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) Source for generating high pressure air in a pneumatic system is called
(a) pump (b) actuator (c) compressor (d) blower.

(ii) Pneumatics and Hydraulics require following component to direct and regulate the flow
(a) energy sources (b) control valves (c) air receiver (d) actuators.

(iii) For a simple hydraulic jack, output is gained as multiplication of
(a) flow rate (b) force (c) power (d) pressure.

(iv) A check valve allows flow in
(a) 4 directions (b) 3 directions (c) 2 directions (d) 1 direction.

(v) Speed of a hydraulic motor depends on
(a) flow rate of oil (b) pressure of oil (c) viscosity of oil (d) density of oil.

(vi) Overall efficiency of hydraulic motor can be calculated as
(a) mechanical efficiency × hydraulic efficiency
(b) volumetric efficiency × hydraulic efficiency
(c) mechanical efficiency × volumetric efficiency
(d) none of the above.

(vii) 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.

(viii) The lubricator used in FRL unit follows the principle of
(a) rotameter (b) venturimeter (c) flow-nozzle (d) orificemeter.

(ix) A swash plate is a component attached to
(a) gear pump (b) vane pump
(c) inline axial piston pump (d) radial piston pump.

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

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? [(CO1)(Remember/LOCQ)]
(b) Briefly discuss the desired properties that a fluid used in hydraulic system should possess. What are the disadvantages of a hydraulic fluid with very high viscosity? [(CO1)(Remember/LOCQ)]

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

3. (a) Explain with neat sketch, the working principle of a vane pump used in fluid power systems. [(CO2)(Understand/LOCQ)]
(b) A gear pump has an outside diameter of 82.6 mm, inside diameter of 57.2 mm and a width of 25.4 mm. If the actual pump flow is 0.00183 m^3/s in 1800 RPM, What is the volumetric efficiency? [(CO2)(Analyse/IOCQ)]

7 + 5 = 12

Group - C

4. (a) With sketch, differentiate between First and Second-class lever systems used with hydraulic cylinders to drive loads. [(CO2)(Understand/LOCQ)]
(b) For the crane system as shown in Fig.1, determine the hydraulic cylinder force required to lift a 2000 N load. [(CO3)(Evaluate/HOCQ)]

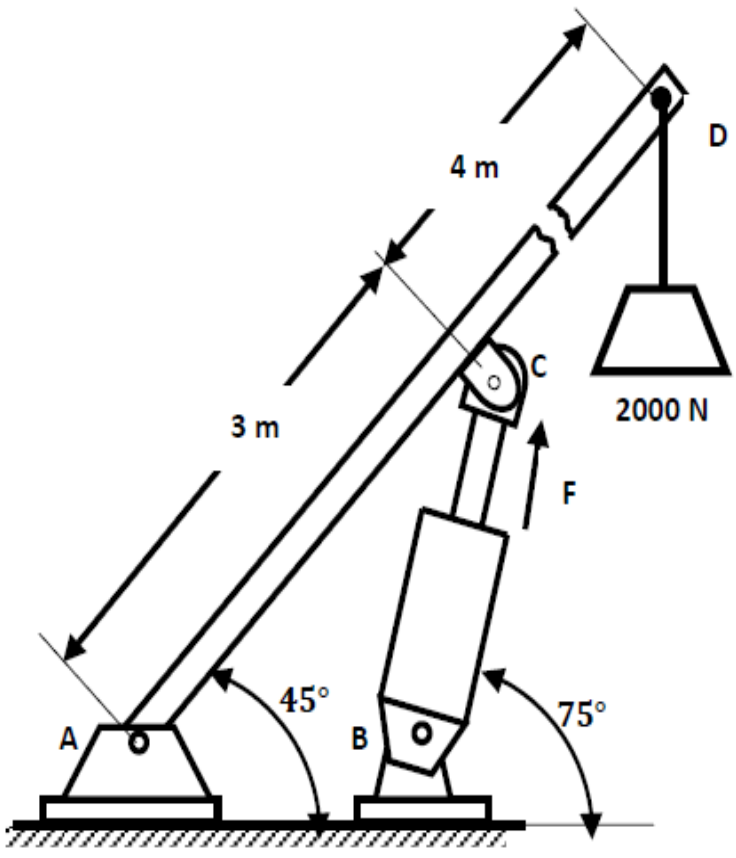

Fig.1

6 + 6 = 12

5. (a) Define hydraulic power. Obtain its expression in terms of flow rate and pressure of the system. [(CO5)(Understand/LOCQ)]
(b) A hydraulic motor has a displacement volume 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. [(CO5)(Evaluate/HOCQ)]

6 + 6 = 12

Group – D

6. (a) With the help of a circuit diagram explain the operation of double pump hydraulic system. [(CO4)(Analyse/IOCQ)]

   (b) A double acting cylinder is hooked up in a regenerative circuit. The relief valve is set at 150 kgf/cm^2 pressure. The piston area is 120 cm^2 and the rod area is 60 cm^2. If the pump flow is 100 litre/min, find the cylinder speed and load-carrying capacity during (i) extending stroke (ii) retracting stroke. [(CO5)(Evaluate/HOCQ)]

6 + 6 = 12

7. (a) Explain the function of pressure compensated flow control valve with sketch. [(CO2)(Analyze/IOCQ)]

   (b) Explain the operation of following valves with symbol:
   (i) 2/2 Direction Control Valve (ii) Pressure Relief Valve. [(CO2)(Remember/LOCQ)]

6 + (3 + 3) = 12

Group - E

8. (a) Draw the diagram of a meter-in circuit and briefly explain the speed control of hydraulic cylinder using the circuit. [(CO4)(Analyse/IOCQ)]

   (b) 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. [(CO3)(Remember/LOCQ)]

6 + 6 = 12

9. (a) Write short notes on (i) Relay and (ii) Solinoid. [(CO6)(Remember/LOCQ)]

   (b) Explain (with suitable circuit diagrams) the reciprocation of a cylinder using pressure switches. [(CO6)(Understand /LOCQ)]

(2 + 2) + 8 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	57.3	23.95	18.75

Course Outcome (CO):

After the completion of the course students will be able to

CO1	Describe the term fluid power, its advantages, the basic components and working fluid used in fluid power systems.
CO2	Explain different types of pumps, actuators, valves and other components used in hydraulic and pneumatic circuits.
CO3	Relate the fundamental laws of fluid mechanics with fluid power and control systems.
CO4	Examine various fluid power circuits.
CO5	Formulate the performance parameters of different components used in fluid power systems.
CO6	Appraise the use of different components in pneumatic systems and electrical devices to control fluid power circuits.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question