SULIT

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI
KEMENTERIAN PENDIDIKAN MALAYSIA

JABATAN KEJURUTERAAN PETROKIMIA

PEPERIKSAAN AKHIR

SESI JUN 2019

DGP2043: THERMODYNAMICS

TARIKH : 05 NOVEMBER 2019
MASA : 2.30 PETANG - 4.30 PETANG (2 JAM)

Kertas ini mengandungi **SEBELAS (11)** halaman bercetak.

Struktur (4 soalan)

Dokumen sokongan yang disertakan : Tiada

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

SULIT

INSTRUCTION:

This section consists of **FOUR (4)** structured questions. Answer **ALL** questions.

ARAHAN:

*Bahagian ini mengandungi **EMPAT (4)** soalan berstruktur. Jawab **SEMUA** soalan.*

QUESTION 1

SOALAN 1

CLO1 C1 (a) Define the following:

Definisikan yang berikut:

i. Boundary

Sempadan

[1 marks]

[*1 markah*]

ii. Surrounding

Keliling

[1 marks]

[*1 markah*]

iii. System

Sistem

[1 marks]

[*1 markah*]

iv. First law of thermodynamics

Hukum pertama termodinamik

[2 marks]

[*2 markah*]

CLO2
C2

(b) Convert the following thermodynamics units:
Tukarkan unit-unit termodinamik berikut:

i. 27 bar to kPa
27 bar kepada kPa

[2 marks]
[2 markah]

ii. 345 m/s to km/hr
345 m/s kepada km/hr

[3 marks]
[3 markah]

iii. 48 mg/liter to kg/m^3
48 mg/liter kepada kg/m^3

[3 marks]
[3 markah]

iv. 16 N/cm^2 to kN/m^2
16 N/cm^2 *kepada* kN/m^2

[3 marks]
[3 markah]

CLO2
C3

(c) 2.1 m^3 of air at 7.5 bar pressure and 110 ^0C temperature is cooled at a constant pressure process until the temperature drop at 45 ^0C . Given R= 0.287 kJ/kg.K and C_p= 1.005kJ/kg.K.

Calculate:

2.1 m^3 udara pada tekanan 7.5 bar dan suhu 110 ^0C disejukkan secara tekanan tetap sehingga suhu menurun kepada 45 ^0C. Diberi R= 0.287 kJ/kg.K dan C_p= 1.005kJ/kg.K. Kirakan:

i. mass of air
jisim udara

[3 marks]
[3 markah]

ii. heat rejected in the process
haba yang dibebaskan semasa proses

[3 marks]
[3 markah]

iii. volume of the air after cooling
isipadu udara selepas disejukkan

[3 marks]
[3 markah]

QUESTION 2

SOALAN 2

CLO2 C1

(a) Define

Takrifkan

i. Flow Process

Proses Aliran Sekata

[3 marks]

[3 markah]

ii. Steady Flow Process

Proses Aliran Mantap

[3 marks]

[3 markah]

iii. Non Steady Flow Process

Proses Aliran Tak Mantap

[3 marks]

[3 markah]

CLO2 C2

(b) In an air conditioning system, air is cooled by passing it over a chilled water coil condenser. Water enters the coil with an enthalpy of 42kJ/kg and leaves the coil with an enthalpy of 80kJ/kg. The water flow rate is 200 kg/h. Determine the rate of heat absorption of the water in ***kilowatts***.

Dalam sistem penyaman udara, udara disejukkan dengan melepasi kondenser gegelung air sejuk. Air memasuki gegelung dengan entalpi 42kJ / kg dan meninggalkan gegelung dengan entalpi 80kJ / kg. Kadar aliran air adalah 200 kg / h. Tentukan kadar penyerapan haba oleh air dalam ***kilowatt****.*

[7 marks]

[7 markah]

CLO2
C3

(c) Steam steadily enters the turbine at 4600 kg / hour and produces a power output of 1000 kJ/kg.

Steam at the entrance is as followed:

Flow velocity 250 m/s, 8.5 bar pressure, energy in 2300 kJ/kg and specific volume 0.55 m^3/kg

Steam on the exit is as followed:

Flow velocity 125 m/s, 2.3 bar pressure, energy in 1700 kJ/kg and specific volume of 1.75 m^3 / kg.

Calculate the value of the heat transferred to the environment if the energy is small and negligible.

Stim mengalir secara mantap memasuki turbin dengan kadar 4600 kg/jam dan menghasilkan kuasa keluaran sebanyak 1000 kJ/kg.

