

**San José State University**  
**Mechanical and Aerospace Engineering Department**  
**ME 114 Heat Transfer, Section 3, Spring 2022**

<b>Instructor:</b>	Dr. Raquib U Khan
<b>Office Location:</b>	Engineering 348 (Not available during Covid Pandemic)
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<b>Office Hours:</b>	Tuesdays and Thursday (video conferencing) 1:15-1:45 pm
<b>Registration Codes:</b>	30060 (ME)
<b>Class Days/Time:</b>	Tuesdays and Thursday 12 noon to 1:15 pm, Rm 403 (or online)
<b>Prerequisites:</b>	ME 113 and Math 133a, both with a C- or better

**Proof of Prerequisites**

You are required to submit proof of prerequisites to your instructor no later than the drop deadline, February 5. If you do not, you will be dropped from the class. Please submit an unofficial transcript with your prerequisite courses highlighted. If you are in the process of asking for equivalency for courses taken at school with which SJSU does not have a transfer agreement, please attach a course description to your unofficial transcript. Graduate students may substitute a recommendation from a graduate advisor that they take ME 114 for unofficial transcripts.

**Canvas and Course Messaging**

Copies of the course materials such as the syllabus, assignments, exam review material, Powerpoint presentations, etc. may be found on the Canvas site for the class. This system will also show you your grades, and it allows you to have discussions or chat with the class. This feature may be especially helpful if you need assistance on a homework problem. Homework assignments and electronic classroom materials (such as Powerpoint slides) are posted on this site.

To log in, go to the Canvas URL <http://sjsu.instructure.com>. Log in with your 9-digit digit SJSU ID and password you use for your SJSUOne account. For questions on the use of Canvas, please check out [http://www.sjsu.edu/at/ec/canvas/student\\_resources/index.html](http://www.sjsu.edu/at/ec/canvas/student_resources/index.html)

You are responsible for regularly checking with the messaging system through Canvas. You can set up your Canvas account to forward all email sent to your Canvas account to any other email address you wish.

## Course Description

Conduction, convection and radiation heat transfer with applications. Analytical, experimental, and computational methods of analyzing heat transfer behavior.

## Course Learning Objectives

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

*Heat and Mass Transfer: Fundamentals and Applications*, by Cengel and Ghajar, 6th ed., McGraw-Hill, 2010. 5<sup>th</sup> editions by Cengel is also OK for study purpose.

This text comes as a course reader in the bookstore to decrease the cost. The reader in the bookstore comes bundled with access to Connect, the online homework system we will be using. You should find an access code in the reader. If you purchase your own text or wish to use an e-book, you'll need to purchase Connect access at a cost of \$100. This access should come with the e-book. If you purchase Connect separately, you can request a printed loose-leaf version of the text for \$40 if you like. You can get a two week free trial to Connect and convert it at the end of the trail period if you wish.

Either way, to log in to Connect use this web address for our class:

<https://connect.mheducation.com/class/r-khan-spring-2022--tuesday-and-thursday-12-noon>

This link will be placed on Canvas so you don't have to type it in.

### Classroom Protocol

Please do not use cell phones in class. Exams will start right at the beginning of class, and quizzes may be at the beginning or end of class, so be on time.

### Assignments and Grading Policy

#### Grade Distribution

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

B+	87-89.9	A	93-100	A-	90-92.9
C+	77-79.9	B	83-86.9	B-	80-82.9
D+	67-69.9	C	73-76.9	C-	70-72.9
		D	63-66.9	D-	60-62.9

#### The course grade will be weighted as follows:

- 15% for Home works/Participation Tasks
- 15% for Quizzes
- 40% for Two Mid terms
- 30% for Final Exam

## Expected Time Commitment

According to university rules: “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.”

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.

## Exams and Quizzes

Two exams and 3-4 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.

- Participation Tasks/Home work: Throughout the semester there will be several participation tasks to promote active engagement. There are no make-up options. Tasks may be in-class or Homework or online, so it is important to attend class and to check Canvas regularly.
- Midterm exam (Two)
- Quizzes: Short sets of questions to demonstrate comprehension of recent lesson material from assigned textbook reading and from lectures. Typically these will be held at the beginning of class on Tuesdays or Thursdays. There are no make-up opportunities for missed Quizzes or tardy arrival. However, the one lowest Quizze will be dropped from average grade computation, mainly to account for unavoidable class absence or tardiness.

