Mata Kuliah: Termodinamika Dasar 02 (ENME600004)

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Responsi 3 Tugas Kelompok

Ketentuan Pengerjaan: 1 Kelompok mengerjakan 1 soal yang terdiri dari beberapa sub pertanyaan. Nomer soal adalah sesuai dengan nomer kelompok.

1. A carnot cycle works with isentropic compression ratio of 5, and hyperbolic expansion ratio of 2. Volume of air at the beginning of the hyperbolic expansion is $0.3m^3$. If the maksimum temperature and pressure is limited to 550K and 21 bar respectively. Determine;
   a) Sketch the p-V diagram for this chase, show the point for each process.
   b) Minimum temperature in the cycle.
   c) Thermal efficiency of the cycle
   d) Pressure at all the salient points
   e) Work done per cycle (take ratio of specific heats as 1.4)

2. As known n = 0,081 kmol of He gas initially at 27^oC and pressure = 2 x 105 N/m^2 is taken over path A → B → C. For He → $C_v = 3R/2$, $C_p = 5R/2$
   Assume the ideal gas las
   a. Howe mus work does the gas do in expanding at constant pressure from A → B?
   b. What is the change in thermal or internal energy of the helium from A → B?
   c. How much heat is absorbed in going from A → B?
   d. If B → C is adiabatic, what is the entropy change?
   e. What is the final pressure if B → C is adiabatic?

3. The specific heat of water is taken as 1 cal/g.K, independent of temperature, where 1 calorie = 4.18 joules.
   a. Define the specific heat of a substance at constant pressure in terms of such quantities as Q (heat), S (entropy), and T (temperature).
   b. One kg of water at 0oC is brought into sudden contact pressure with a large heat reservoir at 100oC. When the water has reached 100oC, what has been the change in entropy of the water? Of the reservoir?
   c. One kg of water at 0oC is brought into sudden contact pressure with a large heat reservoir at 100oC. When the water has reached 100oC, what has been the change in entropy of the water? Of the entire system consisting of both water and the heat reservoir?
   d. If the water had been heated from 0oC to 100oC by first bringing it into contact with a reservoir at 50oC and then another reservoir at 100oC, what would be the change in entropy of the entire system?
   e. Show how the water be heated from 0oC with negligible change in entropy of the entire system.

4. Air at 15°C and 1.05 bar occupies 0.02m3. The air is heated at instant volume until the pressure is 4.2 bar, and then cooled at constant pressure back to the original temperature. Determine:
   a. Heat supplied at constant volume

b. Heat rejected at constant pressure
c. Net decrease in entropy
d. Decrease in entropy of air
e. T-s Diagram

5. Air is compressed steadily by a reversible compressor from an inlet state of 100 kPa and 300 K to an exit pressure of 900 kPa. Determine the compressor work per unit mass for (*a*) isentropic compression with $k = 1.4$, (*b*) polytropic compression with $n = 1.3$, (*c*) isothermal compression, and (*d*) ideal two stage compression with intercooling with a polytropic exponent of 1.3 (*e*) Show the p-V diagram

6. An ideal gas at 100 kPa and 27°C enters a steady-flow compressor. The gas is compressed to 400 kPa, and 10 percent of the mass that entered the compressor is removed for som other use. The remaining 90 percent of the inlet gas is compressed to 600 kPa before leaving the compressor. The entire compression process is assumed to be reversible and adiabatic. The power supplied to the compressor is measured to be 32 kW. If the ideal gas has constant specific heats such that $cv = 0.8$ kJ/kg.K and $cp = 1.1$ kJ/kg.K, (*a*) sketch the compression process on a *T-s* diagram, (*b*) sketch the compression process on a *P-v* diagram (*c*) determine the temperature of the gas at the two compressor exits, in K, and (*d*) determine the mass flow rate of the gas into the compressor, in kg/s. (*e*) determine the total work.

7. Nitrogen gas is compressed from 80 kPa and 27°C to 480 kPa by a 10-kW compressor. Determine the mass low rate of nitrogen through the compressor, assuming the com pression process to be (*a*) isentropic, (*b*) polytropic with $n = 1.3$, (*c*) isothermal, and (*d*) ideal two-stage polytropic with $n = 1.3$. (*e*) Show the T-s and p-V diagram

8. One kilogram of air as an ideal gas executes a Carnot power cycle having a thermal efficiency of 60%. The heat transfer to the air during the isothermal expansion is 40 kJ. At the end of the isothermal expansion, the pressure is 5.6 bar and the volume is 0.3 m3. Determine:
   a. the maximum and minimum temperatures for the cycle, in K.
   b. the pressure at the beginning of the isothermal expansion in bar and m3, respectively.
   c. the volume at the beginning of the isothermal expansion in bar and m3, respectively
   d. the work and heat transfer for each of the four processes, in kJ.
   e. Sketch the cycle on *p–v* coordinates.

9. Air initially occupying a volume of 1 m^3 at 1 bar, 20°C undergoes two internally reversible processes in series
   Process 1–2: compression to 5 bar, 110°C during which $pV^n = constant$
   Process 2–3: adiabatic expansion to 1 bar
   a. Sketch the two processes on *p–v*
   b. Sketch the *T–s* coordinates
   c. Determine *n*.
   d. Determine the temperature at state 3, in °C.
   e. Determine the net work, in kJ.

10. A quantity of air undergoes a thermodynamic cycle consisting of three internally reversible processes in series.

    Process 1–2: isothermal expansion from 6.25 to 1.0 bar

    Process 2–3: adiabatic compression to 550 K, 6.25 bar

    Process 3–1: constant-pressure compression

    Employing the ideal gas model,

    a. sketch the cycle on *p*–*v*

    b. sketch the T-s diagram

    c. determine T_1, in K

    d. If the cycle is a power cycle, determine its thermal efficiency.

    e. If the cycle is a refrigeration cycle, determine its coefficient of performance.