熱力熱傳

熱力部分 50%

<每題10分>

1. 請畫出 $p-v$ diagram for a Carnot power cycle executed by a gas，並稍作說明。

2. 寫出 C_v，C_p 的定义。

$$C_v = \frac{\partial(\ \ )}{\partial T}\bigg)_{(\ )} \quad , \quad C_p = \frac{\partial(\ \ )}{\partial T}\bigg)_{(\ )}$$

並寫出它們的單位

3. 對 a refrigeration cycle 和 a heat pump cycle 的 coefficient of performance 有何不同。

4. 請畫出 — Temperature-entropy diagram of the ideal Rankine cycle，並稍作說明.

5. g 是 specific Gibbs function，
試証明 $dg = v\,dp - s\,dT$

元智機械研究所博士班資格考 911 熱傳試題

1. (15%) Define the following no-dimensional parameters, then describe their physical meanings. (Such as force ratio, property ratio ect.)

(a). Reynolds number (Re), (b). Prandtl number (Pr), (c). Nusselt number(Nu), (d). Grashof number (Gr), (e). Weber number (We)

2. (20%) One of the few situation for which *exact* solution to the convection transfer equations may be obtained involve what is termed parallel flow. In this case fluid motion is only in one direction. Consider a special case of *parallel flow* involving stationary and moving plates of infinite extent separated by a distance L, which intervening space filled by an incompressible fluid. This situation is referred to as Coutte flow and occurs, for example, in a journal bearing.

(1). What is appropriate form of the continuity equation , reduced from eq. 1

(2). Beginning with the momentum equation 2, simplified the equation, at given boundary condition and determine the velocity distribution between the plates

(3). Beginning with the energy equation 3, simplified the equation, at given boundary condition and determine the temperature distribution between the plates.

$$\frac{\partial(\rho u)}{\partial x}+\frac{\partial(\rho v)}{\partial y}=0 \quad \text{eq. 1}$$

$$\rho\left(u\frac{\partial u}{\partial x}+v\frac{\partial u}{\partial y}\right)=-\frac{\partial p}{\partial x}+\frac{\partial}{\partial x}\left\{\mu\left[2\frac{\partial u}{\partial x}-\frac{2}{3}\left(\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}\right)\right]\right\}+\frac{\partial}{\partial y}\left[\mu\left(\frac{\partial u}{\partial y}+\frac{\partial v}{\partial x}\right)\right]+X \quad \text{eq.2}$$

$$\rho c_p\left(u\frac{\partial T}{\partial x}+v\frac{\partial T}{\partial y}\right)=\frac{\partial}{\partial x}\left(k\frac{\partial T}{\partial x}\right)+\frac{\partial}{\partial y}\left(k\frac{\partial T}{\partial y}\right)+\mu\Phi+\dot{q} \quad \text{eq.3}$$

3. (15%) Consider flow in a circular tube. Within the test section length(between 1 and 2) a constant heat flux q_s'' is maintained.

(a). For the two cases identified sketch, qualitatively, the surface temperature $T_S(x)$ and the fluid meam temperature $T_m(x)$ as a function of distance along the test section x. In case A flow is hydrodynamically and thermally fully developed. In case B flow is not developed.

(b). Assuming that the surface flux q_s'' and the inlet mean temperature $T_{m,1}$ are identical for both cases, will the exit mean temperature $T_{m,2}$ for caseA be greater, equal to, or less than $T_{m,2}$ for case B? Briefly explain why.