ชื่อ……..รหัส……

PRINCE OF SONGKLA UNIVERSITY

FACULTY OF ENGINEERING

Midterm Examination Semester II	Academic year :2003
Date : December 23, 2003	Time : 9.00-12.00 น.
Subject : 230 – 392 Basic Chemical Engineering II	Room : R300

อ.กัลยา ศรีสุวรรณ

ผู้ออกข้อสอบ

1) นำเอกสาร ทุกชนิดเข้าห้องสอบได้

2) ข้อสอบมีทั้งหมด 5 ข้อ ให้ทำทุกข้อ

	คะแนนเต็ม	คะแนนที่ได้
ข้อ1	20	
ข้อ2	20	
ข้อ3	20	
ข้อ4	20	
ข้อ5	20	
รวม	100	

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1.

a) A 10-mm steel plate having a thermal conductivity of 44 W/m ^{o}C, is exposed to a radiant heat flux of 4500 W/m^{2} in a vacuum space where the convection heat transfer is negligible. Assuming that the surface temperature of the steel exposed to the radiant energy is maintained at 50 ^{o}C, what will be the other surface temperature if all the radiant energy striking the plate is transferred through the plate by conduction?

(10marks)

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b) A straight rectangular fin has a length of 20 mm and a thickness of 1.5 mm. The thermal conductivity is 40 W/m ^{o}C, and it is exposed to a convection environment at 30 ^{o}C and h = 500 W/m^{2} ^{o}C. Calculate the maximum possible heat loss for a base temperature of 230 ^{o}C. What is the actual heat loss?

(10 marks)

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2. Using the following energy equation to determine an expression for heat-transfer coefficient under the conditions

$$\frac{d}{dx}\left[\int_0^H \left(T_\infty - T\right)udy\right] = \alpha \left.\frac{\partial T}{\partial y}\right|_w$$

$u = u_\alpha$ = const

$$\frac{T - T_w}{T_\infty - T_w} = \frac{y}{\delta_t}$$

where δ_t is the thermal-boundary-layer thickness.

(20marks)

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3. A heat exchanger is constructed so that hot flue gases at 800 K flow inside a 25-mm-ID copper tube with 1.6-mm wall thickness. A 50-mm tube is placed around the 25-mm-diameter tube, and high-pressure water at 150 ^{o}C flows in the annular space between the tubes. If the flow rate of water is 2 kg/s and the total heat transfer is 20 kW. Estimate the length of the heat exchangers for a gas mass flow of 1.0 kg/s. Assume that the properties of the flue gas are the same as those of air at atmospheric pressure and 800 K.

Hint: for annular section , hydraulic diameter is assume to be d_o-d_i

(20marks)

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4. A tube bank uses an in-line arrangement with Sn = Sp = 19 mm and 6.33-mm-diameter tubes. Six rows of tubes are employed with 50 tubes high arranged in in-line pattern. The surface temperature of the tubes is constant at 90 ^{o}C, and atmospheric air at 20 ^{o}C is forced across them at an inlet velocity of 4.5 m/s before the flow enters the tube bank. Calculate the total heat transfer per unit length for the tube bank.

(20 marks)

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5. A shell-and-tube heat exchanger with one shell pass and two tube passes is used to heat 8.0 kg/s of water from 30 ^{o}C to 80 ^{o}C. The water flows in the tubes. Condensing steam at 100 kPa is used in the shell side. Calculate the area of the heat exchanger. If the overall heat-transfer coefficient is 1000 W/m ^{o}C, Suppose this same exchanger is used with entering water at 30 ^{o}C, U = 1000, but with a water flow rate of 1.3 kg/s. What would be the exit water temperature under these conditions?

(20 marks)