent workload expectations as described in the syllabus.

Course Goals and Student Learning Objectives

Students completing ME 182 should have an understanding of how to

- Synthesize previously learned principles in thermodynamics, fluid mechanics, and heat transfer in the analysis and design of thermal and fluid systems such as piping networks, heat exchangers, and electronics cooling systems
- Apply energy analysis in optimizing and designing of thermal-fluid devices and systems (EES software and calculations)
- Gain an understanding of how thermal systems' components such as pumps, fans, valves, piping, and heat exchangers work.
- Apply economic principles in the design of thermal-fluid devices and plants.
- Determine how various types of energy sources may affect health and welfare, society, the economy, and the environment.
- Improve teamwork and communication skills.

Course Content Learning Outcomes

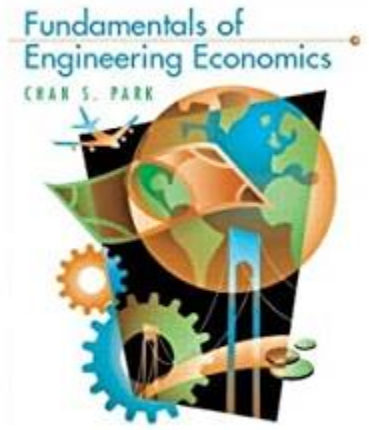
Upon successful completion of this course, students will be able to:

1) Analyze electronic packaging and cooling techniques
2) Understand methods used to model electronic networks using thermal resistance techniques
3) Determine feasibility and important factors to consider when designing cooling for a system of components.
4) Perform a cost estimation of capital equipment and present worth analyses of project after specified projecttimeline.
5) Compare design alternatives using a Present Worth economic analysis.
6) Choose a pump, fan, fluid mover to perform adequate fluid flow rate.
7) Design a series piping system network.
8) Design and analyze a parallel piping system network. (Hardy-Cross Method)
9) Research and make a presentation on a topic related to alternative energy sources or energy resource usageaddressing effects on human health and welfare, society, politics, economics, and the environment.
10) Develop a realistic thermal-fluid design of a solar power assisted water (SAW) heating/cooling system.
11) Work as a team-dividing up tasks, setting deadlines, reviewing each other's work, resolving conflicts.
12) Use the library and internet to search for technical information.
13) Write technical reports and memos.

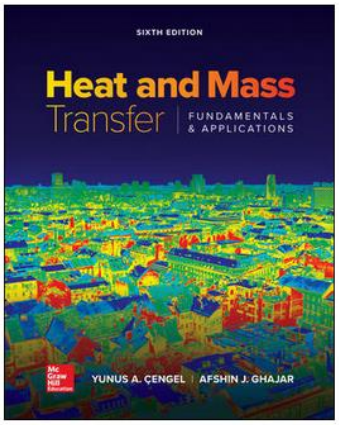
Required Texts/Readings

Text 1. Course Packet from Bookstore*

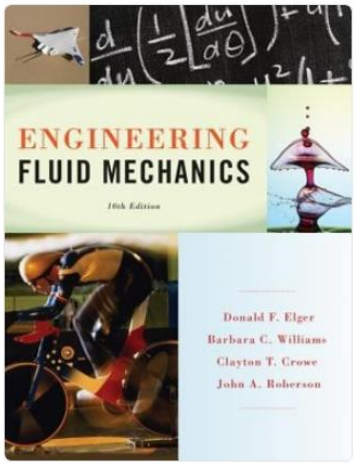
Text 2. *Fundamentals of Engineering Economics*, Chan S. Park, Prentice Hall(Course Packet)



Text 3."*Heat and Mass Transfer* , A Practical Approach" 6th Edition by Yunus A. Cengel & Afshin Ghajar



Text 4. *"Engineering Fluid Mechanics"*, by Crowe, Elger, Williams & Robertson, John Wiley & Sons, 10th Edition, or similar fluid mechanics textbook



Text 5."*Thermodynamics:An Engineering Approach*" 9th Edition by Y.A.Çengel and M.A.Boles, or similar thermodynamics textbook.