The midterm exams and quizzes are closed book (although an equation sheet will be allowed as discussed in class). The final exam can be open/close book with no notes allowed (will be updated before the exam). **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!**

You may use either a printed text or the e-book for open-book quizzes and the final exam.

## Homework

Assignments will be due in class according to syllabus, except for weeks when there are exams scheduled. **No late homework will be accepted without documentation of an emergency.** Most problems will be assigned via Canvas or Connect. Some problems in Connect will require you to submit a written solution that you must scan and upload. In that case, please follow the following format.

- A summary of each problem statement should appear at the beginning of each problem, so that a person would not have to refer to the problem sheet to understand what is being done.
- For all numerical calculations you **must show the equation used in symbolic form, and a numerical value must be given for all terms in the equation.**
- Appropriate units (as applicable) must be given on all answers, and all answers must be clearly marked (by double underlined or a box). **The wrong units on an answer will be considered a major error.**
- Please make sure that your upload is readable. Pictures taken with a camera phone sometimes are difficult to read.
- In class submission or uploading the solution.

If you have difficulty scanning and uploading your solution, you may turn in a hand-written solution for these problems in class instead. Do not email homework to your instructor.

There are 12 additional assignments on Connect called “Learnsmart” assignments. These are assignments to help you learn theory. They are not required, but to motivate you to do them,

## University Policies

### 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/rec-12234.12506.html>. 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/](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/>.

### Consent for Recording of Class and Public Sharing of Instructor Material

[University Policy S12-7](#), <http://www.sjsu.edu/senate/docs/S12-7.pdf>, requires students to obtain instructor’s permission to record the course and the following items to be included in the syllabus:

- Common courtesy and professional behavior dictate that you notify someone when you are recording him/her. You must obtain the instructor's permission to make audio or video recordings in this class. Such permission allows the recordings to be used for your private, study purposes only. The recordings are the intellectual property of the instructor; you have not been given any rights to reproduce or distribute the material.
  - In classes where active participation of students or guests may be on the recording, permission of those students or guests should be obtained as well.
- Course material developed by the instructor is the intellectual property of the instructor and cannot be shared publicly without his/her approval. You may not publicly share or upload instructor generated material for this course such as exam questions, lecture notes, or homework solutions without instructor consent.

### **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](http://www.sjsu.edu/senate/docs/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](http://www.sjsu.edu/studentconduct/) is available at <http://www.sjsu.edu/studentconduct/>.

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—and even encouraged--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](http://www.sjsu.edu/president/docs/directives/PD_1997-03) at [http://www.sjsu.edu/president/docs/directives/PD\\_1997-03.pdf](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](http://www.sjsu.edu/aec) (AEC) at <http://www.sjsu.edu/aec> to establish a record of their disability.

### **Accommodation to Students' Religious Holidays**

San José State University shall provide accommodation on any graded class work or activities for students wishing to observe religious holidays when such observances require students to be absent from class. It is the responsibility of the student to inform the instructor, in writing, about such holidays before the add deadline at the start of each semester. If such holidays occur before the add deadline, the student must notify the instructor, in writing, at least three days before the date that he/she will be absent. It is the responsibility of the instructor to make every reasonable effort to honor the student request without penalty, and of the student to make up the work missed. See [University Policy S14-7](http://www.sjsu.edu/senate/docs/S14-7) at <http://www.sjsu.edu/senate/docs/S14-7.pdf>.

## **Student Technology Resources**

Computer labs for student use are available in the [Academic Success Center](http://www.sjsu.edu/at/asc/) 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. An open department computer labs is available in Engr 215. 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.

The computer program EES, which may used in this class but is not required, is available for download from the instructor's Canvas site. Do not pass on this software on to any student outside the ME Department, since our site license only allows students in our department to download a free copy. This copy will work until 9/1/2016. A quick tutorial will be posted on the Canvas website.

## **SJSU Peer Connections**

Peer Connections, a campus-wide resource for mentoring and tutoring, strives to inspire students to develop their potential as independent learners while they learn to successfully navigate through their university experience. You are encouraged to take advantage of their services which include course-content based tutoring, enhanced study and time management skills, more effective critical thinking strategies, decision making and problem-solving abilities, and campus resource referrals.

