

ChE-101: Approaches to Chemical Engineering Problem Solving
Homework #4
Spring 08
Due 05/07/08

All sections must submit electronic files by 11:00 am
Flowchart diagrams must be submitted to Dr. Botte during the class period on 05/07/08

Submission Instructions:

1. The Matlab programs should be submitted by e-mail to che101@bobcat.ent.ohiou.edu. The title of your e-mail should be Homework 4-yourlastname-SectionXX (e.g., Homework 4-Miller-Section01).
 - a. The e-mail should contain the script file (m files) for the problem (main file) and the function file. Your m file should be named: hw4_lastname (e.g., hw4_botte) and your function file heat_yourlastname.m (e.g., heat_botte).
2. Remember that the matlab files **should have the extensions .m** any other format will not be accepted or graded. Make sure that you receive a confirmation e-mail that I had received your homework. If you don't contact me immediately (see p. 3 of the Class Syllabus).
3. The flowchart diagrams for both problems (hard copies) should be submitted to Dr. Botte during the class period on the due date. Make sure that you have your names on them and that you include the names of the script files that were built using the flowchart diagrams (we are going to need them to grade your code). Follow the homework standards described on p. 3 of the Class Syllabus)

Problem (50 points)

When a fluid is flowing in a pipe and the fluid is at a different temperature from the pipe wall, heat transfer will occur in the direction from hot to cold. If the pipe wall is hotter than the fluid the amount of heat transfer is given by the expression

$$\left(\frac{q}{A}\right) = h(T_w - T_f)$$

where

q/A = the heat transferred per unit area (W/m^2)

h = the heat transfer coefficient ($W/m^2 C$)

T_w = the pipe wall temperature (C)

T_f = the fluid temperature (C)

The heat transfer coefficient is a parameter that depends on the properties of the fluid, the diameter of the pipe, and the velocity of the fluid. For many situations the value of 'h' can be calculated from the Dittus-Boelter equation:

$$h = 0.023 \left(\frac{k}{D}\right) \left(\frac{rDv}{m}\right)^{0.8} \left(\frac{C_p m}{k}\right)^{0.3}$$

where:

k = thermal conductivity ($0.64 \frac{\text{W}}{\text{m C}}$)

D = the pipe diameter (m)

ρ = the fluid density (1000 kg/m^3)

v = the fluid velocity in the pipe (m/s)

μ = the fluid viscosity ($5.62 \times 10^{-4} \frac{\text{kg}}{\text{m s}}$)

C_p = the heat capacity of the fluid ($4180 \frac{\text{J}}{\text{kg C}}$)

Build a flowchart diagram and a Matlab program that will allow you to calculate the values of the heat transfer coefficient and heat transferred per unit area for flow in a pipe. The inputs should be provided by the user. The input and output should be done in a main file which calls a function file. **USE ONLY ONE FUNCTION FILE TO CALCULATE BOTH THE HEAT TRANSFER COEFFICIENT AND THE HEAT TRANSFERRED PER UNIT AREA.**

NOTE: you can't name a variable q/A in Matlab (it will give you a syntax error message).