BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: B.TECH **SEMESTER : VI**
BRANCH: MECHANICAL **SESSION : SP/2025**

SUBJECT: ME373 HYDRAULIC AND PNEUMATIC CONTROL

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	A hydraulic motor having a displacement of 0.5 L/rev operates at a speed of 75 rpm and is required to develop an output torque of 1200 N-m. The volumetric and mechanical efficiencies of the motor are 09. And 0.94, respectively. Determine I. Pressure drop over the motor II. Input flow III. The overall efficiency	[5]	I	IV
Q.1(b)	Define actuators and classify various types of actuators with examples.	[2]	I	I
Q.1(c)	Draw a suitable sketch of a variable displacement vane pump and describe its working principle.	[3]	I	II
Q.2(a)	Explain the working principle of the Pressure Compensated Flow control valve with a suitable diagram, and discuss its advantages over other flow control valves.	[5]	II	II
Q.2(b)	A Spring-Loaded Direct-Operated Check valve having a poppet diameter 20 mm, and spring stiffness 25000 N/m is operated in a hydraulic system. The pump flow rate is 0.5 m^3/s at 6 MPa, and the line pressure after the check valve is 5.5 MPa. Find the spring displacement to open the check valve and allow flow to pass through it. Also, if the leakage resistance of the check valve is 2×10^6 $N.s/m^5$, find out the leakage flow rate and power loss through the check valve.	[5]	II	IV
Q.3(a)	A hydraulic cylinder has a bore of 200 mm and a piston rod diameter of 140 mm. It is operated on a load of 6000 N. For an extended speed of 5 m/min, calculate I. the supply flow rate (Q_E) II. the flow rate from the annulus side on extend (q_E) III. the retract speed using (Q_E) IV. if the power development needs to improve by 20% with the same load, calculate the supply flow rate requirement.	[5]	III	IV
Q.3(b)	Prove that the load-carrying capacity of a regenerative cylinder during extension (refer Figure 1) is less than a regular double-acting cylinder. Also, prove that load-carrying capacity of the regenerative cylinder during extension is **less** than that obtained from a regular double-acting cylinder.	[5]	III	III

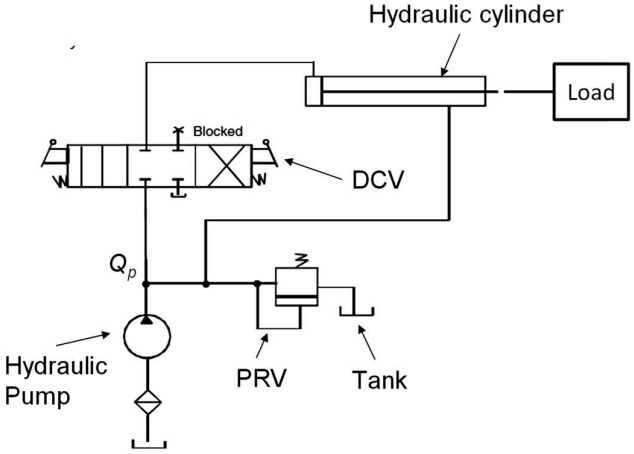

Figure 1

PTO

Q.4(a)	Prove that the maximum energy store in the accumulator is $E_{\max} = \frac{V_0 P_2}{\frac{n}{n^{n-1}}}$, where V_0 is the initial volume, and P_2 is final pressure and n is polytrophic index.	[5]	IV	III
Q.4(b)	A compressor works 8 hrs. work-shift with 5.38 grams of water condensing/m^3 of air compressed. It delivers compressed air at 6 bar with 0.25 m^3/min per kW of actual power requirement. If the power rating (theoretical power) is 100 kW and the efficiency is 75%, calculate the total amount of water condensate in kg.	[5]	IV	IV
Q.5(a)	In a filter, 50000 particles are larger than 5 µm in size on the upstream side, whereas 2500 particles are in the filter on the downstream side. Find out the Beta ratio and Beta efficiency.	[2]	V	IV
Q.5(b)	Draw the PLC ladder logic diagram rung of the Boolean algebra I. Z= [((A.B.C)+D).E] II. $L = \overline{A}.(B+C)+D$ A, B, C, D, and E are normally open switches.	[3]	V	III
Q.5(c)	Describe the truth table, symbol, equation, and PLC ladder logic rung of the AND, OR, NOR and NOT gates.	[5]	V	II

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