所別：機械工程學系碩士班 丙組(熱流) 科目：熱力學(含熱傳)

1. (10 %) What is heat engine? Please explain its purpose, efficiency and give a sketch to show its operating character.

2. (6 %) What is the Kelvin-Planck statement of the second law of thermodynamics?

3. The general expression of a boundary work is $W_b=\int PdV$.
Consider the polytropic process (PV^n=constant)
(a) Plot the P-V diagram for this process. (4%)
(b) Derive the work done during a polytropic process in terms of P_1, V_1, P_2, V_2 and n, where 1 and 2 are the initial and final state of the polytropic process. (6%)
(c) Calculate the boundary work for P_1=100 kPa, V_1=0.1 m^3, P_2=10 kPa, V_2=0.5 m^3, and n=1.4. (4%)

4. (10%) A simple ideal Brayton cycle is modified to incorporate multistage compression with intercooling, multistage expansion with reheating, and regeneration without changing the pressure limits of the cycle. As a result of these modifications,
(a) Does the net work output increase, decrease, or remain the same?
(b) Does the back work ratio increase, decrease, or remain the same?
(c) Does the heat rejected increase, decrease, or remain the same?

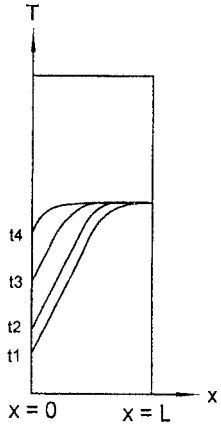
5. (a) Can the enthalpy values determined from a psychrometric chart at sea level be used at higher elevations? Why? (5 %)
(b) What is the value of the Clapeyron equation in thermodynamics? (5%)

6. (5 %) Express the increase of entropy principle for chemically reacting systems.

7. (5 %) How are the absolute entropy values of ideal gases at pressures different from 1 atm determined?

8. (a) What is the physical mechanism of conduction for gas? (5%)
(b) Generally, the gas thermal conductivity increases with increasing temperature but decreases with increasing molecular weight, please make a brief explanation of this phenomenon. (5%)

9. The time variation of temperature in a flat plate is shown in the right figure.
(a) What are the left surface (x = 0) and right surface (x = L) boundary conditions? (4%)
(b) What is heat transfer direction? (2%)
(c) Please explain that is this physically practical if no heat generated within the plate. (4%)



10. (a) What are the assumptions required for the boundary layer approximation? (5%)
(b) Please sketch the velocity boundary layer and heat transfer coefficient profiles qualitatively of uniform flow over a flat plate from the left to the right side on a log scale figure. (5%)

11. You are requested to design an experimental facility to determine the average convection heat transfer coefficient for water heating in a copper tube of uniform cross section area.
(a) Sketch a complete schematic diagram of the experimental facility. Describe all of the components of this test system. (5%)
(b) Write down all data reduction equations to obtain the average convection heat transfer coefficient from original data you measured. (5%)