In addition to offering small group, individual, and drop-in tutoring for a number of undergraduate courses, consultation with mentors is available on a drop-in or by appointment basis. Workshops are offered on a wide variety of topics including preparing for the Writing Skills Test (WST), improving your learning and memory, alleviating procrastination, surviving your first semester at SJSU, and other related topics. A computer lab and study space are also available for student use in Room 600 of Student Services Center (SSC).

Peer Connections is located in three locations: SSC, Room 600 (10th Street Garage on the corner of 10<sup>th</sup> and San Fernando Street), at the 1st floor entrance of Clark Hall, and in the Living Learning Center (LLC) in Campus Village Housing Building B. Visit [Peer Connections website](http://peerconnections.sjsu.edu) at <http://peerconnections.sjsu.edu> for more information.

Peer Connections does not provide tutoring for any ME courses. Additional tutoring for ME courses may be available through the engineering honor societies. An announcement will be made in class when this becomes available.

## **SJSU Counseling Services**

The SJSU Counseling Services is located on the corner of 7<sup>th</sup> Street and San Fernando Street, in Room 201, Administration Building. Professional psychologists, social workers, and counselors are available to provide consultations on issues of student mental health, campus climate or psychological and academic issues on an individual, couple, or group basis. To

schedule an appointment or learn more information, visit [Counseling Services website](http://www.sjsu.edu/counseling) at <http://www.sjsu.edu/counseling>.

More ---

## University Policies

**“University Policies: Office of Graduate and Undergraduate Programs maintains university-wide policy information relevant to all courses, such as academic integrity, accommodations, etc.”**

You may find all syllabus related University Policies and resources information listed on GUP’s [Syllabus Information web page](http://www.sjsu.edu/gup/syllabusinfo/) at <http://www.sjsu.edu/gup/syllabusinfo/>

## Tentative Class Schedule

Day	Topic	Reading	HW due
27-Jan	Introduction, Heat Transfer Overview	Chapter 1	
1-Feb	<i>Introduction to Conduction*</i> , Heat Conduction Eqn.	2.1-2.3	
3-Feb	<i>Applying Boundary Conditions*</i>	2.4, 2.5	
8-Feb	Heat Generation, <i>Resistance Method*</i>	2.6, 3.1, 3.3	√
10-Feb	<i>Resistance Method*</i> , Contact Resistance	3.2	
15-Feb	<b>Quiz 1 Introduction, Heat Cond. Eqn.</b> , Cylinder/Sphere Cond., Fins	3.4-3.6	√
17-Feb	Fins, Common Configurations	3.6-3.7	
22-Feb	Lumped Capacitance, 1-D Transient Heat Transfer	4.1-4.2	√
24-Feb	Semi-Infinite Solids, Multi-Dimensional Systems	4.3-4.4	
1-Mar	<b>Mid term 1 Conduction (chapter 2, 3 (no fins))</b>		√
3-Mar	Steady-State Numerical Methods	5.1-5.4	
8-Mar	Numerical Methods	5.5, special interest	
10-Mar	<b>Quiz 2 Transient Conduction</b> , <i>Introduction to Convection*</i>	6.1-6.6	
15-Mar	Convection Governing Equations, Reynolds Analogy	6.7, 6.11	√
17-Mar	<i>Flow Over Flat Plates*</i>	6.11, 7.1-7.2	
22-Mar	Cylinders and Spheres, Internal Flow	7.3, 8.1-8.4	√
24-Mar	Internal Flow	8.5	
5-Apr	Turbulent Internal Flow, Natural Convection	8.6, 9.1, 9.6	√
7-Apr	Heat Exchangers	11.1, 11.2	
12-Apr	<b>Quiz 3 External Flow</b> , Heat Exchangers	11.4	√
14-Apr	Heat Exchangers	11.5-11.6	
19-Apr	<b>Mid term 2 Convection (no heat exchangers)</b>		√
21-Apr	Introduction to Radiation	12.1-12.4	
26-Apr	Radiative Properties, Atmospheric and Solar Radiation	12.5-12.6	
28-Apr	<b>Quiz 4 Heat Exchangers ?</b> , View Factors	13.1-13.2	
3-May	<i>Black Surface Radiation Heat Transfer*</i>	13.3	√
5-May	Gray Surface Radiation Heat Transfer	13.4	
10-May	Radiation Problem-Solving		√
12-May	Review		√
	Final Exam Wednesday, May 24, 9:45 -12pm		

Feb 7: last day to drop a class without an entry on one's permanent record

Feb 14: last day to add a class

\*Very important topics

