

SULIT



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

JABATAN KEJURUTERAAN MEKANIKAL

**PEPERIKSAAN AKHIR
SESI JUN 2018**

DJJ2073: THERMODYNAMICS

**TARIKH : 28 OKTOBER 2018
MASA : 2.30 PETANG - 4.30 PETANG (2 JAM)**

Kertas ini mengandungi **SEMBILAN (9)** halaman bercetak.

Struktur (4 soalan)

Dokumen sokongan yang disertakan : Formula dan buku Stim

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

SULIT

INSTRUCTION:

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

ARAHAN:

Kertas ini mengandungi EMPAT (4) soalan. Jawab SEMUA soalan.

QUESTION 1**SOALAN 1**

CLO 1
C1

- (a) Define the following terms:

Takrifkan istilah-istilah berikut:

- i. Process.

Proses.

[2 marks]
[2 markah]

- ii. State.

Keadaan.

[2 marks]
[2 markah]

- iii. Principal of energy conversion.

Prinsip perubahan tenaga.

[2 marks]
[2 markah]

CLO 1
C2

- (b) Convert the following units:

Tukarkan unit-unit berikut:

- i. 10 km/h to m/s.

10 km/h kepada m/s.

[2 marks]
[2 markah]

- ii. 15 g/mm³ to kg/m³.

15 g/mm³ kepada kg/m³.

[2 marks]
[2 markah]

- iii. 1 g/cm³ to kg/m³.

1 g/cm³ kepada kg/m.

[2 marks]
[2 markah]

CLO 1
C2

- (c) Given the pressure of wet steam is 36 bar and the dryness fraction is 0.62. Calculate:

Diberi tekanan stim basah bersamaan dengan 36 bar dan pecahan kekeringan 0.62. Kirakan nilai:

- i. Specific volume.

Isipadu tentu.

[3 marks]
[3 markah]

- ii. Specific enthalpy.

Enthalpi tentu.

[3 marks]
[3 markah]

- iii. Specific entropy.

Entropi tentu.

[3 marks]
[3 markah]

- iv. Specific internal energy.

Tenaga Dalam tentu.

[4 marks]
[4 markah]

QUESTION 2 SOALAN 2

CLO 1
C1

- (a) Define the following term:

Takrifkan yang berikut:

- i. Microscopic energy

Tenaga mikroskopik.

[2 marks]
[2 markah]

- ii. Energy transfer by work.

Pemindahan tenaga kerja.

[2 marks]
[2 markah]

CLO 1
C2

- (b) 0.25 kg of gas is at a temperature of 17°C , volume 0.19 m^3 and pressure 115 kN/m^2 . If the gas has a value of $C_v = 720\text{ J/kg K}$, determine:

0.25 kg gas pada suhu 17°C , berisipadu 0.19 m^3 dan tekanan 115 kN/m^2 . Jika gas tersebut mempunyai $C_v = 720\text{ J/kg K}$, tentukan:

- i. Gas constant

Pemalar gas

[2 marks]
[2 markah]

- ii. Specific heat at constant pressure

Haba tentu pada tekanan tetap

[2 marks]
[2 markah]

- iii. Specific heat ratio

Nisbah haba tentu

[2 marks]
[2 markah]

CLO 1
C3

- (c) A quantity of air occupies a volume of 0.45 m^3 at the pressure 1.5 bar and 23°C of temperature. The air is compressed isothermally to a pressure of 6.3 bar and then expanded adiabatically to its initial volume.

Given $\gamma = 1.4$, $R = 0.287\text{ kJ/kgK}$ and $C_p = 1.006\text{ kJ/kgK}$. Calculate:

Sejumlah udara mempunyai tekanan isipadu 0.45 m^3 pada tekanan 1.5 bar dan suhu 23°C . Udara ini dimampatkan secara sesuhu sehingga tekanan bernilai 6.3 bar seterusnya dikembangkan secara proses adiabatik sehingga mencapai isipadu asal.

