CHAPTER 5: FUNDAMENTALS OF CONVECTION

CHAPTER OUTLINE

1. Physical mechanism of convection

2. Convection boundary layers
   a. Velocity and thermal boundary layers (handout 5.1)
   b. Internal vs. external flows
   c. Natural vs. forced flows
   d. Laminar vs. turbulent flows

3. Conservation equations
   a. Derivation and equation summary (handout 5.2)
   b. Example: velocity and temperature distribution in a journal bearing (handout 5.3)

4. Velocity boundary layer
   a. Scaling
   b. Velocity BL equations

5. Thermal boundary layer
   a. Scaling
   b. Thermal BL equation

6. Non-dimensional forms of BL equations
   a. Non-dimensional equations
   b. Dimensionless parameters
   c. Functional forms of frictions and convection coefficients
   d. Example: turbine blade cooling (handout 5.4)

CHAPTER OBJECTIVES

- Understand the physical mechanism of convection, and its classification
- Visualize the development of velocity and thermal boundary layers during flow over surfaces
- Gain a working knowledge of the dimensionless Reynolds, Prandtl and Nusselt numbers
- Distinguish between laminar and turbulent flows
- Derive the differential equations that govern convection on the basis of mass, momentum and energy balances