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)* Write down the advantages of fluid powered systems over the electrical systems. 2

(b) What are the desirable characteristics of a fluid to be used in fluid power based systems ? 2

(c) Explain with necessary diagram how a hand operated hydraulic jack can be used to lift and lower a heavy object. 4

(d) A hydraulic cylinder can compress a body to the desired extent in 5 *sec.* This operation requires a 100 *inch* stroke and 800*lb* force. If a 1000*psi* pump has been selected and the system is having a frictional force of 100*lb*; Calculate the required piston area, necessary pump flow rate and the hydraulic horsepower delivered to the cylinder. 6

(e) Explain how venturi effect is used in automobile curburetor. Derive the expression of pressure differential in venturi. 2+4=6

2. (a) What are the different sources of energy losses in case of a hydraulic system ? Determine the head loss and pressure drop a valve of $k = 0{\cdot}2$ with diameter of 1 *inch*, when oil (S.G. = 0·9) flows through it at a rate of 30*gpm*.

2+4=6

(b) The oil tank for the hydraulic system of *Fig. 1* is air pressurised at 10*psig*. The inlet line to the pump is 10*ft* below the oil level. The pump flow rate is 30*gpm*. Find the pressure at station 2. If —

(a) There is no head loss between stations 1 and 2

(b) There is a 25*ft* head loss between stations 1 and 2. 14

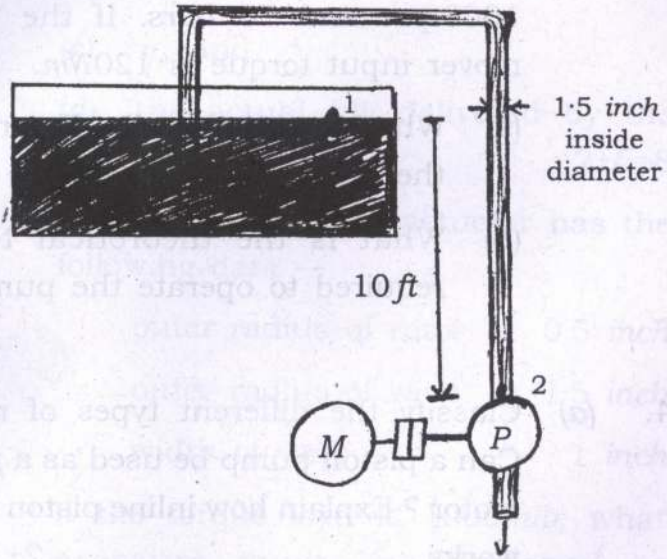

Fig. 1

3. *(a)* What are the differences between positive displacement and dynamic pump ? Explain the working of centrifugal pump. 2+4=6

(b) Why 100% efficiency is not achieved in case of hydraulic pump ? Explain the working of a lobe type gear pump and unbalanced vane pump. 2+6=8

(c) A pump has a displacement volume of $100 cm^3$. It delivers $0{\cdot}0015 m^3/sec$ at $1000 rpm$ and 70 *bars*. If the prime mover input torque is $120 Nm$. 6

(a) What is the overall efficiency of the pump ?

(b) What is the theoretical torque required to operate the pump ?

4. *(a)* Classify the different types of motor. Can a piston pump be used as a piston motor ? Explain how inline piston motor works. 2+1+5=8

(b) What is the mechanical efficiency and volumetric efficiency ?

A hydraulic motor has a displacement of $164 cm^3$ and operates with a pressure of 70 *bars* and a speed of 2000*rpm*. If the actual flow rate consumed by the motor is $0{\cdot}006 m^3/sec$ and the actual torque delivered by the motor is 170*Nm*. Find

(a) η_v

(b) η_m

(c) η_o and

(d) the actual *kW* delivered by the motor. 2+6=8

(c) A single vane rotary actuetor has the following data —

outer radius of rotor = 0·5 *inch*

outer radius of vane = 1·5 *inch*

width of vane = 1 *inch*

If the torque load is 1000*inlb*, what pressure must be developed to overcome the load ?

5. *(a)* Derive the transfer function of force balance type pneumatic proportional controller. 10

(b) Draw a neat sketch of pneumatic pressure transmitter and explain its working. 7

(c) Enlist the factors for the selection of a suitable valve. 3

6. *(a)* With the help of a neat sketch describe an application of pressure relief valve with rupture disc as a safety device. 10

(b) Explain the phenomena of cavitation and flashing. 6

(c) Describe the working of a smart positioner. 4

7. *(a)* Derive the transfer function of hydraulic proportional controller. 10

(b) Implement an OR and Memory gate using MPL devices. 3

(c) Explain the sequential control of two double acting cylinders using necessary diagram. 7
