

ชื่อ.....รหัส.....

มหาวิทยาลัยสงขลานครินทร์
คณะวิศวกรรมศาสตร์

การสอบปลายภาค ประจำปีการศึกษาที่ 1

ประจำปีการศึกษา 2550

วันที่ : 1 ตุลาคม 2550

เวลา : 9:00 – 12:00

วิชา : Heat Transfer (230-313)

ห้องสอบ : R201

- อนุญาตให้นำหนังสือและเอกสารอื่นๆ เข้าห้องสอบได้
- อนุญาตให้นำเครื่องคิดเลขทุกรุ่นเข้าห้องสอบได้
- ข้อสอบมีทั้งหมด 6 ข้อ (9 หน้า) ให้ทำทุกข้อ
- กระดาษไม่พอให้ทำต่อด้านหลัง
- ใช้ดินสอทำข้อสอบได้

ทุจริตในการสอบโทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 1 ภาคการศึกษา

หน้าที่	ข้อที่	คะแนนเต็ม	คะแนนที่ได้
2	1	15	
3	2	25	
5	3	20	
6	4	15	
7	5	15	
8	6	20	
รวมคะแนน		110	

อ. ผกามาศ เจษฎ์พัฒนานนท์

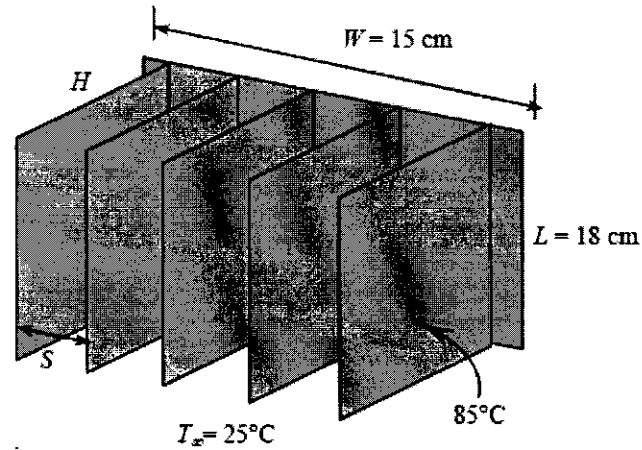
24 กันยายน 2550

1. The forming section of a plastics plant puts out a continuous sheet of plastic that is 1.2 m wide and 2 mm thick at a rate of 15 m/min. The temperature of the plastic sheet is 90°C when it is exposed to the surrounding air, and the sheet is subjected to air flow at 30°C at a velocity of 3 m/s on both sides along its surfaces normal to the direction of motion of the sheet. The width of the air cooling section is such that a fixed point on the plastic sheet passes through that section in 2 s. Determine the rate of heat transfer from the plastic sheet to the air by forced convection and the temperature of the plastic sheet at the end of the cooling section. Take the density and specific heat of the plastic to be $1,000\text{ kg/m}^3$ and $1.5\text{ kJ/kg}\cdot^{\circ}\text{C}$, respectively. (15 points)

2. Combustion air in a manufacturing facility is to be preheated before entering a furnace by hot water at 100°C flowing through the tubes of a tube bank located in a duct. Air enters the duct at 20°C and 1 atm with a mean velocity of 5 m/s, and flows over the tubes in normal direction. The outer diameter of the tubes is 3 cm, and the tubes are staggered arrangement with $S_L = S_T = 6$ cm. There are six rows in the flow direction with six tubes in each row. Determine the rate of heat transfer per unit length of the tubes, and the pressure drop across the tube bank (25 points)

3. Water at 15°C is heated by passing it through 2-cm internal-diameter thin-walled copper tubes. Heat is supplied to the water by steam that condenses outside the copper tubes at 120°C . If water is to be heated to 65°C at a rate of 0.2 kg/s, determine the length of the copper tube that needs to be used and the pumping power required to overcome pressure losses. Assume the entire copper tube to be at the steam temperature of 120°C (20 points)

4. A 15-cm-wide and 18-cm-high vertical hot surface in 25°C air is to be cooled by a heat sink with equally spaced fins of rectangular profile. The fins are 0.1 cm thick and 18 cm long in the vertical direction. Determine the optimum fin height and the rate of heat transfer by natural convection from the heat sink if the base temperature is 85°C . The criteria for optimum fin height H in the literature is given by $H = \sqrt{hA_c / pk}$. Take the thermal conductivity of fin material to be $177 \text{ W/m}\cdot^{\circ}\text{C}$.



(15 points)

5. Consider two concentric horizontal cylinders of diameters 55 cm and 65 cm, and length 125 cm. The surfaces of the inner and outer cylinders are maintained at 54°C and 106°C , respectively. Determine the rate of heat transfer between the cylinders by natural convection if the annular space is filled with water. (15 points)

6. A counter-flow double-pipe heat exchange is to heat water from 30 to 90°C at a rate of 2 kg/s. The heating is to be accomplished by geothermal water available at 180°C at a mass flow rate of 3 kg/s. The inner tube is thin-walled and has a diameter of 2 cm. If the overall heat transfer coefficient of the heat exchanger is 600 $\text{W/m}^2\cdot^{\circ}\text{C}$.

6.1 Determine the length of the heat exchanger required to achieve the desired heating.

6.2 Determine the maximum heat transfer rate and the outlet temperature of the geothermal water for this case.

6.3 A heat exchanger is to be selected to cool a hot liquid chemical at a specified rate to a specified temperature. Explain the steps involved in the selection process.

(20 points)