KOLEJ YAYASAN PELAJARAN JOHOR

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FINAL EXAMINATION

COURSE NAME	:	**THERMODYNAMICS**
COURSE CODE	:	**DKM 3203**
EXAMINATION	:	**OCTOBER 2019**
DURATION	:	**3 HOURS**

INTRUCTION TO CANDIDATES /
ARAHAN KEPADA CALON

1. This examination paper consists of **ONE (1)** part./ (100 Marks)
   *Kertas soalan ini mengandungi **SATU (1)** bahagian sahaja.* *(100 Markah)*
2. Candidates are not allowed to bring any material to examination room except with the permission from invigilator. The formula was attached at the back question paper./
   Calon tidak dibenarkan membawa masuk sebarang bahan/nota ke dalam bilik peperiksaan kecuali dengan kebenaran pengawas peperiksaan. Rumus dilampirkan di belakang kertas soalan peperiksaan.
3. Please check to make sure that this examination pack consists of:/
   Sila pastikan kertas soalan peperiksaan ini mengandungi:

   i. Question Paper
   Kertas Soalan

   ii. Answer Booklet
   Buku Jawapan

   iii. Steam Table
   Jadual Stim

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO /
JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIBERITAHU

This examination paper consists of **12** printed pages including front page
*Kertas soalan ini mengandungi **12** halaman bercetak termasuk muka hadapan*

This part contains of **FIVE (5)** questions. Answer **FOUR (4)** question only in the answer booklet.

*Bahagian ini mengandungi **LIMA (5)** soalan. Jawab **EMPAT (4)** soalan sahaja di dalam buku jawapan.*

QUESTION 1/*SOALAN 1*

a. Convert the following units:
Tukarkan unit berikut:

(i) 25 g/mm^3 to kg/m^3
25 g/mm^3 kepada kg/m^3

(ii) 21 N/cm^2 to kN/m^2
21 N/cm^2 kepada kN/m^2

(iii) 100 MN/m^2 to N/mm^2
100 MN/m^2 kepada N/mm^2

(9 marks/*9 markah*)

b. Define the following terms with diagram :
Berikan definisi bagi istilah-istilah berikut berserta gambar rajah:

(i) System
Sistem

(ii) Boundary
Sempadan

(iii) Surrounding
Sekeliling

(6 marks/*6 markah*)

c. Steam at 1000 kPa as the specific internal energy 2480 kJ/kg. Find the:

(i) dryness fraction

(3 marks/*3 markah*)

(ii) specific volume

(3 marks/*3 markah*)

(iii) specific enthalpy

(3 marks/*3 markah*)

(iv) sketch and locate the dryness fraction on the P-v diagram.

(1 marks/*1markah*)

Stim pada tekanan 1000 kPa mempunyai tenaga dalamnya 2480 kJ/kg. Kirakan

(i) pecahan kekeringan

(ii) isi padu tentu

(iii) entalpi tentu

(iv) lakar dan tandakan titik pecahan kekeringan pada rajah P-v.

QUESTION 2/*SOALAN 2*

a. 2.3 kg of gas at 15 °C is heated using isobaric process from 0.52 m^3 to 0.127 m^3. Determine:
Given R = 0.263 kJ/kg.K and C_v = 655 J/kg.K

(i) the initial pressure

(3 marks/*3 markah*)

(ii) the final temperature

(3 marks/*3 markah*)

(iii) the work done

(3 marks/*3 markah*)

(iv) the heat transfer of the gas

(6 marks/*6 markah*)

2.3 kg gas pada suhu 15 °C telah dipanaskan menggunakan proses isobarik dari 0.52 m^3 kepada 0.127 m^3. Tentukan:
Diberi R = 0.263 kJ/kg.K dan C_v = 655 J/kg.K

(i) tekanan awal

(ii) suhu akhir

(iii) kerja terlaku

(iv) haba yang terpindah oleh gas

b. According to the steam table, at pressure of 3.25 MN/m^2, determine:

(i) saturation temperature

(2.5 marks/*2.5 markah*)