Stim pada bahagian masuk berkeadaan seperti berikut:

Halaju aliran 250 m/s, tekanan 8.5 bar, tenaga dalam 2300 kJ/kg dan isipadu tentu 0.55 m^3*/kg*

Stim pada bahagian keluar pula berkeadaan seperti berikut:

Halaju aliran 125 m/s, tekanan 2.3 bar, tenaga dalam 1700 kJ/kg dan isipadu tentu 1.75 m^3*/kg.*

Hitungkan nilai haba yang dipindahkan ke sekitaran sekiranya tenaga keupayaan kecil dan boleh diabaikan.

[9 marks]
[*9 markah*]

QUESTION 3

SOALAN 3

CLO1
C1

(a) Define the following terms:
Definisikan terma-terma berikut:

i. Enthalpy
Entalpi

[1 marks]
[1 markah]

ii. Solid phase
Fasa pepejal

[2 marks]
[2 markah]

iii. Liquid phase
Fasa cecair

[2 marks]
[2 markah]

CLO2
C2

(b) Consider a steam power plant operating on the ideal Rankine Cycle. Superheated steam enters the turbine at 35 bar and 500 °C and exits the condenser as a saturated liquid at 0.045 bar. The pump work is negligible. Determine:
Andaikan kendalian loji kuasa stim beroperasi dengan Kitaran Rankine unggul. Stim panas terlampau memasuki sebuah dandang pada tekanan 35 bar serta suhu 500 °C dan keluar melalui kondenser sebagai cecair tepu pada tekanan 0.045 bar. Abaikan kerja yang dilakukan oleh pam. Tentukan:

i. The work for turbine
Kerja untuk turbin

[10 marks]
[*10 markah*]

ii. Thermal efficiency
Kecekapan terma

[3 marks]
[*3 markah*]

CLO2
C3

(c) If the steam at pressure of 90 bar and the enthalpy is at 3118 kJ/kg, calculate the specific internal energy for the steam.
Jika suatu stim berada pada tekanan 90 bar dan entalpinya ialah 3118 kJ/kg, kirakan tenaga dalam spesifik stim tersebut.

[7 marks]
[*7 markah*]

QUESTION 4
SOALAN 4

CLO2 C1

(a) Define Reversible Process and sketch the appropriate P-V diagram to illustrate the process.
Takrifkan Proses Bolehbalik dan lakarkan rajah P-V yang sesuai untuk menggambarkan proses tersebut.

[5 marks]
[5 markah]

CLO2 C2

(b) A perfect gas undergoes an expand of adiabatic process. The initial state was at 9.5 bar pressure and 0.011 m^3 volume. After the pressure expansion the value of the pressure is 1.05 bar. Given C_p = 1.026 kJ/kgK and C_v = 0.747 kJ/kgK.
Calculate:
Satu gas sempurna mengalami proses pengembangan secara adiabatic. Keadaan awal gas adalah pada tekanan 9.5 bar dan isipadu 0.011 m^3. Selepas pengembangan didapati tekanannya bernilai 1.05 bar. Diberi C_p = 1.026 kJ/kgK dan C_v = 0.747 kJ/kgK
Hitungkan :

i. Final volume
Isipadu akhir

[4 markah]
[4 markah]

ii. Work done
Kerja yang dilakukan

[3 markah]
[3 markah]

iii. Change of internal energy
Perubahan tenaga dalam

[3 markah]
[3 markah]

CLO2
C3

(c) 1 kg of perfect gas at 30°C is in the cylinder. If the heat entering the system is 350 kJ/kg, calculate the entropy change when:
1 kg gas sempurna pada suhu 30°C berada dalam selinder. Jika haba yang masuk ke dalam system adalah 350 kJ/kg, kirakan perubahan entropy bila:

i. The process is constant volume
Proses adalah isispadu tetap

[5 markah]
[5 markah]

ii. The process is constant pressure
Process adalah tekanan tetap

[5 markah]
[5 markah]

Take C_p = 1.0 kJ/kgL and C_v = 0.7 kJ/kgK
Ambil C_p = 1.0 kJ/kgL dan C_v = 0.7 kJ/kgK

SOALAN TAMAT

BASIC THERMODYNAMICS

- $Pv = mRT$
- $R = C_p - C_v$
- $U_2 - U_1 = Q - W$
- $\gamma = \frac{C_p}{C_v}$
- $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$
- $R = \frac{R_o}{M}$

