KOLEJ UNIVERSITI TEKNIKAL KEBANGSAAN MALAYSIA
PEPERIKSAAN AKHIR SEMESTER I
SESI 2005/2006

FAKULTI KEJURUTERAAN PEMBUATAN

KOD MATAPELAJARAN	:	DMFD 3413
MATA PELAJARAN	:	KUASA BENDALIR (FLUID POWER)
PENYELARAS	:	CIK SILAH HAYATI BINTI KAMSANI
KURSUS	:	DMF
MASA	:	3 JAM
TARIKH	:	14 NOVEMBER 2005

ARAHAN KEPADA CALON :

1. Kertas soalan ini mengandungi 7 soalan secara keseluruhannya .
2. Sila jawab mana-mana 5 soalan dan setiap soalan bernilai 20 markah. (Dibenarkan untuk menjawab dalam Bahasa Melayu atau Bahasa Inggeris).
3. Jawab setiap soalan dihelaian yang berasingan.

KERTAS SOALAN INI TERDIRI DARIPADA (19) MUKA SURAT
(TERMASUK MUKA SURAT HADAPAN) SULIT

(VERSI BAHASA MELAYU)

Soalan 1

a) Berikan **6** perbezaan antara sistem pneumatik dengan sistem hidraulik.

(6 markah)

b) Senaraikan **4** kebaikan dan keburukan sistem pneumatik.

(8 markah)

c) Senaraikan komponen-komponen yang terdapat dalam sistem hidraulik berserta fungsi-fungsinya.

(6 markah)

Soalan 2

a) Rajah S2.1 menunjukkan sebuah penekan hidraulik. Data-data berikut adalah diberikan:

$A_1 = 4\ \text{in}^2$

$A_2 = 40\ \text{in}^2$

$S_1 = 2\ \text{in}$

$F_1 = 200\ \text{lb}$

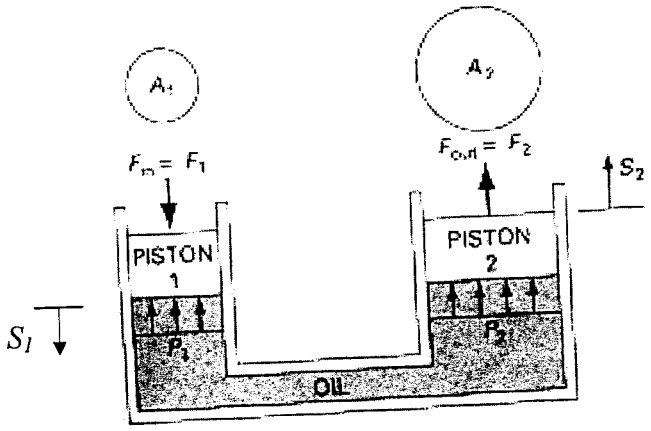
Cari:

i) F_2

ii) S_2

iii) Nisbah tenaga masukan kepada tenaga keluaran

(6 markah)



Rajah S2.1

b) Rajah S2.2 menunjukkan suatu sistem penggalak tekanan yang digunakan untuk memacu beban, F melalui silinder hidraulik. Diberi:

$P_1 = 100$ psi

$A_1 = 20$ in^2

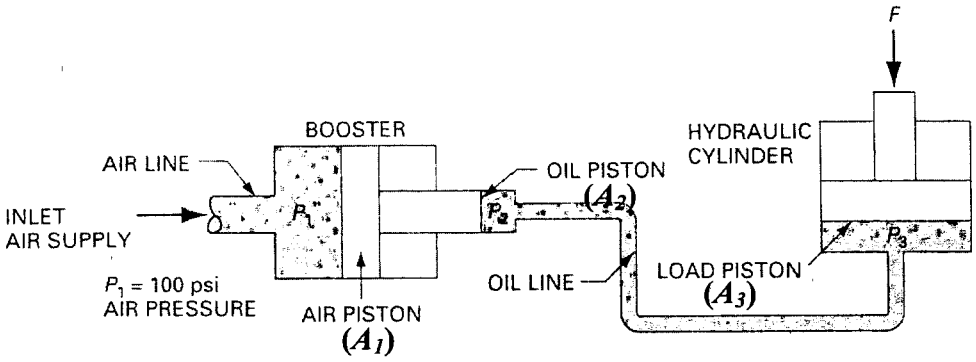
$A_2 = 1$ in^2

$A_3 = 25$ in^2

i) Cari F?

ii) Terangkan juga kebaikan aplikasi sebuah sistem penggalak tekanan.