Diberi $\gamma = 1.4$, $R = 0.287\text{ kJ/kgK}$ dan $C_p = 1.006\text{ kJ/kgK}$. Kirakan:

- i. Mass of air during the compression

Jisim udara ketika proses mampatan

[3 marks]
[3 markah]

- ii. Heat received or rejected (state which) during the compression

Haba yang dibekalkan atau dikeluarkan semasa proses mampatan dan nyatakan yang mana satu.

[4 marks]
[4 markah]

- iii. Change of internal energy during the expansion
Perubahan tenaga dalam ketika proses pengembangan

[8 marks]

[8 markah]

QUESTION 3
SOALAN 3

CLO 1
C1

- (a) State **FOUR (4)** devices that use the principal of flow process.
*Nyatakan **EMPAT (4)** peranti yang menggunakan prinsip proses aliran.*

[4 marks]

[4 markah]

CLO 1
C2

- (b) A steam enters a boiler with specific enthalpy of 175 kJ/kg and exit with specific enthalpy of 2100 kJ/kg. If the mass flow rate is 950 kg/h, determine the heat transfer in kW.

Stim memasuki dandang dengan entalpi tentu 175 kJ/kg dan keluar dengan entalpi tentu 2100 kJ/kg. Jika kadar alir jisim adalah 950 kg/jam, tentukan tenaga haba yang dibekalkan kepada dandang dalam kilowatt (kW).

[6 marks]

[6 markah]

CLO 1
C3

- (c) Steam flows steadily into a turbine at 6000 kg/h and produce 2400 kW of power. Properties of steam for inlet and outlet part of the turbine are shown in the Table 3 below. Assuming that changes in potential energy may be neglected, determine:

Stim mengalir secara mantap memasuki sebuah turbin dengan kadar 6000 kg/jam dan menghasilkan kuasa keluaran sebanyak 2400 kW. Keadaan stim pada bahagian masuk dan keluar dari turbin adalah seperti di Jadual 3 di bawah. Jika perubahan tenaga keupayaan diabaikan, tentukan:

	Inlet <i>Masukan</i>	Outlet <i>Keluaran</i>
Pressure, P <i>Tekanan</i> (bar)	9	1.5
Internal energy, u <i>Tenaga Dalam</i> (kJ/kg)	3770	2550
Velocity, C <i>Halaju Aliran</i> (m/s)	320	110
Specific Volume, v <i>Isipadu Tentu</i> (m ³ /kg)	0.55	1.90

Table 3: Properties of Steam

- Heat which is transferred to surrounding in kW.
Haba yang dipindahkan ke persekitaran dalam kW.
- Area of the outlet vessel.
Luas permukaan bahagian keluar vessel.

[12 marks]
[12 markah]

[3 marks]
[3 markah]

QUESTION 4**SOALAN 4**CLO 1
C1

- (a) Define the following terms:

Takrifkan istilah-istilah berikut:

- i. Second Law of Thermodynamics

Hukum Kedua Termodinamik

[2 marks]

[2 markah]

- ii. Heat Engine

Enjin Haba

[2 marks]

[2 markah]

CLO 1
C2

- (b) A heat pump absorbed 190 kJ/s of heat at temperature of 7°C and heat rejected at 30,000 kJ/min. Determine power input, coefficient of performance and sink temperature.

Sebuah pam haba menyerap 190 kJ/s haba pada suhu 7°C serta haba disingkirkan sebanyak 30,000 kJ/min. Tentukan kuasa masukan, pekali pengembangan prestasi dan suhu keluaran.

[9 marks]

[9 markah]

CLO 1
C3

- (c) A steam power plants operates between a boiler pressure of 40 bar and a condenser pressure of 0.04 bar. If steam entry to the turbine with dry saturated, calculate for a Rankine cycle :

Sebuah penjana kuasa stim beroperasi di antara tekanan dandang 40 bar dan tekanan pemeluwap 0.04 bar. Sekiranya stim masuk ke dalam turbin pada tekanan.

- i. Feed pump work.

Kerja pam suapan.

[2 marks]

[2 markah]

- ii. Rankine efficiency.

Kecekapan kitar Rankine.

[8 marks]

[8 markah]

- iii. Specific steam consumption.

