53 (IE 711) FLPC

2021

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 primary functions of a hydraulic fluid ? 2

   (b) Name the properties a hydraulic fluid should possess. 2

   (c) State Torricellis theorem. 2

   (d) Explain how a syphon operates. 2

   (e) What is meant by the terms Elevation head, Pressure head and Velocity head ? 2

(f)   A cylindrical container has a diameter of $0.5\,m$ and a height of $1\,m$. If it is to be filled with a liquid having a specific weight of $2000\ N/m^3$, how many kilogram of this liquid must be added.

2

(g)   For the pump in *Fig. 1*, $Q_{out} = 30\ gpm$ of oil having a specific gravity of 0.9, specific weight = 56.2.

(i)   What is Q_{in}?

(ii) Find the pressure difference between points A and B if the input power to the pump is $2\,HP$.
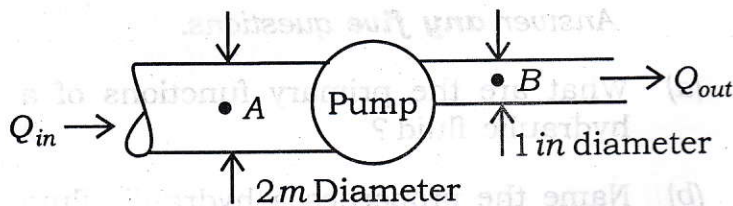
8

Fig. 1

2.   (a)   Explain the advantages of positive displacement pump over hydrodynamic pumps.   5

(b)   Explain the working of a variable displacement vane pump.   5

(c) A gear pump has 75 mm outside diameter, 50 mm inside diameter and a 25 mm width. If volumetric efficiency is 90% at rated pressure, what is the corresponding flow rate? The pump speed is 1000 rpm.   10

3. (a) For a Crane system of Fig. 2, determine the hydraulic cylinder force required to lift 2000 lb. load.   10
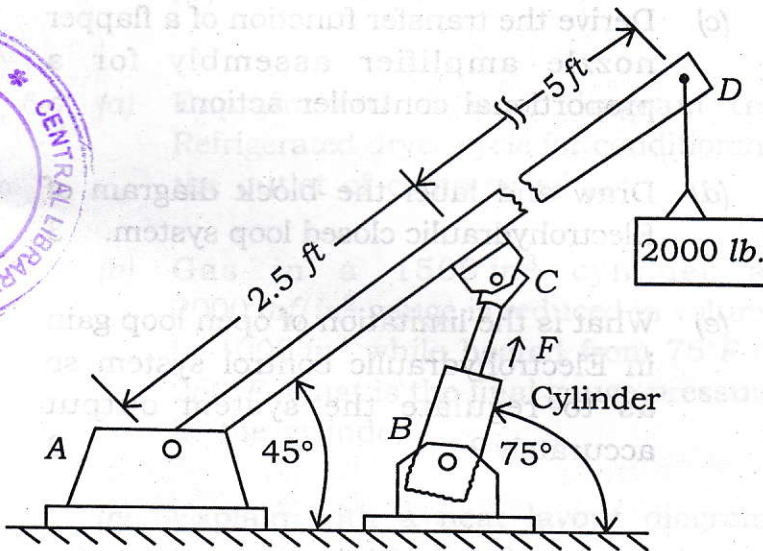
Fig. 2

(b) Determine the hydraulic cylinder force required to drive non axial loads using the first class, second class and third class lever system.   10

4. (a) Explain the use of dashpot in hydraulic control system. Find out the step change responses. 5

(b) Derive the transfer function of a hydraulic proportional plus integral controller for a pilot operated servo valve. 5

(c) Derive the transfer function of a flapper nozzle amplifier assembly for a proportional controller action. 5

(d) Draw and label the block diagram of Electrohydraulic closed loop system. 3

(e) What is the limitation of open loop gain in Electrohydraulic control system so as to regulate the system output accurately ? 2

5. (a) Explain with a neat diagram, the working of a smart positioner used with control valves. 8

(b) Explain the working of an I/P converter. Label the parts in the diagram. 7

(c) Discuss the specific factors considered for design and selection of pressure relief devices for industrial safety — 5

(i) Back pressure

(ii) Discharge capacity

(iii) Inlet pressures losses

(iv) Blow down.

6. (a) Explain with a neat diagram the Refrigerated dryer cycle for conditioning the outlet of compressed air. 5

(b) Gas in a $1500\ in^3$ cylinder at $2000\ lbf/in^2$ gauge is reduced in volume to $1000\ in^3$ while heated from $75°F$ to $250°F$. What is the final gauge pressure in the cylinder ? 5

(c) Explain with a neat layout diagram, the pneumatic distribution system of compressed air for a new plant being set up in your factory. 5

(d) Explain the working of Rotary lobe screw compressor. 5

7. (a) For the logic circuit of *Fig.* 3 use Boolean algebra to show that value 3 is not required. 5

Fig. 3

(b) Fluid Power is controlled primarily through the use of control devices. Discuss the three types of devices and explain their functional use in Fluid Power circuits. 6

(c) A pump delivers oil to a cylindrical storage tank as shown in *Fig.* 4. A faulty electric pressure switch which controls

the electric motor driving pump, allows the pump to fill the tank completely. This causes the pressure P1 near the base of the tank to build up to 15 *psig*. What force is exerted on the top of the tank ? What does the pressure difference between the tank top and point 1 say about Pascal's law ?   5
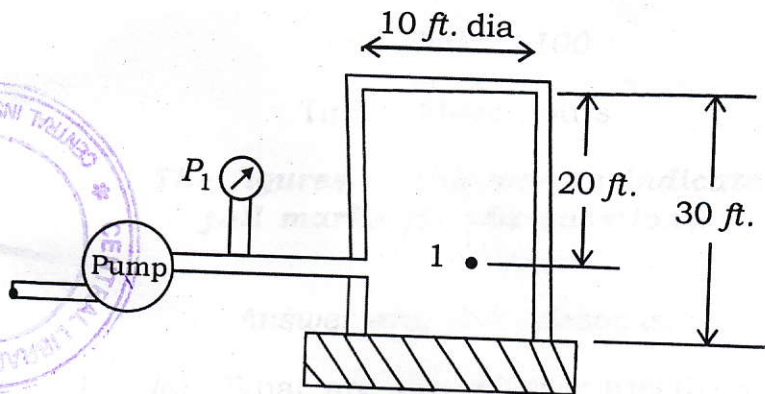

Fig. 4

(d) Air is used at a rate of 30 *cfm* from a receiver at 90°F and 125 *psi*. If the atmospheric pressure is 14.7 *psia* and the atmospheric temperature is 70°F, how many *cfm* of free air must the compressor provide ?   4

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