

San José State University
Mechanical Engineering Department
ME 114 Heat Transfer, spring 2020

Instructor: Syed Sohail H. Zaidi
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Office Hours: Appointments ONLY (Wed and Thurs 12:00 pm to 1:00 pm at ENG113)
Class Days/Time: Tu/Th 9:00 am to 10:15 am (Engineering Building 339)

Prerequisites: ME 113 and Math 133a, both with a C- or better

Course Format

Technology Intensive

This course heavily relies on class lectures. The covered material in the class is reinforced by the use of software packages including MATLAB, Excel, and NASA web pages related to the subject.

Service learning (SL) Courses or Credit bearing Internships

Not Applicable

Faculty Web Page and MYSJSU Messaging

Syllabus and other additional documents are sent directly via email to each student.

Course Description

Conduction, convection and radiation heat transfer with applications. Analytical, experimental, and computational methods of analyzing heat transfer behavior. Course Goals and Student Learning Objectives

Course Learning Objectives (Overall)

By the end of the course, each student should demonstrate an ability to

- 1) Apply the heat diffusion equation to calculate temperature distributions and heat transfer rates in simple geometries.
- 2) Determine the variation of thermal conductivity between classes of materials (metals, ceramics, and polymers), phases of matter, and with temperature (and pressure for gases).
- 3) Calculate thermal resistances, including contact resistances, and develop thermal circuits.
- 4) Analyze heat transfer from finned surfaces.
- 5) Apply finite difference techniques to compute heat conduction in 1- and 2-dimensional configurations, under steady and transient conditions.
- 6) State sources of uncertainty in computational fluid dynamics programs and determine ways to improve their accuracy
- 7) Analyze transient conduction using lumped capacitance and determine when its use is appropriate.
- 8) Calculate temperatures for transient heat conduction in multi-dimensional geometries where lumped capacitance does not apply.
- 9) Explain the importance of boundary layers to heat transfer.
- 10) Explain the importance and source of the convection transfer equations.
- 11) Explain the significance of non-dimensional parameters such as Re, Pr, Nu, and Sc.
- 12) Explain the analogy between heat and mass transfer.
- 13) Use correlations to determine heat transfer coefficients and/or temperatures for external flow over plates, cylinders, and spheres.
- 14) Use correlations to determine heat transfer coefficients and/or temperatures for internal flow in tubes.
- 15) Determine conditions under which convection is natural, forced, or mixed.
- 16) State the main categories of heat exchangers.
- 17) Determine overall heat exchanger coefficients for heat exchangers using the log-mean-temperature-difference (LMTD) and number of transfer units (NTU) methods.
- 18) Calculate heat transfer and pressure drop for a heat exchanger given a graph of j and f vs. Re.
- 19) Explain the differences among intensity, emissive power, radiosity, and irradiation and between spectral and hemispherical.
- 20) Explain the difference between diffuse and grey.
- 21) Apply Wien's Displacement Law, the Stefan-Boltzmann Law, band emission, and blackbody functions.

- 22) Compute the radiative properties emissivity, absorptivity, reflectivity, and transmissivity.
- 23) Apply Kirchoff's Law.
- 24) Account for environmental radiation.
- 25) Compute view factors.
- 26) Calculate radiation exchange between blackbodies.
- 27) Analyze radiation exchange between two diffuse, gray surfaces in an enclosure.

Required Texts/Readings

Textbook

Heat and Mass Transfer: Fundamentals and Applications, by Cengel and Ghajar, 5th ed., McGraw-Hill, 2010. 2nd and 3rd editions by Cengel are also OK. The bookstore has a cheaper paperback version of the text available for sale. It has the chapters that we don't use removed to lower the price.

Classroom Protocol

Please do not use cell phones in class. Exams and most quizzes will be given at the beginning of class, so plan to be on time.

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

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

Assignments and Grading Policy

Grade Distribution

		A	93-100	A-	90-92.9
B+	87-89.9	B	83-86.9	B-	80-82.9
C+	77-79.9	C	73-76.9	C-	70-72.9
D	60.0-69.9	F	< 60.0		

Exams (2@15% each)	30%		
Final Exam	30%		
Quizzes (3 @ 5% each)	15%		
Homework	10%	and	Project 15%

An exceptionally good final exam (10% higher than your average score going into the final) may result in a grade slightly higher than what is shown here. One extra credit project will be available during the semester, but no extra credit will be available at the end of the semester.

