SULIT

KOLEJ UNIVERSITI TEKNIKAL KEBANGSAAN MALAYSIA

PEPERIKSAAN SEMESTER 1

SESI 2006/2007

FAKULTI KEJURUTERAAN PEMBUATAN

KOD MATAPELAJARAN	**: DMFD 3413**
MATAPELAJARAN	**: KUASA BENDALIR**
PENYELARAS	**: MOHD IRMAN BIN RAMLI**
KURSUS	**: DIPLOMA KEJURUTERAAN PEMBUATAN**
MASA	**: 9.00 PG – 12.00 TGH HR (3 JAM)**
TARIKH	**: 7 NOVEMBER 2006**

Arahan kepada calon :

1. **Kertas ini mengandungi 7 soalan secara keseluruhannya**
2. **Sila jawab SEMUA soalan di seksyen 1 dan pilih hanya DUA (2) soalan dari seksyen 2.**
3. **Setiap soalan mengandungi 20 markah.**
4. **Jawab setiap soalan di helaian yang berasingan.**

KERTAS SOALAN INI TERDIRI DARIPADA SEBELAS (9) MUKA SURAT SAHAJA (TERMASUK MUKA SURAT HADAPAN)

SULIT

SECTION 1 : Answer All Questions

Question 1.

a) Give two(2) differences between pneumatic fluid power and hydraulic fluid power.

[2 marks]

b) Give five(5) basic components which are required in a hydraulic circuit.

[5 marks]

c) List down three(3) properties that a hydraulic fluid should posses.

[3 marks]

d) Define the terms *density*, *specific weight* and *specific gravity*.

[6 marks]

e) Give three (3) phenomenons of a liquid which has high viscosity and one (1) when it has low viscosity.

[4 marks]

Question 2.

a) Explain the meaning of Bernoulli's equation, together with sketches to derive it and related equation.

[8 marks]

b) (i) Define the term *torque*

(ii) Define the term *efficiency*

(iii) Differentiate between *energy* and *power*.

[4 marks]

c) A hydraulic cylinder is to compress a car body down to bale size in 10 sec. The operation requires a 9-ft stroke and a 5,000-lb force. If a 2,000 psi pump has been selected, and assuming the cylinder is 98% efficient, find

(i) The required piston area

(ii) The necessary pump flow rate

(iii) The hydraulic horsepower delivered to the cylinder

(iv) The output horsepower delivered by the cylinder to the load

[8 marks]

Question 3

a) Give the physical difference between laminar and turbulent flow.

[4 marks]

b) State the findings that creates the *Reynolds number* N_R.

[3 marks]

c) The kinematic viscosity of a hydraulic oil is 0.001 m^2/s. If it is flowing in a 25 mm diameter pipe at a velocity of 5 m/s, what is the Reynolds number? Is the flow laminar or turbulent?

[3 marks]

d) A vane pump is to have a volumetric displacement of 110 cm^3. It has a rotor diameter of 75 mm, a cam ring diameter of 65.3 mm and a vane width of 45.6 mm. Find the eccentricity.

[3 marks]

e) A pump has a displacement volume of 99.3 cm^3. It delivers 0.0125 m^3/s of oil at 1000 rpm and 60 bars. If the prime mover input torque is 123.4 Nm, find

(i) The overall efficiency of the pump

(ii) The theoretical torque required to operate the pump.

[7 marks]

SECTION 2 : Answer two(2) questions out of four(4)

Question 4

a) Explain the definitions of

(i) Positive displacement pump

(ii) Centrifugal pump

(iii) Fixed displacement pump

(iv) Variable displacement pump

[8 marks]

b) Give five(5) important considerations when choosing a pump for a specific application.

[5 marks]

c) A gear pump has a 82.6 mm outside diameter, a 57.2 mm inside diameter and a 25.4 mm width. If the actual pump flow rate at 1800 rpm and rated pressure is 0.00183 m^3/s, determine the volumetric efficiency?

[7 marks]

Question 5

a) Give a difference between a single acting and a double acting hydraulic cylinder.

[2 marks]

b) For a hydraulic motor, define *volumetric*, *mechanical* and *overall efficiency*.

[6 marks]

c) A hydraulic motor receives a flow rate of 18 gpm at a pressure of 1600 psi. The motor speed is 500 rpm. If the motor has a power loss of 5 HP, find the motor

(i) Actual output torque

(ii) Overall efficiency

[4 marks]

d) A pump supplies oil at 25 gpm to a 1.5-in diameter double acting hydraulic cylinder. If the load is 1200-lb (extending and retracting) and the rod diameter is 0.75-in, find the

(i) Hydraulic pressure during the extending stroke

(ii) Piston velocity during the extending stroke

(iii) Hydraulic pressure during the retracting stroke

(iv) Piston velocity during the retracting stroke

[8 marks]

Question 6

a) Give two(2) reasons for using pneumatics rather than hydraulics in certain application.

[4 marks]

b) Describe the function of

(i) Air filter

(ii) Air pressure regulator

(iii) Lubricator

[6 marks]

c) An air hydraulic intensifier is connected to a hydraulic cylinder driving a 12000-lb load, as shown in Figure 1. The diameter of the hydraulic cylinder piston is 1.5-in.

