

# Michigan Tech

## CM3110 Morrison HW 5

### Answers to Assigned Problems:

1. See assignment. Answer: 23 kJ
2. Problem H: Answer: 8.9kW/m<sup>2</sup>.
3. Geankoplis 1.6-3 (note: the mass flows should be per sec) Answer: 76°C
4. See assignment. Answers:  $T = \left(\frac{S_e}{4k}\right)(R^2 - r^2) + \frac{S_e R}{2h} + T_b, \left.\frac{q_r}{A}\right|_{r=R} = \frac{S_e R}{2}$
5. Geankoplis 4.2-4, modified, see assignment. Answer:  $\frac{q}{A} = \frac{a(T_1 - T_2) + \frac{b}{2}(T_1^2 - T_2^2) + \frac{c}{4}(T_1^4 - T_2^4)}{H}$
6. See assignment. Answer: see TA or instructor.
7. Geankoplis 4.1-1: 40 W/m<sup>2</sup>
8. See assignment. Answer: -430 W/m<sup>2</sup>
9. See assignment. Solution: see TA or instructor.
10. See assignment. Solution: see TA or instructor.
11. See assignment. Answer: a) 1100 W/m<sup>2</sup>; b) 92 W/m<sup>2</sup>
12. See assignment. Answer: 37.5°C
13. See assignment. a) -900 - (-17,000) W/m<sup>2</sup> (1 sig fig) b) 0.0028 m/W  
c) 0.0058 - 0.012 m/W d) 0.022 - 0.69 m/W, 2) e) oil side heat transfer coefficient dominates.
14. See assignment. Answers: a) -16,000 W/m<sup>2</sup> b) higher magnitude of flux

15. Mechanism	$h, \frac{BTU}{hr \ ft^2 \ ^\circ F}$	$h, \frac{W}{m^2 \ K}$
Condensing steam	1000-5000	5700-28,000
Condensing organics	200-500	1100-2800
Boiling liquids	300-5000	1700-28,000
Moving water	50-3000	280-17,000
Moving hydrocarbons	10-300	55-1700
Still air	0.5-4	2.8-23
Moving air	2-10	11.3-55