FLUID POWER CONTROL
(MECH 3131)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) Modern fluid power is based on the principle of
(a) Newton's second law (b) Stokes' law
(c) Pascal's law (d) Newton's law of viscosity.

(ii) In a simple hydraulic jack, the force amplification is obtained by
(a) increasing area (b) increasing pressure
(c) decreasing pressure (d) decreasing area.

(iii) To direct flow in a predetermined sequence, the valve that is being used is called
(a) direction control valve (b) sequence valve
(c) flow control valve (d) counterbalance valve.

(iv) A double acting cylinder
(a) has rod at both ends (b) area ratio of 2
(c) use fluid power in both directions (d) has two pump connections.

(v) In unloading circuit, the return line pressure is almost _____ for _____ power consumption.
(a) zero, minimum (b) zero, maximum
(c) system pressure, minimum (d) system pressure, maximum.

(vi) Bernoulli's equation is based on principle of conservation of
(a) mass (b) momentum (c) energy (d) force.

(vii) In a regenerative circuit, _____ blocked.
(a) 1 port is (b) 2 ports are (c) 3 ports are (d) all ports are.

(viii) In a regenerative circuit having 2:1 area ratio for piston and rod area
(a) equal speed and force is achieved in both directions
(b) equal force is achieved in both directions
(c) equal speed is achieved in both directions
(d) equal pressure and force is achieved in both directions.

(ix) Solenoids are _____ that provide a force to operate valves.
(a) springs (b) solid levers
(c) electromagnets (d) voltage sources.

(x) A pressure reducing valve
(a) is used to limit its outlet pressure
(b) is used to limit its inlet pressure
(c) is normally a close type valve
(d) is used to supplement pressure relief valve.

Group – B

2. (a) State the basic components required in a hydraulic circuit. What are the advantages of a hydraulic system over a pneumatic system?

(b) Discuss five desired properties of working fluid required in hydraulic system.

(3 + 4) + 5 = 12

3. (a) Explain with neat sketch, the working principle of a vane pump used in fluid power systems.

(b) Define volumetric efficiency, mechanical efficiency and overall efficiency of hydraulic pump used in fluid power circuit.

6 + 6 = 12

Group – C

4. (a) An automobile lift raises a 15600 N car, 2.13 m above the ground floor level. If the hydraulic cylinder contains a piston of diameter 20.32 cm and a rod of diameter 10.16 cm, determine the
(i) Work necessary to lift the car.
(ii) Required pressure.
(iii) Power needed if the lift raises the car in 10s.
(iv) Descending speed of the lift for 0.000629 m^3/s flow rate at the rod end.
(v) Flow rate at the rod end, for the lift to descend in 10s.

(b) (i) What is the function of a hydraulic cylinder in a hydraulic system?
(ii) How is a single-acting cylinder retracted?
(iii) What is a cylinder cushion? What is its purpose?

6 + 6 = 12

5. (a) With sketch, differentiate between First and Second-class lever systems used with hydraulic cylinders to drive loads.

(b) A hydraulic motor has a displacement volume of 164 cm^3 per revolution and operates with a pressure of 70 bar and a speed of 2000 rpm. If the actual flow rate consumed by the motor is 0.006 m^3/s and the actual torque delivered by the motor is 170 Nm, find

(i) Volumetric efficiency (ii) Mechanical efficiency (iii) Overall efficiency (iv) Actual power delivered by the motor in kW.

5 + 7 = 12

Group – D

6. (a) Draw the sectional view and ANSI symbol of a 4/2 Direction Control Valve and explain its working principle.

   (b) Why a pressure reducing valve is employed in a fluid circuit? Draw the ANSI symbol of a pressure reducing valve.

7 + (3+2) = 12

7. (a) With the help of a neat sketch describe the operation of a regenerative cylinder circuit.

   (b) With the help of a circuit diagram explain the operation of double pump hydraulic system.

6 + 6 = 12

Group – E

8. (a) With the help of schematic diagram, briefly explain the operation of (i) Air Filter and (ii) Pressure Regulator used in FRL unit of a pneumatic system.

   (b) Draw the diagram of a meter-out circuit and briefly explain the speed control of hydraulic cylinder using the circuit.

(3 + 3) + 6 = 12

9. (a) Explain the method of control of a single acting cylinder using a solenoid controlled Direction Control Valve and limit switches.

   (b) Explain (with suitable circuit diagrams) the reciprocation of a cylinder using pressure switches.

6 + 6 = 12

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