國立臺灣大學 102 學年度碩士班招生考試試題

1. **(20%)** Please answer the following questions:
   (a) What is the corresponding states principle?
   (b) What is the Joule-Thomson effect?
   (c) How does the Rankine cycle differ from the Carnot cycle?
   (d) How can we increase the efficiency of the Rankine cycle?

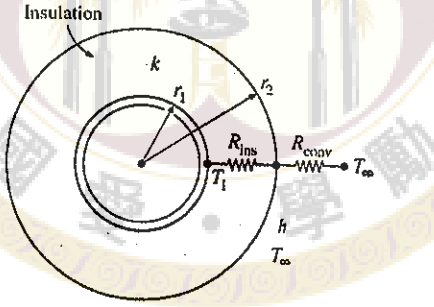
   For problem 2 and 3, the specific heat ratio k of air is roughly equal to 1.4, the specific heat c_p is 1.005 kJ/kg · K, and the gas constant R is 0.287 kJ/kg · K.

2. **(18%)** A tank with a volume of 2 m^3 is filled with air at a pressure of 7 bars and a temperature of 250 °C. Determine (a) the final temperature, (b) the percent of the mass left in the tank, and (c) the quantity of mass, in kilograms, that left the tank if the gas is permitted to leave the tank under adiabatic conditions until the pressure drops to 1.0 bar.

3. **(12%)** A 100-m^3 rigid tank contains compressed air at 5 MPa and 300 K. Determine the maximum useful work (exergy, or availability) can be obtained from the air if the environment conditions are 100 kPa and 300 K.

4. **(18%)** A heat exchanger is to heat pure water (c = 4.18 kJ/kg · K) from 300 to 350 K at a rate of 150 kg/s. And the heating is to be accompanlished by geothermal water (c = 4.32 kJ/kg · K) available at 400 K at a mass flow rate of 100 kg/s. If the measured outlet geothermal water temperature is 320 K, and the atmospheric temperature is 298 K and pressure is 100 kPa. Determine the (a) heat loss, (b) exergy change of pure water, and (c) overall exergy destroyed during heat transfer process.

5. **(12%)** Write down heat transfer equation (with the expression of total thermal resistance) from the insulated pipe to the surrounding air



6. **(20%)** A fluid with negligible viscosity flows between parallel plates. The low viscosity allows the assumption that the fluid velocity throughout the flow is a constant value *V*. The energy equation becomes

$$(V/x)\frac{\partial T}{\partial x} = \left(\frac{\partial^2 T}{\partial y^2}\right)$$

Please derive an expression for $\mathbf{Nu_\delta}$ for the case of $\mathbf{q_\delta > 0}$ and $\mathbf{q_o = 0}$.

Assumptions: The lower plate with heat flux $\mathbf{q_o}$ is at $y = 0$ and the upper plate with heat flux $\mathbf{q_\delta}$ is at $y = \delta$.

試題隨卷繳回