國立臺灣大學95學年度碩士班招生考試試題

1. (a). What is the difference between a closed and an open system? (5%)

(b). Consider an open system in which the fluid velocity is not uniform but is given by the expression $V_i = 20(1-(\frac{r}{2})^2)$

where V_i = velocity at the inlet section of circular pipe,

r = variable radius, distance measured from the center of the pipe. Find the mass rate into the open system. (15%)

2. A turbine is driven by 10,000 lb_m/hr of steam, which enters the turbine at 650 psia and 850 °F with a velocity of 200 ft/sec. The steam leaves the turbine exhaust at a point 10 ft below the turbine inlet with a velocity of 1200 ft/sec. The shaft work produced by the turbine is measured as 943 hp, and the heat loss from the turbine has been calculated to be 10^5 Btu/hr.

A small portion of the exhaust steam from the turbine is passed through a throttling valve and discharges at atmospheric pressure. Velocity changes across the valve may be neglected. (a) What is the temperature of the steam leaving the valve? (15%) (b). What is the quality or degrees of superheat (whichever is applicable) of the steam leaving the throttling valve? (15%)

3. (a) Consider an adiabatically enclosed room of constant volume (4×6×3 m^3) that contains an ideal diatomic gas ($\bar{C}_P = \frac{7}{2}R$) initially at 1 atm. Calculate the minimum amount of work that must be passed into the room to heat it from 10°C to 25 °C. (10%)

(b) Consider a typical enclosed room in a house that is very well thermally insulated with constant volume (4×6×3 m^3) that contains an ideal diatomic gas ($\bar{C}_P = \frac{7}{2}R$) initially at 1 atm. Calculate the minimum amount of work that must be passed into the room to heat it from 10°C to 25 °C. (10%)

4. Reduce $(\frac{\partial H}{\partial V})_{T,N}$ in terms of C_p, α, κ_T, T and P. (10%)

5. A 2-liter constant-volume bomb is evacuated and then filled with 0.10 g-mole of methane, after which the temperature of the bomb and its contents is raised to 1000 °C . At this temperature the equilibrium pressure is measured to be 7.02 atm. Assuming that methane dissociation according to the reaction

$CH_4(g) \longleftrightarrow C(s) + 2H_2(g)$

and that ideal gas and solution behavior prevails, what is K_a for this reaction at 1000 °C ? (20%)