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 'spring centred DCV', the valve spool is returned to the _____ position by spring force, when the actuating effort is released.
(a) right envelope (b) left envelope
(c) both (a) and (b) (d) centre.

(iii) 'Cracking Pressure' is a term related to
(a) valve opening (b) valve closing
(c) valve bypassing (d) valve throttling.

(iv) A hydraulic actuator is used to convert
(a) pressure energy to mechanical energy
(b) mechanical energy to pressure energy
(c) pressure energy to kinetic energy
(d) kinetic energy to pressure energy.

(v) Hydraulic Power input is defined as
(a) Pressure × Discharge (b) Force × Displacement
(c) Force × Discharge (d) All of the above.

(vi) A pressure reducing valve is normally
(a) open type
(b) close type
(c) both (a) and (b)
(d) same as pressure relief valve.

(vii) 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.

(viii) A meter-in circuit controls the speed of a cylinder during
(a) retraction stroke (b) extending stroke
(c) both (a) and (b) (d) unloading.

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

(x) For same system pressure, leakage losses are
(a) more in Pneumatic system
(b) more in Hydraulic system
(c) zero in Hydraulic system
(d) zero in Pneumatic system.

Group – B

2. (a) Discuss four basic components required in a hydraulic circuit. What are the advantages of fluid power system compared to a mechanical system?

(b) A force of P = 850 N is applied to the smaller cylinder of a hydraulic jack. The area a of the small piston is 15 cm^2 and the area A of the larger piston is 150 cm^2. What load W can be lifted on the larger piston (i) if the pistons are at the same level, (ii) if the large piston is 0.75 m below the smaller one? The mass density ρ of the liquid in the jack is 103 kg /m^3.

(4 + 2) + (3 + 3) = 12

3. (a) What is swash plate? What is the function of shoe plate in inline axial piston pump?

(b) Describe the working principle of external gear pump used in hydraulic circuit, with neat sketch.

(3 + 3) + (4 + 2) = 12

Group – C

4. (a) Define volumetric efficiency, mechanical efficiency and overall efficiency of hydraulic motor. Why is the actual flow rate required by a hydraulic motor higher than the theoretical flow rate?

(b) A hydraulic motor has a displacement of 164 cm^3 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.

(3 + 2) + (4 + 3) = 12

5. (a) Draw the sectional view and symbol of a 4/3 Direction Control Valve. Also describe the operational principle of the same.

(b) With neat sketch briefly discuss the functioning of a Pressure Relief valve.

(3 + 2 + 3) + 4 = 12

Group – D

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

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

7 + 5 = 12

7. (a) Find an expression for the ratio of extending and retracting cylinder speeds for a regenerative cylinder circuit.

(b) With neat sketch, explain the pump unloading circuit.

6 + 6 = 12

Group – E

8. (a) Discuss two main advantages of pneumatic system compared to hydraulic system. What are the functions of air receiver, aftercooler and exhaust silencers used in pneumatic system?

(b) With a sketch, mention the various external parts of a Piston type reciprocating air compressor used in pneumatic system.

(2 + 2 + 2 + 2) + 4 = 12

9. (a) Explain the process of reciprocation of a cylinder using pressure and limit switches.

(b) Draw the symbols of different limit and push button switches.

8 + (2 + 2) = 12