KOLEJ YAYASAN PELAJARAN JOHOR

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PEPERIKSAAN AKHIR

NAMA KURSUS	:	**TERMODINAMIK**
KOD KURSUS	:	**DKM 3203**
PEPERIKSAAN	:	**APRIL 2019**
MASA	:	**3 JAM**

ARAHAN KEPADA CALON

1. Kertas soalan ini mengandungi **SATU (1)** bahagian sahaja.
2. Calon tidak dibenarkan membawa masuk sebarang peralatan ke dalam bilik peperiksaan kecuali dengan kebenaran pengawas peperiksaan.
3. Sila pastikan bahan-bahan berikut diperoleh untuk sesi peperiksaan ini:
   i. Kertas Soalan
   ii. Buku Jawapan
   iii. Jadual Stim

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIBERITAHU

KERTAS SOALAN INI MENGANDUNGI 7 HALAMAN BERCETAK TERMASUK MUKA HADAPAN

Bahagian ini mengandungi **LIMA (5)** soalan.
Jawab **EMPAT** daripada LIMA soalan. Jawab dalam Buku Jawapan.

QUESTION 1/*SOALAN 1*

a. Convert the following units:
Tukarkan unit berikut:

(i) 5 MN/mm^3 to N/m^2
5 MN/mm^3 kepada N/m^2

(ii) $6N/cm^2$ to kN/m^2
$6N/cm^2$ kepada kN/m^2

(iii) 380 km/hr to cm/minute
380 km/j kepada cm/minit

(9 marks/*9 markah*)

b. Define the following terms :
Berikan definisi bagi istilah-istilah berikut :

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

(i) dryness fraction */ pecahan kekeringan*

(ii) specific volume */ isi padu tentu*

(iii) specific enthalpy */ entalpi tentu*

Then, sketch and locate the dryness fraction on the P-v diagram.
Kemudian, lakar dan tandakan titik pecahan kekeringan pada rajah P-v.

(10 marks/*10 markah*)

QUESTION 2/*SOALAN 2*

a. Determine the volume occupied by 1 kg of steam at a pressure 0.85 MN/m^2 with a dryness fraction of 0.97. This volume is expanded adiabatically to a pressure of 0.175 MN/m^2 with the law of expansion $PV^{1.13}$=constant. Determine the final dryness fraction of the steam and the change of internal energy of the steam during the expansion.

Tentukan isi padu yang dipenuhi oleh 1 kg stim yang berada pada tekanan 0.85 MN/m^2 dengan pecahan kekeringan 0.97. Stim tersebut dikembangkan secara adiabatik ke tekanan 0.175 MN/m^2 berdasarkan hukum $PV^{1.13}$=pemalar. Tentukan pecahan kekeringan stim akhir dan perubahan tenaga dalam stim semasa pengembangan.

(15 marks/*15 markah*)

b. According to steam table, at pressure of 2.75 MN/m^2, determine:

Berpandukan jadual stim, pada tekanan 2.75 MN/m^2, tentukan:

(i) saturation temperature / *suhu tepu*

(ii) specific liquid enthalpy / *entalpi cair tentu*

(iii) specific enthalpy of evaporation / *entalpi tentu penyejatan*

(iv) specific enthalpy of dry saturated steam / *entalpi tentu stim tepu kering*

(10 marks/*10 markah*)

SOA

QUESTION 3/*SOALAN 3*

a. Sketch the P-v diagram and label the critical point, saturated liquid line, dry saturated steam line, wet steam region and compress liquid region.
Lukiskan gambar rajah P-v dan tandakan titik kritikal, garisan cecair tepu, garisan stim tepu, kawasan wap basah dan kawasan cecair termampat.

(7 marks/*7 markah*)

b. Explain briefly the steady flow process
Terangkan secara ringkas proses aliran sekata.

