MECH 7970: Conduction and Radiation Heat Transfer
Spring 2013

Course Description

Instructor: Daniel Mackowski
3418H Wiggins Hall
4–3334
dmckwski@eng.auburn.edu

Office Hours: anytime

Text: Notes prepared by the instructor.
They are available at the web site
www.eng.auburn.edu/users/dmckwski/mech7210
in .pdf formats.

Grading
Assignments/projects: 90%
Class Participation: 10% (off-campus students get a pass on this)

Course Objectives

The main focus of the course is on methods for solving conduction heat transfer problems. The emphasis will be on analytical, rather than numerical methods. In addition, we will devote approximately the last month of the course to a condensed overview of radiation heat transfer, focussing primarily on radiant exchange between surfaces and the prediction of radiation transfer in absorbing, emitting, and scattering media.

Computer/software usage

The course, in the past, has made extensive use of the symbolic/numerical mathematics package Mathematica – both for derivation of analytical solutions and for numerical computation and plotting of the solutions. I have used Mathematica throughout the lecture notes.

The course will require the use of a mathematical software package to perform numerical evaluations of functions/solutions and to plot the solutions. You can use whatever package you wish, i.e., high–level packages such as Mathematica, MatLab, Maple, or low–level, computer language methods (Fortran, c++). The use of spreadsheets for calculations (Excel) is not recommended.

MatLab is the standard high–level package in the College, and I will attempt to convert some of the Mathematica routines in the notes to MatLab.
Tentative Schedule of Topics

Part I: Analytical Methods in Conduction Heat Transfer

2. Advanced 1–D methods: Bessel’s equation and Bessel functions, application of Mathematica to solution of ordinary differential equations.
3. Transient and 1–D conduction: Separation of variables method, eigenfunctions, eigenconditions, and eigenvalues, series solutions to partial differential equations, the partial solutions method.
4. 2–D steady conduction: Extension of the SOV method, the superposition technique.
5. General multidimensional conduction: 2–D and 3–D transient problems, reduction to 1–D, cylindrical and spherical harmonics, the method of variation of parameters.

Part II: Radiation Heat Transfer

8. Radiation transfer in participating media: The radiative transfer equation, extinction and scattering properties of gases and aerosols, overview of solution methods and applications.

References

The ‘text’ in the course will consist of my lecture notes. The following reference texts are also available from me or the library

Conduction heat transfer

3. Poulilakos, D., Conduction Heat Transfer: A basic graduate–level text, similar to Myers but with more engineering applications.
4. Arpaci, V. S., Conduction Heat Transfer
5. Ozisik, M. N., Heat Conduction
6. Kakac, S., and Yener, Y., Heat Conduction

Radiation heat transfer

2. Modest, M. F., Radiative Heat Transfer. Excellent organization; very readable yet also comprehensive.