國立清華大學 104 學年度碩士班考試入學試題

系所班組別：工科與系統科學系　乙組

考試科目（代碼）：熱傳學 (2604)

1. In a cold winter day, the temperature outside is 10℃and a class room is remained at 20℃. Estimate the heat transfer rate from the class room to outside air through a double-layer-glass window with stagnant air in between. The thickness is 0.5 mm for both glass layers and of 5 mm for the stagnant air. The area for the window is 1 m^2. Neglect solar radiation. Assume the thermal conductivity for the glass and the stagnant air is 1.00 W/mK and 0.0263 W/mK, respectively. The heat transfer coefficient due to the natural convection of air in both sides is 5 W/m^2K. (20%)

2. The exposed surface (x=0) of a plane wall of thermal conductivity k is subject to radiation that results in volumetric heating to vary as

$$g = g_o \exp(-ax)$$

where g_o (W/m^3) is a constant, a (m^{-1})is the attenuation coefficient and is also a constant, and x is the distance from the exposed wall. The boundary at x=L is perfectly insulated, while the exposed surface is cooled with a coolant at temperature T_∞ and heat transfer coefficient of h. Determine the steady-state temperature distribution T(x) in the wall. (20%)

3. Consider a pin fin with diameter D and length L attached to a substrate which surface temperature T_b and is subject to a fluid flow with bulk temperature T_∞ and heat transfer coefficient h. The thermal contact resistance per unit area between the fin and substrate is $R''_{t,c}$ (m^2K/W). Assume the fin tip is adiabatic, please determine the fin heat transfer rate, fin effectiveness and fin efficiency. (20%)

國立清華大學 104 學年度碩士班考試入學試題

系所班組別：工科與系統科學系 乙組

考試科目（代碼）：熱傳學 (2604)

4. A plane wall with thickness L is initially at temperature T_i and for t > 0 the plane surface at x =L is kept adiabatic while the surface at x =0 is subject to a fluid convection with temperature T_∞ and heat transfer coefficient h. Determine the transient temperature distribution in the wall. (20%)

5. (a) Please describe the Newton's law of viscosity and Newton's law of cooling, respectively. (5 %)
(b) Why the heat transfer coefficient in the tube entrance region is higher than that in the fully developed region? (5 %)
(c) Consider internal flow in a pipe with uniform surface temperature T_s and heat transfer coefficient of h, please determine T_m (x), which is the mean fluid temperature at x and x is the distance from the pipe inlet. (10 %)