Homework Assignment Number Ten
Assigned: Wednesday, March 31, 1999
Due: Wednesday, April 7, 1999 BEFORE LECTURE STARTS.

Problem 1. Geankoplis 4.7-6, page 322

Problem 2. Geankoplis 4.8-2, page 323

Problem 3.

Under the Lecture Notes Section of the Course Website, there is a handout titled "Algorithm for the solution of a shell and tube heat exchanger problem". The algorithm contains 35 steps. Also in the hand-out is a sample MATLAB code which conducts those 35 steps.

(a) Write your own code (probably quite similar to the one in the hand-out to solve the heat exchanger problem). Your code should output six properties.

(i) shell-side film heat transfer coefficient, h_{shell}

(ii) tube-side film heat transfer coefficient, h_{tube}

(iii) over-all heat transfer coefficient (based on outer diameter), U_o

(iv) the heat transfer rate, q

(v) the shell-side outlet temperature, $T_{shell,out}$

(vi) the tube-side outlet temperature, $T_{tube,out}$

For part (a), I want a print-out of the code.

(b) Use your code to solve the following problem:

We will be using cold water to cool hot water in a 1-1 shell and tube heat exchanger. The hot water is inside the tubes. The cold water is in the shell. The flow is counter-current.

The cold water enters the shell at $T_{shell,in} = 250K$. The hot water enters the tubes at $T_{tube,in} = 400K$. The flow-rate of the hot stream is $\dot{m}_{tube} = 0.10 \frac{kg}{s}$ and the flow-rate of the cold stream is $\dot{m}_{shell} = 0.20 \frac{kg}{s}$.

The heat exchanger is made of stainless steel tubes of outside diameter 1 inch ,BWG 10. The length of the tubes and the length of the shell are $L = 4.0m$; the number of tubes, $N_{tube} = 24$; the diameter of the shell, $D_{shell} = 0.15m$. Use fouling factors for city water.

Determine the six quantities specified in part (a)

(c) Repeat Part (b) with cocurrent flow.

(d) Repeat Part (b) with $L = 1.0m$

(e) Repeat Part (b) with the hot fluid in the shell and the cold fluid in the tube.