(4 markah)



Rajah S2.2

c) Rajah S2.3 menunjukkan satu sistem hidraulik dengan data-data berikut:

i) kuasa kuda pam hidraulik = 5

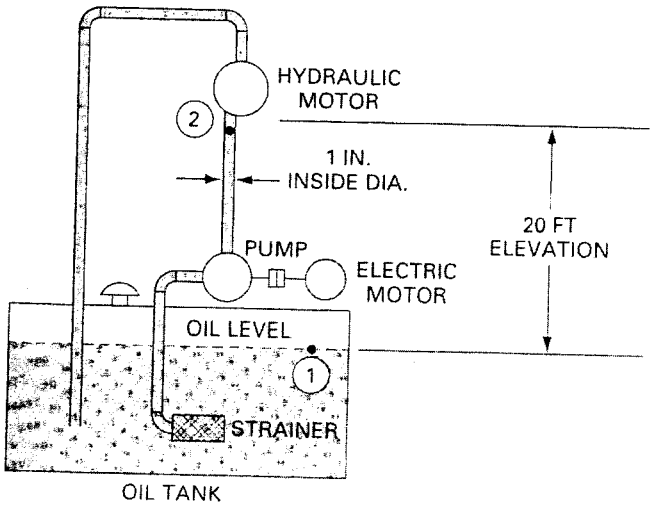
ii) aliran pam = 30 gpm

iii) diameter dalam paip = 1 inci

iv) graviti tentu mintak = 0.9

Cari tekanan pada motor hidraulik apabila tekanan pada stesen 1 dalam tangki hidraulik ialah atmosfera dan kehilangan turus, H_L disebabkan geseran antara stesen 1 dan 2 ialah 30 kaki.

(10 markah)



Rajah S2.3

Soalan 3

a) Pam vane adalah sejenis pam anjakan positif. Terangkan dengan jelas prinsip kerja pam tersebut.

(4 markah)

b) Sebuah pam mempunyai isipadu anjakan sebanyak 5 in^3. Kadar aliran sebenar pam ialah 20 gpm pada kelajuan 1000 rpm dan tekanan 1000 psi. Jika data kilasan sebenar pam ialah 900 in.lb, cari

i) kecekapan keseluruhan pam?

ii) daya kilasan teori untuk operasi pam?

(8 markah)

c) Berikan 4 contoh jenis injap kawalan tekanan serta simbol-simbolnya.

(8 markah)

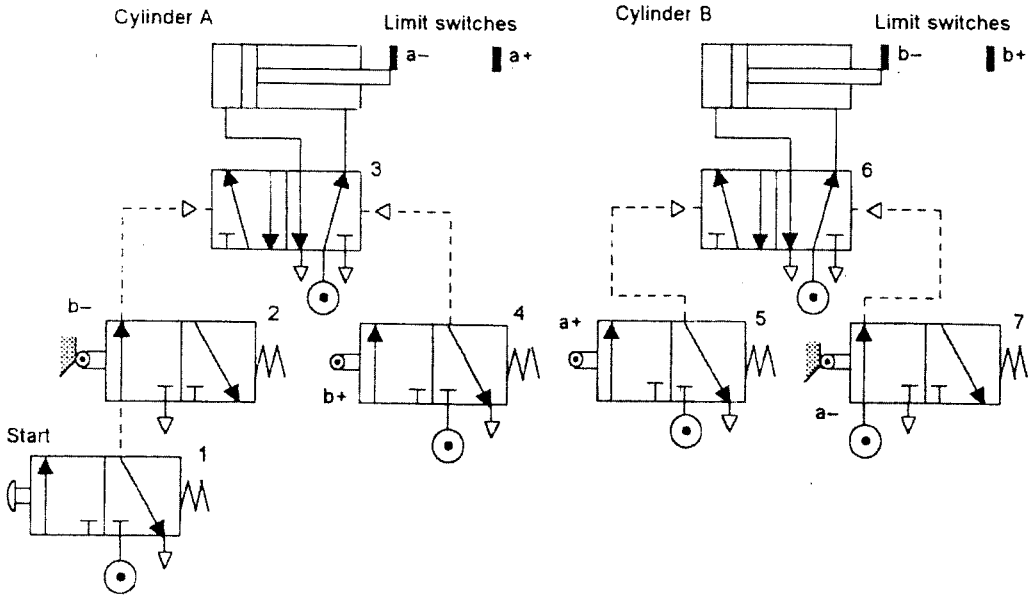
Soalan 4

a) Apakah perbezaan antara kawalan silinder satu tindakan dengan silinder dwi tindakan? Lukiskan simbol kedua-dua jenis silinder ini.

