INSTRUCTION:
This section consists of **FOUR (4)** structured questions. Answer all questions.

ARAHAN:
*Bahagian ini mengandungi **EMPAT (4)** soalan struktur. Jawab semua soalan.*

QUESTION 1
SOALAN 1

CLO1 C1 (a) List **FOUR (4)** factors that are important to consider when extending pump life.

*Senaraikan **EMPAT (4)** faktor penting yang perlu dipertimbangkan untuk memanjangkan jangka hayat pam.*

[4 *markah*]
[4 marks]

CLO1 C2 (b) Determine the loss of head due to friction in a pipe which is 25 meters long and 2 meters in diameter which carries 1.5 m/s oil. Take into consideration $f = 0.06$.

Tentukan kehilangan turus disebabkan geseran dalam paip 25 meter panjang dan diameter 2 meter yang membawa 1.5 m / s minyak. Mengambil kira $f = 0.06$.

[4 marks]
[4 *markah*]

CLO2 C3 (c) A single acting reciprocating air compressor has cylinder diameter and stroke of 200mm and 300mm respectively. The air enters into the compressor at 1 bar and 27°C and delivers at 8 bar while running at 100 r.p.m. Find:

(i) Indicated power of the compressor
(ii) Mass of air delivered by the compressor per minute
(iii) Temperature of the air delivered by the compressor

The compression follows the law $pv^{1.25} = C$. Take R as 287 J/kg K.

Pemampat udara salingan tindakan tunggal mempunyai diameter silinder dan lejang 200mm dan 300mm. Udara masuk kedalam pemampat pada 1 bar dan 27 ℃ dan keluar pada 8 bar sambil berputar pada 100 r.p.m. Cari:

(i) Kuasa kitar pemampat

(ii) Jisim udara dimampatkan oleh pemampat setiap minit

(iii) Suhu udara yang dihantar oleh pemampat

Mampatan berlaku pada $pv^{1.25} = C$. Ambil R sebagai 287 J / kg K.

[11 marks]
[11 *markah*]

QUESTION 2

SOALAN 2

CLO2
C2

(a) Explain **3 THREE (3)** things that are required to be in a correct combination before ignition and combustion can take place.

*Terangkan **TIGA (3)** perkara-perkara yang diperlukan dalam kombinasi yang betul sebelum pencucuhan dan pembakaran boleh berlaku:*

[4 marks]
[4 *markah*]

CLO2
C3

(b) Determine the stoichiometric mass air for 1 kg of propane $\mathbf{C_3\ H_8}$.

Tentukan jisim udara stoikiometric untuk pembakaran 1 kg propane $\boldsymbol{C_3\ H_8}$.

[8 marks]
[8 *markah*]

(c) The analysis of gas supply is as follows:

CLO2
C4

82.3% CH_4, 1.9% C_2H_6, 0.6% C_3H_8, 0.4% C_4H_{10}, 12.3% N_2, and 0.7% CO_2

Calculate:

(i) The stoichiometric A/F ratio using the chemical equilibrium method

(ii) The A/F ratio, the dry and wet analysis of the products of combustion by volume, when 25% excess air is supplied

Analisis bekalan gas adalah seperti berikut:

82.3% CH_4, 1.9% C_2H_6, 0.6% C_3H_8, 0.4% C_4H_{10}, 12.3% N_2, and 0.7% CO_2

Hitung:

(i) nisbah U/B stoikiometri menggunakan kaedah keseimbangan kimia.

(ii) Analisa basah dan kering mengikut isipadu bila udara lebihan sebanyak 25% dibekalkan

[13 marks]
[13 *markah*]

QUESTION 3
SOALAN 3

CLO2
C2

(a) Explain the differences between critical temperature ratio and critical pressure ratio.

Terangkan perbezaan di antara nisbah suhu kritikal dan nisbah tekanan kritikal.

[4 marks]
[4 *markah*]

CLO2
C3

(b) Nozzle is used widely in the engineering sector. Sketch the types and shapes of the nozzles.

Muncung digunakan secara meluas dalam sektor kejuruteraan. Lakarkan jenis dan bentuk muncung.

[8 marks]
[8 *markah*]

CLO2
C4

(c) Air at 400°C flows through a convergent-divergent nozzle with a specific volume of 0.345 m^3/kg. The temperature decreases at throat to 314°C. The air flow rate is 4.6 kg/minute. Given a specific gas constant at 0.287kJ/kg K, calculate:

(i) Ratio of specific heat

(ii) Ratio of critical pressure

(iii) Throat area

Udara pada 400°C mengalir melalui muncung tumpu-capah dengan isipadu tentu 0.345 m3 / kg. Suhu berkurangan di tekak hingga 314°C. Kadar aliran udara adalah 4.6 kg / minit. Dengan pemalar gas tertentu pada 0.287kJ / kg K, hitung:

(i) Nisbah haba tertentu

(ii) Nisbah tekanan kritikal

(iii) Kawasan tekak

[13 marks]
[13 *markah*]

QUESTION 4
SOALAN 4

CLO1
C2

(a) Sketch the velocity diagram for Impulse Turbine.
Lakarkan gambarajah halaju bagi Turbin Dedenyut.