(6 marks/*6 markah*)

c. Steam enters a turbine with a velocity of 20 m/s and specific enthalpy 3990 kJ/kg. The steam leaves the turbine withe the velocity of 35 m/s and specific enthalpy 1030 kJ/kg. The heat loss to the surroundings as the steam passes through the turbine is 20 kJ/kg. The steam flow rate is 42400 kg/h. Calculate the power generated by the turbine in kW.
Stim memasuki turbin dengan halaju 20 m/s dan entalpi tentu 3990 kJ/kg. Stim meninggalkan turbin dengan halaju 35 m/s dan entalpi tentu 1030 kJ/kg. Haba hilang ke persekitaran apabila stim melalui turbin ialah 20 kJ/kg. Kadar aliran aliran stim 42400 kg/h. Hitungkan kuasa yang dijanakan oleh turbin dalam kW.

(12 marks/*12 markah*)

QUESTION 4/*SOALAN 4*

a. Explain about Second Law of Thermodynamics.
Terangkan Hukum Kedua Termodinamik.

(3 marks/*3 markah*)

b. 4.5 kg of steam has an initial pressure of 3 MN/m^2 and temperature of 300 °C. The steam then expands reversibly to a new pressure of 0.1 MN/m^2 with a dryness factor of 0.96. The expansion of the steam appears as a straight line when plotted on a temperature-entropy chart. Determine:
Stim berjisim 4.5 kg berada pada tekanan awal 3 MN/m^2 dan suhu awal 300 °C. Stim tersebut mengembang secara boleh balik kepada tekanan yang baru iaitu 0.1 MN/m^2 dengan faktor kekeringan 0.96. Proses pengembangan stim dilihat sebagai satu garisan lurus apabila diplotkan di atas carta suhu-entropi. Tentukan:

(i) the heat transfer during the expansion / *haba terpindah semasa proses pengembangan.*

(12 marks/*12 markah*)

(ii) the work done during the expansion / *kerja terlaku semasa proses pengembangan*

(10 marks/*10 markah*)

QUESTION 5/*SOALAN 5*

a. Elaborate the Carnot Principles.
Huraikan tentang Prinsip Carnot.

(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:
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) the pressure / *tekanan*

(7 marks/*7 markah)*

(ii) volume / *isi padu*

(6 marks/*6 markah)*

(iii) temperature at each corner of the cycle / *suhu di setiap penjuru kitar.*

(7 marks/*6 markah*)

Summarize the final answer in table.
Tuliskan jawapan akhir dalam bentuk jadual.

Given R= 0.29kJ/kg.K and γ=1.4
Diberi R= 0.29 kJ/kg.K dan γ=1.4

[100 MARKS/*100 MARKAH*]

KERTAS SOALAN TAMAT

(1) Hukum Pertama Termodinamik / *First Law of Thermodynamics*

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

(2) Proses Alir / *Flow Process*

$$\dot{m} = \rho v A = \rho V (kg/s) = \dot{m} = \frac{CA}{V} \qquad Q - W = \dot{m}\left[(h_2 - h_1) + \left(\frac{C_2^2 - C_1^2}{2}\right) + (Z_2 - Z_1)g\right]$$

$$C_t = \sqrt{\left\{2\frac{n}{n-1}P_1V_1\left(1 - \left[\frac{P_t}{P_1}\right]^{(n-1)/n}\right)\right.} \qquad Q_T - W_T = \dot{m}\left[(h_2 - h_1) + \left(\frac{C_2^2 - C_1^2}{2}\right) + (Z_2 - Z_1)g\right]$$

$$V_t = V_1\left(\frac{P_1}{P_t}\right)^{1/n} \qquad A_t = \frac{\dot{m}V_t}{C_t} \qquad T_2 = T_1\left(\frac{P_2}{P_1}\right)^{(n-1)/n}$$

(3) Sifat Bahan Tulen / *Properties of Pure Substance*

Stim / *Steam*

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

Gas Unggul / *Ideal Gas*

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

(4) Proses Tak Alir / *Non-Flow Process*

Proses Isoterma / *Isothermal Process* $(PV = C)$

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

Proses Adiabatik / *Adiabatic Process* $(PV\gamma = C)$

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

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

(5) Hukum Kedua Termodinamik / *Second Law of Thermodynamics*

Enjin Haba / *Heat Engine*

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

Pam Haba / *Heat Pump*

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