(4 markah)

b) Rajah S4.1 menunjukkan satu litar jujukan pneumatik yang mengandungi dua silinder dwi tindakan. Analisa sistem aliran garis pandu yang terdapat dalam rajah tersebut dan terangkan jujukan pemanjangan dan pemendekan rod silinder apabila udara dibekalkan pada sistem. Keadaan awal semua rod silinder adalah dalam keadaan memendek.

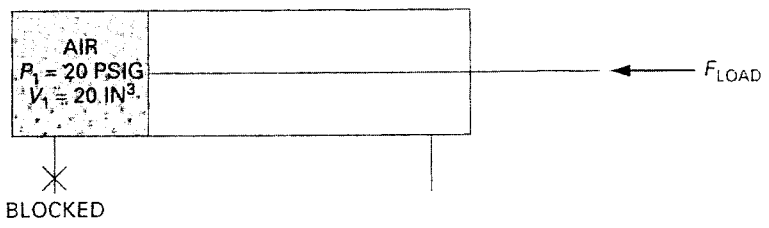
(12 markah)



Rajah S4.1

c) Sebuah piston di dalam silinder pneumatik dengan diameter 2 inci seperti dalam Rajah S4.2 memendek 5 inci daripada keadaan asal (P_1 = 20 psig, V_1 = 20 in^3) disebabkan beban luaran yang dikenakan pada rod. Jika liang pada hujung silinder piston tersebut disekat, cari tekanan yang baru dengan menganggarkan bahawa suhu adalah tidak berubah.

(4 markah)



Rajah S4.2

Soalan 5

a) i. Kira saiz yang diperlukan untuk sesebuah penerima yang membekalkan udara pada satu sistem pneumatik yang mneggunakan 30 scfm untuk 10 minit antara 120 psi dan 100 psi sebelum pemampat menjalankan semula operasi.

ii. Apakah saiz yang diperlukan jika pemampat sedang beroperasi dan mengeluarkan udara pada 6 scfm?

(8 markah)

b) Udara pada 100°F melalui orifis dengan dimaeter 0.5 inci mempunyai pemalar kapasiti aliran $C_v = 7$. Jika tekanan hulu, $P_1 = 125$ psi, apakah kadar aliran maksimum dalam unit scfm?

(4 markah)

c) Sebuah silinder pneumatik satu tindakan mempunyai piston berdiameter 3 inci dan lejang sepanjang 12 ini beroperasi pada 100 psig dan membuat salingan pada kadar 30 kitar per minit. Kira penggunaan udara dalam scfm. (Udara dalam cfm pada keadaan atmosfera ialah 14.7 psia dan 68°F)

(4 markah)

d) Nyatakan **4** faktor penting yang perlu diambil kira dalam mereka bentuk sesebuah litar pneumatik.

(4 markah)

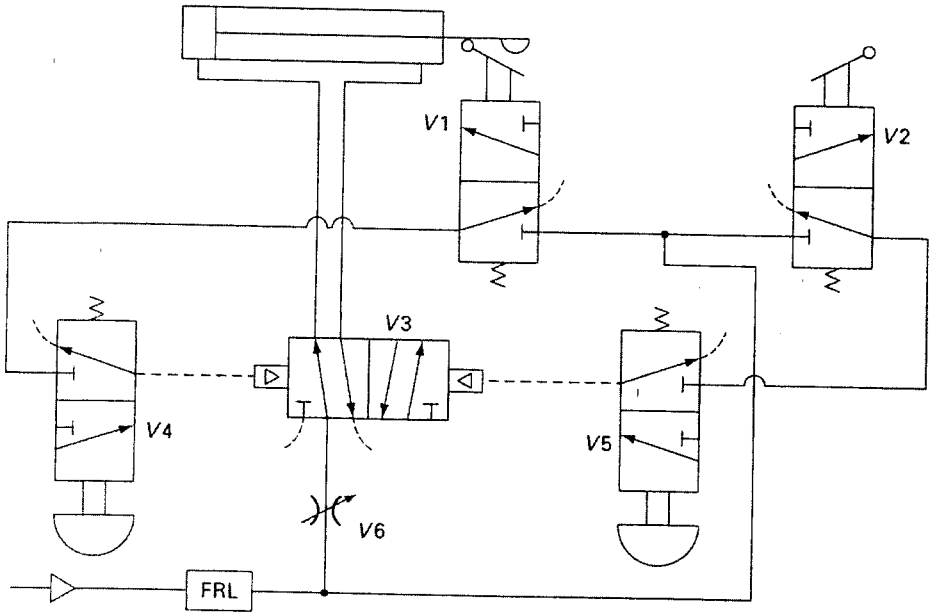
Soalan 6

a) Lihat Rajah S6.1.