The following data applies to the intensifier:

Air piston diameter = 8-in

Oil piston diameter = 1-in

Intensifier stroke = 2-in

Intensifier cycle frequency = 1 stroke/s

Determine :

(i) Volume displacement of the intensifier oil piston

(ii) Volume displacement of the hydraulic cylinder piston per intensifier stroke

(iii) Movement of the hydraulic cylinder piston per intensifier stroke

(iv) Volume displacement of the blank end of the intensifier air cylinder piston

(v) Oil flow rate from the intensifier

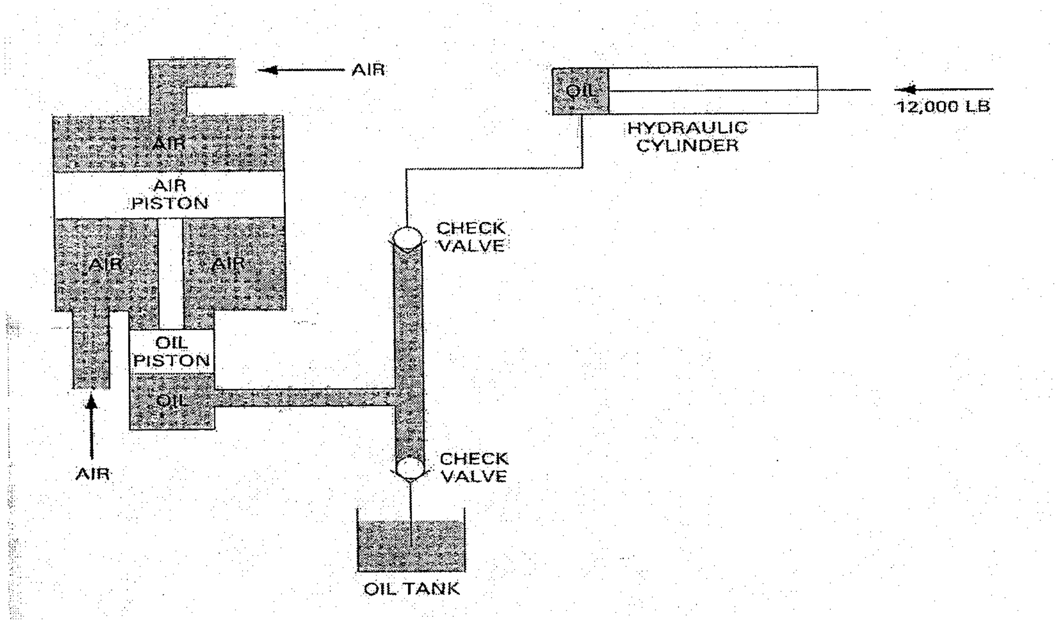

Figure 1 : Air-hydraulic intensifier system

[10 marks]

Question 7

a) Name four(4) important considerations when designing a pneumatic circuit.

[4 marks]

b) What is the pneumatic vacuum system?

[2 marks]

c) Describe, with sketches, the operation of single acting cylinder in a simple pneumatic circuit.

[7 marks]

d) Describe, with sketches, the operation of double acting cylinder in a simple pneumatic circuit.

[7 marks]

Related formulas:

Pressure : $P = \frac{F}{A}$ ---1

$P(lb/in^2)$, $F(lb)$, $A(in^2)$

Volumetric displacement $V_D\,(ft^3) = A(ft^2) \times S(ft)$ ----------------------------2

Flow rate : $Q\,(ft^3/s) = \frac{V_D(ft^3)}{t(s)}$ ---3

$$Q = \frac{A(ft^2) \times s(ft)}{t(s)}$$

$Q(gpm) = 449 \times Q\,(ft^3/s)$

$W = F \times S$

$W(in.lb)$, $F(lb)$, $S(in)$ --4

Power = FS/t ---5

since S/t = v, power = Fv

Power(*in.lb/s*), velocity(*in/s*),

Brake or torque horse power, $HP = \frac{TN}{63000}$ -----------------------------------6

T = torque (*in.lb*) ---7

N = rotational speed (*rpm*) ---8

Hydraulic horse power, $HHP = \frac{p(psi) \times Q(gpm)}{1714}$ ------------------------------9

Mechanical horse power $HP = \frac{F(lb) \times v(ft/s)}{550}$ --------------------------------10

Output horse power, $OHP = HHP \times \frac{\eta}{100}$ -------------------------------------11

or OHP = HHP – HP loss

Overall efficiency (1) $\eta_o = \frac{outputHP}{HHP}$ --12

Reynolds Number = $N_R = \dfrac{v(m/s)D(m)}{\nu(m^2/s)}$ --13

Volumetric displacement (m^3)= $V_D = \dfrac{\pi}{2}(D_C + D_R)eL$ ------------------------14

L (width of rotor) (m)

e (eccentricity) (m)

D_R (diameter of rotor) (m)

D_C (diameter of cam ring) (m)

Overall efficiency (2), $\eta_o = \eta_v \times \eta_m$ ---15

Volumetric efficiency, $\eta_v = \dfrac{Q_A}{Q_T}$ --16

Mechanical efficiency, $\eta_m = \dfrac{pQ_T}{T_A N}$ ---17

$N(rad/s) = 2\dfrac{\pi}{60} \times N(rpm)$ ---18

Q_T = pump theoretical flow rate (m^3/s)

T_A = actual torque deliver to pump (Nm)

P = pump discharge pressure (Pa)

Gear pump volumetric displacement = $V_D = \dfrac{\pi}{4}(D_0^2 - D_i^2)L\ (m^3)$ -----------19

Theoretical flow rate of a pump = $Q_T = V_D N(m^3/s)$ --------------------------20

Cylinder extension force = $F_{ext} = pA_p$

Cylinder extension velocity = $V_{ext} = \dfrac{Q_{in}}{A_p}$

Cylinder retraction force = $F_{ret} = p(A_p - A_r)$

Cylinder retraction velocity = $V_{ret} = \dfrac{Q_{in}}{A_p - A_r}$

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