

ME 5316: Thermal Conduction (Sections 001 and 002)
Fall 2017
Mechanical and Aerospace Engineering Department
The University of Texas at Arlington

Thermal Conduction is a fundamental graduate-level course that develops an understanding of the flow of heat by conduction. This course provides the basic skills and tools necessary for detailed design and analysis of engineering systems in which thermal conduction plays a significant. This course is based on and teaches a considerable amount of engineering mathematics, particularly the analysis of ordinary and partial differential equations. Concepts learnt in this class will be helpful for real-life applications in engineering as well as for advanced graduate-level research work.

Class location and timing: Tues, Thurs 8:00am – 9:20am, NH229.

Section Information: Section 001 for local students, Section 002 for remote students.

Class Website: elearn.uta.edu (Blackboard)

Instructor: Dr. Ankur Jain

Instructor's Contact Information: Engineering Lab Building (ELB), Rm 203, email: jaina@uta.edu, (Ph.) 817-272-9338

Instructor's Research Lab Website: www.uta.edu/mtl

Instructor Faculty Profile: <https://www.uta.edu/profiles/ankur-jain>

Graduate Teaching Assistant: TBA

Office Hours: Instructor: Tues, Thurs 2:15pm-3:00pm, ELB-203; GTA Office Hours: TBA.

Course Content: Fundamental laws, initial and boundary conditions, basic equations for isotropic and anisotropic media, related physical problems and steady and transient temperature distributions in solid structures.

Student Learning Outcomes: Through this course, it is expected that students will gain an understanding of fundamental physics of thermal conduction in engineering, learn how to apply mathematical tools to analyze thermal conduction problems, and expand their understanding of applied mathematics for use in other engineering applications as well.

Textbook: There is no required textbook. Material for the class will be sourced from a number of thermal conduction textbooks. Here are the books that will be used primarily:

1. 'Analytical Methods in Conduction Heat Transfer', G.E. Myers, 2nd Ed., AMCHT Publications, Madison, WI, 1998.
2. 'Heat Conduction', M.N. Özışık, 2nd Ed., Wiley-Interscience, 1993.

3. 'Conduction of Heat in Solids', H.S. Carslaw & J.C. Jaeger, 2nd Ed., Oxford University Press, 1986.
4. 'Heat Conduction Using Green's Functions', K.D. Cole, J.V. Beck, A. Haji-Sheikh and B. Litkouhi, 2nd Edition, Taylor & Francis, 2010.

Important Dates: 11-Sep – Census Date; 1-Nov – Last Day to Drop Class; 29-Aug, 26-Sep – No class (Instructor on travel. Make-up class TBA); 23-Nov – No class (Thanksgiving); 11-Dec – Final Project Due, 12-Dec – Final Exam.

Tentative Course Schedule:

| Number of Lectures | Topics |
|---------------------------|--|
| 1 | General introduction |
| 3 | Mathematical foundations |
| 3 | Basic concepts of thermal conduction. Fourier's law. Boltzmann transport equation. |
| 6 | Steady state conduction in various coordinates. |
| 5 | Transient conduction. |
| 5 | Solution of conduction problems through numerical analysis. |
| 4 | Other methods of solving conduction problems. |
| 3 | Experimental methods for heat transfer measurements. |
| 6 | Microscopic origins of conduction. |
| 3 | Reviews (just before exams). |
| 3 | Exams. |

The schedule may undergo minor tweaks based on class needs and requirements.

Quizzes and Exams: Two exams will be conducted. Dates will be announced well in advance. Around 5-6 quizzes will be given. Quizzes may be unannounced. One quiz score will be dropped for grade calculations. A makeup quiz or exam will be permitted only in case of a well-documented medical emergency or an emergency of another nature.

Homework Assignments: Homeworks are a key medium of learning in this course. Homeworks are expected to be worked upon individually, unless specified otherwise. Around 6-7 homework assignments will be given. One homework score will be dropped for grade calculations. Homeworks are expected to be turned in by the deadline. There will be a 10% penalty per day for late submission. Homework will not be accepted more than three days after due date. Prior arrangements must be made with the instructor if your homework is expected to be late due to a well-documented medical or other extenuating reason. Electronic copies of homeworks will not be accepted, except for remote students.

Final Project: A final project will be assigned towards the last one-third of the semester, and will comprise of an extended homework problem involving somewhat more work than a

typical homework assignment. Final project is tentatively due Dec 11. Precise deadline will be communicated in advance, and will be a hard deadline.