i) Apakah yang terjadi pada silinder sekiranya injap V4 ditekan?

ii) Apakah yang terjadi pada silinder sekiranya injap V5 ditekan?

(4 markah)



Rajah S6.1

b) Lihat Rajah S6.2. Silinder 1 tidak akan menahan beban semasa silinder 2 memendek. Ubahsuai litar tersebut dengan menambah sebauh injap pandu sehala dan perpaipan yang bersesuaian supaya silinder 1 dapat bertahan pada posisisnya walaupun silinder 2 memendek. (Lukis litar yang telah diubahsuai).

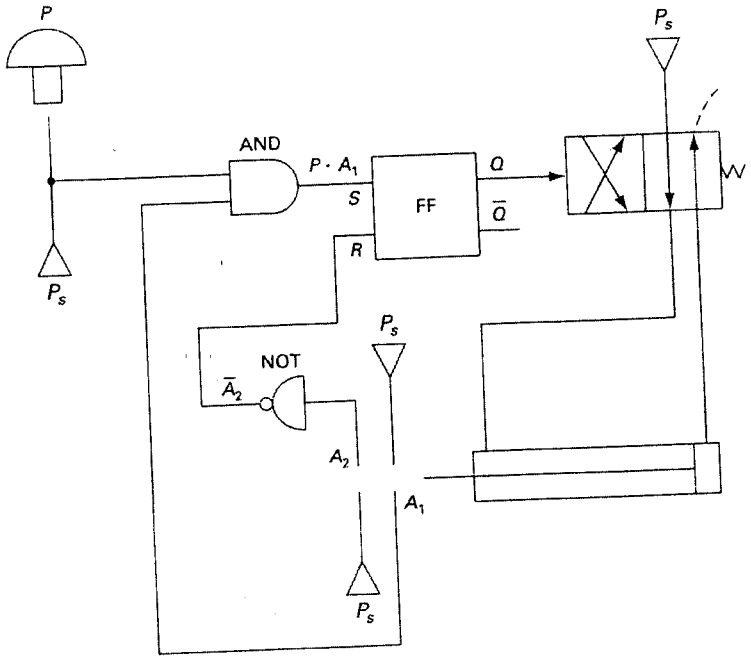
(10 markah)

c) Nyatakan 3 kaedah MPL (moving-part logic) boleh digerakkan.

(6 markah)

Soalan 7

a) Terangkan operasi sistem logik bendalir dalam Rajah S7.1. (10 markah)



Rajah S7.1

b) Lukis rajah tetangga logik PLC (programmable logic controller) untuk setiap persamaan Boolean di bawah:

i. $Z = A + B$

ii. $Z = A \cdot B$

iii. $Z = A \cdot (B + C)$

iv. $Z = (A + B) \cdot C \cdot D$

v. $Z = A \cdot \overline{B} \cdot C + \overline{D} + E$

(10 markah)

(ENGLISH VERSION)

Question 1

a) State **3** differences between pneumatic system and hydraulic system.

(6 marks)

b) List down **4** advantages and disadvantages of pneumatic system.

(8 marks)

c) List down the components involved in hydraulic system and state down its function.

(6 marks)

Question 2

a) Figure S2.1 shows a hydraulic press. The data is given as follows:

$A_1 = 4 \text{ in}^2$

$A_2 = 40 \text{ in}^2$

$S_1 = 2 \text{ in}$

$F_1 = 200 \text{ lb}$

Find:

i) F_2

ii) S_2

iii) Ratio between energy input to energy output

(6 marks)