(ii) specific liquid enthalpy

(2.5 marks/*2.5 markah*)

(iii) specific enthalpy of evaporation

(2.5 marks/*2.5 markah*)

(iv) specific enthalpy of dry saturated steam

(2.5 marks/*2.5 markah*)

Berpandukan jadual stim, pada tekanan 3.25 MN/m^2, tentukan:

(i) suhu tepu

(ii) entalpi cair tentu

(iii) entalpi tentu penyejatan

(iv) entalpi tentu stim tepu kering

QUESTION 3/*SOALAN 3*

a. Differentiate between flow process and non-flow process.
Bezakan antara proses alir dan proses tak-alir.

(6 marks/*6 markah*)

b. A hammer mass is 50 kg. The hammer head has an area of 7.1×10^{-4} m^2. Calculate the pressure.
Jisim tukul adalah 50 kg. Kepala tukul mempunyai luas 7.1×10^{-4} m^2. Kirakan tekanan.

(3 marks/*3 markah*)

c. A gas with molecular mass of 68 kg/kmol enters a compressor at pressure of 0.2 bar, velocity of 10 m/s and temperature 29 °C. The gas leaves the compressor with velocity of 44 m/s at pressure 3.8 bar. The power of 780 kW is required to compress the gas adiabatically. Calculate:

(i) the enthalpy change and

(11 marks/*11 markah*)

(ii) the mass flow rate of the gas

(5 marks/*5 markah*)

Given $C_v = 0.65$ kJ/kg.K

Gas dengan berat molekul 68 kg/kmol memasuki pemampat pada tekanan 0.2 bar, halaju 10 m/s dan suhu 29 °C. Gas meninggalkan pemampat dengan kelajuan 44 m/s pada tekanan 3.8 bar. Kuasa sebanyak 780 kW diperlukan untuk memampatkan gas secara adiabatik. Kirakan:

(i) perubahan entalpi

(ii) kadar alir jisim gas

Diberi $C_v = 0.65$ kJ/kg.K

QUESTION 4/*SOALAN 4*

a. Explain the Second Law of Thermodynamics and state device used that applied that law.
Terangkan Hukum Kedua Termodinamik dan nyatakan alat yang digunakan untuk mengaplikasikan hukum tersebut.

(4 marks/*4 markah)*

b. Based on steady flow equation below, state the quantity and unit for each equation's symbol.
Berdasarkan persamaan aliran mantap di bawah, nyatakan kuantiti dan unit bagi setiap simbol persamaan.

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

(5 marks/*5 markah*)

c. A steam enters a nozzle with pressure of 1.05 bar and specific volume of 0.55 m^3/kg and exit with pressure 2.23 kN/m^2 with specific volume is 0.18 m^3/kg. The steam exit a nozzle at velocity of 159 m/s and outlet area is 3.3 m^2 with specific enthalpy change of 433 kJ/kg. Determine:

(i) Velocity at the nozzle inlet

(3 marks/*3 markah*)

(ii) Mass flow rate

(3 marks/*3 markah*)

(iii) Inlet diameter

(6 marks/*6 markah*)

(iv) Specific internal energy change

(4 marks/*4 markah*)

Stim memasuki muncung dengan tekanan 1.05 bar dan isipadu tentu 0.55 m^3/kg dan keluar dengan tekanan 2.23 kN/m^2 dengan isipadu tentu 0.18 m^3/kg. Stim keluar melalui muncung pada halaju 159 m/s dan luas keluaran adalah 3.3 m^2 dengan perubahan entalpi tentu 433 kJ/kg. Tentukan:

(i) halaju masukan pada muncung

(ii) kadar alir jisim

(iii) diameter masukan

(iv) perubahan tenaga dalam tentu

QUESTION 5/*SOALAN 5*

a. Explain the process involved in Rankine Cycle.
Terangkan proses yang terlibat di dalam Kitar Rankine.

