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

ARAHAN:
*Bahagian ini mengandungi **EMPAT (4)** soalan esei. Jawab **SEMUA** soalan.*

QUESTION 1
SOALAN 1

CLO1 C1 (a) State **FOUR (4)** comparisons between rotodynamics & rotary pumps.
*Nyatakan **EMPAT (4)** perbandingan diantara pam rotodinamik dan rotari.*

[4 marks]
[4 *markah*]

CLO1 C2 (b) Identify **FIVE (5)** matters to take into consideration when purchasing a pump.
*Nyatakan **LIMA (5)** perkara yang perlu diambil kira apabila membeli sebuah pam.*

[10 marks]
[10 *markah*]

CLO2 C3 (c) A single stage, single acting air compressor running at 11 rev/second, has a diameter of 0.40 m and stroke of 0.60 m. The clearance volume is 3% of the swept volume. The inlet pressure and temperature are 90 000 N/m^2 and 30°C respectively. The delivery pressure is 760 000 N/m^2. Assume the index of polythropic is 1.3. Calculate:

(i) Volume induced

(ii) Indicated Power

Sebuah pemampat udara salingan tindakan tunggal, satu peringkat mempunyai diameter 0.40 m dan lejang 0.60m.Pemampat beroperasi dengan kelajuan 11 putaran/saad. Isipadu kelegaan adalah 3% daripada isipadu tersapu. Tekanan masuk 85 000 N/m^2 dan suhu masuk 30℃. Tekanan penghantaran 760 000 N/m^2. Andaikan indeks politropik ialah 1.3. Kira :

(i) Isipadu teraruh

(ii) Kuasa tertunjuk

[11 marks]
[11 *markah*]

QUESTION 2
SOALAN 2

CLO1 C2

(a) Explain **FOUR (4)** types of liquid fuel.

*Terangkan **EMPAT (4)** jenis bahan api cecair.* [4 marks]
[4 *markah*]

CLO2 C2

(b) Determine the stoichiometric mass air for 1 kg of Petrol C_2 H_5O

Tentukan jisim udara stoikiometric untuk pembakaran 1 kg Petrol C_2 H_5O

[6 marks]
[6 *markah*]

CLO2 C3

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

85% CH_4, 3.5% C_2H_6, 0.6% C_3H_8, 0.4% C_4H_{10}, 10% N_2, and 0.5% CO_2

Calculate:

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

(ii) The A/F ratio and the dry and wet analysis of the products of combustion by volume, when 35% excess air is supplied.

Analisis bekalan gas adalah seperti berikut:

85% CH_4, 3.5% C_2H_6, 0.6% C_3H_8, 0.4% C_4H_{10}, 10% N_2, and 0.5% CO_2

Kira:

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

(ii) Nisbah U/B sebenar dan analisa basah dan kering hasil pembakaran mengikut isipadu, bila udara lebihan sebanyak 35% dibekalkan.

[15 marks]
[15 *markah*]

QUESTION 3
SOALAN 3

CLO1
C2

(a) List **FOUR (4)** nozzle applications in engineering sector.

*Senaraikan **EMPAT (4)** aplikasi muncung dalam sektor kejuruteraan*

[4 marks]

[4 *markah*]

CLO2
C3

(c) The inlet condition of air to a convergent divergent nozzle is 2.2 MPa and 260°C. The exit pressure is 0.4 MPa with $\gamma = 1.4$. Throat area of 32.2 cm^2 , determine:

(i) Critical Pressure

(ii) Critical Temperature

(iii) Critical Velocity

(iv) The mass flowrate

(v) The exit Temperature

(vi) The exit Velocity

(vii) The exit area.

Keadaan salur masuk udara untuk muncung tumpu campa ialah 2.2 MPa dan 260 ℃. *Tekanan keluar ialah 0.4 MPa dengan nilai* $\gamma = 1.4$. *luas keratan rentas kerongkong ialah 32.2* cm^2, *kirakan:*

(i) Tekanan Kritikal

(ii) Suhu Kritikal

(iii) Halaju Kritikal

(iv) Kadaralir jisim

(v) Suhu pada keluaran

(vi) Halaju pada keluaran

(vii) Luas keratan rentas keluaran.