*Available at Student Bookstore

Additional Readings

*Heat Transfer, A Practical Approach,*Yunus A. Cengel, McGraw Hill,1998, 2nd or 3rd Ed.
Thermodynamics, An Engineering Approach, 5th Edition, Y. A. Cengel and M.A. Boles, McGraw-Hill, Inc.
Analysis and Design of Energy Systems, 3rd Edition, B.K. Hodge and Robert P. Taylor, Prentice Hall, Inc. (Course Packet)
Elements of Thermal-Fluid System Design, L. C. Burmeister, Prentice Hall, Inc. (Course Packet)
Design and Simulation of Thermal Systems, N.V. Suryanarayana and O. Arici, McGraw Hill, Inc. (Course Packet)
Design of Fluid Thermal Systems, 3rd Edition, W.S. Janna, C.L. Engineering
Fundamentals of Heat Transfer, Incropera& DeWitt, J.Wiley and Sons
Heat Transfer, J.P. Holman, McGraw-Hill

Other equipment / material requirements (optional)

Project#1, $30? (Maybe Simple Project Online, or Preordered Parts) (only if thermal test could be setup using power source, wall power, 2 x thermocouples).

Class Hmwk Questions (5% of Grade)

During lectures In Class or Learnsmart questions may be presented for you to complete. Solutions will be uploaded to CANVAS. If you do not respond to a question, that will count as an incorrect answer (so don't miss too many classes!).

>80% correct	5 points
60-79.9% correct	2 points
50-59.9% correct	1 point
0-50% incorrect	0 points

We will start using this system after the first week of class, or Aug. 25. Note: Extra Credit is limited at 5% maximum for your grade.

Class Protocol

High ethical standards are required of every student at San Jose State University. It is your responsibility to foster an atmosphere of honesty and integrity. All exams and homework (unless otherwise instructed) must be your own work. Copying another's work or allowing another to copy your work are both considered cheating and may result in failure of the course. However, you are encouraged to **discuss** homework and projects with other students in the class.
Also, please be punctual to Zoom Class Meetings and do not repeatedly interrupt class during lecture, best to use Zoom chat.

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 calendar web page located at http://www.sjsu.edu/academic_programs/calendars/academic_calendar/. 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/.

Attendance and Participation

Attendance per se shall not be used as a criterion for grading. However, students are expected to attend all Zoom meetings for the courses in which they are enrolled as they are responsible for material discussed therein, and active participation is frequently essential to ensure maximum benefit to all class members. In some cases, attendance is fundamental to course objectives; for example, students may be required to interact with others in the Zoom class. Attendance is the responsibility of the student. Participation may be used as a criterion for grading.

Assignments and Grading Policy

Quizzes (3)	15%
In Class Hmwk and Class Notebook	5%
Homework	17%
Project #1 (LED Electronics Cooling Project)	18%
Project #2 (Solar Assisted Water Heating/Piping Project)	17%
Alternative Fuel Presentation	10%
Final Exam	18%
Total	100%

Grade Distribution:

A	94-100	A-	90-93.9		
B+	85-89.9	B	82-84.9	B-	80-81.9
C+	75-79.9	C	72-74.9	C-	70-71.9
D+	65-69.9	D	62-64.9	D-	60-61.9

A final exam score that is 10 points or more higher than your course average may result in a grade somewhat higher than indicated here.

Exams:

Three quizzes and one final exam will be given. They must be taken on the scheduled dates unless a) you show a note from doctor or the SJSU health center documenting illness or other emergency or b) you make other arrangements with the instructor before the exam date. **The Final Examination is on Thursday December 8th, 2:45-5:00pm.**

Homework:

Homework format should be neat, and every step in the solution process should be shown. Taking cell phone images may not be sufficient for readability and grading and may result in a lower grade than expected (I use the Genius Scan+ App!) Assumptions, knowns, and unknowns should be included. **Summarize the problem statement at the beginning**. Feel free to work the problems using MathCad, EES, or any other software programs. During exams problems may only allow a calculator, and without aid of a computer. You are encouraged to **discuss** homework problems with your classmates (or the instructor). **½ maximum credit will be given for late homework**.

University Policies

Academic integrity

Your commitment as a student to learning is evidenced by your enrollment at San Jose State University. The University's Academic Integrity policy, located at (www.) 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.