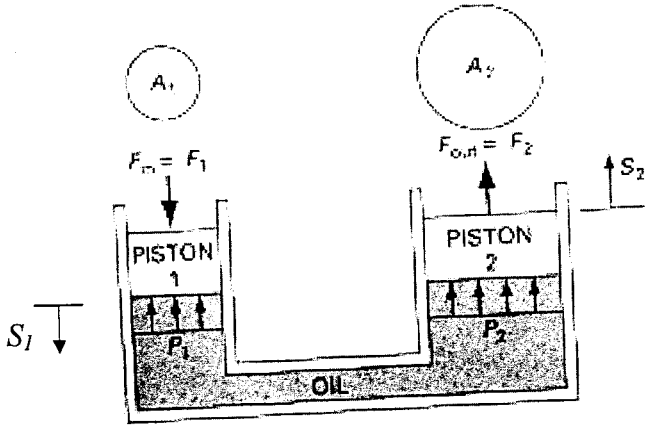


Figure S2.1

b) Figure S2.2 shows a pressure booster system to drive load, F through hydraulic cylinder. The data given as follows:

$P_1 = 100$ psi

$A_1 = 20$ in^2

$A_2 = 1$ in^2

$A_3 = 25$ in^2

i) Find F?

ii) Explain the advantages of using pressure booster.

(4 marks)

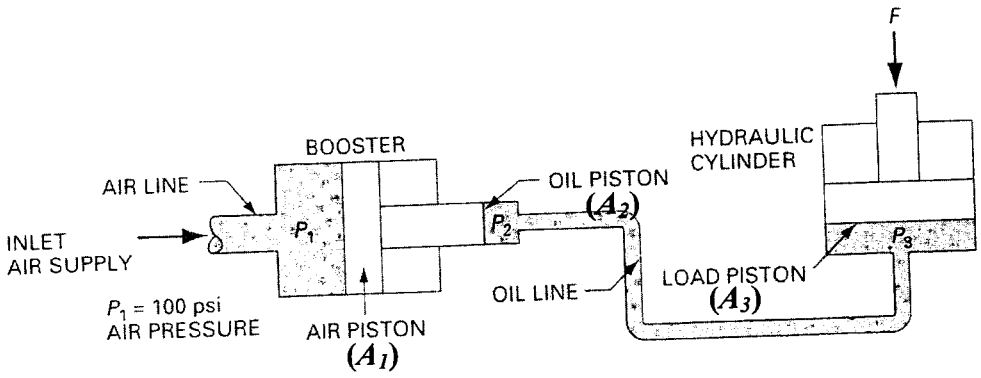


Figure S2.2

c) Figure S2.3 shows a hydraulic system with the given data:

i) hydraulic pump horsepower = 5

ii) pump flow = 30gpm

iii) inside diameter of pipe = 1in

iv) specific gravity of oil = 0.9

Find pressure athydraulic motor when pressure at station 1 inside hydraulic tank is atmospheric and the head loss, H_L due to friction between station 1 and 2 is 30ft.

(10 marks)

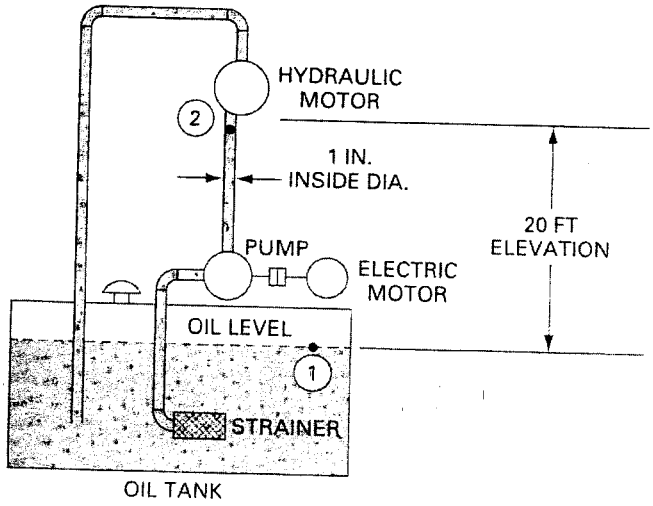


Figure S2.3

Question 3

a) Vane pump is one of positive displacement pump. Explain in detail the operation of this pump.

(4 marks)

b) A pump has a displacement volume of 5 in^3. The actual flow rate is 20 gpm at the speed of 1000 rpm and pressure 1000 psi. If the actual torque is 900 in.lb, find

i) the pump overall efficiency

ii) theoritical torque value of the operating pump

(8 marks)

c) Give **4** example of pressure control valve and its symbols.

(8 marks)

Question 4

a) What is the difference between single-acting cylinder and double-acting cylinder. Draw the symbol for each cylinder.

