CHE312A: Homework 6

Instructions: Upload your original, legible and handwritten solution in pdf format, with the exact filename ⟨yourrollnumber⟩.pdf (e.g. 06302016.pdf). Include your name and roll number on the top of the first page. Include all necessary steps in detail, define all symbols and state all assumptions made in your solution. Use material properties reported in appendices of either Incropera's or Cengel's book, unless specified otherwise.

1. Draw a schematic of a two shell passes and 6 tube passes shell and tube heat exchanger. Mark direction of fluid flow for both fluids through all passes, and label all essential parts. (2 points)

2. State and prove the assumptions under which the log mean temperature difference for a heat exchanger will be equal to the arithmetic mean temperature difference. (2 points)

3. A double pipe parallel flow heat exchanger is used to heat water (c_p = 4180 J/kg·K) from 25°C to 60°C at a rate of 0.2 kg/s, using geothermal water (c_p = 4310 J/kg·K available at 140°C at a mass flow rate of 0.3 kg/s. The thin-walled inner tube has a diameter of 0.8 cm. If the overall heat transfer coefficient is 550 W/m^2·K, determine the length of tube required to achieve the desired heating. (2 points)

4. Assuming that the operating fluid conditions (flow rates, temperatures, etc.) are fixed, can you suggest a modification so that a 25 m long double pipe heat exchanger can suffice? (2 points)

5. Consider a water to water counter flow double pipe heat exchanger. Hot water enters at 95°C while cold water enters at 20°C. Exit temperature of hot water is 15°C greater than that of cold water, and the mass flow rate of hot water is 50% greater than that of cold water. The product UA = 1400 W/K. Taking specific heat of both waters to be c_p = 4180 J/kg·K, determine the outlet temperatures and mass flow rates of both water streams, the effectiveness of the heat exchanger and the heat transfer rate. (2 points)