Attendance: At The University of Texas at Arlington, taking attendance is not required but attendance is a critical indicator in student success. Each faculty member is free to develop his or her own methods of evaluating students' academic performance, which includes establishing course-specific policies on attendance. As the instructor of this section, I require all students to attend all classes (in case of remote students, to stay up-to-date with posted lectures). It is easy to lose track of the material and get completely lost if you miss classes. Please attend all classes. I understand the challenges of attending an 8am class, and appreciate your efforts to not miss any classes. Just doing this gives you a strong headstart in the class. However, while UT Arlington does not require instructors to take attendance in their courses, the U.S. Department of Education requires that the University have a mechanism in place to mark when Federal Student Aid recipients "begin attendance in a course." UT Arlington instructors will report when students begin attendance in a course as part of the final grading process. Specifically, when assigning a student a grade of F, faculty report the last date a student attended their class based on evidence such as a test, participation in a class project or presentation, or an engagement online via Blackboard. This date is reported to the Department of Education for federal financial aid recipients.

Grading Policy: Final score will be calculated based on the following weights: Final Project – 15%, Homeworks – 15%, Mid-Term Exam – 20%, Final Exam – 30%, Quizzes – 20%. Tentative final grade policy is as follows: A=85%+, B=75-85, C=60-75, D=50-60, F=50 or below. Students are expected to keep track of their performance throughout the semester and seek guidance from available sources (including the instructor) if their performance drops below satisfactory levels; see "Student Support Services," below.

Calculator Policy: Only nonprogrammable calculators with basic computational features, such as arithmetic and transcendental functions will be allowed during exams.

Use of Electronics Policy: Laptops and other electronic devices could be an effective method for taking notes. However, this particular class involves significant mathematics, making it best to take notes on paper. The use of laptops and other electronic devices during class is thus not permitted.

Other Notes:

- 1. Classroom etiquette:** Please be on time for the class. Working on laptops/cellphones, texting, working on other courses, etc. are not permitted.
- 2. Two-way interaction:** It is very boring to teach and learn if students do not ask questions! Asking questions during lectures is highly encouraged. In my teaching, I have noticed a strong correlation between asking questions and getting good grades. Please do not feel shy. No question is too silly to ask!
- 3. E-mail communication:** E-mail is the preferred means for communicating with the instructor outside class. To ensure that emails are read and responded to promptly, please include 'ME5316' in the subject line. Please use your UTA email address.
- 4. Drop Policy:** Students may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period

through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. Undeclared students must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is the student's responsibility to officially withdraw if they do not plan to attend after registering. Students will not be automatically dropped for non-attendance. Repayment of certain types of financial aid administered through the University may be required as the result of dropping classes or withdrawing. For more information, contact the Office of Financial Aid and Scholarships (<http://www.uta.edu/aao/fao/>).

5. **Disability Accommodations:** UT Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including The Americans with Disabilities Act (ADA), The Americans with Disabilities Amendments Act (ADAAA), and Section 504 of the Rehabilitation Act. All instructors at UT Arlington are required by law to provide “reasonable accommodations” to students with disabilities, so as not to discriminate on the basis of disability. Students are responsible for providing the instructor with official notification in the form of a **letter certified by** the Office for Students with Disabilities (OSD). Only those students who have officially documented a need for an accommodation will have their request honored. Students experiencing a range of conditions (Physical, Learning, Chronic Health, Mental Health, and Sensory) that may cause diminished academic performance or other barriers to learning may seek services and/or accommodations by contacting:

The Office for Students with Disabilities, (OSD) www.uta.edu/disability or calling 817-272-3364. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at www.uta.edu/disability.

Counseling and Psychological Services, (CAPS) www.uta.edu/caps/ or calling 817-272-3671 is also available to all students to help increase their understanding of personal issues, address mental and behavioral health problems and make positive changes in their lives.

6. **Non-Discrimination Policy:** *The University of Texas at Arlington does not discriminate on the basis of race, color, national origin, religion, age, gender, sexual orientation, disabilities, genetic information, and/or veteran status in its educational programs or activities it operates. For more information, visit www.uta.edu/eos.*
7. **Title IX Policy:** The University of Texas at Arlington (“University”) is committed to maintaining a learning and working environment that is free from discrimination based on sex in accordance with Title IX of the Higher Education Amendments of 1972 (Title IX), which prohibits discrimination on the basis of sex in educational programs or activities; Title VII of the Civil Rights Act of 1964 (Title VII), which prohibits sex discrimination in employment; and the Campus Sexual Violence Elimination Act (SaVE Act). Sexual misconduct is a form of sex discrimination and will not be tolerated. *For information regarding Title IX, visit www.uta.edu/titleIX or contact Ms. Jean Hood, Vice President and Title IX Coordinator at (817) 272-7091 or jmhood@uta.edu.*
8. **Academic Integrity:** Students enrolled all UT Arlington courses are expected to adhere to the UT Arlington Honor Code:

I pledge, on my honor, to uphold UT Arlington’s tradition of academic integrity, a tradition that values hard work and honest effort in the pursuit of academic excellence.