Cheating on exams or plagiarism (presenting the work of another as your own, or the use of another person's ideas without giving proper credit) will result in a failing grade and sanctions by the University. For this class, all assignments are to be completed by the individual student, or project team, unless otherwise specified. If you would like to include your assignment or any material you have submitted, or plan to submit for

another class, please note that SJSU's Academic Policy S07-2 requires approval of instructors.

Student Technology Resources and Remote Labs Websites:

Software Resources: **(**https://sjsu.zoom.us/my/studenttechtrainingcenter)

Software training can be accessed via the Martin Luther Library website above. Software training includes Microsoft Softwares (Powerpoint, Excel, Word, etc), Adobe Softwares, Zoom Meetings.

Remote Labs: https://www.sjsu.edu/ecs/remotelabs/
Computer labs may be open on as needed basis. However, remote labs can be accessed using the weblink above. Computers are also available in the Martin Luther King Library.

SJSU Writing Center(https://www.sjsu.edu/writingcenter/)

The SJSU Writing Center is located in Room 126 in Clark Hall. It is staffed by professional instructors and upper-division or graduate-level writing specialists from each of the seven SJSU colleges. Our writing specialists have met a rigorous GPA requirement, and they are well trained to assist all students at all levels within all disciplines to become better writers.The Writing Center website is located at https://www.sjsu.edu/writingcenter/.

Peer Mentor Center (https://www.sjsu.edu/access/peer_mentors/)

The Peer Mentor Center is located on the 1st floor of Clark Hall in the Academic Success Center. The Peer Mentor Center is staffed with Peer Mentors who excel in helping students manage university life, tackling problems that range from academic challenges to interpersonal struggles. On the road to graduation, Peer Mentors are navigators, offering "roadside assistance" to peers who feel a bit lost or simply need help mapping out the locations of campus resources. Peer Mentor services are free and available on a drop –in basis, no reservation required. ThePeer Mentor Center website is located at https://www.sjsu.edu/access/peer_mentors/.