[6 marks]
[6 *markah*]

CLO2
C3

(b) In an impulse turbine, the mean diameter of the blades are 1.05 m and the speed is 3000 rpm. The nozzle angle is 18^{o}, the ratio of the blade speed to steam speed is 0.42 and the ratio of the relative velocity at outlet from the blades to inlet is 0.84.The outlet angle of the blade is to be made 3^{o} less than the inlet angle. The steam flow is 10 kg/s. Draw the velocity diagram for the blades and calculate the following:

(i) Tangential thrust on the blades
(ii) Axial thrust on the blades
(iii) Power developed
(iv) Blade efficiency

Di dalam satu turbin dedenyut, diameter bilah adalah 1.05 m dan kelajuan 3000 ppm. Sudut muncung ialah 18^{o}, nisbah halaju bilah kepada halaju stim adalah 0.42 dan nisbah halaju relatif keluaran kepada masukan adalah 0.84. Sudut keluaran bilah adalah 3^{o} kurang dari sudut masukan. Kadar alir stim adalah 10 kg/s. Lukis gambarajah halaju bilah dan hitung:

(i) Tujahan tangen ke atas bilah.
(ii) Tujahan paksi ke atas bilah.
(iii) Kuasa keluaran.
(iv) Kecekapan bilah.

[8 marks]
[8 *markah*]

CLO2
C4

(c) An atmospheric air with barometric pressure of 1.013 bar has 30°C and a specific humidity of 0.0095 kg/kg of dry air. Without the aid of psychometric chart, determine:

(i) Relative humidity
(ii) Percentage saturation

Udara atmosfera dengan tekanan barometer 1.013 bar mempunyai 20 °C dan kelembapan tertentu 0.0095 kg/kg udara kering. Tanpa bantuan carta psychometric, tentukan:

(i) Kelembapan relatif
(ii) Peratus tepu

[11marks]
[11 *markah*]

SOALAN TAMAT

POLITEKNIK MALAYSIA
SEBERANG PERAI

RUMUS DJL5032–POWER PLANT ENGINEERING 2

NOZZEL

$$C_2 = \sqrt{2(h_1 - h_2)} = \sqrt{2 \times Cp \times (T_1 - T_2)}$$

$$C_2 = 44.72\sqrt{(h_1 - h_2)}$$

$$\frac{T_1}{T_2} = \left[\frac{P_1}{P_2}\right]^{\gamma-1/\gamma}$$

Mass flow, $\dot{m} = \frac{CA}{v}$

$$\frac{P_c}{P_1} = \left(\frac{2}{\gamma+1}\right)^{\gamma/\gamma-1}$$

$$\frac{T_c}{T_1} = \frac{2}{\gamma+1}$$

$$Cc = \sqrt{(\gamma R T_c)}$$

STEAM TURBINE

$$C_{bl} = \frac{\pi DN}{60}$$

$$K = \frac{C_{ro}}{C_{ri}}$$

$$POWER\ DEVELOPED = m_s \frac{(C_{wi} + C_{wo})C_{bl}}{1000}$$

$$\text{STAGE EFFICIENCY} = \frac{(C_{wi} + C_{wo})C_{bl}}{(h_1 - h_2)}$$

$$BLADE\ EFFICIENCY = \frac{2C_{bl}(C_{wi} + C_{wo})}{C_i^{\ 2}}$$

$$AXIAL\ THRUST = m_s(C_{fi} - C_{fo})$$

$$GROSS\ EFFICIENCY = \frac{WORK\ DONE}{ENTALPHY\ DROP}$$

$$ENTALPHY\ DROP = 2 \times \frac{Ci^2 - \psi Co^2}{2\eta}$$

COMBUSTION

Stoichiometric Air-Fuel Ratio:

$$\frac{100}{23.3}\left[\frac{8}{3}C + 8H + S - O\right]$$

Actual A/F Ratio: $\frac{100}{23.3}\left[\frac{8}{3}C + 8H + S - O\right] + \frac{excess.air}{100} \times \frac{100}{23.3}\left[\frac{8}{3}C + 8H + S - O\right]$

POLITEKNIK MALAYSIA
SEBERANG PERAI

RUMUS DJL5032–POWER PLANT ENGINEERING 2

PUMP

$$\text{NPSH} = \left[\frac{P_a - P_v}{\rho g}\right] - h_f - h_v - h_{fitting} \pm h_s$$

$$\textit{Velocity Head} = \frac{V^2}{2g}$$

$$\textit{Pressure} = \rho g H_T \; N/m^2$$

$$\textit{Power} = \frac{\rho g Q H_T}{\eta_{mech.pump}} watt$$

AIR CONDITIONING

$$(\phi) = P_s / P_g$$

$$\psi = \frac{100\omega(P_B - P_g)}{0.622 P_g}$$

$$\psi = \frac{p_s}{p_g}\left[\frac{p_b - p_g}{p_b - p_s}\right]$$

$$\omega = 0.622 \times \left(\frac{P_S}{P_B - P_S}\right)$$

COMPRESSOR

Work input per cycle: $\frac{n}{n-1} \times \dot{m} R(T_2 - T_1)$

Indicated Power : $\frac{n}{n-1} \times pV\left\{\left(\frac{P_2}{P_1}\right)^{\frac{n-1}{n}} - 1\right\} \times N$

Compressor mechanical efficiency = Indicated Power / Shaft Power

Delivery temperature $T_2 = T_1 \times \left[\frac{P_2}{P_1}\right]^{\frac{n-1}{n}}$

Volumetric efficiency = $1 - \frac{Vc}{Vs} \times \left\{\left(\frac{P_2}{P_1}\right)^{\frac{1}{n}} - 1\right\}$

TABLE FOR WET AND DRY ANALYSIS (CHEMICAL METHOD)

PRODUCT	KMOL/KMOL FUEL	% BY VOL. (WET)	% BY VOL. (DRY)
TOTAL (100%)		**100**	**100**
	WET =		
	DRY =		

TABLE FOR WET AND DRY ANALYSIS

COMBUSTION RESULT	MASS/KG FUEL	% MASS	M	MASS/KG FUEL / M	%WET ANALYSIS	%DRY ANALYSIS
TOTAL			WET			
			DRY			