SJSU SAN JOSÉ STATE UNIVERSITY

Charles W Davidson College of Engineering · Mechanical Engineering

# Heat Transfer Section 02

## ME 114

Spring 2023 3 Unit(s) 01/25/2023 to 05/15/2023 Modified 01/20/2023

## Contact Information

| | |
|---|---|
| **Instructor:** | Prof. Abdie Tabrizi |
| **Office Location:** | Engr 348 |
| **Telephone:** | 408-924-3854 (please use the email given below) |
| **Email:** | Abdie.Tabrizi@evc.edu |
| **Office Hours:** | Mondays & Wednesdays 8:30 – 9:00 AM (Also by appointment) |
| **Class Days/Time:** | Mondays & Wednesdays 9:00 - 10:15 AM |
| **Classroom:** | Engr 401 |
| **Prerequisites:** | ME113, and Math 33A or Math 33LA, with a C- or better in each |
| **Course Website:** | To access lecture material/homework/exams, click on the McGraw Hill Connect link from the canvas website. |
| **Course Format** | Weekly, MW (on-campus lectures) |
| **Start-End Dates** | 1/25/2023 - 5/15/2023 |

### Library Liaison: Rachel Silverstein

**Email:** rachel.silverstein@sjsu.edu
**Website:** http://libguides.sjsu.edu/me (http://libguides.sjsu.edu/me)

When completing the research project (information to follow), the library liaison may be helpful. She can point you to databases of papers, useful books on your topic of interest, citation managers, etc.

## Course Information

**Course Format**

There will be pre-lecture readings assignments posted on Canvas. There will also include In-Class Problem (ICP) solving activities in groups with worksheet submissions. Canvas will be used to post lecture notes, worksheets, handouts, grades, homework solutions, and weekly announcements. It is your responsibility to check Canvas regularly for any updates or course materials. It is strongly

suggest having all announcements forwarded to an email address you check daily. To use Canvas, go to http://my.sjsu.edu, click "Canvas", and login with your 9-digit SJSU ID and password.

A separate online system called McGraw-Hill Connect will be used to facilitate the learning. There will be assigned readings as well analytical and conceptual problems for assignments.

# Course Description and Requisites

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

Prerequisite(s): MATH 33A or MATH 33LA, and ME 113 (each with a grade of 'C-' or better).

Letter Graded

# Classroom Protocols

**Canvas and Connect**

All lectures will be delivered through in-person classroom meetings (unless required to go online due to COVID) using board work, written notes, discussion, PowerPoint, and assigned textbook material. Communications will be done via my office hours, in-class information, email, and appointments, if possible. You are responsible for keeping up-to-date with the latest information about the course. Homework will be available through a link to the textbook publisher at the course Canvas site. Announcements and discussion topics will be through the canvas site. To use Canvas, go to http://my.sjsu.edu, Links to an external site. (http://my.sjsu.edu/)click "Canvas," and log in with your 9-digit SJSU ID and password. If you have any questions about using Canvas, please see me or visit http://www.sjsu.edu/at/ec/canvas/student_resources/index.html Links to an external site. (http://www.sjsu.edu/at/ec/canvas/student_resources/index.html).

All homework will be posted, submitted, and graded via a separate online system called McGraw-Hill Connect. You are required to purchase access to the Connect site in order to access the ebook, homework, and other instructional material. You will receive an email (and an announcement posting) regarding your textbook. In order to complete homework, you will need regular access to a computer (tablet, laptop, or desktop) with access to the internet. If you require special accommodation(s), please contact me ASAP at the start of the semester. The McGraw-Hill Connect system has been integrated into the Canvas so you do not need to access two different websites. Of course, you still need to purchase access to the Publisher material through the Connect link within Canvas.

**Class Attendance**

NOTE that University policy F69-24 at http://www.sjsu.edu/senate/docs/F69-24.pdf Links to an external site. (http://www.sjsu.edu/senate/docs/F69-24.pdf)states that "Students should attend all meetings of their classes, not only because they are responsible for material discussed therein, but because active participation is frequently essential to ensure maximum benefit for all members of the class.

Attendance per se shall not be used as a criterion for grading." However, class participation earns recognition. Extra credit opportunities, if any, **are only available to those without absences**.

Make-up for any missed activity in class, such as a quiz, will only be given for a substantiated medical excuse.

