53 (IE 711) FPCN

2016

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)* What are the advantages and disadvantages of pneumatic system? Describe how fluidic power can be more effective in certain applications as compared to its electrical and mechanical counterparts.

   Explain the operation of hand operated hydraulic jack. 3+3+4=10

(b) Define the following terms : 3

(i) Bulk modulus

(ii) Head loss

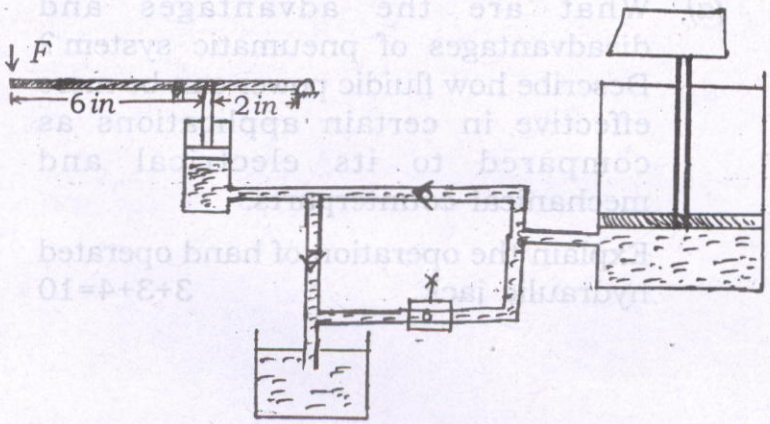
(iii) Specific gravity

(iv) Absolute viscosity

(v) Specific weight and

(vi) Gage pressure

(c) An operator makes one complete cycle per second interval using a hydraulic jack whose diagram is given below. Each complete cycle consists of two pump cylinder strokes (intake and power). The pump cylinder has 1 *inch* diameter piston and the load cylinder has 4 *inch* diameter piston.



If the average hand force is 25*lb* during the power stroke, how much load can be lifted and how many cycles are required to lift the load 10 *inch* assuming no oil leakage? The pump piston has 2 *inch* stroke. 7

2. *(a)* Define Torricelli's theorem. Obtain the expression of velocity of free jet of liquid flowing from the port of a tank. 1+4=5

(b) A siphon made of 1 *inch* inside diameter pipe is used to maintain a constant level in a 20*ft* deep tank. If the siphon discharge is 30*ft* below the top of the tank, what will be the flow rate if the fluid level is 5*ft* below the top of the tank? 5

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

(d) Find the linear approximation for the change of flow of liquid flowing through an axial piston pump governed by the equation $Q = 25AN \tan\theta$.

Where A is the piston area, N is the *rpm* of pump and θ is the offset angle. 5

3. (a) What are the differences between dynamic and positive displacement pumps?

Explain the theory of working of centrifugal pump. 2+5=7

(b) Why the pump efficiency is always less than unity?

Describe how balanced vane pump operates. 2+5=7

(c) How much hydraulic power would a pump produce operating at 140*bars* and delivering $0{\cdot}001 m^3/s$ of oil? Determine the motor power required to drive the pump if its overall efficiency is 85%. 6

4. *(a)* What is the difference between rotary actuator and motor?

Explain the working principle of inline piston motor. 1+6=7

(b) Why lubricator is a must in the pneumatic system? Explain how the pressure is controlled using a pneumatic pressure regulator. 2+6=8

(c) The actual power required to drive a compressor which delivers 75 *scfm* of air at 100 *psig*. Find out the theoretical power if the efficiency is 80%. 5

5. *(a)* Explain how rupture disc pressure relief valve works. 5

(b) With necessary schematic diagram explain the working of pressure relief valve. 5

(c) What do you mean by valve coefficient ? Explain the working of 2 position 3-way valve and solenoid actuated valve. 2+4+4=10

6. (a) Derive the transfer function of a hydraulic spool valve and cylinder combination. 10

(b) With the help of schematic diagram explain the working of fail safe system with overload protection. 6

(c) Explain how pneumatic amplifier works. 4

7. (a) Explain the operation of valve positioner. 4

(b) Describe the operation of sequential controlling of two double acting cylinders. 6

(c) Write short notes on ***any two*** of the following : 2×5=10

(i) Control valve noise

(ii) I/P Converter

(iii) Phenomena of cavitation

(iv) Gear Pump.
