มหาวิทยาลัยสงขลานครินทร์

คณะวิศวกรรมศาสตร์

การสอบกลางภาค ประจำภาคการศึกษาที่ 1 ประจำปีการศึกษา 2550

วันที่ 4 สิงหาคม 2550 เวลา 13.30-16.30 น.

วิชา 215-391 Fundamental of Mechanical Engineering ห้อง A 401, A 403

Do all problems

ชื่อ-สกุล..... รหัส.....

รศ.ดร.ชูเกียรติ คุปตานนท์

ผู้ออกข้อสอบ

No.	Marks
1	
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ทุจริตในการสอบ โทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 1 ภาคการศึกษา

ชื่อ-สกุล..... รหัส.....

1. A small, thin metal plate of area A m^2 is kept insulated on one side and exposed to the sun on the other side. The plate absorbs solar energy at a rate of 500 W/m^2 and dissipates it by convection into the ambient air at 300 K with a convection heat transfer coefficient 20 $W/(m^2 . {}^{\circ}C)$ and by radiation into a surrounding area which may be assumed to be a blackbody at T_{sky} = 280 K. The emissivity of the surface is 0.9.

Determine the equilibrium temperature of the plate. [Stefan – Boltmann constant = 5.67×10^{-8} $W/m^2 K^4$]

ชื่อ-สกุล..... รหัส.....

2. A thermopane window consists of two 5-mm-thick sheets of glass separated by a stagnant air space of thickness 10 mm. The thermal conductivity of the glass is 0.78 W/(m . °C), and that of air is 0.025 W/(m . °C). The convection heat transfer coefficients for the inside and outside air are 10 W/(m^2 . °C) and 50 W/(m^2 . °C), respectively.

(a) Determine the rate of heat loss per square meter of the glass surface for a temperature difference of 60°C between the inside and outside air.

(b) Compare the result with the heat loss if the window had only a single sheet of glass of thickness 5 mm instead of the thermopane.

ชื่อ-สกุล..... รหัส.....

3. A steel tube [k = 15 W/(m . °C)] of outside diameter 7.6 cm and thickness 1.3 cm is covered with and insulation material [k = 0.2 W/(m . °C)] of thickness 2 cm. A hot gas at 320°C with a heat transfer coefficient of 200 W/(m^2 . °C) flows inside the tube. The outer surface of the insulation is exposed to cooler air at 20°C with a heat transfer coefficient of 50 W/(m^2 . °C). Calculate

(a) the heat loss from the tube to the air for a 5-m length of the tube ;

(b) the temperature drops due to the thermal resistances of the hot gas flow, the steel tube, the insulation layer, and the outside air.

ชื่อ-สกุล..... รหัส.....

4. Determine the time required for a solid steel ball of radius 2.5 cm [k = 54 W/(m . °C), ρ = 7833 kg/m^3, and C_p = 0.465 kJ/(kg . °C)] to cool from 850°C to 250°C if it is exposed to an air stream at 50°C having a heat transfer coefficient h = 100 W/(m^2 . °C).

ชื่อ-สกุล..... รหัส.....

5. A counter-flow heat exchanger is to be used to cool water from $22^{\circ}C$ to $6^{\circ}C$, using brine entering at $-2^{\circ}C$ and leaving at $3^{\circ}C$. The overall heat transfer coefficient is estimated to be 500 $W/m^2\ ^{\circ}C$. Calculate the heat transfer *surface area* for a design heat load of 10 kW.