# "SOS!"

Sometimes, life happens. If you are really struggling with the course material, and/or if something is going on outside of class that may significantly disrupt your studies (financial concerns, upheaval in your home life, physical or mental health issues, etc.), I will do everything I can to help you succeed. If I am personally unable to help you, I will direct you to the appropriate resource. If you aren't

comfortable talking to me about a personal issue, that's fine, too! I will maintain a list on Canvas of all the resources available to you as an SJSU student. The earlier you ask for help with a problem, the easier it is to solve.

# Course Learning Outcomes (CLOs)

Upon successful completion of this course, students will be able 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. Analyze transient conduction using lumped capacitance and determine when its use is appropriate.
6. Apply finite difference techniques to compute heat conduction in 1--dimensional configurations, under steady conditions Explain the importance of boundary layers to heat transfer.
7. Explain the importance and source of the convection transfer equations.
8. Explain the significance of non-dimensional parameters such as Re, Pr, Nu, and Sc.
9. Explain the analogy between heat and mass transfer.
10. Use correlations to determine heat transfer coefficients and/or temperatures for external flow over plates, cylinders, and spheres.
11. Use correlations to determine heat transfer coefficients and/or temperatures for internal flow in tubes.
12. State the main categories of heat exchangers.
13. Determine overall heat exchanger coefficients for heat exchangers using the log-mean-temperature- difference (LMTD) and number of transfer units (NTU) methods.
14. Calculate heat transfer and pressure drop for a heat exchanger given a graph of j and f vs. Re.
15. Explain the differences among intensity, emissive power, radiosity, and irradiation and between spectral and hemispherical.
16. Explain the difference between diffuse and grey.
17. Apply Wien's Displacement Law, the Stefan-Boltzmann Law, band emission, and blackbody functions.
18. Compute the radiative properties emissivity, absorptivity, reflectivity, and transmissivity.
19. Apply Kirchoff's Law.
20. Account for environmental radiation.
21. Compute view factors.
22. Calculate radiation exchange between blackbodies.
23. Analyze radiation exchange between two diffuse, gray surfaces in an enclosure.

## ABET Learning Outcomes

This course addresses the following outcomes for our accreditation by the Accreditation Board for Engineering and Technology. Graduates are expected to attain the following outcomes:

a. an ability to apply knowledge of mathematics, science and engineering.

e. an ability to identify, formulate and solve engineering problems.

j. knowledge of contemporary issues.

# Course Materials

## Heat and Mass Transfer: Fundamentals and Applications

**Author:** Cengel and Ghajar
**Publisher:** McGraw Hill
**Edition:** 6th

**McGraw-Hill Connect® Online Platform**

Your course materials are being delivered digitally via Canvas through the ***Inclusive Access*** Program. Please access the material through Canvas on the first day of classes to make sure there are no issues in the delivery, and if you are having a problem or question, they can be addressed quickly.

You automatically have access to the course materials on Day-One without entering a code or being charged upfront. After the add drop period, your bursar account will be billed at a discounted rate for the required course materials representing significant savings for you as the student. If you choose to not have your account be billed, you must "opt out" before the required deadline. If you do not opt out, you will be charged. We highly recommend you do not opt out if you are going to continue in this course because this is the lowest cost available for this product.

After you have paid for the product, you will have access for the remainder of the term.

# Course Requirements and Assignments

**Prerequisites**

To enroll in this course, you must have completed ME113 and Math 33A or 33LA, with a C- or better in each. You must turn in an unofficial transcript with the prerequisites highlighted by **the second lecture of the semester**, or you will be dropped from the class.

**Expected Time Commitment**

SJSU classes are designed such that in order to be successful, it is expected that students will spend a minimum of forty-five hours for each unit of credit (normally three hours per unit per week), including preparing for class, participating in course activities, completing assignments, and so on. More details about student workload can be found at http://www.sjsu.edu/senate/docs/S12-3.pdf.Links to an external site. (http://www.sjsu.edu/senate/docs/S12-3.pdf)

Effort and course performance are strongly correlated. I don't give A's for effort, but putting the time and energy into this class will give you a much better chance of performing well. You should plan to spend 2-3 hours outside of class for every lecture hour of class; for a 3-credit class such as this one, you should expect to spend 6-9 hours outside of class every week. Some students may spend more or less time than this, but this is a good guideline. How you spend this time is dependent on how you best learn, but I would suggest reviewing your notes, reading pertinent sections of the book, doing or redoing homework problems, and completing LearnSmart activities (discussed subsequently).