(4 marks)

b) Figure S4.1 shows a pneumatic sequence circuit of two double-acting cylinder. Analyze the pilot flow line system in the figure and explain the sequence of extending and retraction of the rod involve when air is supply to the system. The initial condition of all rod are in retarct position.

(12 marks)

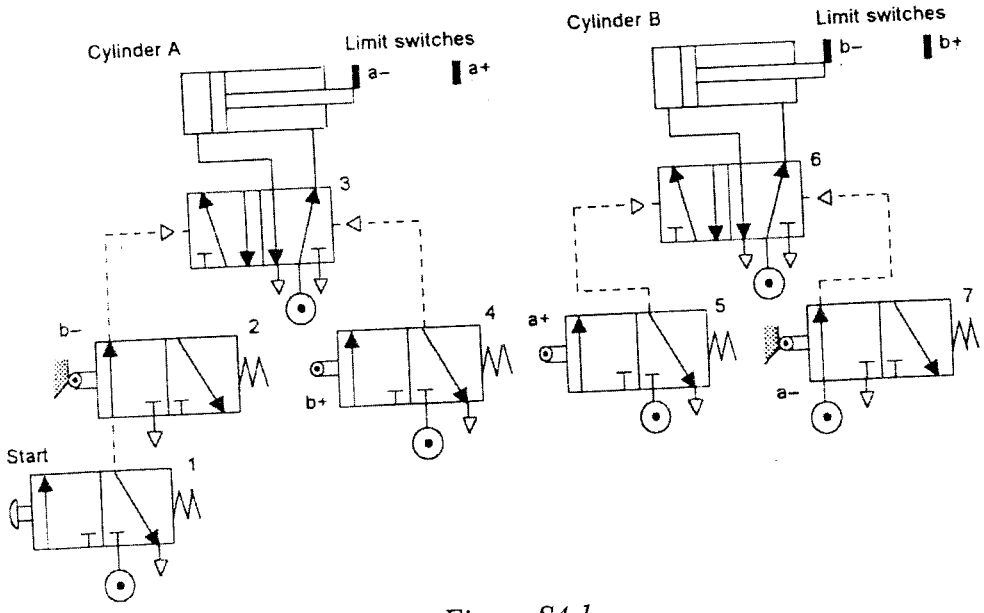


Figure S4.1

c) A piston inside a pneumatic cylinder with diameter of 2 in. As in Figure S4.2 retracts 5 in from its original position (P_1 = 20 psig, V_1 = 20 in^3) due to external load on the rod. If the port at the blank end of the piston is blocked, find the new pressure by assuming there is no temperature change.

(4 marks)

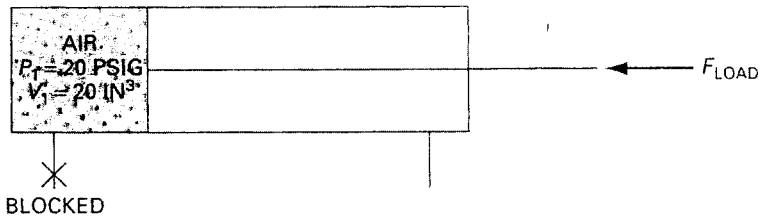


Figure S4.2

Question 5

a) i) Calculate the size required for a receiver to supply air to a pneumatic system that consume 30 scfm for 10 min between 120 psi and 100 psi before compressor resumes its operation.

ii) What is the size required if the compressor is operating and delivering air at 6 scfm?

(8 marks)

b) Air at 100°F flow through orifice with diameter 0.5 in and flow capacity constant, C_v = 7. If the upstream pressure, P_1 = 125 psia, what is the air maximum flow rate in unit scfm?

(4 marks)

c) A single-acting pneumatic cylinder has a piston with diameter 3 in and stroke 12 in operating at 100 psig and reciprocating at 30 cycles per min. Calculate the consumption of air in scfm. (cfm of air at standard atmospera conditions of 14.7 psia and 68°F).

(4 marks)

d) State 4 important factor that need to be considered when designing a pneumatic circuit.

(4 marks)

Question 6

a) Refer to Figure S6.1,

i) What happens to cylinder if V4 is depressed?

ii) What happens to cylinder if V5 is depressed?