ME182-01 COURSE SCHEDULE FOR FALL 2022

Date	General Lecture Topic	Reading	For Review	Projects/Exams/Quizzes
23-Aug	*Introduction, Overview of Design Principles, Econ. Analyses, Defn of Terms, Interest Formulas*	Engineering Economics in Course Notebook, Handouts	Sury.& Ar. Ch 11 & Chan S. Park	
25-Aug	*Econ. Analyses, Cash Flow Diagrams, Payment Schedules, MARR, Present/Future Worth*	Engineering Economics in Course Notebook Handouts	Sury.& Ar. Ch 11 & Chan S. Park	
30-Aug	*Economics: MARR, Present/Future Worth Conduction, Convection, & Radiation Heat Transfer Review*	Heat &Mass Xfer, Cengel	Cengel, Chp 1	**Project #1 Assigned**
1-Sept	*Ext/Int Convection(Nu#), Radiation Heat Transfer(T^4), Thermal Resistance Networks(T)*	Heat &Mass Xfer, Cengel	Cengel, Chp 3	**Hmwk#1 (Econ) Due**
6-Sept	*Chip Package Thermal Analysis and Resistance Networks, (Θja, Θjc, Θjb)*	Heat &Mass Xfer, Cengel, Handouts	Cengel, Chp 3	**Alt.Pwr. Present. Topics Selected, Quiz #1 (Economics)**
8-Sept	*Heatsink Design (L/kA +1/hA), Contact Resistance and Thermal Interfaces*	Heat &Mass Xfer, Cengel, Handouts	Cengel, Chp 7,8	
9-Sept	*Heatsink Design Analyses (Internal/External Flow Analyses, Nu correlation selection)*	Heat &Mass Xfer, Cengel, Class Handouts	Cengel, Chp 7,8	
15-Sept*	*Heatsink Design Analyses Algorithm (Single Fluid, "h" convection coeff calculations)* ***Last Day to Drop, or Add, Course***	Heat &Mass Xfer, Cengel, Class Handouts	Cengel, Chp 7,8	**Hmwk#2 (Thml Res) Due**
17-Sept	*Fans and System/Heatsink Pressure Drop*	Fans and Pressure Drop Course Notebook, Handout	Burmeister, Chp 2	
22-Sept	*Fan Affinity Laws, Fan Pressure Drop Experiment, ANSYS Icepak (B.C.s, Matls, Θ's)*	Fans & Pressure Drop in Course Notebook, Handout	Burmeister, Chp 2	**Hmwk#3 (Hsk&Fans)Due**
24-Sept	*ANSYS Icepak Elect. Cooling Simulation Introductio*	Handouts	Icepak Tutorials	
29-Sept	*ANSYS Icepak Electronics Cooling Simulation Contd.*	Handouts	Icepak Tutorials	
4-Oct	*Heat Exchanger Design (Two Fluid), LMTD*	Handouts	Icepak Tutorials	**Quiz#2, Elect. Cooling**
6-Oct	*Heatpipe B.O.E. Calcs & Documented Comparisons*	Burmeister Handout	Burmeister, Chp 4	
11-Oct	*Heat Exchanger Design NTU (ε vs NTU, C)*	Handouts	Icepak Tutorials	
13-Oct	*Heat Exchanger Design (Two Fluid) LMTD vs.NTU*	Heat &Mass Xfer, Cengel, Janna Chp. 8	Cengel, Chp 11 Janna, Chp 8	
18-Oct	*Heat Exchangers (Two Fluid) Icepak (Heatpipes, Optimization, Postprocessing)*	Heat &Mass Xfer, Cengel, Janna Chp. 8	Cengel, Chp 11 Janna, Chp 8	
20-Oct	*Project #1 Work Day, Show Icepak/Flotherm Results*	Heat &Mass Xfer, Cengel, Janna Chp. 8	Cengel, Chp 11 Janna, Chp 8	**Hmwk#4 (HXgers) Due**
25-Oct	*Project #1 Work Day, Report Overview and Formatting*	Series Piping in Course Notebook	Hodge and Taylor, Pg 19-31	**Detailed Alt. Pwr. Pres. Outline Due**
27-Oct	*Project#2, "Solar Assisted Water Heating Project"; Series Piping Network Design*	Project#2 Handouts	Hodge and Taylor, Pg 19-31	**Project #1 Due Project #2 Assigned**
1-Nov	*Series Piping Network Review ($\Delta P=\rho f L/DV^2/2$)*	Series Piping in Course Notebook	Hodge and Taylor Burmeister, Chp 2	
3-Nov	*Series Piping Network Design + Valve Types and Minor Loss Types*	Series Piping in Course Notebook	Hodge and Taylor Burmeister, Chp 2	**Quiz#3, Parallel/Series Piping**
8-Nov	*Guest Speaker(Notes Reqd, ? for Final Exam)*	Engineering Fluid Mech, & Course Notebook	Hodge and Taylor, Pg 32-38	
10-Nov	*Simple Parallel Piping Networks*	Engineering Fluid Mech, & Course Notebook	Hodge and Taylor, Pg 43-70	
15-Nov	*Introduction to Hardy Cross Parallel Pipe Method (R+S-1=Loop#)*	Engineering Fluid Mech, & Course Notebook	Hodge and Taylor, Pg 43-70	**Hmwk#5 Due (Serial Piping)**
17-Nov	*Hardy Cross Method(Derivation & Iter w/ MS Excel)*	H. Cross Class Handout	H. Cross Handout	

22-Nov	*Hardy Cross Method Contd.(Iterations w/ MS Excel)*	H. Cross Class Handout and R+S-1 Handout	H. Cross Class &R+S-1 Handout	
Date	**General Lecture Topic**	**Reading**	**For Review**	**Projects/Exams/Quizzes**
24-Nov	*Thanksgiving Holiday, No Class*	Engineering Fluid Mech, &Course Notebook	Burmeister, Chp 2	**Hwk#6(ParallelPipe) Due**
29-Nov	*Pump Design and Pump Affinity Laws*			
1-Dec	*Project #2 Review and Economic Considerations* *Project #2 Work Day/Alt Energy Presentations*			
6-Dec	LAST DAY OF INSTRUCTION FALL 2022 *Final Examination Review,* *Alternative Power Presentations*			
8-Dec	**(12/8, Thursday, 2:45-5:00pm) FINAL EXAM**			**Final Examination**

***Last Day to Add or Drop Class**

Blue=Completed or Holiday