**Class Attendance**

NOTE that University policy F69-24 at http://www.sjsu.edu/senate/docs/F69-24.pdf Links to an external site. (http://www.sjsu.edu/senate/docs/F69-24.pdf)states that "Students should attend all meetings of their classes, not only because they are responsible for material discussed therein, but because active participation is frequently essential to ensure maximum benefit for all members of the class.

Attendance per se shall not be used as a criterion for grading." However, class participation earns recognition. Extra credit opportunities, if any, **are only available to those without absences**.

Make-up for any missed activity in class, such as a quiz, will only be given for a substantiated medical excuse.

**Homework**

There will be chapter assignments throughout the semester. Homework will be assigned for every chapter, and it will be due Thursday of the following week at 11:00 PM unless otherwise announced. All homework is done via the McGraw-Hill Connect website. Some assignments will require you to scan and upload a solution done by hand. These uploads must be *.doc, *.docx, or *.pdf files. It is **your responsibility** to make sure that the scanned document is legible; many cellphones can take a legible photo, but please double-check before submitting it. If you are unable to scan and upload these files, please ask me for help.

For problems done by hand, please include the following:

- List your name, date, and homework assignment number at the top of your
- Summarize the problem statement before beginning each Give enough information that you could return to this problem a month or a year from now and understand what it is asking without looking up the problem in the book.
- Drawing a figure may be helpful as well, particularly on more complex
- List all
- Write down all equations in the symbolic form first, before plugging in numbers.
- Write units next to all equations! This will keep you from making If you learn nothing else from this class, please learn to keep track of your units.

No late homework will be accepted without a university-authorized excuse; however, **one lowest homework score will be dropped**.

**Smart Book Exercises**

There will be Smart Book assignments per chapter throughout the semester. These are guided readings with theory-based questions, and they reinforce the course material. They are structured so that if you get a question wrong, it will ask you more questions on the same topic until you achieve 100% completion. These due dates coincide with our completion of the corresponding material in class.

**Quizzes**

Four quizzes will be given during the semester. The best way to study for these quizzes is to understand the lecture and textbook examples and do the assigned homework and make sure that you have mastery of the subject including all physical concepts and definitions.

**McGraw-Hill Connect Assignments**

The Connect system gives all homework problems an "all-or-nothing" score based on your answer (within 5% of the correct answer). However, there are cases in which a small error in an otherwise correct solution prevents you from getting the right answer, and Connect would assign you a 0, which doesn't seem fair.

If you cannot get Connect to accept your answer, please discuss this with me in my office.

# ✔ Grading Information

**Problem Solving Guideline**

- The guideline for analyzing an engineering problem is outlined as follows:
  - A summary of the problem statement.
  - A drawing or illustration of the problem.
  - A list of all assumptions.
  - Equations written in symbolic form first, before plugging in numbers.
  - The answer indicated clearly, including units.
  - Review the answer obtained to assure its correctness before it is finalized.

**Grade Errors and Regrades**

Grading errors (points added or recorded incorrectly) or regrading (when you believe you deserve more points for something) may only be requested within one week of the date the graded assignment/exam is returned to class. If you are absent when a graded assignment/exam is returned, it is your responsibility to bring my attention to request a regrade. Please note that, your grade may

increase, decrease or no change as a result of regrade.

**Exam Policy**

All exams will be CLOSED BOOK and CLOSED NOTES. A formula sheet will be provided for the exams and quizzes. The formula sheet will be made available ahead of time for you to make yourself familiar with it. Violation of academic integrity will result in zero in the exam and a report to Student Conduct and Ethical Development.

Without a documented excuse, exams must be taken on the indicated dates. If you have any serious problems with the examination dates, please see me ASAP and I will attempt to make alternative arrangements.

**Calculator Policy**

The calculator use policy for this course is the same as the policy put forth by National Council of Examiners for Engineering and Surveying (NCEES) for Fundamentals of Engineering (FE) exams stated at https://ncees.org/exams/calculator. The acceptable calculator models are:

- **Casio:** All fx-115 and fx-991 models (Any Casio calculator must have "fx-115" or "fx-991" in its model name.)
- **Hewlett Packard:** The HP 33s and HP 35s models, but no others

**Texas Instruments:** All TI-30X and TI-36X models (Any Texas Instruments calculator must have "TI-30X" or "TI-36X" in its model name.)

