San José State University
Department of Mechanical Engineering
ME182-Thermal Systems Design, Section 01, #42786, Fall 2018

Instructor:	Dr. Ernest M. Thurlow
Office Location:	Eng. 348 (or classroom)1/2hr before class and 1/2hr after class
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Office Hours:	Tuesday/Thursday/11:30-12:00pm or 1:15-1:30pm
Class Days/Time:	Tuesday and Thursday/12:00pm-1:15pm
Classroom:	Eng.341
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/1266919

Course Description

Design of power systems and cooling/heating systems by engineeringgroups/teams using course information, class examples, and computer software.Designs will be discussed in written team reports for each of the three projectdesigns. The final project, the “alternative fuel design”, will be presented to theclass.

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
- Understand how to utilize ANSYS Icepak to setup and optimize a thermal simulation model, and obtain useful post processing results.
- 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, theeconomy, 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) Simulate and optimize a thermal-fluid system using a computer (F-Chart, EES, MS Excel)
12) Work as a team-dividing up tasks, setting deadlines, reviewing each other's work, resolving conflicts.
13) Use the library and internet to search for technical information.
14) Write technical reports and memos.
15) Understandhow to simulate/model electronic systems and optimized them using ANSYS Icepaksoftware.

Required Texts/Readings

Text 1. Course Packet from Bookstore*
Text 2."Heat and Mass Transfer , A Practical Approach" 4th Edition by Yunus A. Cengel
Text 3."Engineering Fluid Mechanics", by Crowe, Elger, Williams & Robertson, John Wiley & Sons, Ninth Edition, 2009, or similar fluid mechanics textbook
Text 4."Thermodynamics:An Engineering Approach" 6th Edition by Y.A.Çengel and M.A.Boles, or similar thermodynamics textbook.

*Available at Student Bookstore

AdditionalReadings

*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.
Fundamentals of Engineering Economics, Chan S. Park, Prentice Hall(Course Packet)
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?Price limit for additional supplies (only if thermal testing is required).

iClicker/In Class Hmwk Questions (5% of Grade)

During lectures iClicker or Learnsmart questions may be presented for you to complete. These are multiple choice questions that can be answered using a cell phone, laptop, or an iClicker that you check out. Results are uploaded into CANVAS. Credit will be awarded based on a semester average of iClicker responses. 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

If for some reason this system becomes unworkable during the semester, an alternate option for extra credit will be given. To get access to this system, a form will be provided during the first week of class:

We will start using this system after the first week of class, or Aug. 27. Note: Extra Credit is limited at 5% maximum for your grade.

Classroom Protocol

High ethical standards are required of every student at San JoseStateUniversity. 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 class and do not leave class or interrupt class during lecture.Cell phones must be put in offline mode during class.

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 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 class. Attendance is the responsibility of the student. Participation may be used as a criterion for grading when the parameters and their evaluation are clearly defined in the course syllabus and the percentage of the overall grade is stated. The full policy language can be found at http://www.sjsu.edu/senate/docs/S15-12.pdf

Assignments and Grading Policy

Quizzes (2)	15%
Iclicker and/or In Class Hmwk	5%
Homework	15%
Project #1 (LED Electronics Cooling Project)	15%
Project #2 (Solar Assisted Water Heating/Piping Project)	17%
Alternative Fuel Presentation	10%
Class Notebook	5%
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 can 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 December 14th, 9:45-12:00pm inEng. 341.**

Homework:

Homework format should be neat, and every step in the solution process should be shown. 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 program you wish. However, during exams all problems will be done without aid of a computer. You are encouraged to **discuss** homework problems with your classmates (or the instructor). **1/2maximum credit will be given for late homework**.

University Policies(http://www.sjsu.edu/gup/syllabusinfo/)

Academic integrity

Your commitment as a student to learning is evidenced by your enrollment at San JoseStateUniversity. TheUniversity's Academic Integrity policy, located at http://www.sjsu.edu/senate/S07-2.htm, 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 websiteis available at http://www.sa.sjsu.edu/judicial_affairs/index.html.

Instances of academic dishonesty will not be tolerated. 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 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.

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 make an appointment with me as soon as possible, or see me during office hours. Presidential Directive 97-03 requires that students with disabilities requesting accommodations must register with the Disability Resource Center (DRC) at http://www.drc.sjsu.edu/ to establish a record of their disability.

Student Technology Resources(http://www.sjsu.edu/gup/syllabusinfo/)

Computer labs for student use are available in the Academic Success Center located on the 1st floor of Clark Hall and 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 digital and VHS camcorders, VHS and Beta video players, 16 mm, slide, overhead, DVD, CD, and audiotape players, sound systems, wireless microphones, projection screens and monitors.

SJSU Writing Center(http://www.sjsu.edu/gup/syllabusinfo/)

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 http://www.sjsu.edu/writingcenter/about/staff/.