(4 marks)

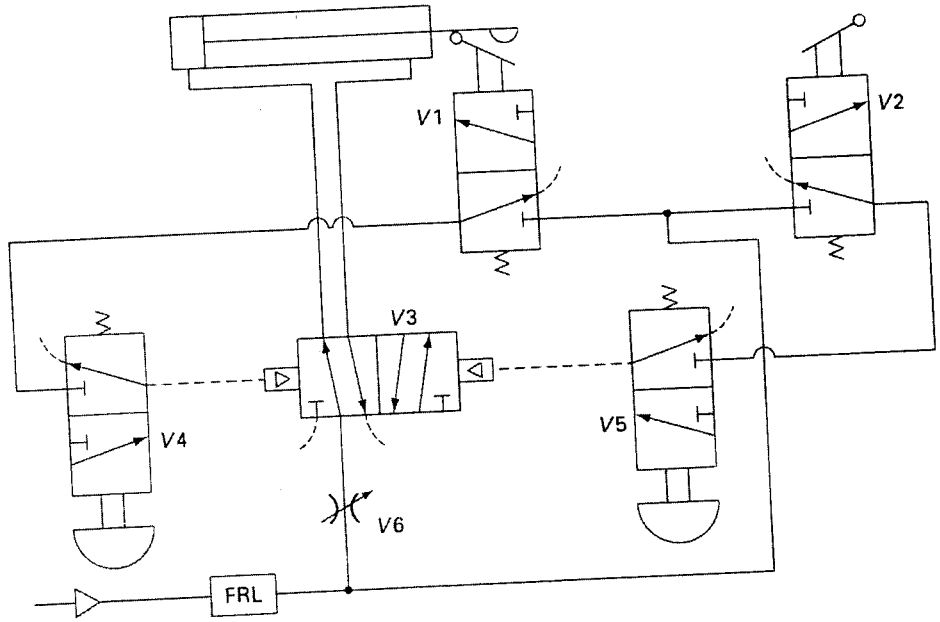


Figure S6.1

b) Refer to Figure S6.2. Cylinder 1 will not hold a load when cylinder 2 is retracting. Modify the circuit by adding a pilot check valve and appropriate piping so that cylinder will hold even though cylinder 2 is at retract position. (Draw the modified circuit).

(10 marks)

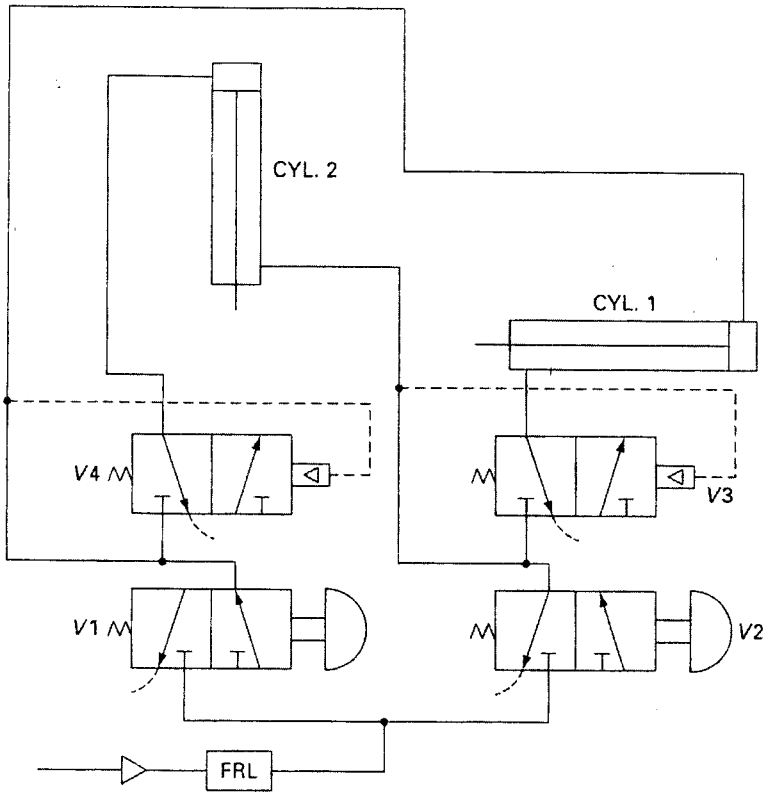


Figure S6.2

c) Name 3 methods to actuate MPL (moving-part logic)

(6 marks)

Question 7

a) Explain the operation of fluid logic system in Figure S7.1.

