



# Ph.D. Qualifying Exam: Heat Transfer

Department of Mechanical Engineering University of Utah

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## Exam Description:

This qualifying exam will test the student's graduate-level knowledge of heat transfer. The reference textbook and course material that serve as a basis for this exam are taken from ME EN 3650: Heat Transfer and ME EN 6650: Intermediate Heat Transfer. The exam is focused on testing the knowledge and approach to problem solving involving fundamental concepts appropriate to the field of heat transfer. Students are expected to be comfortable with the following concepts: energy balance, the heat diffusion equation, 1D steady-state conduction, extended surfaces, 2D steady-state conduction, transient conduction, external convection, internal convection, free convection, heat exchangers, the fundamentals of radiation (solid angle, intensity, radiative properties, blackbody distribution, Kirchhoff's law), radiation exchange between surfaces, and multimode heat transfer.

## Recommended Reference:

T.L. Bergman, A.S. Lavine, F.P. Incropera and D.P. DeWitt, *Fundamentals of Heat and Mass Transfer*, 8<sup>th</sup> edition, John Wiley & Sons, 2017 (ISBN 9781119353881). Previous editions are appropriate as well.

## Exam Materials:

An equation sheet will be provided to students for their preparation before the exam. The same sheet will be provided with the exam. Students will also be provided necessary material property tables with the exam. Students may bring a department issued calculator. No other materials will be allowed during the exam.

## Topics:

Topic	Bergman et al., 8 <sup>th</sup> edition
Introduction to Heat Transfer, Energy Balance	Chapter 1
Fourier's Law, Heat Diffusion Equation	Chapter 2
1D Steady-State Conduction, Extended Surfaces (Fins)	Chapter 3
2D Steady-State Conduction	Chapter 4
Transient Conduction	Chapter 5
Introduction to Convection	Chapter 6
External Convection	Chapter 7
Internal Convection	Chapter 8
Free (Natural) Convection	Chapter 9
Heat Exchangers	Chapter 11
Fundamentals of Thermal Radiation	Chapter 12
Radiation Exchange Between Surfaces, Multimode Heat Transfer	Chapter 13