本試題是否可以使用計算機： ☑可使用 ， □不可使用 （請命題老師勾選）

I. Explain the following terms: (20%)
(1) Fourier's law of heat conduction
(2) Biot number
(3) Natural convection
(4) Nusselt number
(5) Steady state

II. Answer the following questions: (40%)
(1) 請寫出三種熱傳之應用實例（不含電腦散熱）。
(2) 請簡述桌上型電腦之散熱系統。
(3) CPU 之功率越做越高，散熱問題越來越嚴重，如何改善此問題？
(4) 天氣冷了，添加衣服可保暖。請以熱傳觀點，闡釋其原因。
(5) 高功率元件，常以鰭片(fin)幫助散熱。請以熱傳觀點，闡釋其理由。
(6) 上兩題中，穿衣服可可保暖，以此推論，高功率元件外加鰭片，也類似於幫高功率元件穿衣服，如此加鰭片不利於散熱。此推論之結果與事實不符，請指出其錯誤之處，並陳述為何錯誤。
(7) 請簡述太陽能應用與熱傳有何關係。
(8) 以熱傳觀點，請簡述如何估算一間房間所需冷氣機之大小？

III. (1) In what conditions a fin can be regarded as a one-dimensional problem mathematically? (5%)
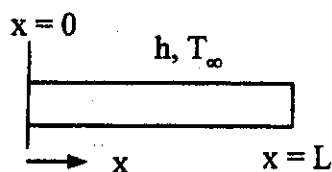
(2) Prove that the (one-dimensional) energy equation of a fin with constant cross-sectional area is
$$\frac{d^2T}{dx^2} - \frac{hP}{kA}(T-T_\infty) = 0,$$

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, $-k\frac{dT}{dx} = h(T - T_\infty)$.

Find the temperature solution. (10%)

IV. Consider a 0.8-m-high and 1.5-m-wide glass window with a thickness of 8 mm and a thermal conductivity of k = 0.78 W/m·°C. Determine steady rate of heat transfer through this glass window and the temperature of its inner surface for a day during which the room temperature is maintained at 20°C while the temperature of the outdoors is -10 °C. Take the heat transfer coefficients on the inner and outer surfaces to be h_1 = 10 W/m²·°C and h_2 = 40 W/m²·°C, which include the effects of radiation. (15%)
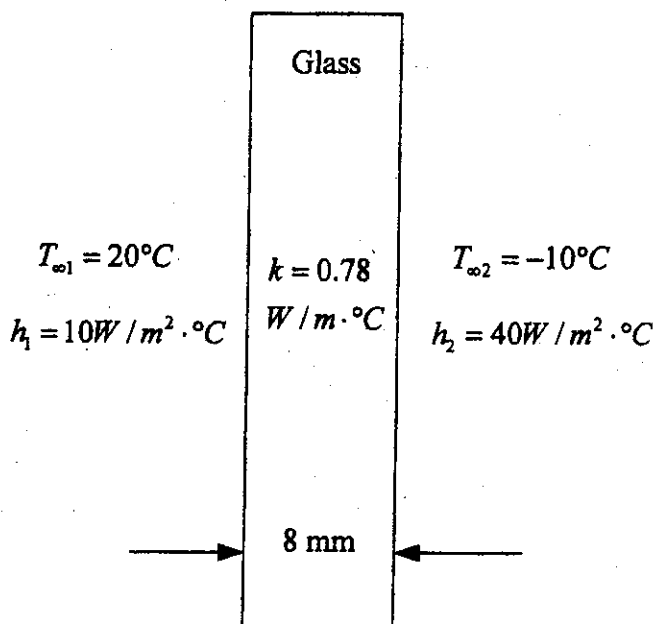
Hint:
$R_{glass} = thickness/(kA)$, $R_{conv} = 1/(hA)$