MEEN 461-501 Heat Transfer Fall 2016

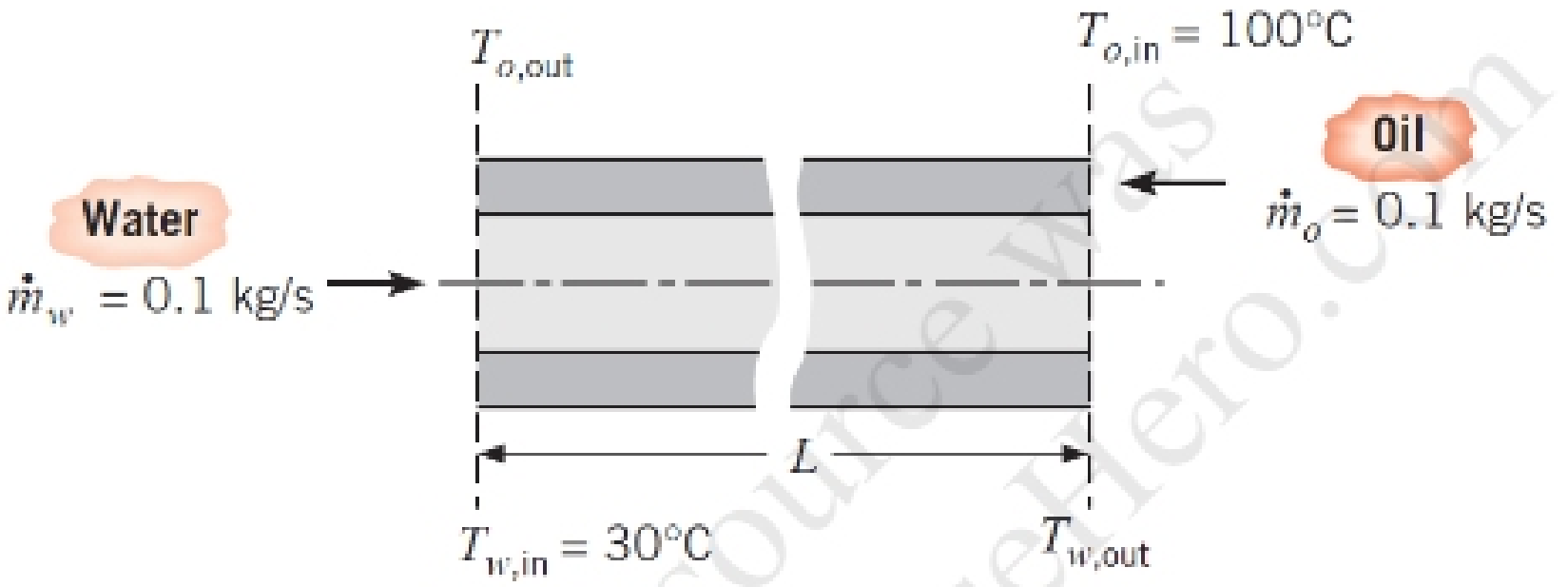
Homework 9

Due Tuesday, November 15, 2016

11.9 A finned-tube, cross-flow heat exchanger is to use the exhaust of a gas turbine to heat pressurized water. Laboratory measurements are performed on a prototype version of the exchanger, which has a surface area of 10 m^2, to determine the overall heat transfer coefficient as a function of operating conditions. Measurements made under particular conditions, for which $\dot{m}_h = 2\,kg/s$, $T_{h,i} = 325°C$, $\dot{m}_c = 0.5\,kg/s$, and $T_{c,i} = 25°C$, reveal a water outlet temperature of $T_{c,o} = 150°C$. What is the overall heat transfer coefficient of the exchanger?

11.14 A shell-and-tube exchanger (two shells, four tube passes) is used to heat 10,000 kg/h of pressurized water from 35 to 120°C with 5000 kg/h pressurized water entering the exchanger at 300°C. If the overall heat transfer coefficient is 1500 $W/m^2 \cdot K$, determine the required heat exchanger area.

11.23 A concentric tube heat exchanger for cooling lubricating oil is comprised of a thin-walled inner tube of 25-mm diameter carrying water and an outer tube of 45-mm diameter carrying the oil. The exchanger operates in counterflow with an overall heat transfer coefficient of 60 $W/m^2 \cdot K$ and the tabulated average properties.



Properties	Water	Oil
ρ (kg/m^3)	1000	800
c_p ($J/kg \cdot K$)	4200	1900
ν (m^2/s)	7×10^{-7}	1×10^{-5}
k ($W/m \cdot K$)	0.64	0.134
Pr	4.7	140

11.40 Saturated steam at 0.14 bar is condensed in a shell-and-tube heat exchanger with one shell pass and two tube passes consisting of 130 brass tubes, each with a length per pass of 2 m. The tubes have inner and outer diameters of 13.4 and 15.9 mm, respectively. Cooling water enters the tubes at 20°C with a mean velocity of 1.25 m/s. The heat transfer coefficient for condensation on the outer surfaces of the tubes is 13,500 $W/m^2 \cdot K$.

(a) Determine the overall heat transfer coefficient, the cooling water outlet temperature, and the steam condensation rate.