## Criteria

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|---|---|---|---|---|---|
| A | 93.0-100 | A- | 90.0-92.9 | | |
| B+ | 87.0-89.9 | B | 84.0-86.9 | B- | 80.0-83.9 |
| C+ | 77.0-79.9 | C | 74.0-76.9 | C- | 70.0-73.9 |
| D | 60.0-69.9 | | | | |

## Breakdown

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|---|---|
| Smart Book Assignments | 5% |
| Homework | 15% |
| Quizzes (4) | 20% |
| Midterms (2) | 30% |
| Final Exam | 30% |

Grading Percentages

# University Policies

Per University Policy S16-9 (http://www.sjsu.edu/senate/docs/S16-9.pdf), relevant university policy concerning all courses, such as student responsibilities, academic integrity, accommodations, dropping and adding, consent for recording of class, etc. and available student services (e.g. learning assistance, counseling, and other resources) are listed on Syllabus Information web page

(https://www.sjsu.edu/curriculum/courses/syllabus-info.php) (https://www.sjsu.edu/curriculum/courses/syllabus-info.php). Make sure to visit this page to review and be aware of these university policies and resources.

## Course Schedule

# ME 114: Heat Transfer Section 2, Spring 2023, Tentative Course Schedule

| Date | Readings Topics | Chapter | Assignments |
|---|---|---|---|
| Jan-25 | Introduction, Heat Transfer Overview | 1.1-1.4 | HW_Ch1, SB1,IC1 |
| Jan-30 | Heat Transfer Mechanisms | 1.5-1.9 | |
| Feb-1 | Conduction in Cartesian Coordinates | 2.1-2.5 | HW_Ch2, SB2,IC2 |
| Feb-6 | Conduction in Spherical & Cylindrical Coordinates | 2.1-2.5 | |
| Feb-8 | Heat Generation in Solids | 2.6 | |
| Feb-13 | Thermal Resistance Network & Contact Resistance | 3.1-3.2 | HW_Ch43 SB3, IC3 |
| Feb-15 | General Thermal Resistance & Conduction in Cylinders & Spheres | 3.3-3.4 | |
| Feb-20 | **Quiz 1**, Critical Radius of Insulation, Finned Surfaces | 3.5-3.6 | |
| Feb-22 | Fins Effectiveness, Common Configurations | 3.6, 3.8 | |
| Feb-27 | Lumped Capacitance, 1-D Transient Heat Transfer | 4.1-4.2 | HW_Ch4, SB4, IC4 |
| Mar-1 | **Midterm 1** | | |
| Mar-6 | Semi-infinite Solids | 4.3 | |
| Mar-8 | Multi-Dimensional Systems | 4.4 | |
| Mar-13 | Numerical Methods in Steady-State Heat Conduction | 5.1-5.3 | HW_Ch5, SB5, IC5 |
| Mar-15 | **Quiz 2**, Introduction to Convection | 6.1-6.6 | HW_Ch6, SB6, IC6 |

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|---|---|---|---|
| Mar-20 | Convection Equation, Reynolds Analogy | 6.7-6.11 | |
| Mar-22 | Flow Over Flat Plates | 7.1-7.2 | HW_Ch7, SB7, IC7 |
| | **Spring Break (March 27-31)** | | |
| Apr-3 | Cylinders, Spheres, Internal Flows | 7.3, & 8.1-8.4 | |
| Apr-5 | **Quiz 3**, Internal Flows | 8.5 | HW_Ch8, SB8, IC8 |
| Apr-10 | Turbulent Internal Flow | 8.6 | |
| Apr-12 | Heat Exchanges | 11.1-11.4 | HW_Ch11, SB11,IC11 |
| Apr-17 | **Midterm 2** | | |
| Apr-19 | Heat Exchanges | 11.5-11.6 | |
| Apr-24 | Introduction to Radiation | 12.1-12.4 | HW_12, SB12,IC12 |
| Apr-26 | Radiation Properties, Atmospheric and Solar Radiation | 12.5-12.6 | |
| May-1 | View Factors | 13.1-13.2 | HW_Ch13,SB13,IC13 |
| May-3 | **Quiz 4,** Black Surface Radiation Heat Transfer | 13.3 | |
| May-8 | Gray Surface | 13.4 | |
| May-10 | Numerical Computation | | |
| May-15 | Review | | |
| May-23 | **FINAL EXAM: 7:15-9:30 AM (Tuesday)** | | |

Schedule of lectures

IC: In-class discussions.

LS/HW: Smart Book and homework assignments are due on Mondays following the week when a chapter is covered. Please see the assignment page for deadlines.

**Important Dates**

**Last day to drop (No W): Feb 20**

**Last day to add:  Feb 20**

**Spring Break: Mar 27-31**

**Last day of class: 5/15**

**Final exam: 5/23**