В.ТЕСН/МЕ/5^{тн} SEM/MECH 3131/2021 FLUID POWER CONTROL (MECH 3131)

Time Allotted : 3 hrs

Full Marks: 70

 $10 \times 1 = 10$

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and <u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> 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:
 - (i) Source for generating high pressure oil in a hydraulic system is called [C01]
 (a) pump
 (b) actuator
 (c) compressor
 (d) blower
 - (ii) 'Power Pack' is a component of [CO1]
 (a) Electrical system
 (c) Pneumatic system
 - (iii) Hydraulic Power output is defined as [CO5]
 (a) Pressure × Discharge
 (c) Force × Discharge
- (b) Force × Displacement

(b) Hydraulic system

(d) Mechanical system.

- (d) Pressure × Displacement.
- (iv) Cushioning in hydraulic cylinder is done to [CO2]
 - (a) prevent shock due to stopping loads at the end of the piston stroke
 - (b) prevent heat due to seal friction
 - (c) increase the velocity of the cylinder
 - (d) prevent overloading of the cylinder.

(v) Which of the following mounting is used to allow angular movement of hydraulic cylinder? [CO2]

- (a) Flange mounting
- (c) Clevis mounting

- (b) Foot mounting
- (d) Flush side mounting.
- (vi) In an axial piston motor, the piston [CO2]
 - (a) reciprocates parallel to the axis of the cylinder block.
 - (b) reciprocates perpendicular to the axis of the cylinder block.
 - (c) reciprocates at any angle to the axis of the cylinder block.
 - (d) rotates about the axis of the cylinder block.
- (vii) The speed control circuit best suited in application where negative loading may occur is [CO4]
 (a) meter-in circuit
 (b) unloading circuit

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	(c) meter-out circuit		(d) synchronization circuit.	
(viii)	Continuity equation (a) mass	n is based on principle of con (b) momentum	nservation of [CO3] (c) energy	(d) force.
(ix)	A shoe plate is a component attached to [CO2](a) gear(b) vane pump(c) inline axial piston pump(d) radial piston pump.		p.	
(x)	A switch that keeps the contact open or close, based on the system pressur known as [CO6](a) pressure relief valve(b) pressure reducing valve (c) limit switch(c) limit switch(d) pressure switch.		oressure is svalve	

Group – B

- (a) State the basic components required in a pneumatic circuit. Compare the advantages and disadvantages of a hydraulic system and a pneumatic system.
 [(C01)(Remember/LOCQ)]
 - (b) Compare the use of fluid power to a mechanical system by listing the advantages and disadvantages of each system. [(CO1)(Understand/LOCQ)]

(3+4)+5=12

- 3. (a) Explain with neat sketch, the working principle of a radial piston pump used in fluid power systems. [(CO2)(Understand/LOCQ)]
 - (b) Draw the performance curves of a positive displacement rotary pump and mention the factors affecting the actual flow rate. [(CO2)(Remember/LOCQ)]

7 + 5 = 12

Group – C

4. (a) For the hydraulic system shown in Figure 1, the following data are given:

The pump is adding 8 kW energy to the fluid (i.e. the hydraulic power of the pump).

The pump flow rate is 0.002m³/s. The pipe has an inside diameter of 25 mm.

The specific gravity of oil is 0.8.

Point 2 is at an elevation of 0.6 m above the oil level, that is, point 1.

The head loss due to friction in the line between points 1 and 2 is 15 m.

Determine the fluid pressure at point 2, the inlet to the hydraulic motor. Neglect the pressure drop at the strainer. The oil tank is vented to atmosphere. [(CO3)(Evaluate/HOCQ)]



Fig.1

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(b) A hydrostatic transmission operating at 100 bar pressure has the following characteristics:

For Pump, $V_{D, pump} = 100 \text{ cm}^3$, $\eta_V = 85\%$, $\eta_m = 90\%$, $N_{pump} = 1000 \text{ rpm}$ For Hydraulic motor, $\eta_V = 94\%$, $\eta_m = 92\%$, $N_{motor} = 500 \text{ rpm}$. Symbols have their usual meaning.

Find the (i) volumetric displacement of motor V_{D, motor} and (ii) actual output torque delivered by motor. [(CO5) (Evaluate/HOCQ)]

6 + 6= 12

- 5. (a) A hydraulic cylinder is to compress a body down to bale size in 10 sec. The operation requires a 3 m stroke and a 40000 N force. If a 10MPa pump has been selected, assuming the cylinder to be 100% efficient, find (i) the required piston area (ii) the necessary pump flow rate (iii) the hydraulic power delivered to the cylinder (iv)Assuming a 400 N friction force and a leakage of 1 LPM, what will be the necessary pump flow rate and total flow rate. [(CO5)(Evaluate/HOCQ)]
 - (b) Define volumetric efficiency, mechanical efficiency and overall efficiency of hydraulic motor. Why the actual flow rate required by a hydraulic motor is higher than the theoretical flow rate? [(CO5)(Understand/LOCQ)]

7 + (3 + 2) = 12

Group – D

- 6. (a) Explain (with diagram) the synchronization operation of two cylinders in a hydraulic circuit. [(CO4)(Analyse/IOCQ)]
 - (b) What is meant by 'pump unloading'? Draw and briefly explain a pump unloading circuit with ANSI symbols. [(CO4)(Analyse/IOCQ)]

6 + (2 + 4) = 12

- 7. (a) A double acting cylinder is hooked up in a regenerative circuit. The relief valve is set at 100 kgf/cm² pressure. The piston area is 130 cm² and the rod area is 65cm². 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)]
 - (b) With neat sketch, briefly discuss the working principle and function of Non-Pressure compensated Flow Control Valve. [(CO2) (Remember/LOCQ)]

(3+3)+6=12

Group – E

- 8. (a) Briefly discuss the factors to be considered for selection of pipeline in pneumatic systems. [(CO6)(Remember/LOCQ)]
 - (b) Draw a pneumatic circuit diagram for operation of a double acting cylinder and discuss about its performance. [(CO4)(Analyse/IOCQ)]

6 + 6 = 12

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- 9. (a) What is the function of limit switch? Draw the symbols of different limit switches. [(CO6)(Understand/LOCQ)]
 - (b) Explain the method of control of a double acting cylinder using a solenoid controlled Direction Control Valve and limit switches.
 [(CO6)(Understand/LOCQ)]

(2+4)+6=12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	55.2%	18.75%	26.05%

Course Outcome (CO):

After the completion of the course students will be able to

CO 1	Describe the term fluid power, its advantages, the basic components and working
	fluid used in fluid power systems.
CO 2	Explain different types of pumps, actuators, valves and other components used in
	hydraulic and pneumatic circuits.
CO 3	Relate the fundamental laws of fluid mechanics with fluid power and control
	systems.
CO 4	Examine various fluid nower circuits
	Examine various nulu power en cures.
CO 5	Formulate the performance parameters of different components used in fluid power
	systems.
CO 6	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

Department & Section	Submission link:	
ME	https://forms.gle/7q6goeCwh37E7hfH9	