[21 marks]
[*21 markah*]

QUESTION 4
SOALAN 4

CLO1
C1

(a) List **FOUR (4)** desirable properties of a good refrigerant. (4 marks)
*Berikan **EMPAT (4)** sifat-sifat bahan pendingin yang baik.* *(4 markah)*

CLO2
C2

(b) Refrigerant 134a is the working fluid in a vapour-compression refrigeration cycle and operates on an ideal vapour compression refrigeration cycle between −15°C and 40°C. Dry saturated vapour is delivered to the compressor where it is compressed isentropically. The condition of the liquid after condensation process is undercooled by 5°C. Illustrate the process cycle the temperature versus entropy (T–s) in a diagram. If the mass flow rate of refrigerant is 0.085 kg/s, calculate the following:-

i. Compressor power in kilowatt (kW)
ii. Refrigerating effect in kilowatt (kW)
iii. Coefficient of performance of refrigerator ($C.O.P_{REF.}$)
iv. Coefficient of performance of heat pump, ($C.O.P_{HP}$)

[13 marks]
[13 *markah*]

CLO2
C4

(c) Atmospheric air with barometric pressure of 1.013 bar has 40°C dry bulb temperature and 26°C wet bulb temperature. Without the aid of psychrometric chart, determine:

(i) Relative humidity
(ii) Saturation percentage

Udara atmosfera dengan tekanan barometer 1.013 bar mempunyai 40°C suhu bebuli kering dan 26°C suhu bebuli basah. Tanpa bantuan carta psikrometer, tentukan:

(i) Kelembapan relatif
(ii) Peratus ketepuan

[8 marks]
[8 *markah*]

SOALAN TAMAT

POLITEKNIK MALAYSIA
SEBERANG PERAI

RUMUS DJL40032–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, $\dot{m} = \frac{CA}{v}$

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

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

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

REFRIGERATION

WORK INPUT = $(h_2 - h_1)$

REFRIGERATION EFFECT = $(h_1 - h_4)$

$$COP_{ref} = \frac{Q}{W} = \frac{(h_1 - h_4)}{(h_2 - h_1)}$$

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 DJL40032–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 = $1 - \frac{Vc}{Vs} \times \left\{\left(\frac{P_2}{P_1}\right)^{\frac{1}{n}} - 1\right\}$

POLITEKNIK MALAYSIA
SERDANG PERAI

TABLE FOR WET AND DRY ANALYSIS (CHEMICAL METHOD)

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

POLITEKNIK MALAYSIA
SERDANG PERAI

TABLE FOR WET AND DRY ANALYSIS

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


POLITEKNIK
MALAYSIA
SERDANG PERAI

R134a - TetraFlouroEthane Saturation Properties - Temperature Table (-40°C - 20°C)

