53 (IE 711) FLPC

2017

FLUIDIC POWER AND CONTROL

Paper : IE 711

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1. *(a)* Briefly describe a few applications of fluid powered system. What are the advantages of fluid powered system over other source of powers ? 5+3=8

   (b) Explain the working of air to hydraulic pressure booster. 4

   (c) Derive the equation of pressure difference for a venturimeter. 4

   (d) A hydraulic cylinder is to compress a car body down to bale size in 10 *sec.* The operation requires a 10*ft* stroke and 8000*lb* force. If a 1000*psi* pump is selected and assuming the cylinder is 100% efficient, find

   (i) the required piston area

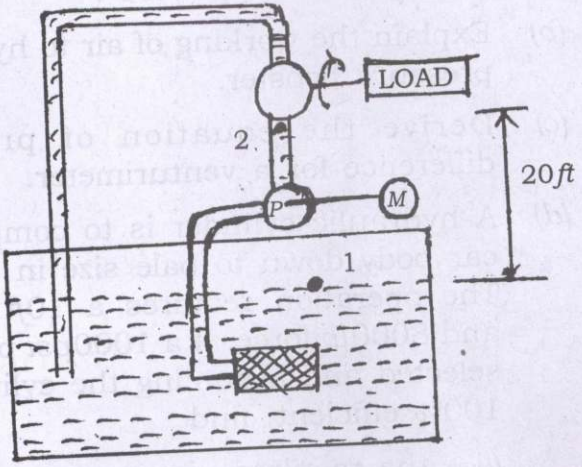
(ii) the necessary pump flow rate and

(iii) the hydraulic horse power delivered to the cylinder.

4

2. (a) A pump is adding 5*HP* to the fluid, whose flow rate is 30*gpm*, the pipe has a 1*inch* inside diameter and specific gravity of oil is 0·9. Find the pressure available at the inlet to the hydraulic motor. The pressure at station 1 in the hydraulic tank is atmospheric pressure. The head loss H_L due to friction between stations 1 and 2 is 30*ft* of oil.

10



(b) What is the head loss across a 50*mm* wide open gate valve when oil $\left(\nu = 0{\cdot}001\, m^2/s\right)$ and $\gamma = 8800\, N/m^3$ flows through it at the rate of $0{\cdot}02\, m^3/sec$. [k for wide open gate valve=0·19] 5

(c) Hydraulic oil ($\nu = 100 cs$) flows through a 1*inch* diameter commercial steel pipe at a rate of 30*gpm*. What is the equivalent length of 1*inch* wide open globe valve placed in the line (k=10). 5

3. (a) Explain the pumping theory with necessary diagram ? Describe the working of external gear pump and axial piston pump. 3+5+5=13

(b) What is volumetric efficiency and mechanical efficiency of a pump ? Why is volumetric efficiency always less than unity ?

Find the flow rate of an axial piston pump that delivers at 1000*rpm*. The pump has nine numbers of 15*mm* diameter pistons arranged on a 125*mm* diameter piston circle. The offset angle is set at 10° and the volumetric efficiency is 94%. 2+1+4=7

4. *(a)* Enlist the pneumatic fluid conditioning elements. Explain the working of air filter and air pressure regulator. 2+6=8

(b) Explain the working of a balanced vane motor. 5

(c) A hydrostatic transmission operating at 1000*psi* pressure has the following data

Pump	Motor
$V_D = 5\ inch^3$	$V_D = ?$
$\eta_v = 82\%$	$\eta_v = 92\%$
$\eta_m = 88\%$	$\eta_m = 90\%$
$N = 500\ rpm$	$N = 400\ rpm$

Find the displacement of the motor and motor output torque. 7

5. *(a)* Explain the working of pressure reducing valve. 5

(b) Describe how directional servocontrolled valve works. 6

(c) Illustrate the working of I/P converter ?

Explain how the excess pressure in a pneumatic system can be released by rupture disc pressure relief valve. 5+4=9

6. *(a)* Derive the transfer function of a flapper nozzle based pneumatic proportional controller. 10

(b) Design the logic gates AND and OR using MPL devices. 4

(c) Describe how smart positioner works. 6

7. Write short notes on ***any four*** of the following : 4×5=20

(i) Pressure safety vaves

(ii) Pneumatic amplifier

(iii) Piston pump

(iv) Butterfly valve

(v) Inherent characteristics of control valve.
