

**ME 513**  
**Thermal Convection**  
**Spring 2008**

**References:** Kays and Crawford, Convection Heat and Mass Transfer, McGraw Hill 2005  
Bejan, Convection Heat Transfer, Wiley, 2004  
Kaviany, Principles of Convective Heat Transfer, Springer, 2001  
Kakac, Convection Heat Transfer, CRC Press, 1995  
Burmeister, Convection Heat Transfer, Wiley, 1993  
Arpaci and Larsen, Convection Heat Transfer, Prentice Hall, 1984  
Gebhart, et al., Buoyancy-Induced Flows and Transport, Hemisphere, 1988  
Schlichting, Boundary Layer Theory, McGraw Hill, 1987  
Rohsenow, et al., Handbook of Heat Transfer, McGraw Hill, 1998

**Journals:** ASME Journal of Heat Transfer  
International Journal of Heat and Mass Transfer  
Advances in Heat Transfer  
Experimental Heat Transfer  
Numerical Heat Transfer  
AIAA Journal of Thermophysics and Heat Transfer  
Experimental Thermal and Fluid Sciences  
International Journal of Heat and Fluid Flow  
International Journal of Transport Phenomena  
Proceedings of International Heat Transfer Conferences

**Major Topics:**

- Classification of Convection Heat Transfer
- Heat Transfer Coefficient and Nusselt Number
- Governing Equations for Convection Heat Transfer
  - ❖ Conservation Equations
  - ❖ Scale Analysis
  - ❖ Boundary Layer Equations
- Forced Convection
  - ❖ Scale Analysis
  - ❖ Similarity Solution
  - ❖ Integral Solution
- Effects of Prandtl Number
- Effects of Wall Suction or Injection
- Effects of Thermal Boundary Conditions
- Effects of Viscous Dissipation
- Turbulent Fundamentals
- Turbulent Heat Transfer
- Free Convection
  - ❖ Scale Analysis
  - ❖ Similarity Solution
  - ❖ Integral Solution

- Rayleigh-Benard Convection
- Heat-Source-Driven Convection
- Convection Heat Transfer in Internal Flows
  - ❖ Fully Developed Flow
  - ❖ Thermal Entry Problems
  - ❖ Turbulent Convection in Internal Flows
  - ❖ Reynolds Analogy
- Combined Heat and Mass Transfer - Dissolution Boundary Layers
- Convection Heat Transfer with Phase Change
  - ❖ Interfacial Energy Balance
  - ❖ Melting and Freezing in Fluid Flows
  - ❖ Thermal Processing of Materials: Freeze-Coating Process
- ❖ Two-Phase Heat Transfer

<b>Grading Policy:</b>	Homework/Projects	50%
	Midterm Exam	25%
	Final Exam	25%

**Instructor:** Dr. Fan-Bill Cheung  
 Professor of Mechanical Engineering and Nuclear Engineering  
 Room 304 Reber Building  
 863-4261  
 fxc4@psu.edu

**Office Hours:** MTWR 4:00 – 5:15

**Academic Integrity:** Please refer to "[www.engr.psu.edu/undergrad/acad\\_int/students](http://www.engr.psu.edu/undergrad/acad_int/students)"