ชื่อ.....รหัส.....

PRINCE OF SONGKLA UNIVERSITY

FACULTY OF ENGINEERING

Final Examination : Semester I **Academic year : 2012**

Date : 6 October, 2010 **Time : 13.30 – 16.30**

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

รายละเอียดการทำข้อสอบ

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

ข้อที่	คะแนนเต็ม	คะแนนที่ได้
1	20	
2	25	
3	25	
4	25	
5	25	
รวม	120	

อ.จันทิมา ชั่งสิริพร

ผู้ออกข้อสอบ

รหัส.....

1. Air in pressure vessel at 70°C and total pressure 4000 mmHg contains 7.6% water by volume. Calculate: (20 marks)

1) Partial pressure of water in the air stream.

2) What is the condition of this air in the vessel?

3) After the system gets new saturation (equilibrium) condition, what is water content in the air?

4) If the system is heated up to 90°C at constant pressure, what is this new condition?

2. Use the humidity chart (psychrometric chart) to estimate the condition of the humid air flow (200 kg/h) at wet-bulb temperature 23°C and moisture content 0.012 kg/kg dry air: (25 marks)

1) What are dry bulb temperature (T_{db}), relative humidity, and specific enthalpy of the humid air?

2) What is the volumetric flow rate of the humid air at this condition?

3) If the air is heated up to 50°C. How much enthalpy is required for the 200 kg/h humid air?

4) Draw the picture of psychrometric chart to explain for all process in this problem.

3. Streams of saturated water (Stream 1) and saturated steam (Stream 2) are mixed and heated by heat source in the heat exchanger to form superheated steam. Process data are given here.

Feed stream 1: 120 kg/h at 100°C Feed stream 2: 200 kg/h at 120°C

1) Draw flow diagram of the heat exchanger.

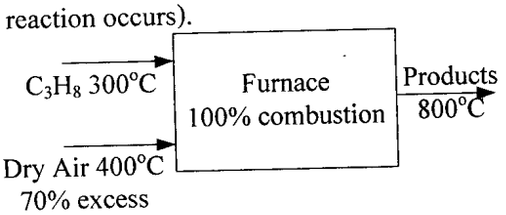
2) Calculate the required heat input to the heat exchanger in kJ/h if the exiting steam is superheated steam at 200°C and 1.5 bar.

3) If heat source for the heat exchanger is superheated steam (inlet at 320°C, 3 bar and outlet at 250°C, 2 bar). What flow rate of the superheated steam (heat source) is required to the system?

Neglect the kinetic and static energies of all streams. (25 marks)

4. Propane (C_3H_8) 15 mol/h at 300°C is fed with dry air (400°C, 1 atm) at 70% excess air. Products from the reaction are produced at 800°C. (Assuming complete reaction occurs).

$$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$$

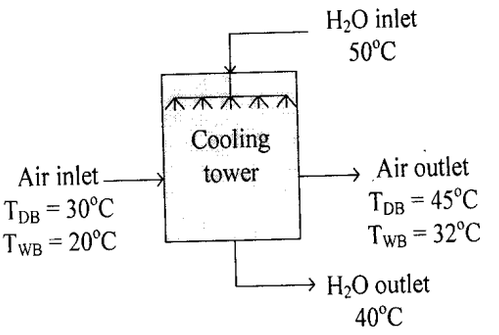


Calculate: (25 marks)

1) Flow rate of air stream feeding to the furnace.
2) Standard heat of reaction (combustion) of the propane.
3) Composition and flow rate of the product from combustion.
4) Heating rate to the combustion in furnace.

5. Cooling tower is designed to produce cooling water (0.5 m^3/h) by feeding humid air at 30°C (T_{wb}= 20°C) to the system and discharging at 45°C (T_{wb}= 32°C) (outlet). The water temperature at inlet and outlet stream is 50°C and 40°C, respectively. (25 marks)

(C_p of water = 4.1855 J/(g·K))



1) How much enthalpy of the water is changed in the system?

2) Calculate volumetric flow rate of humid air feeds to the system for producing the cooling water.

3) Calculate quantity of water vapor from cooling water loss (evaporate) to the air stream.