ชื่อ.....รหัส.....

PRINCE OF SONGKLA UNIVERSITY

FACULTY OF ENGINEERING

Final Examination: Semester I **Academic year : 2010**

Date : 9 October, 2010 **Time : 13.30 – 16.30**

Subject : 231-201 Material and Energy Balances **Room : A401**

รายละเอียดการทำข้อสอบ

1. ห้ามนำข้อสอบบางส่วนหรือทั้งหมดออกจากห้องสอบ
2. สามารถนำหนังสือหรือเอกสารทุกชนิดเข้าห้องสอบได้
3. ใช้ดินสอหรือปากกาในการทำข้อสอบได้
4. ข้อสอบมีทั้งหมด 6 ข้อ มีจำนวนทั้งหมด 7 หน้า
5. อนุญาตให้ทำข้อสอบด้านหลังกระดาษคำตอบแต่ละข้อได้
6. กรอกชื่อและรหัสนักศึกษาด้านหน้าข้อสอบและกรอกรหัสในข้อสอบทุกหน้าของกระดาษ

ข้อที่	คะแนนเต็ม	คะแนนที่ได้
1	25	
2	20	
3	25	
4	25	
5	20	
6	15	
รวม	130	

อ.จันทิมา ชั่งสิริพร

ผู้ออกข้อสอบ

1. A stream of air in pressure vessel at 80°C with partial pressure of water in the air at 370 mmHg contains 8% water by volume. (25 marks)

1) Calculate total pressure of the air stream in the system.

2) What is the condition (superheated, saturation, or condersation) of this air stream?

3) Calculate the % of the vapor that condenses to get the new saturation condition.

4) The final temperature of the air stream if the system is heated to saturation condition at constant pressure.

2. An liquid mixture of n-hexane and toluene is in equilibrium with it vapor at 40°C. The content of n-hexane in the liquid mixture is 0.79 and the toluene content is 0.21. (20 marks)

1) What is the system pressure?

2) Calculate the composition of the vapor in the system.

3. Use the humidity chart (psychrometric chart) to estimate the condition of the humid air at 35°C and 30% relative humidity:

1) The wet-bulb temperature, moisture content, and specific enthalpy of humid air.

2) The mass flow rate of water in 25 kg/h of dry air flow at these conditions.

3) If the air is heated up to 45°C. How much enthalpy is required?

(25 marks)

4. Two streams of water are mixed and heated in the heat exchanger to form the saturated steam feed to a boiler. Process data are given here.

Feed stream 1: 150 kg/h at 50°C

Feed stream 2: 275 kg/h at 74°C

1) Draw flow diagram of the heat exchanger.

2) Calculate the required heat input to the heat exchanger in kJ/h if the exiting steam is saturated steam at 100°C.

Neglect the kinetic energies of the liquid inlet streams. (25 marks)

5. Calculation of heat of reaction. (20 marks)

1) The standard heat of the combustion of n-butane vapor is

$$C_4H_{10}(g) + \tfrac{13}{2}O_2(g) \rightarrow 4CO_2(g) + 5H_2O(l): \quad \Delta H_r^\circ = -2878\,kJ/mol$$

Calculate the rate of enthalpy change, $\Delta\dot{H}\,(kJ/h)$, if 1600 mol/h of CO_2 is produced in this reaction and the reactants and products are all at 25°C.

2) Determine the standard heat of reaction for the combustion of 20 mol/h liquid n-pentane, assuming $H_2O(l)$ is a combustion product.

$$C_5H_{12}(l) + 8O_2(g) \rightarrow 5CO_2(g) + 6H_2O(l)$$

6. Calculate the heating rate required to raise 50 kg/h of Nitrous oxide (N_2O) from 100°C to 250 °C in constant-volume vessel. The heat capacity of N_2O in this temperature range is given by the equation

$Cp = (kJ/kg.^\circ C) = 0.95 + 9.37 \times 10^{-4} T$, where T is in °C

(15 marks)