I promise that I will submit only work that I personally create or contribute to group collaborations, and I will appropriately reference any work from other sources. I will follow the highest standards of integrity and uphold the spirit of the Honor Code.

UT Arlington faculty members may employ the Honor Code as they see fit in their courses, including (but not limited to) having students acknowledge the honor code as part of an examination or requiring students to incorporate the honor code into any work submitted. Per UT System Regents' Rule 50101, §2.2, suspected violations of university's standards for academic integrity (including the Honor Code) will be referred to the Office of Student Conduct. Violators will be disciplined in accordance with University policy, which may result in the student's suspension or expulsion from the University.

9. **Campus Carry:** Effective August 1, 2016, the Campus Carry law (Senate Bill 11) allows those licensed individuals to carry a concealed handgun in buildings on public university campuses, except in locations the University establishes as prohibited. Under the new law, openly carrying handguns is not allowed on college campuses. For more information, visit <http://www.uta.edu/news/info/campus-carry/>.
10. **Student Support Services:** UT Arlington provides a variety of resources and programs designed to help students develop academic skills, deal with personal situations, and better understand concepts and information related to their courses. Resources include tutoring, major-based learning centers, developmental education, advising and mentoring, personal counseling, and federally funded programs. For individualized referrals, students may contact the Maverick Resource Hotline by calling 817-272-6107, sending a message to resources@uta.edu, or visiting www.uta.edu/resources.
11. **Electronic Communication:** UT Arlington has adopted MavMail as its official means to communicate with students about important deadlines and events, as well as to transact university-related business regarding financial aid, tuition, grades, graduation, etc. All students are assigned a MavMail account and are responsible for checking the inbox regularly. There is no additional charge to students for using this account, which remains active even after graduation. Information about activating and using MavMail is available at <http://www.uta.edu/oit/cs/email/mavmail.php>.
12. **Student Feedback Survey:** At the end of each term, students enrolled in classes categorized as lecture, seminar, or laboratory will be asked to complete an online Student Feedback Survey (SFS) about the course and how it was taught. Instructions on how to access the SFS system will be sent directly to students through MavMail approximately 10 days before the end of the term. UT Arlington's effort to solicit, gather, tabulate, and publish student feedback data is required by state law; student participation in the SFS program is voluntary.
13. **Emergency Exit Procedures:** Should we experience an emergency event that requires us to vacate the building, students should exit the room and move toward the nearest exit, which is marked in Red Signs in the class. When exiting the building during an emergency, one should never take an elevator but should use the stairwells. Faculty

members and instructional staff will assist students in selecting the safest route for evacuation and will make arrangements to assist handicapped individuals.

Emergency Procedures for Disabled Personnel

If the disabled person cannot safely evacuate the building, one person should stay with the disabled individual while another person reports his/her location to the University Police. Hearing impaired and visually impaired persons need only one person each to notify them of a fire alarm or guide them to safe escape routes during an evacuation. After evacuating employees and students have cleared all stairways, disabled persons should be assisted to the stairwell landings to await emergency personnel. All doors to the stairwells must be kept closed during this time.

Environmental Health & Safety would like to offer the following reminders to those who are disabled or have special needs:

- Take control without depending on others to take the first step.
- Don't be afraid to let others know you need assistance.
- Don't hesitate to communicate what your special needs are in order to make the evacuation easier and safer for you and for your assistants.
- Communicate with those who can help as soon as you are able by dialing 3003 to campus Police.
- Plan ahead. Be prepared. Know what you are going to do before an emergency arises. Make a plan and then test it. Determine what your alternatives are.
- When you enter an unfamiliar building, look it over and locate the most available telephones, note horizontal exits and ramps, note exit signs and enclosed stairwells determine if landings are large enough), note rooms that would make good areas of refuge, and note the location of fire alarm pull stations.
- Never take an elevator in a building on fire.
- Don't delay your evacuation or communication to evacuate. Speaking with someone over the telephone will help to keep you calm.

14. Final Review Week: A period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week *unless specified in the class syllabus*. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. During this week, classes are held as scheduled. In addition, instructors are not required to limit content to topics that have been previously covered; they may introduce new concepts as appropriate.

Good Luck with ME5316 and all your other endeavors this semester!

Emergency Phone Numbers: In case of an on-campus emergency, call the UT Arlington Police Department at **817-272-3003** (non-campus phone), **2-3003** (campus phone). You may also dial 911.