53 (IE 711) FLPC

2018

FLUIDIC POWER AND CONTROL

Paper : IE 711

Full Marks : 100

Time : Three hours

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

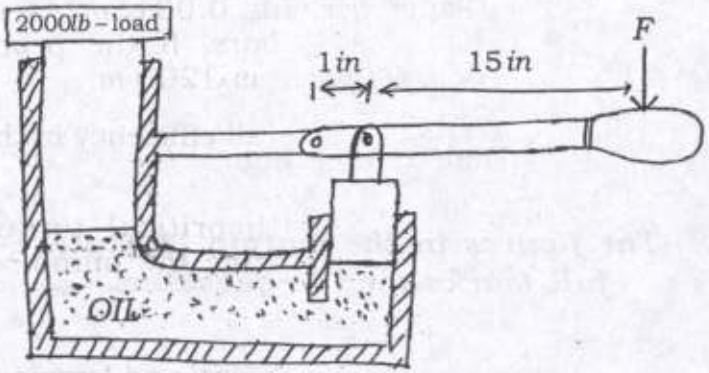
*Answer **any five** questions.*

1. *(a)* "Fluid power is the muscle"– Discuss the advantages of fluid power, also state the disadvantages of fluid power. 3+2

   (b) Why can't air be used for all fluid power applications ? 1

   (c) List out the components in pneumatic system. 4

(d) The hydraulic jack shown in the *fig.* is filled with oil. The large and small pistons have diameter of 3 *in* and 1*in* respectively. What force '*F*' on the handle is required to support the 2000*lb* weight ? If the force moves down 5*in*, how far will the weight be lifted ? 5



(e) What is the head loss across a 50*mm* wide open gate valve when oil $\left(\upsilon = 0.001mm^2/s, r = 8800N/m^3\right)$ flows through it at a rate of $0.02m^3/s\,(k = 0.19)$? 5

2. (a) Explain the working of —

(i) External/Internal gear pump

(ii) Radial piston pump. 5+5=10

(b) Find the flow rate in units of L/S that an axial pump delivers at 1000*rpm*. The pump has nine 15*mm* diameter pistons arranged on a 125*mm* diameter piston circle. The offset angle is set at 10° and volumetric efficiency is 94%. 5

(c) A pump has a displacement volume of $100cm^3$. It delivers $0.0015m^3/s$ at 1000*rpm* and 70 *bars*. If the prime mover input torque is 120*N-m*,

(i) what is the overall efficiency of the pump ?

(ii) what is the theoritical torque required to operate the pump ? 5

3. (a) Define the term 'moment' and 'moment arm'. 2

(b) Differentiate between 1st, 2nd and 3rd class lever system. 6

(c) What is the purpose of a hydraulic shock absorber ? Name *two* applications. 2

(d) Find the cylinder force '*F*' required to move weight of 6000*lb* –

(i) on a horizontal surface at a constant velocity. The co-efficient of friction equals 0.14.

(ii) Along a direction which is 30° from the horizontal, the weight is moved at constant velocity.

(iii) The weight is lifted upward in a vertical direction. The weight is moved at a constant velocity of $8 ft/sec$.

(iv) Accelerate the weight from zero velocity to a velocity of $8 ft/sec$ in $0.50 sec$.

2+2+3+3=10

4. (a) Define volumetric, mechanical and overall efficiency for a hydraulic motor. 3

(b) What is hydrostatic transmission? Name the advantages it typically possess. 4

(c) Explain why, theoritically, the torque output from a fixed displacement hydraulic motor operating at constant pressure is the same regardless of changes in speed. 3

(d) A hydraulic motor has a displacement of 10 in^3 and operate with a pressure of $1000 psi$ and a speed of $2000 rpm$. If

the actual flow rate consumed by the motor is $95 gpm$ and the actual torque delivered by the motor is 1500 $in–lb$, find– 6

(i) η_v

(ii) η_m

(iv) η_0

(e) What is the importance of linearisation? State an example using numerical values to prove that the error percentage due to linearisation is quite within limits. 5

5. (a) Derive the transfer function of Electrohydraulic servo valve. 10

(b) Explain the operation and working of a regenerative cylinder circuit. 3

(c) Derive the formula for cylinder ratio of extending and retracing speed. 3

(d) A pressure relief valve contains a poppet with a 0.75 in^2 area on which system pressure acts. During assembly a spring with a spring constant of $2500 lb/in$ is installed to hold the poppet against its seat. The adjustment

mechanism is then set so that the spring is initially compressed 0.20 *in* from its free length condition. In order to pass full pump flow through the valve at the PRV pressure setting, the poppet must move 0.10 *in* from its fully closed condition. Determine the —

(i) Cracking pressure.

(ii) Full pump flow pressure (PRV pressure setting). 2+2=4

6. *(a)* What is the difference between a flared fitting and a compression fitting? 2

(b) What is meant by schedule number of standard pipe? 1

(c) What is an accumulator? Explain the use of an accumulator as an auxiliary power source. 1+2

(d) What are the various sealing devices? Discuss the characteristics of O-ring and common materials used for seals. 4

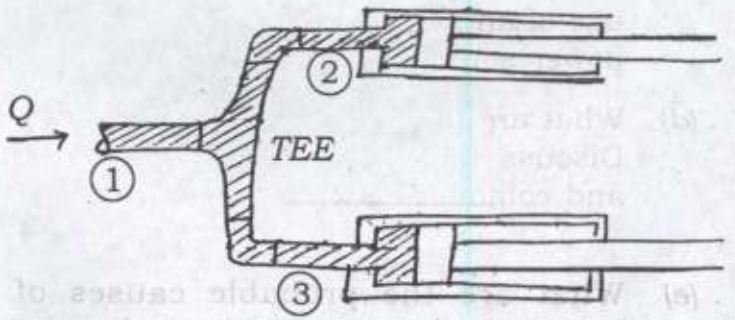
(e) What are the probable causes of hydraulic system problems for the following operations? 8

- Noisy pump

- Slow/erratic motion of actuator
- No pressure
- Overheating of hydraulic fluid

(f) State *four* important environmental issues being considered in industry. 2

7. *(a)* Oil with specific gravity 0.9 enters a tee as shown in *fig.* below with velocity $v_1 = 5m/s$. The diameter at section 1 is $10cm$, the diameter at section 2 is $7cm$, & the diameter at section 3 is $6cm$. If equal flow rates are to occur at sections 2 and 3, find v_2 and v_3. 10



(b) Explain the operation of Spool-type four way valve in the functioning of drilling machine. 5

(c) A pipe handles a flow rate of $0.002 m^3/s$. Find the minimum inside diameter that will provide an average fluid velocity not to exceed $6.1 m/sec$. 5

8. Write short notes on : ***(any four)*** 5×4=20

- Smart positioner
- I/P converter
- Air filter regulator
- Rotameter
- Force-balance booster relay
- MPL circuits (AND, OR, NOT).