(5 marks/*5 markah*)

b. One kilogram of air is taken through a Carnot Cycle. The initial pressure and temperature of the air are 1.73 MN/m^2 and 250 °C, respectively. From the initial condition, the air is expanded isothermally to three times its initial volume and then further expanded adiabatically to six times its initial volume. Isothermal compression followed by adiabatic compression with completes the cycle. Determine:

(i) the pressure

(7 marks/*7 markah)*

(ii) volume

(6 marks/*6 markah)*

(iii) temperature at each corner of the cycle

(6 marks/*6 markah*)

(iv) summarize the final answer in table.

(1 mark/*1 markah*)

Given R= 0.29kJ/kg.K and γ=1.4

Satu kilogram udara digunakan dalam Kitar Carnot. Tekanan awal 1.73 MN/m^2 dan suhu awal 250 °C. Dari keadaan awal, udara dikembangkan secara isoterma menjadi tiga kali isi padu asal dan diikuti pengembangan adiabatik sebanyak enam kali isi padu asal. Mampatan isoterma dan diikuti pula dengan mampatan adiabatik dengan melengkapkan kitar tersebut. Tentukan:

(i) tekanan

(ii) isi padu

(iii) suhu di setiap penjuru kitar.

(iv) tuliskan jawapan akhir dalam bentuk jadual.

Diberi R= 0.29 kJ/kg.K dan γ=1.4

[100 MARKS/*100 MARKAH*]

END OF THE QUESTION PAPER / *KERTAS SOALAN TAMAT*

FORMULA

1. FIRST LAW OF THERMODYNAMICS

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

2. FLOW PROCESS

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

$$Q - W = \dot{m}[(h_2 - h_1) + \left(\frac{c_2^2 - c_1^2}{2}\right) + g(Z_2 - Z_1) \qquad h = u + PV$$

3. PROPERTIES OF PURE SUBSTANCE

Steam

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

Ideal Gas

$PV = mRT \qquad R = \frac{R_o}{M} \qquad R = c_p - c_v \qquad \gamma = \frac{c_p}{c_v}$ c_p= 1.005kJ/kg.K

4. NON FLOW PROCESS

Isothermal Process $(PV = C)$

$U_2 - U_1 = 0 \qquad Q = W \qquad W = P_1V_1 \ln\left(\frac{V_2}{V_1}\right) @ W = P_1V_1 \ln\left(\frac{P_1}{P_2}\right)$

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

$U_2 - U_1 = mc_v(T_2 - T_1) \quad Q = 0 \qquad W = \frac{P_1V_1 - P_2V_2}{\gamma - 1} = \frac{mR(T_2 - T_1)}{\gamma - 1}$

$\frac{T_2}{T_1} = \left(\frac{P_2}{P_1}\right)^{(\gamma-1)/\gamma} = \left(\frac{V_1}{V_2}\right)^{\gamma-1} \qquad \eta_{th,rev} = 1 - \frac{T_L}{T_H} \qquad nisbah\,\text{ker}\,ja = \frac{\ln\frac{V_2}{V_1}(T_1 - T_3)}{T_1 \ln\frac{V_2}{V_1} + \frac{T_1 - T_3}{\gamma - 1}}$

Isobaric Process

$Q = mC_P(T_2 - T_1) \qquad W = P(V_2 - V_1) \qquad \Delta U = Q - W \qquad PV = mRT \qquad \frac{V_1}{T_1} = \frac{V_2}{T_2}$

Isometric Process

$Q = mC_v(T_2 - T_1)$ $\quad PV = mRT$ $\quad \frac{P_1}{T_1} = \frac{P_2}{T_2}$ $\quad \Delta U = Q$

Polytropic Process ($PV^n = C$)

$\frac{T_2}{T_1} = \left(\frac{P_2}{P_1}\right)^{\frac{n-1}{n}} = \left(\frac{V_1}{V_2}\right)^{n-1}$ $\quad U_2 - U_1 = mC_v(T_2 - T_1)$ $\quad Q = \frac{\gamma - n}{\gamma - 1} \times W$

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

$P_1V_1^n = P_2V_2^n$

5. SECOND LAW OF THERMODYNAMICS

Heat Engine

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

Heat Pump

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