Expected Time Commitment

Many students who do poorly in ME 114 appear to do so because they do not devote enough time to learning and practicing the subject material. You should plan to spend 2-3 hours outside of class for every hour in class, for a total of **6-9 hours outside of class**. This time should be spent reviewing notes, reading the book, doing homework problems, and studying for exams. You may need to do more homework problems than those assigned in class to get a good understanding of some of the material. The university requires the following related language to be on all course syllabi:

“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.”

Exams and Quizzes

Two exams and four quizzes will be given in addition to the final exam. They must be taken on the scheduled dates unless a) you can show a note from the medical center or a hospital documenting illness or other emergency or b) you make other arrangements with the instructor before the exam date. The exams are closed book (although an equation sheet will be allowed as discussed in class). The quizzes and final exam are open book with no notes allowed. **WARNING: open book exams require as much studying as closed book exams. You will not have enough time to learn the material while taking the final exam!**

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](http://www.sjsu.edu/senate/S07-2.htm), 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 website](http://www.sa.sjsu.edu/judicial_affairs/index.html) is 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.

A major problem in ME 114 is that many students copy homework from one another or else rely very heavily on assistance from friends in completion of homework. This may improve your homework grade, but it will result in poor or even failing exam grades. The best way to handle homework is to struggle through it in your own first. Use your book and notes to help you. Then if you're stuck, ask your instructor or friends from class for hints. You are welcome to compare homework answers or solution methods with your friends after you have completed your problems.

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](http://www.drc.sjsu.edu/) (DRC) at <http://www.drc.sjsu.edu/> to establish a record of their disability.

Student Technology Resources

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 are available in ENG 213/215. Computers are also available in the Martin Luther King Library. The computer program EES, which is used in this class, is available for download from the instructor's [ME 115 website](http://www.engr.sjsu.edu/ndejong/me_115.htm) located at http://www.engr.sjsu.edu/ndejong/me_115.htm. The password is your instructor's last name, all in lowercase. Do not pass on this password to any student outside the MAE Department, since our site license only allows students in our department to download a free copy. This copy will work until 9/1/2012. Your textbook may also include a copy of EES, but it is a very limited copy that does not allow you to copy or print.

Learning Assistance Resource Center

The Learning Assistance Resource Center (LARC) is located in Room 600 in the Student Services Center. It is designed to assist students in the development of their full academic potential and to motivate them to become self-directed learners. The center provides support services, such as skills assessment, individual or group tutorials, subject advising, learning assistance, summer academic preparation and basic skills development. The [LARC website](http://www.sjsu.edu/larc/) is located at <http://www.sjsu.edu/larc/>.

Additional tutoring may be available through the engineering honor societies. An announcement will be made in class when this becomes available.

Peer Mentor Center

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. The [Peer Mentor Center website](http://www.sjsu.edu/muse/peermentor/) is located at <http://www.sjsu.edu/muse/peermentor/>

Topics

Topic	Reading
Introduction, Heat Transfer Overview	Chapter 1
Introduction to Conduction, Heat Conduction Eqn. Applying Boundary Conditions	2.1-2.3 2.4, 2.5
Heat Generation, Resistance Method Resistance Method, Contact Resistance	2.6, 3.1, 3.3 3.2
Cylinder/Sphere Cond., Fins Fins, Common Configurations	3.4-3.6 3.6-3.7
Lumped Capacitance, 1-D Transient Heat Transfer Semi-Infinite Solids, Multi-Dimensional Systems	4.1-4.2 4.3-4.4
Steady State Numerical Methods	5.1-5.4
Transient Numerical Methods, Controlling Error Introduction to Convection	5.5, special interest 6.1-6.7, 6.11
Flow Over Flat Plates Flow over Flat Plates, Cylinders and Spheres	7.1-7.2 7.3
Internal Flow Internal Flow	8.1-8.4 8.5
Turbulent Internal Flow Natural Convection, Heat Exchangers	8.6 9.1, 9.6, 11.1
Heat Exchangers Heat Exchangers	11.2-11.4 11.5-11.6
Introduction to Radiation	12.1-12.4
Radiative Properties, Atmospheric and Solar Radiation	12.5-12.6 13.1-13.2
Black Surface Radiation Heat Transfer Gray Surface Radiation Heat Transfer	13.3 13.4
Radiation Problem-Solving	