

Syllabus for ME520: Heat Conduction

Spring 2025: 1:00 - 2:50pm on Tuesdays and Thursdays in LuMEB 2051
Mechanical Science and Engineering, University of Illinois at Urbana-Champaign

Instructor:

Prof. Kyle C. Smith

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Teaching Assistant:

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Office Hours: To be determined following a scheduling poll for the entire class.

Prerequisites: Graduate course in heat transfer (e.g., ME420) or consent from Prof. Smith. This course welcomes participation within MechSE and outside of it. However, you *must* contact me to discuss your readiness for the course in the event that you have *not* taken a graduate course in heat transfer. I will likely encourage many such students to take ME520, provided that they have sufficient mathematical and physical knowledge and that they are motivated to develop a depth of knowledge in heat conduction.

Course Objectives:

- To solve multi-dimensional, time-dependent heat conduction problems using analytical approaches;
- To understand the microscopic origins of heat conduction and thermal energy storage, multi-physical driving forces for heat transfer and heat generation (e.g., thermoelectric, Dufour effects, Joule heating, and chemical heating), and the distinction between diffusive and ballistic conduction modes;
- To understand the theory and practice of numerical methods for arbitrary non-linear heat conduction problems with complex domains; and
- To apply knowledge of heat conduction theory to interpret and extend contemporary research.

Course Texts: Material from a variety of texts will be used throughout the semester.

- Analytical methods -- [*Heat Conduction by David Hahn and Necati Ozisik*](#)* (3rd Edition, Wiley, 2012).
- Numerical methods -- *Numerical Methods in Heat, Mass, and Momentum Transfer*** by Jayathi Murthy and Sanjay Mathur (Draft Notes, Purdue University, 2002).
- Heterogeneous materials -- [*Random Heterogeneous Materials by Salvatore Torquato*](#)* (Springer-Verlag, 2002).

* This textbook is available as an E-book through UIUC Libraries.

** This reference is uploaded to the Canvas site for this course.

Lectures: Lectures will be delivered in person. I look forward to engaging with you in interactive ways during that time. In-person lecture participation is required for all students registered in section ME520-E. Students registered in section ME520-ONL are required to watch all lecture recordings.

Assignments: Student grades will be determined as a weighted average of the assignments listed below.

- **Homework** will be assigned roughly on a biweekly basis to exercise and extend course concepts (30% overall). Assignments will be listed on the ME520 Canvas site under *Homework*.
- **Exams** will be given to assess depth of knowledge (45% overall). Examination information will be listed on the ME520 Canvas site under *Exams*.
- **One Article Assessment Assignment** will be completed individually by each student on a journal article related to heat conduction that is selected by the student and approved by Prof. Smith (25% overall). The assignment will culminate in a written report due on May 13. Article assessment assignment details are listed on the ME520 Canvas site under *Article Assessment*.