53 (IE 711) FLPC

2014

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) On the basis of which two laws, fluid powered devices work ? Write *two* advantages of hydraulic system over pneumatic system.   1+2=3

     (b) Explain the working of hand operated hydraulic jack. Prove that the displacement of the bigger diameter cylinder is lesser than the smaller diameter cylinder in a hydraulic jack.   4+2=6

(c) Briefly explain the following terms :

$$1 \cdot 5 \times 4 = 6$$

    (i) Viscosity

    (ii) Bulk modulus

    (iii) Head loss

    (iv) Gauge pressure and vacuum pressure.

(d) A hydraulic cylinder is used to displace a body to its destination point in 15*sec*. This operation requires 20*feet* stroke, 8000*lb* force. If a 1000*psi* pump is selected and assuming the cylinder 80% efficient, find

    (i) the required piston area *(ii)* the necessary pump flow rate *(iii)* the hydraulic horse power delivered to the cylinder.   5
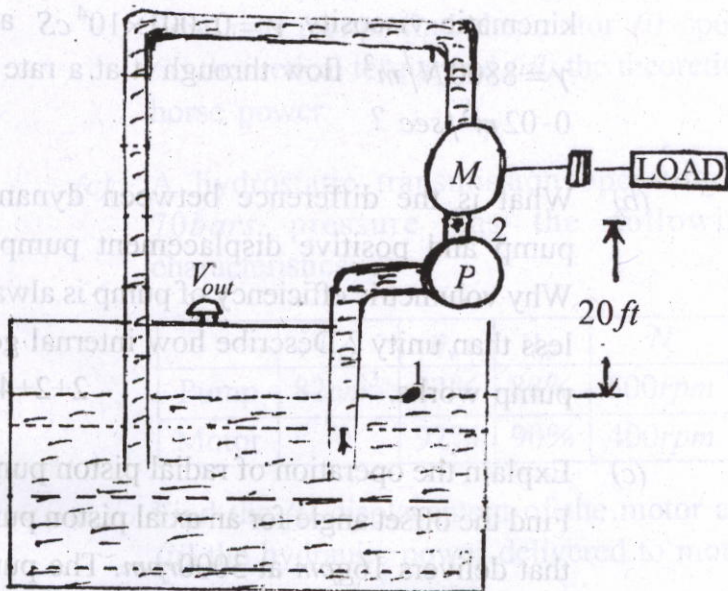
2.   *(a)* What is Torricellis' theorem ? Derive the expression of velocity of fluid coming out off an opening made at a depth '*h*' from the top of a tank.   4

    (b) What is the potential energy of 100 gallon of water at 100*ft*.   3

(c) For a hydraulic system, a pump is adding

5HP to the fluid, pump flow is 30gpm, the pipe has a 1inch inside diameter, the specific gravity of oil is 0·9, the kinematic viscosity of oil is 100cS. Calculate the pressure available at the inlet to the hydraulic motor, if the pressure at the oil top surface level in the tank is 0psig and the head loss between station 1 and 2 is 10ft.   13

3. (a) Determine the head loss across a 50mm wide open gate valve $(k = 0.19)$, when oil of kinematic viscosity $\nu = 0.001 \times 10^4 cS$ and $\gamma = 8800\,N/m^2$ flow through it at a rate of $0.02\,m^3/sec$? 4

(b) What is the difference between dynamic pump and positive displacement pumps? Why volumetric efficiency of pump is always less than unity? Describe how internal gear pump works. 2+2+4=8

(c) Explain the operation of radial piston pump. Find the offset angle for an axial piston pump that delivers 16gpm at 3000rpm. The pump has nine 1/2 $inch$ diameter pistons arranged on a 5$inch$ diameter piston circle. The volumetric efficiency is 95%. 4+4=8

4. (a) Derive the expression of torque capacity of a hydraulic motor.

Explain how an inline piston motor works. 5+5=10

(b) The volumetric displacement of a hydraulic motor is $6in^3$. If its pressure rating is 2000*psi* and receives oil from a 15*gpm* theoretical flow rate pump, find the motor *(i)* speed *(ii)* theoretical torque and *(iii)* the theoretical horse power. 5

(c) A hydrostatic transmission operating at 70*bars* pressure has the following characteristics

	V_D	η_v	η_m	N
Pump	$82cm^3$	82%	88%	500*rpm*
Motor	?	92%	90%	400*rpm*

Find the *(i)* displacement of the motor and *(ii)* the hydraulic power delivered to motor. 5

5. (a) Describe the operation of three way and solenoid actuated valve. 4+4=8

(b) Design a hydraulic system to control the speed of a hydraulic motor and explain its operation. 8

(c) Explain the working of vane compressor. 4

6. (a) Determine the output pressure of a compressor operating with the following data

(a) Actual power required to drive the compressor is $20kW$ (b) Overall efficiency of the compressor is 75% (c) Compressor delivers 4 standard m^3/min and (d) Compressor inlet pressure is $100kPa$ abs.

5

(b) Derive the transfer function of a hydraulic proportional controller. 6

(c) Design a memory function using MPL devices. What are moving part logic devices ?

Design a system using MPL devices for sequential controlling of two double acting cylinder. 1+2+6=9

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

(i) Air lubricator

(ii) Hydrostatic transmission system

(iii) Screw compressor

(iv) Unbalanced Vane pump

(v) Pressure reducing valve.