NON FLOW PROCESS

1. **Isothermal Process ($T_1 = T_2$)**
   - $U_2 - U_1 = 0$
   - $Q = W$
   - $W = P_1V_1 \ln\left(\frac{V_2}{V_1}\right)$ @ $W = P_1V_1 \ln\left(\frac{P_1}{P_2}\right)$
2. **Adiabatic Process (Seentropi)**
   - $U_2 - U_1 = mC_v(T_2 - T_1)$
   - $W = \frac{P_1V_1 - P_2V_2}{\gamma - 1} = \frac{mR(T_1 - T_2)}{\gamma - 1}$
   - $Q = 0$
   - $\frac{T_2}{T_1} = \left(\frac{P_2}{P_1}\right)^{\frac{\gamma-1}{\gamma}} = \left(\frac{V_1}{V_2}\right)^{\gamma-1}$
3. **Polytropic Process**
   - $U_2 - U_1 = mC_V(T_2 - T_1)$
   - $W = \frac{P_1V_1 - P_2V_2}{n-1} = \frac{mR(T_1 - T_2)}{n-1}$
   - $Q = \frac{\gamma - n}{\gamma - 1} \times W$
   - $\frac{T_2}{T_1} = \left(\frac{P_2}{P_1}\right)^{\frac{n-1}{n}} = \left(\frac{V_1}{V_2}\right)^{n-1}$
4. **Constant Pressure Process ($P_1 = P_2$)**
   - $Q = mC_P(T_2 - T_1)$
   - $U_2 - U_1 = Q - W = mC_V(T_2 - T_1)$
   - $W = P(V_2 - V_1) = mR(T_2 - T_1)$
5. **Constant Volume Process ($V_1 = V_2$)**
   - $Q = U_2 - U_1 = mC_V(T_2 - T_1)$
   - $W = 0$

FLOW PROCESS

- $Q - W = \dot{m}\left[(h_2 - h_1) + \left(\frac{C_2^2 - C_1^2}{2000}\right) + \left(\frac{Z_2 - Z_1}{1000}\right)g\right]$
- $h_2 - h_1 = (U_2 - U_1) + (P_2v_2 - P_1v_1) = C_p(T_2 - T_1)$
- $\dot{m} = \frac{CA}{v}$

PROPERTIES OF STEAM

- $V = x(V_g)$
- $U = U_f + x(U_g - U_f)$
- $h = h_f + x(h_{fg})$
- $S = S_f + x(S_{fg})$
- $h = U + Pv$

2nd LAW THERMODYNAMICS

1. **STEAM**
   a. **Constant Pressure Process ($P_1 = P_2$)**
      $W = P(V_2 - V_1) = Q - (u_2 - u_1)$
      $Q = h_2 - h_1$
   b. **Constant Volume Process ($V_1 = V_2$)**
      $W = 0$ $Q = u_2 - u_1$
   c. **Isothermal Process ($T_1 = T_2$)**
      $Q = T(s_2 - s_1)$ $W = Q - (u_2 - u_1)$
   d. **Adiabatic Process (Seentropi)**
      $s_1 = s_2$ $Q = 0$ $W = u_1 - u_2$
   e. **Polytropic Process**
      $W = \frac{P_1V_1 - P_2V_2}{n-1}$ $Q = (u_2 - u_1) + W$

2. **PERFECT GAS**
   a. **Constant Pressure Process ($P_1 = P_2$)**
      - $s_2 - s_1 = mC_p \ln\left(\frac{T_2}{T_1}\right)$
   b. **Constant Volume Process ($V_1 = V_2$)**
      - $s_2 - s_1 = mC_v \ln\left(\frac{T_2}{T_1}\right)$
   c. **Isothermal Process ($T_1 = T_2$)**
      - $s_2 - s_1 = mR\ln\left(\frac{v_2}{v_1}\right) = mR\ln\left(\frac{P_1}{P_2}\right)$
   d. **Polytropic Process**
      - $s_2 - s_1 = mR\ln\left(\frac{v_2}{v_1}\right) - mC_v \ln\left(\frac{T_1}{T_2}\right)$

      Or

      - $s_2 - s_1 = mR\ln\left(\frac{P_1}{P_2}\right) - mC_p \ln\left(\frac{T_1}{T_2}\right)$

POWER CYCLES STEAM

- $\eta_c = \frac{(h_1 - h_2) - (h_4 - h_3)}{(h_1 - h_4)}$
- $r_w = \frac{(h_1 - h_2) - (h_4 - h_3)}{(h_1 - h_2)}$
- $s.s.c. = \frac{3600}{(h_1 - h_2) - (h_4 - h_3)}$

CHEMICAL EQUILIBRIUM

- $\Delta S = Q_p (S_P - S_A)$
- $\Delta G = \Delta G^0 + RT \ln K$
- $\frac{d(\ln K)}{dT} = \frac{\Delta H}{RT^2}$