Penggunaan stim tepu.

[2 marks]

[2 markah]

SOALAN TAMAT

1. PROPERTIES OF PURE SUBSTANCE

Steam

$$v = xv_g \quad h = h_f + xh_{fg} \quad u = u_f + x(u_g - u_f) \quad s = s_f + xs_{fg}$$

Ideal Gas

$$PV = mRT \quad R = \frac{R_o}{M} \quad R = C_p - C_v \quad \gamma = \frac{C_p}{C_v}$$

2. FIRST LAW OF THERMODYNAMICS

$$\Sigma Q = \Sigma W \quad Q - W = U_2 - U_1$$

Flow Process

$$\dot{m} = \rho CA = \frac{CA}{V}$$

$$h = u + pv$$

$$h = C_p \Delta T$$

$$Q - W = \dot{m} \left[(h_2 - h_1) + \left(\frac{C_2^2 - C_1^2}{2} \right) + (Z_2 - Z_1)g \right]$$

Non-Flow Process

1. Isothermal Process ($PV = C$)

$$U_2 - U_1 = 0 \quad Q = W$$

$$W = P_1 V_1 \ln \left(\frac{V_2}{V_1} \right) \quad @ \quad W = P_1 V_1 \ln \left(\frac{P_1}{P_2} \right)$$

$$Q = P_1 V_1 \ln \left(\frac{V_2}{V_1} \right) \quad @ \quad Q = P_1 V_1 \ln \left(\frac{P_1}{P_2} \right)$$

2. Adiabatic Process ($PV^\gamma = C$)

$$U_2 - U_1 = mC_v(T_2 - T_1) \quad W = \frac{P_1 V_1 - P_2 V_2}{\gamma - 1} = \frac{mR(T_1 - T_2)}{\gamma - 1}$$

$$Q = 0$$

$$\frac{T_2}{T_1} = \left(\frac{P_2}{P_1} \right)^{\frac{\gamma-1}{\gamma}} = \left(\frac{V_1}{V_2} \right)^{\gamma-1}$$

3. Polytropic Process ($PV^n = C$)

$$U_2 - U_1 = mC_v(T_2 - T_1) \quad W = \frac{P_1V_1 - P_2V_2}{n-1} = \frac{mR(T_1 - T_2)}{n-1}$$

$$Q = \frac{\gamma - n}{\gamma - 1} \times W \quad \frac{T_2}{T_1} = \left(\frac{P_2}{P_1}\right)^{\frac{n-1}{n}} = \left(\frac{V_1}{V_2}\right)^{n-1}$$

4. Isobaric Process

$$U_2 - U_1 = mC_v(T_2 - T_1)$$

$$W = P(V_2 - V_1) = mR(T_2 - T_1)$$

$$Q = mC_p(T_2 - T_1)$$

5. Isometric Process

$$U_2 - U_1 = mC_v(T_2 - T_1)$$

$$W = 0$$

$$Q = U_2 - U_1 = mC_v(T_2 - T_1)$$

3. SECOND LAW OF THERMODYNAMICS

$$W_{net} = Q_H - Q_L$$

Heat Engine

$$\eta_{th} = \frac{W_{net, out}}{Q_H} = 1 - \frac{Q_L}{Q_H}$$

Refrigerator

$$COP_{R, rev} = \frac{T_L}{T_H - T_L} = \frac{1}{T_H / T_L - 1}$$

Heat Pump

$$COP_{HP, rev} = \frac{T_H}{T_H - T_L} = \frac{1}{1 - T_L / T_H}$$

Power Cycle

$$\eta_{Rankine} = \frac{W_T - W_P}{Q_B} = \frac{(h_1 - h_2) - (h_4 - h_3)}{(h_1 - h_4)}$$

$$Work\ ratio = \frac{W_T - W_P}{W_T} = \frac{(h_1 - h_2) - (h_4 - h_3)}{(h_1 - h_2)}$$

$$S.S.C = \frac{3600}{W_T - W_P} = \frac{3600}{(h_1 - h_2) - (h_4 - h_3)}$$