Michigan Tech
CM3110 Morrison HW 6

Answers to Assigned Problems:

1. See assignment. No answer provided (summary of data correlations). See lecture notes for an example.
2. Geankoplis 4.5-6: $84\ \mathrm{lb_m/h}$
3. Geankoplis 4.7-1: $\mathrm{h} = 5.4\ \mathrm{W/m^2}$, $\mathrm{q} = 92\ \mathrm{W/m}$ (not using the simplified equation); $\mathrm{q} = 85\mathrm{W/m}$ (simplified equation)
4. Geankoplis 4.7-3: $\mathrm{Q} = 45\mathrm{W}$
5. Geankoplis 4.5-4: $\mathrm{T_1'} = 299.5^{\mathrm{o}}\mathrm{C}$, $\mathrm{A} = 97\mathrm{m^2}$ (assume double-pipe heat exchanger; note Geankoplis' use of an improbable number of sig figs)
6. Geankoplis 4.5-4, except with 1-2 shell-and-tube heat exchanger: $\mathrm{T_1'} = 299.5^{\mathrm{o}}\mathrm{C}$, $\mathrm{A} = 97\mathrm{m^2}$. How does the 1-2 shell-and-tube compare to the double pipe?
7. See assignment. Answers: a) $26\ kW$, b) $\Delta T_{lm} = 63^o C$; c) $U_o = 500\ W/m^2K$
8. See assignment. Answer: 180kW.
9. Geankoplis 4.10-3: $160\mathrm{W}$
10. See assignment. Answer: $260\mathrm{W}$. Neither radiation nor natural convection dominates.
11. Geankoplis 4.11-1: a)$14{,}000\ \mathrm{W/m^2}$, b) $4500\ \mathrm{W/m^2}$
12. Geankoplis 4.7-8: We need to calculate radiation and natural convection contributions to the total. Answers: radiation 5.5kW; natural convection 1.3 kW; total 6.8 kW.
13. See assignment. Answer: Only heat exchanger C will work.
14. See assignment. Answers: a)$h_i = 6900\frac{W}{m^2K}, h_0 = 2200\ W/m^2K, U_o = 1400\ W/m^2K$ b) with water-side fouling $U_o = 1100\ W/m^2K$, with orange-juice side fouling, $U_o = 900\ W/m^2K$, with fouling on both sides, $U_o = 800\ W/m^2K$
15. Problem N(stretch). Answer: b; $h_{lm} = 5300\frac{W}{m^2K}, T = 21^o C$
16. Problem M. Answer: c; yes, radiation is important; $h_{total} = 62\frac{W}{m^2K}; \frac{q}{A} = 6300 W/m^2$
17. Problem K. Answer: $h = 7.0\frac{W}{m^2K}, q = 130\ W$ (natural convection only)