ชื่อ.....รหัส.....

มหาวิทยาลัยสงขลานครินทร์
คณะวิศวกรรมศาสตร์

การสอบปลายภาค ประจำภาคการศึกษาที่ 1 ประจำปีการศึกษา 2552

วันที่ : 3 ตุลาคม 2552 เวลา : 9:00 – 12:00

วิชา : Momentum and Heat Transfer (231-311) ห้องสอบ : R201

- อนุญาตให้นำหนังสือและเอกสารอื่นๆ เข้าห้องสอบได้
- อนุญาตให้นำเครื่องคิดเลขทุกรุ่นเข้าห้องสอบได้
- ข้อสอบมีทั้งหมด 5 ข้อ (9 หน้า รวมปก) ให้ทำทุกข้อ
- กระดาษไม่พอให้ทำต่อด้านหลัง
- ใช้ดินสอทำข้อสอบได้

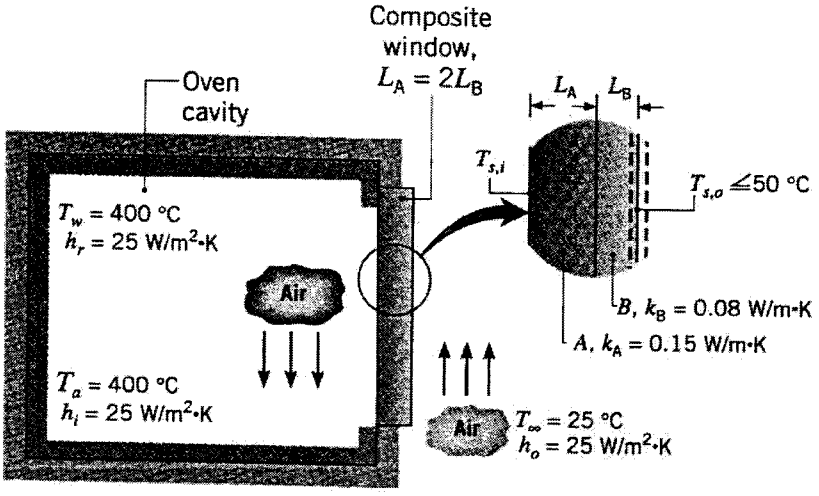
ทุจริตในการสอบโทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 1 ภาคการศึกษา

ข้อที่	คะแนนเต็ม	คะแนนที่ได้
1	15	
2	10	
3	25	
4	20	
5	30	
รวมคะแนน	100	

ผศ.ดร.ผกามาศ เจษฎ์พัฒนานนท์

ผู้ออกข้อสอบ

1. A leading manufacturer of household appliances is proposing a self-cleaning oven design that involves use of a composite window separating the oven cavity from the room air. The composite is to consist of two high-temperature plastics (A and B) of thicknesses $L_A = 2L_B$ and thermal conductivities $k_A = 0.15$ W/m.K and $k_B = 0.08$ W/m.K. During the self-cleaning process, the oven wall and air temperature, T_w and T_a are 400 °C, while the room air temperature T_∞ is 25 °C. The inside convection and radiation heat transfer coefficients h_i and h_r, as well as the outside convection coefficient h_o, are each approximately 25 W/m^2.K. What is the minimum window thickness, $L = L_A + L_B$, needed to ensure a temperature that is 50 °C or less at the outer surface of the window? This temperature must not be exceeded for safety reasons. (15 points)



2. A 0.4-m internal diameter spherical container made of 1-cm-thick stainless steel (k = 15 W/m.^{o}C) is used to store liquid nitrogen at 50 K. The container is covered with 15-mm-thick insulation (k = 0.0017 W/m.K) and its outer surface is exposed to ambient air at 295 K. The convection heat transfer coefficient is known to be 25 W/m^2.K. The lalent heat of vaporization and the density of liquid nitrogen are 2×10^5 J/kg and 804 kg/m^3, respectively.

2.1 What is the rate of heat transfer to the liquid nitrogen?

2.2 What is the rate of liquid boil-off? (Answer in liters/day)

(10 points)

3. A hot surface at 140^{o}C is to be cooled by attaching 0.25-mm-diameter and 3-cm-long copper fins to it, with a center-to-center distance of 0.6 cm. The temperature of the surrounding air is 0^{o}C, and the heat transfer coefficient on the surfaces is 20 W/m^{2}.^{o}C.

3.1 Determine the rate of heat transferred from the surface for a 1-m × 1-m section of the plate.

3.2 Determine the overall effectiveness of the fins.

3.3 Determine the percent error in the rate of heat transfer from one fin when the infinitely long fin assumption is used instead of the adiabatic fin tip assumption.

(25 points)

Note See Figure P17-118, p.716 in textbook "Fundamentals of Thermal-Fluid Sciencs"

4. Water at 10°C is heated by passing it through 3-cm internal-diameter thin-walled copper tubes. Heat is supplied to the water by steam that condenses outside the copper tubes at 200°C. If water is to be heated to 90°C at a rate of 0.5 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 200°C (20 points)

5. A counter-flow double-pipe heat exchange is to heat water from 30 to 100°C at a rate of 1 kg/s. The heating is to be accomplished by oil available at 120°C at a mass flow rate of 1.5 kg/s. The copper inner tube is thin-walled and has a diameter of 4 cm. The inner diameter of the shell is 5 cm.

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

5.2 Determine the maximum heat transfer rate and the outlet temperature of the oil for this case. (30 points)

Hint Allow to take temperature of oil at 120°C for its properties.

Reserved page for question 5