Exam Topic Area: Heat Transfer

Questions on the exam are designed to test a thorough understanding of the fundamentals and applications of heat transfer. The questions' difficulty will generally be at the level of challenging undergraduate material, and often requires understanding and application of multiple concepts to come to the correct solution.

Questions will test the student's ability to present and apply fundamental principles of heat transfer and derive the outcomes of analyses based on them. Students will be allowed to bring a one page (front and back) equation sheet which must be turned in with the exam. On the equation sheet, there can be equations, notes about the equations, etc. But worked-out solutions to problems will not be allowed. Non-programmable calculators will be allowed. Any necessary tables or figures will be provided with the exam.

Reference List: Introduction to Heat Transfer, by Incropera et al, Sixth Edition, John Wiley & Sons, 2011.

List of question topic for Heat Transfer:

- 1-D steady-state conduction, including use of resistances in thermal networks
- Composite wall
- Contact resistance
- 1-D steady-state radial systems, including the concept of critical insulation thickness
- 1-D steady state conduction with heat generation, including radial systems
- Heat transfer from extended surfaces, including concepts of fin efficiency and effectiveness, and fin resistance
- Derivation of uniform cross-section fin governing equations
- 2-D steady-state conduction, including the method of separation of variables and finite difference representation
- Transient conduction – lumped capacitance approximation
- Transient conduction – 1-D models including: plain wall, infinite cylinder, and sphere geometries
- Transient conduction – finite difference method
- Introduction to convection, including concepts of boundary layer, laminar v. turbulent, entrance region v. fully developed flows
- External flow convection, including flow over a flat plate, flow over cylinders and spheres
- Internal flow convection, including prescribed temperature and prescribed heat flux boundary conditions
- Heat exchanger analysis, energy balances and temperature distributions as applied to various flow arrangements including cross-flow heat exchangers
- Heat exchanger design approaches: epsilon-NTU and LMTD
- Fundamental concepts of radiation, including the spectral and directional characteristics of radiation
- Concept of view factor and radiative energy balance on a surface
- Radiation exchange between opaque, diffuse, gray surfaces in an enclosure
- Radiation exchange between two black body surfaces

Undergraduate courses offered in this area:

Courses listed here are for your reference only and may be helpful for relearning/reviewing the material. Questions on the exam are limited by the topics list and reference list, not by the material covered in the course(s): ME 325 Heat Transfer