Peer Mentor Center (http://www.sjsu.edu/gup/syllabusinfo/)

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 http://www.sjsu.edu/muse/peermentor/

ME182-01 COURSE SCHEDULE FOR FALL 2018

Date	General Lecture Topic	Reading	For Review	Projects/Exams/Quizzes
21-Aug	*Introduction, Overview of Design Principles, Econ. Analyses, Defn of Terms, Interest Formulas*	Engineering Economics in Course Notebook	Sury.& Ar. Ch 11	
23-Aug	*Econ. Analyses, Cash Flow Diagrams, Payment Schedules, MARR, Present/Future Worth*	Engineering Economics in Course Notebook	Sury.& Ar. Ch 11	
28-Aug	*Conduction, Convection, and Radiation Heat Transfer Review*	Heat &Mass Xfer, Cengel	Cengel, Chp 1	**Project #1 Assigned**
30-Aug	*Ext/Int Convection(Nu#), Radiation Heat Transfer(T^4), Thermal Resistance Networks(T)*	Heat &Mass Xfer, Cengel	Cengel, Chp 3	**Hmwk#1 (Econ) Due**
4-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)**
6-Sept	*Heatsink Design (L/kA +1/hA), Contact Resistance and Thermal Interfaces*	Heat &Mass Xfer, Cengel, Handouts	Cengel, Chp 7,8	
11-Sept	*Heatsink Design Analyses (Internal/External Flow Analyses, Nu correlation selection)*	Heat &Mass Xfer, Cengel, Class Handouts	Cengel, Chp 7,8	
13-Sept	*Heatsink Design Analyses Algorithm (Single Fluid, "h" convection coeff calculations)*	Heat &Mass Xfer, Cengel, Class Handouts	Cengel, Chp 7,8	**Hmwk#2 (Thml Res) Due**
18-Sept	*Fans and System/Heatsink Pressure Drop, ANSYS Icepak (Model Development Introduction))*	Fans and Pressure Drop Course Notebook, Handout	Burmeister, Chp 2	
20-Sept	*Fan Affinity Laws, Fan Pressure Drop Experiment, Icepak (B.C.s, Matls, Θ's)*	Fans & Pressure Drop in Course Notebook, Handout	Burmeister, Chp 2	**Hmwk#3 (Hsk&Fans)Due**
25-Sept	*Icepak (Model Building>>>PCBs, Chip Packages) + Evening Training Sessions*	Handouts	Icepak Tutorials	
27-Sept	*Icepak (Model Building>>>PCBs, Chip Packages) + Evening Training Sessions*	Handouts	Icepak Tutorials	
2-Oct	*Icepak (Meshing) + Evening Training Sessions*	Handouts	Icepak Tutorials	**Quiz#2, Elect. Cooling**
4-Oct	*Icepak (Meshing) + Evening Training Sessions*	Handouts	Icepak Tutorials	
9-Oct	*Heat Exchanger Design (Two Fluid), LMTD*	Heat &Mass Xfer, Cengel, Janna Chp. 8	Cengel, Chp 11 Janna, Chp 8	
11-Oct	*Heat Exchanger Design NTU (ε vs NTU, C)*	Heat &Mass Xfer, Cengel, Janna Chp. 8	Cengel, Chp 11 Janna, Chp 8	
16-Oct	*Heat Exchanger Design (Two Fluid) LMTD vs.NTU*	Heat &Mass Xfer, Cengel, Janna Chp. 8	Cengel, Chp 11 Janna, Chp 8	**Hmwk#4 (HXgers) Due**
18-Oct	*Heat Exchangers (Two Fluid) Icepak (Heatpipes, Optimization, Postprocessing)*	Series Piping in Course Notebook	Hodge and Taylor, Pg 19-31	**Detailed Alt. Pwr. Pres. Outline Due**
23-Oct	*Project #1 Work Day, Implementing Icepak Results*	Icepak Handouts and Tutorials	Hodge and Taylor, Pg 19-31	**Project #1 Due Project #2 Assigned**
25-Oct	*Project #1 Work Day, Report Overview and Formatting*	Series Piping in Course Notebook	Hodge and Taylor Burmeister, Chp 2	
30-Oct	*Project#2, "Solar Assisted Water Heating Project"; Series Piping Network Design*	Series Piping in Course Notebook	Hodge and Taylor Burmeister, Chp 2	
1-Nov	*Series Piping Network Review ($\Delta P=\rho fL/DV^2/2$)*	Engineering Fluid Mech, & Course Notebook	Hodge and Taylor, Pg 32-38	
6-Nov	*Series Piping Network Design + Valve Types and Minor Loss Types*	Engineering Fluid Mech, & Course Notebook	Hodge and Taylor, Pg 43-70	
8-Nov	*Field Trip/Guest Speaker(Notes Reqd, ?Final Exam)*	Engineering Fluid Mech, & Course Notebook	Hodge and Taylor, Pg 43-70	**Hmwk#5 Due (Serial Piping)**
13-Nov	*Simple Parallel Piping Networks*	H. Cross Class Handout	H. Cross Handout	
15-Nov	*Introduction to Hardy Cross Parallel Pipe Method (R+S-1=Loop#)*	H. Cross Class Handout and R+S-1 Handout	H. Cross Class & R+S-1 Handout	

20-Nov	*Hardy Cross Method(Derivation & Iter w/ MS Excel)*			
22-Nov	*Thanksgiving Holiday, No Class*	*Handouts*	*Handouts*	
27-Nov	*Pump Design and Pump Affinity Laws*	Engineering Fluid Mech, & Course Notebook	Burmeister, Chp 2	**Hmwk#6(Parallel Piping) Due**
29-Nov	*Project #2 Review and Economic Considerations* *Project #2 Work Day/Alt Energy Presentations*			
4-Dec	*Alternative Energy Presentations*			
6-Dec	LAST DAY OF INSTRUCTION FALL 2018 *Final Examination Review,* *Alternative Power Presentations*			
14-Dec	**(12/14, Wednesday, 9:45-12:00pm) FINAL EXAM**			**Final Examination**

Blue=Completed or Holiday