

# Exam Description:

Ph.D. Qualifying Exam: Heat Transfer

Department of Mechanical Engineering University of Utah

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 References:

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

# Exam Materials:

An equation sheet will be provided to students with the exam. Students need to bring a calculator. No other materials will be allowed during the exam.

**Topics:**

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| **Topic** | **Bergman et al., 8th edition** |
| Introduction to Heat Transfer, EnergyBalance | Chapter 1 |
| Fourier’s Law, Heat DiffusionEquation | 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 BetweenSurfaces, Multimode Heat Transfer | Chapter 13 |