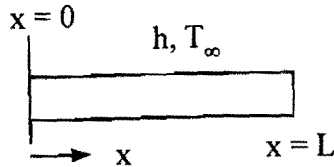


系所組別： 工程科學系在職專班乙組

考試科目： 熱傳學（專班）

考試日期： 0225，節次： 3

- I. (1) In what conditions can a fin be regarded as a one-dimensional problem mathematically? (5%)



- (2) Prove that the (one-dimensional) energy equation of a fin with constant cross-sectional area is

$$\frac{d^2T}{dx^2} - \frac{hP}{kA}(T - T_\infty) = 0,$$

where A is the cross-sectional area and P is the perimeter. (10%)

- (3) The boundary conditions of the fin are
 $x = 0, T = T_b;$
 $x = L, \frac{dT}{dx} = 0.$

Find the temperature solution. (10%)

II. Explain the following terms: (24%)

- (1) Thermal conductivity
- (2) Convection heat-transfer coefficient
- (3) Radiation shape factor
- (4) Heat flux
- (5) Prandtl number
- (6) Emissivity

III. Answer the following questions: (25%)

- (1) 請舉三個自然對流之例子。
- (2) 如何做到絕熱（也就是如何減少熱量之損耗）的效果？
- (3) 以熱傳觀點，來闡釋毛線衣的禦寒效果？
- (4) 以熱傳觀點，來闡釋雨衣的禦寒效果？其與毛線衣有何不同？
- (5) The following equation is the energy equation for the conduction heat transfer.

$$\rho c \frac{\partial T}{\partial t} = \nabla \cdot (k \nabla T) + q'''$$

Simplify the equation for the one-dimensional steady condition without heat source.

- IV. One face of copper plate of 3 cm thick is maintained at 400°C, and the other face is maintained at 100°C. How much heat flux is transferred through the plate? The thermal conductivity for copper is 370 W/(m·°C). (10%)

- V. Air at 20 °C blows over a hot plate 50 by 75 cm² maintained at 250°C. The convection heat-transfer coefficient is 25 W/m². Calculate the heat transfer rate transferred from the plate to the air. (10%)

- VI. An un-transparent flat surface has the area of A₁ and the temperature of T₁. The surface is put on the floor of a big room, whose area and temperature are A₂ and T₂, respectively. A₂ is much larger than A₁.

- (1) If the surface is black body, what's the radiation heat transfer between the surface and the room? (3%)
- (2) If the surface is gray and diffuse with the emissivity of ε₁, what's the radiation heat transfer between the surface and the room? (3%)