(10 marks)

b) Draw PLC (Programmable Logic Controller) ladder diagram rung for the every Boolean equations below:

i) $Z = A + B$

ii) $Z = A \cdot B$

iii) $Z = A \cdot (B + C)$

iv) $Z = (A + B) \cdot C \cdot D$

v) $Z = A \cdot \overline{B} \cdot C + \overline{D} + E$

(10 marks)

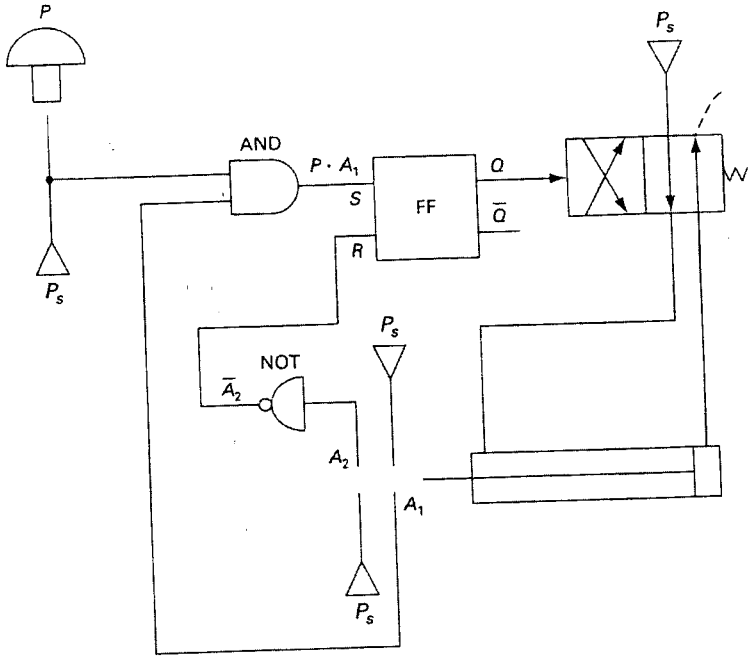


Figure S7.1

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FORMULA

Pressure-force relationship: $P = \frac{F}{A}$

Pascal's Law: $P_1 = P_2$

Energy: $Energy = FS$

Bernoulli's equation: $Z_1 + \frac{P_1}{\gamma} + \frac{\upsilon_1^2}{2g} = Z_2 + \frac{P_1}{\gamma} + \frac{\upsilon_1^2}{2g}$

Energy equation

(Modified Bernoulli's equation): $Z_1 + \frac{P_1}{\gamma} + \frac{\upsilon_1^2}{2g} + H_p - H_m - H_L = Z_2 + \frac{P_1}{\gamma} + \frac{\upsilon_1^2}{2g}$

Pump Head: $H_p(ft) = \frac{3950 \times (HHP)}{Q(gpm) \times S_g}$

Fluid velocity: $\upsilon = \frac{Q}{A}$

$\upsilon(ft/s) = \frac{0.408Q(gpm)}{[D(in.)]^2}$

Specific gravity: $S_g = \frac{\gamma}{\gamma_{water}}$

Theoretical flow rate of a pump: $Q_T(gpm) = \frac{V_D(in^3/rev) \times N(rpm)}{231}$

Pump volumetric efficiency: $\eta_\upsilon = \frac{Q_A}{Q_T} \times 100$

Pump mechanical efficiency: $\eta_m = \frac{P(psi) \times Q_T(gpm)/1714}{T_A(in.\cdot lb) \times N(rpm)/63{,}000} \times 100$

$\eta_m = \frac{T_T}{T_A} \times 100$

Pump overall efficiency: $$\eta_o = \frac{\eta_v \times \eta_m}{100}$$

Boyle's Law: $$\frac{V_1}{V_2} = \frac{P_2}{P_1}$$

Air receiver size: $$V_r(ft^3) = \frac{14.7t(\text{min}) \times (Q_r - Q_c)scfm}{(P_{\max} - P_{\min})psi}$$

Flow rate of air through an orifice: $$Q(scfm) = 22.7C_v\sqrt{\frac{(P_1 - P_2)psi \times P_2(psia)}{T_1(^oR)}}$$

Air capacity rating of compressors: $$Q_1 = Q_2\left(\frac{P_2}{P_1}\right)\left(\frac{T_1}{T_2}\right)$$

Absolute pressure: absolute pressure (psia) = gage pressure (psig) + 14.7

Absolute temperature: absolute temperature (^{o}R) = temperature (^{o}F) + 460