Temp	Pressure	volume (m^3/kg)		enthalpy (kJ/kg)			entropy (kJ/kg.K)		
°C	kPa	vf	vg	hf	hfg	hg	sf	sfg	sg
-40	51.2	0.0007054	0.3611	0.00	225.86	225.86	0.0000	0.9687	0.9687
-36	62.9	0.0007112	0.2977	5.04	223.35	228.39	0.0214	0.9418	0.9632
-32	76.7	0.0007172	0.2473	10.10	220.81	230.92	0.0425	0.9157	0.9582
-28	92.7	0.0007234	0.2068	15.20	218.23	233.43	0.0634	0.8902	0.9536
-26	101.7	0.0007265	0.1896	17.76	216.92	234.68	0.0738	0.8777	0.9515
-24	111.3	0.0007297	0.1741	20.33	215.60	235.93	0.0841	0.8653	0.9495
-22	121.7	0.0007329	0.1601	22.91	214.26	237.17	0.0944	0.8531	0.9476
-20	132.7	0.0007362	0.1474	25.49	212.92	238.41	0.1046	0.8411	0.9457
-18	144.6	0.0007396	0.1359	28.09	211.55	239.64	0.1148	0.8292	0.9440
-16	157.3	0.0007430	0.1255	30.69	210.18	240.87	0.1250	0.8174	0.9423
-14	170.8	0.0007464	0.1161	33.30	208.79	242.09	0.1350	0.8057	0.9407
-12	185.2	0.0007499	0.1074	35.92	207.39	243.31	0.1451	0.7941	0.9392
-10	200.6	0.0007535	0.0996	38.55	205.97	244.52	0.1550	0.7827	0.9377
-8	216.9	0.0007571	0.0924	41.19	204.53	245.72	0.1650	0.7714	0.9364
-6	234.3	0.0007608	0.0859	43.84	203.08	246.92	0.1749	0.7602	0.9351
-4	252.7	0.0007646	0.0799	46.50	201.61	248.11	0.1848	0.7490	0.9338
-2	272.2	0.0007684	0.0744	49.17	200.12	249.29	0.1946	0.7380	0.9326
0	292.8	0.0007723	0.0693	51.86	198.60	250.46	0.2044	0.7271	0.9315
2	314.6	0.0007763	0.0647	54.55	197.07	251.62	0.2142	0.7162	0.9304
4	337.7	0.0007804	0.0604	57.25	195.53	252.78	0.2239	0.7055	0.9294
6	362.0	0.0007845	0.0564	59.97	193.95	253.92	0.2336	0.6948	0.9284
8	387.6	0.0007887	0.0528	62.69	192.36	255.05	0.2432	0.6842	0.9274
12	443.0	0.0007975	0.0463	68.19	189.11	257.29	0.2625	0.6632	0.9256
16	504.3	0.0008066	0.0408	73.73	185.74	259.47	0.2816	0.6424	0.9240
20	571.7	0.0008161	0.0360	79.32	182.28	261.6	0.3006	0.6218	0.9224

R134a - TetraFlouroEthane Saturation Properties - Temperature Table (20°C - 101.06°C)

Temp	Pressure	volume (m^3/kg)		enthalpy (kJ/kg)			entropy (kJ/kg.K)		
°C	kPa	vf	vg	hf	hfg	hg	sf	sfg	sg
20	571.7	0.0008161	0.0360	79.32	182.26	261.60	0.3006	0.6218	0.9224
24	645.8	0.0008261	0.0319	84.98	178.70	263.68	0.3196	0.6014	0.9210
26	685.4	0.0008313	0.0300	87.83	176.87	264.7	0.3290	0.5912	0.9203
28	726.9	0.0008367	0.0283	90.70	175.00	265.69	0.3385	0.5811	0.9196
30	770.2	0.0008421	0.0266	93.58	173.09	266.67	0.3479	0.5710	0.9189
32	815.4	0.0008478	0.0251	96.48	171.16	267.64	0.3573	0.5609	0.9182
34	862.6	0.0008536	0.0237	99.40	169.18	268.58	0.3667	0.5508	0.9175
36	911.9	0.0008595	0.0224	102.33	167.17	269.50	0.3761	0.5407	0.9168
38	963.2	0.0008657	0.0211	105.29	165.12	270.41	0.3855	0.5307	0.9162
40	1016.6	0.0008720	0.0200	108.27	163.01	271.28	0.3949	0.5206	0.9155
42	1072.2	0.0008786	0.0189	111.26	160.88	272.14	0.4043	0.5105	0.9147
44	1130.1	0.0008854	0.0178	114.28	158.69	272.97	0.4136	0.5004	0.9140
48	1252.9	0.0008997	0.0160	120.39	154.16	274.55	0.4324	0.4800	0.9125
52	1385.4	0.0009150	0.0143	126.60	149.41	276.01	0.4513	0.4595	0.9108
56	1528.2	0.0009317	0.0128	132.92	144.40	277.32	0.4702	0.4387	0.9089
60	1681.8	0.0009498	0.0114	139.36	139.13	278.49	0.4892	0.4176	0.9068
70	2116.8	0.0010038	0.0087	156.14	124.37	280.51	0.5376	0.3624	0.9000
80	2633.2	0.0010773	0.0064	174.25	106.42	280.67	0.5880	0.3014	0.8894
90	3244.2	0.0011936	0.0046	194.78	82.49	277.27	0.6434	0.2272	0.8706
100	3972.4	0.0015357	0.0027	225.15	34.39	259.54	0.7232	0.0921	0.8153
101.06	4059.1	0.0019535	0.0020	241.49	0	241.49	0.7665	0	0.7665