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

CLASS: B. TECH **SEMESTER: VII**
BRANCH: MECHANICAL **SESSION: MO/2023**

SUBJECT: ME473 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 bent axis pump has the following parameters: number of pistons (z) = 9; piston diameter (d) = 9.3 mm; pitch circle diameter (D) =33 mm driving speed (n) = 4000 rpm; inlet pressure (P_i) = 0.3 MPa; exit pressure (P_e) = 18 MPa; volumetric efficiency (η_v) = 0.94; total efficiency (η_o) = 0.89; hydraulic efficiency (η_h) = 1; inclination angle of cylinder block (a) = 20°. Calculate the pump theoretical flow (Q_{th}), real flow (Q_{act}), input mechanical power (P) and driving torque (T).	[4]	I	4
Q.1(b)	Prove that the internal leakage resistance (R_L) through a radial clearance between two concentric cylindrical bodies or between a spool and a sleeve is $R_L = \frac{12\rho\nu L}{\pi D c^3}$; where L and D are the Length of leakage path and spool diameter, respectively; ν is the kinematic viscosity; ρ is the density of the oil; c is the radial clearance.	[4]	I	3
Q.1(c)	What is Hydrostatic Transmission System (HST)? Write various applications of the HST.	[2]	I	1
Q.2(a)	A pressure relief valve contains a poppet with a 0.65 mm^2 area on which system pressure acts. During assembly, a spring with a spring constant of 200 N/m is installed in the valve to hold the poppet against its seat. The adjustment mechanism is then set so that the spring initially compresses 5 mm from its free-length condition. In order to pass full pump flow through the valve at the PRV pressure setting, the poppet must move 10 mm from its fully closed position. Determine the a) Cracking pressure b) Full pump flow pressure (PRV pressure setting) c) Compute the power loss across this valve if it returns all the flow back to the tank from a 0.2 m^3/s pump.	[4]	II	4
Q.2(b)	Describe working principle of a Pilot Operated Pressure Relief Valve with suitable sketch.	[3]	II	3
Q.2(c)	Describe working principle and applications of a Shock Absorbers with a suitable sketch.	[3]	II	3
Q.3(a)	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	3

PTO

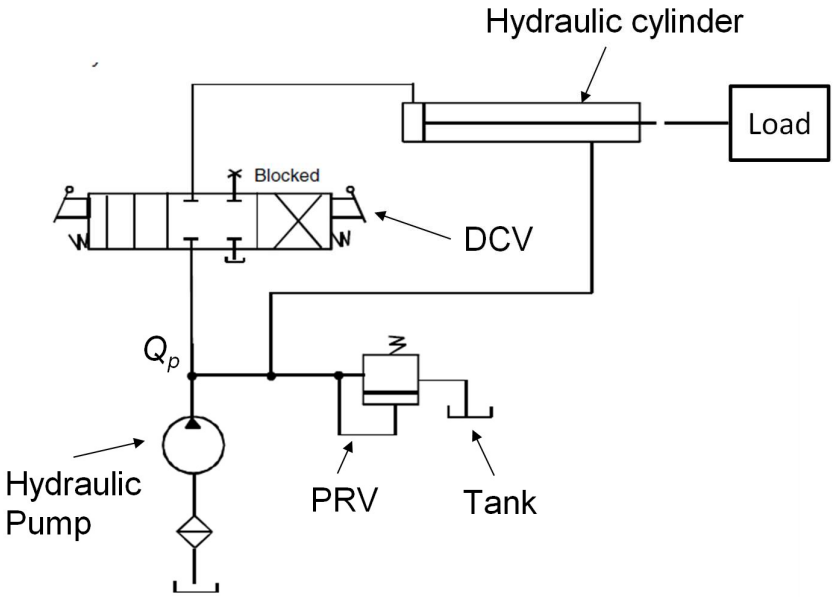

Figure 1

Q.3(b)	In a hydraulic system, two cylinders are hooked in series to synchronize both cylinders, and output flow rate from the first cylinder is same as input flow rate to second cylinder. The piston and the rod diameter of the second hydraulic cylinder are 50 mm and 20 mm, respectively whereas the rod diameter of the first hydraulic cylinder piston is 30 mm. The inlet and outlet pressure of the first cylinder are 6 MPa and 2 MPa, respectively. Find out the piston diameter of the first cylinder and load carrying capacity of both cylinders. Assume tank pressure is in atmospheric pressure 1×10^5 Pa.	[5]	III	4
Q.4(a)	Prove that the maximum energy store in the accumulator is $E_{\max} = \frac{V_0 P_2}{n^{\frac{n}{n-1}}}$, where V_0 is the initial volume, and P_2 is final pressure and n is polytrophic index.	[5]	IV	3
Q.4(b)	Describe the role of an accumulator in power hydraulic system and discuss working principle of an accumulator (any type) in detail.	[5]	IV	2
Q.5(a)	Develop a Ladder Logic diagram to control a drilling operation on a production line using two reciprocating double acting pneumatic cylinders. One cylinder controls the position of the workpiece, and another cylinder controls the drilling operation sequentially. The sequence of operations is as follow: 1. First cylinder extension to fix the workpiece at proper place 2. Delay 30 sec. 3. Second cylinder extension for drilling operation 4. Delay 10 sec. 5. Second cylinder retraction for removing the drilling tool 6. First cylinder retraction for releasing the workpiece for removal 7. Delay 30 sec.	[5]	V	5
Q.5(b)	Write short note: 1. Strainers 2. Moving Part Logic device	[5]	V	2

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