Name: _____ Student ID _____

Prince of Songkla University

Faculty of Engineering

Exam: Midterm Exam, Semester II | Academic Year: 2008

Date: December 22, 2009 | Time: 9.00-12.00

Subject: 230-302 Basic Chemical Engineering II | Room: A 401

ทุจริตในการสอบ โทษขั้นต่ำคือปรับตกในวิชานั้น และพักการเรียน 1 ภาคการศึกษา

Instructions:

- There are a total 7 questions.
- The points for each problem are not distributed evenly. Place your name and the student ID number on every page.
- Students are allowed to use
- 1) A pen or pencil
- 2) Calculator
- 3) Note A4 5 sheets
- 4) Heat transfer (J.P. Holman)

Points Distribution (For Grader Only)

Question	Points Value	Score
1	20	
2	15	
3	20	
4	20	
5	25	
6	20	
7	15	
Total	**135**	

GOOD LUCK!

Supawan Tirawanichakul

December 16, 2009

PLEASE CHECK TO MAKE SURE THAT

YOU HAVE ALL 8 PAGES OF THE EXAM BEFORE BEGINNING

(including the cover sheet)

1. (20 points) Find the the heat transfer per unit area through the composite wall sketched.

   Assume the one dimensional heat flow.

   Thermal conductivity of A, B, C and D is 155, 30, 50 and 70 W/m K, respectively.

2. (15 points) A vertical square plate, 30 cm on a site is maintained at $50^{\circ}C$ and exposed to room air at $20^{\circ}C$. The surface emissivity is 0.8 .Calculate the total heat lost by both sides of the plate.

3. (20 points) A bottom of a copper pan, 150 mm. in a diameter, is maintained at 115°C by the heating of element of an electric range. Calculate

(a) the power require to boil the water in this pan.

(b) the critical heat flux

(c) the evaporation rate.

4. (20 points) A straight rectangular fin has a length of 1.50 cm and a thickness of 2 mm. The thermal conductivity is 55 W/m K, and it is expose to environment temperature at 25°C and the convection heat transfer coefficient is 500 W/m^2 K. Calculate

(a) The maximum possible heat lost for a base temperature of 300°C.

(b) The actual heat loss.

5. (25 points) Water flows on the inside of a steel pipe (k = 43 W/m K) with an ID of 2.5 cm. The wall thickness is 2 mm, and the convection coefficient on the inside is 500 W/m^2 K. The convection coefficient on the outside is 12 W/m^2 K. Calculate

(a) The overall heat transfer coefficient

(b) If this pipe is covered with a layer of asbestos (k = 0.18 W/m K). Calculate the critical insulation radius and the heat transfer increased or decreased if adding an insulation thickness to 10 mm.

6. (20 points) A square array of six hundred and twenty-five 3.5 mm diameter tubes is used condense steam at atmospheric pressure. The tube walls are maintained at 88°C by coolant flowing inside the tubes. Calculate mass of steam condensed per hour per unit length of the tubes.