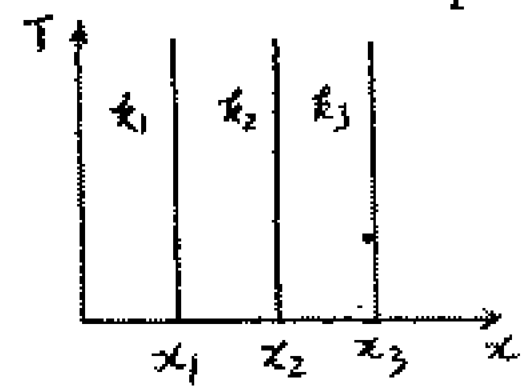
九十學年度 工程與系統科學 系（所） 乙 組碩士班研究生招生考試

科目 熱傳學 科號 2804 共 一 頁第 一 頁 *請在試卷【答案卷】內作答

Answer the following questions: (5% each)

1. What is meant by a thermal boundary layer?
2. Define the Prandtle number. Why is it important?
3. Describe the relation between fluid friction and heat transfer
4. What is the hydraulic diameter? When is it used?
5. What is the Nusselt number, Biot Number.
6. Discuss the problem of combined free and forced convection.

7. Plot the temperature distribution across three slabs of thermal conductivities k_1, k_2, and K_3. $k_1 > k_2 > k_3$ (16%)



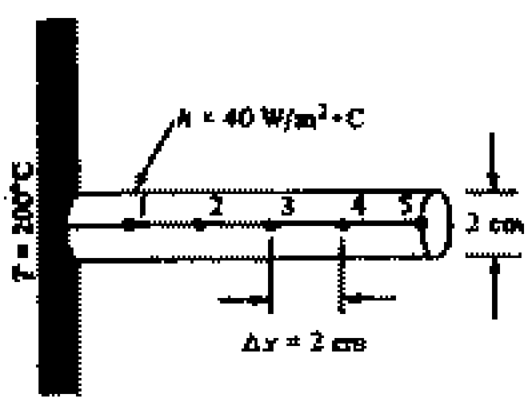
8. A copper sphere initially at a uniform temperature T_0 is immersed in a fluid. Ele heaters are placed in the fluid and controlled so that the temperature of the follows a periodic variation given by

$$T_\infty - T_m = A \sin \omega\tau$$

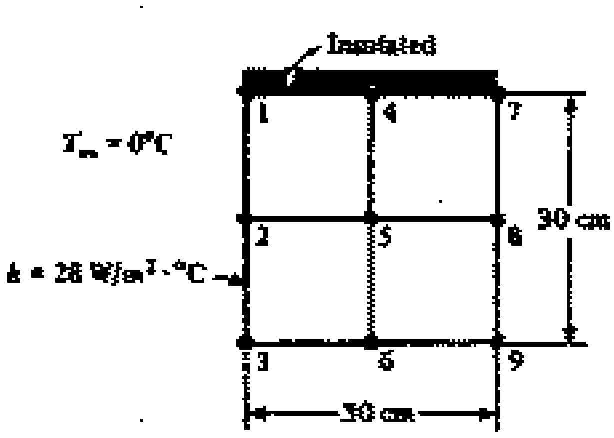
where T_m = time-average mean fluid temperature
A = amplitude of temperature wave
ω = frequency

Derive an expression for the temperature of the sphere as a function of tim the heat-transfer coefficient from the fluid to the sphere. Assume that the peratures of the sphere and fluid are uniform at any instant so that the lu capacity method of analysis may be used. (18%)

9. A rod having a diameter of 2 cm and a length of 10 cm has one end maintained at 200°C and is exposed to a convection environment at 25°C with h = 40 W/m² · °C. The rod generates heat internally at the rate of 50 MW/m³ and the thermal conductivity is 35 W/m · °C. Calculate the temperatures of the nodes shown in the figure assuming one-dimensional heat flow. (18%)



10. In the section illustrated, the surface 1-4-7 is insulated. The convection heat-transfer coefficient at surface 1-2-3 is 28 W/m² · °C. The thermal conductivity of the solid material is 5.2 W/m · °C. Using the numerical technique, compute the temperatures at nodes 1, 2, 4, and 5. (18%)



$T_3 = T_6 = T_9 = 38°C$
$T_7 = T_8 = 10°C$