BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION MO/2022)

CLASS: M. TECH. **SEMESTER:** I
BRANCH: MECHANICAL ENGINEERING **SESSION:** MO/2022

SUBJECT: ME526 FLUID POWER AND CONTROL

TIME: 03 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. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates

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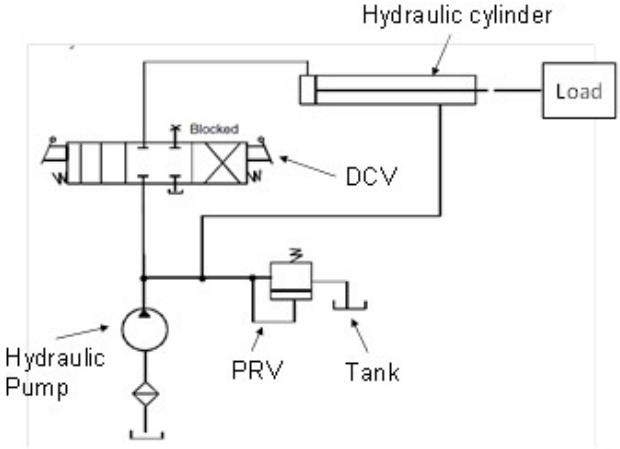
Q.1(a)	Prove that the internal leakage resistance (R_L) through a radial clearance between two concentric cylindrical bodies or between a spool and a sleeve is $R_L = \frac{12\rho\nu L}{\pi D c^3}$; where L and D are the Length of leakage path and spool diameter, respectively; ν is the kinematic viscosity; ρ is the density of the oil; c is the radial clearance.	[3]	3	I
Q.1(b)	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]	6	I
Q.1(c)	Discuss the effect of temperature and pressure variations on the oil viscosity in hydraulic system.	[3]	2	I
Q.2(a)	A pressure relief valve contains a poppet with a 0.00005 m^2 area on which system pressure acts. During assembly, a spring with a spring constant of 10000 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]	6	II
Q.2(b)	Design and describe the working principle of a direct operated pressure relief valve with a suitable sketch and symbol.	[3]	5	II
Q.2(c)	Describe working principle and applications of a shock absorbers with a suitable sketch.	[3]	2	II
Q.3(a)	Prove that the load-carrying capacity of a regenerative cylinder during extension (refer Figure) is less than a regular double-acting cylinder.	[4]	3	III



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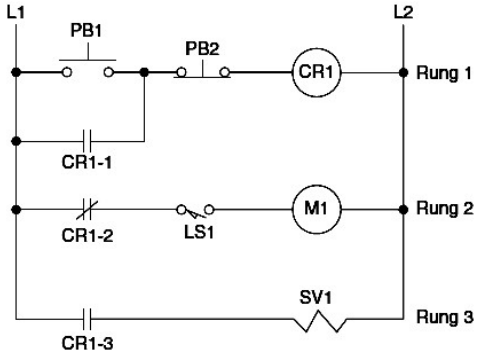
Q.3(b)	Draw and discussed the working principle of Meter-In and Meter-Out circuits.	[3]	2	III
Q.3(c)	In a regenerative circuit, a hydraulic pump is supplying flow to a double acting hydraulic cylinder (refer Figure Q. 3(a)). The pump pressure and flow rate are 10.5 MPa and 0.0016 m^3/s, respectively. The piston and the rod diameter of the hydraulic cylinder are 50 mm and 20 mm, respectively. Find the cylinder speed and load carrying capacity during extension and retraction operation of the cylinder.	[4]	6	III
Q.4(a)	If a double-acting cylinder of 40 mm diameter bore, 10 mm diameter rod and 20 mm stroke operate at 550 kPa and cycles at 100 cycles/min, how long will it take to consume 100 m^3 of free air? (Assume no change in temperature.)	[3]	6	IV
Q.4(b)	Write short note: (i) Air filter (ii) Stainer	[4]	3	IV
Q.4(c)	Describe the function of an accumulator in pneumatic system using suitable pneumatic circuit.	[3]	2	IV
Q.5(a)	Describe Moving-part logic (MPL) control system with AND, OR and MEMORY FUNCTION.	[4]	2	V
Q.5(b)	Prove that $A+(A.B)=A$ using a truth table. A and B are inputs.	[2]	3	V
Q.5(c)	Analyze the status of Relay Coil (CR1), Motor (M1), and Solenoid (SV1) in Figure under the following conditions? (i) Push button (PB1) is not pushed, and Limit Switch (LS1) is open. (ii) PB1 is pushed, and LS1 is open. (iii) PB1 is pushed, and LS1 is close.	[3]	4	V



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