

HOUR EXAM II Steady Convective Heat Transfer

Monday November 25, 2002
Closed Book, Closed Notes

Instructions

1. This exam is closed books and closed notes. Test notes are provided.
2. Write on the exam script only, and write **ONLY** on the front side of any page. Extra paper can be obtained from the instructor.
3. Reference the table number, and equation number where applicable, from which formulas are taken.
4. Show all work. *All* calculations and numerical substitutions must be shown to receive credit.

GOOD LUCK!

Problem	Points	Possible
1		10
2		15
3		15
Total		40

Problem 1

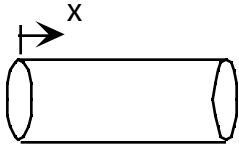
(a) (4 points) In words, define free convection and forced convection.

(b) (6 points) For turbulent flow over a horizontal flat plate, write the expression that would be used to compute the local drag coefficient as a function of x , where x is the distance from the leading edge. On the graph, qualitatively sketch the variation of the drag coefficient with x .



Problem 2

For fully developed forced convection through a tube with a uniform wall heat flux, from a differential control volume, derive the mean temperature as a function of axial position in the tube $T(x)$ and as a function of the mean inlet temperature T_{mi} , uniform wall heat flux q_s'' , tube perimeter P , mass flowrate \dot{m} and specific heat c_p .



Problem 3

Assuming that a human may be approximated by a vertical cylinder 30 cm in diameter and 2.0 m tall, estimate the free convective heat loss for a surface temperature of 24°C in ambient air at 20°C. Under these conditions, air has a thermal conductivity 0.025843 W/m•K, kinematic viscosity 15.252×10^{-6} m²/s, and thermal diffusivity 0.215115×10^{-4} m²/s.