(B&W softcover ~ $100 at bookstore; Hardcover color $286.95 was not ordered)

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Office Hours: Drop-in (usually available) and/or by appointment (definite).

Teaching Assistant: Ms. Dantong Shi; shidg@mail.uc.edu

Grading System:

Conduction: Exam I 17.5% (1-D SS heat conduction, heat gen)  
Conduction: Exam II 17.5% (heat gen, fins, 2-D steady, 1-D transient)  
Radiation: Exam III 17.5% (radiation heat transfer only)  
Convection: Exam IV 30% (GE, external & internal convection)  
HW 17.5% (no curve)  

All exams will be OPEN book

Homework: Ten (10) homework problem sets from the textbook (1 set per each chapter) are given on the BB website, of which many of these problems will be discussed in class. (Understand these problems, and you will be “good to go” for the exams.) These HW problems from the textbook will not be collected, but rather, there will also be one or two “additional problems” in the set not from the textbook (or a textbook problem that has been significantly modified) which will be collected and graded by the TA (worth 17.5% of the total course grade). Solutions to all of the HW problems will be posted on the web.

Project: There is no formal class project.

Prerequisites: Thermodynamics. Ordinary differential equations. Spreadsheets (or simple Matlab program) may be helpful in evaluating appropriate equations. Numerical methods and computer programming will not be required to solve the assigned HW problems. (Numerical methods, i.e. finite difference, are covered in great detailed in other courses, but overview and example of method / solution wrt to 2-D steady-state HT will be given.)

Class Handouts: For your convenience and to help with the class instruction, most of the lecture notes, all homework assignment/solutions, and sample solved exams (i.e. former exams from the very last semester that I taught HT) are posted on Blackboard.
Goal: Main objective of this class is to learn how to analyze and solve heat conduction (40%), convection (40%) & radiation (20%) heat transfer problems. More specifically, the student is expected to 1) gain a fundamental understanding of the basic underlying concepts and principles, and 2) learn the various analysis tools and techniques needed to solve typical textbook and basic applied engineering heat transfer problems.

### CONDUCTION AND RADIATION OUTLINE

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<td>Radiation exchange between blackbody</td>
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<td>and diffuse gray surfaces, radiation HT shields</td>
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<td>RADIATION HT TEST (17.5%)</td>
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CONVECTION OUTLINE

Overall Goal: Basically, to learn how to handle heat transfer problems involving fluid flow (convection). To become familiar with the governing equations, i.e., Navier-Stokes and differential thermal energy equations, and their underlining concepts. Learn the basic analysis tools (limited mainly to analytical techniques but with proper perspective given to experimental and numerical methods) and simplifying assumptions such as external “boundary layer approximations”, “fully-developed” internal flows, and the benefits of nondimensionalization. To apply the above theory and / or the results obtained from theory, to understand and to be able to calculate the rate of convective heat transfer in engineering systems involving either external or internal forced flows. (We will not cover convective mass transfer.)

Topics

VI. Governing equations (GE)
- Navier-Stokes, thermal energy equation
  - momentum transport
  - thermal energy transport
- Solution Methodology
  - Nondimensionalization (as time permits)
    - dimensionless parameters

VII. External Forced Convection
- Boundary layer approximations
- Flat plate in parallel flow geometry:
  - laminar similarity solution
    - momentum transport
    - energy transport
  - turbulent correlations.
- Single cylinder and tube bank in crossflow

VIII. Internal Forced Convection
- Fully developed duct flow
  - momentum transport
  - thermal energy transport.
- Developing channel flow
- Turbulent flow in circular tubes
- Noncircular tubes

CONVECTION TEST (30%)