

มหาวิทยาลัยสงขลานครินทร์

คณะวิศวกรรมศาสตร์

การสอบปลายภาค ประจำภาคการศึกษาที่ 2

ประจำปีการศึกษา 2546

วันที่ 27 กุมภาพันธ์ 2547

เวลา 09.00-12.00 น.

วิชา 216-332 Heat Transfer

ห้อง R 300

ชื่อ-สกุล..... รหัส.....

คำสั่ง

ข้อสอบมีทั้งหมด 4 ข้อ ให้ทำทุกข้อ

ผศ.ดร.ชูเกียรติ กุปตานนท์

ผู้ออกข้อสอบ

ข้อสอบ	คะแนน
1	
2	
3	
4	
รวม	

*“ทุจริตการสอบ โทษหนักดำปรับตกในรายวิชานั้น และพักการเรียน
1 ภาคการศึกษา สูงสุดให้ ๑๐๐”*

1.

a) What are the mechanisms of heat transfer? How are they distinguished from each other?

b) What is the physical mechanism of heat conduction in a solid, a liquid, and a gas?

- c) Consider a refrigerator whose dimensions are $1.8 \text{ m} \times 1.2 \text{ m} \times 0.8 \text{ m}$ and whose walls are 3 cm thick. The refrigerator consumes 600 W of power when operating and has a COP of 2.5. It is observed that the motor of the refrigerator remains on for 5 minutes and then is off for 15 minutes periodically. If the average temperatures at the inner and outer surfaces of the refrigerator are 6°C and 17°C , respectively.

Determine the average thermal conductivity of the refrigerator walls. Also, determine the annual cost of operating this refrigerator if the unit cost of electricity is 2.5 Baht/kWh.

2.

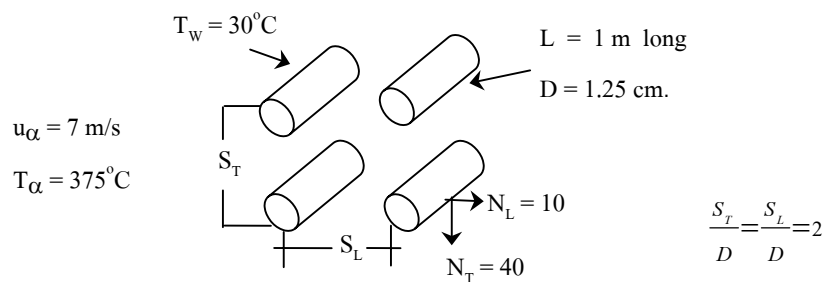
- a) It was found during a test in which water flowed with a velocity of 2.44 m/s through a tube 2.54 cm. inside diameter and 6.08 m. long, that the head loss due to friction was 1.22 m of water

Estimate the surface heat transfer coefficient, base on Reynolds analogy

For water $\rho = 998 \text{ kg/m}^3$, $C_p = 4,187 \text{ J/kg}^\circ\text{C}$.

- b) Hot flue gases at 375°C flow across a tube bank consisting of 1.25-cm-OD tube which are maintained at a uniform temperature of 30°C by flowing water through the tubes. The tube bundle is 10 rows deep in the direction of flow and contains 40 tubes in each row. The tubes are $L = 1\text{ m}$ long and have an in-line arrangement with $S_L/D = S_T/D = 2$. The velocity of flue gases before entering the tube matrix is $u_{\infty} = 7\text{ m/s}$.

Determine the average heat transfer coefficient and the total heat transfer rate in the tube matrix. (Treat flue gases as air.)



3.

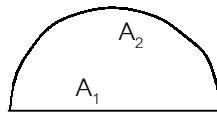
- a) The interior walls of a furnace are maintained at 1300 K and can be regarded as black. The furnace has a 10 cm by 10 cm glass window which has a spectral transmissivity to radiation at 1300 K given by

$$\tau_1 = 0.7 \quad \text{in } 0 < \lambda < 2.5 \mu\text{m}$$

$$\tau_2 = 0 \quad \text{in } 2.5 < \lambda < \infty$$

Calculate the average transmissivity of the glass for radiation emitted at 1300 K. Determine the amount of radiant energy transmitted through the window into the surrounding environment.

- b) Determine the view factors between the surfaces, (long, semicylindrical duct) F_{12} , F_{21} , and F_{22} .



4.

a) Name five different types of heat exchanger

b) Name some basic weakness of LMTD and NTU approach to heat exchanger design.

c) Water at the rate of 4 kg/s is heated from 35 to 55°C in a shell and tube heat exchanger. On the shell side one pass is used with water as the heating fluid, 2 kg/s, entering the exchanger at 95°C. The overall heat-transfer coefficient is 1420 W/m²C, and the average water velocity in the 20 mm diameter tubes is 0.4 m/s. Because of space limitations the tube length must not be longer than 2.5 m.

Calculate the number of tube passes, the number of tubes per pass, and the length of the tubes, consistent with this restriction. For water $C_p = 4.18 \text{ kJ/kg}^\circ\text{C}$.