



Note: Assume any data required, state your assumption clearly.

Answer all the following Questions:-

Question (1) (15 Marks)

1-a) Discuss the principal of operation of the hydraulic power systems, and list the major advantages and drawbacks of these systems (3 Marks)

1-b) Distinguish between fluid power systems and fluid transmission systems? (3 Marks)

1-c) A pump has a displacement volume of 100 cm^3 . It delivers $0.0015 \text{ m}^3/\text{s}$ at 1000 rpm and 70 bars. If the prime mover input torque is 120 N.m. Calculate the pump volumetric, torque (mechanical) and overall efficiencies and the theoretical pump torque. If this pump supplies oil to hydraulic motor has a displacement volume of 80 cm^3 and volumetric efficiency of 90%, calculate its speed. If the pump is driven by electrical motor has an overall efficiency of 85% and the hydraulic system is operated 12 hours per day for 250 days per year and the cost of electricity is 0.1LE/kW.hr. Calculate the annual cost of electricity to operate the hydraulic system and annual cost of electricity due to inefficiencies of the electrical motor and pump. (9 Marks)

Question (2) (15 Marks)

2.a) Explain the construction and operation of the pressure-compensated flow control valve. (3 Marks)

2.b) What are the different factors considered in pump selection? (3 Marks)

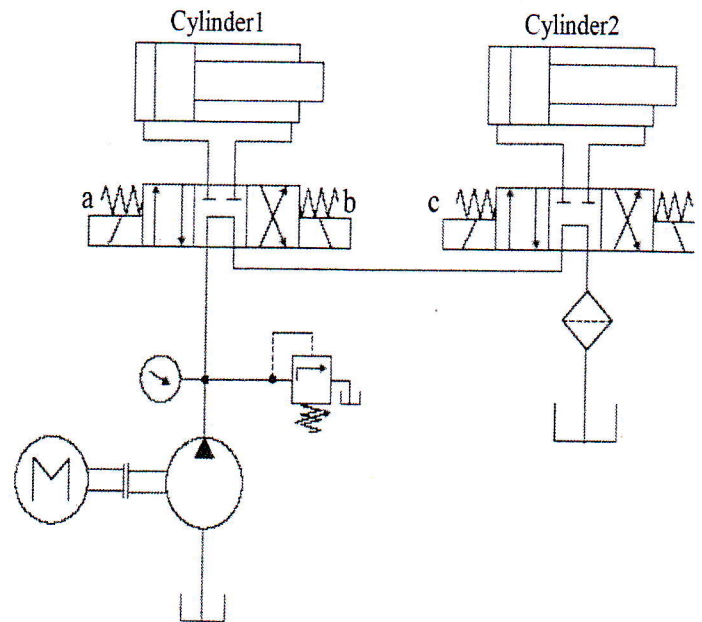
2.c) The hydraulic circuit shown in the figure has two identical cylinders of diameter 100 mm and rod diameter of 70 mm. both cylinders extending and retracting load of 10 tonnes. When solenoids (a) and (c) are energized both cylinders extend. If the pump flow rate is 100 LPM, find: (9 Marks)

i. Calculate the cylinders speed and direction as well as the pressure at the pump for the following operation cases

Solenoid	a	B	c	d
Case1	1	0	1	0
Case2	1	0	0	1
Case3	0	1	1	0
Case4	0	1	0	1

ii. Suggest setting for the pressure relief valve.

iii. If both cylinders are required to extend at the same speed when solenoids (a) and (c) are energized, redesign one of these cylinders to fulfill this condition.



Question (3) (20 Marks)

3.a) Explain by drawing a circuit the operation of dual pump circuit. Name one application for this circuit. (3 Marks)

3.b) A hydraulic press is supplied by dual pump circuit has cylinder of 100 mm diameter and rod of 75 mm diameter. The cylinder has a rapid approach speed of 5 m/min at force of 5 kN. The pressing force is 100 kN at a speed of 0.5 m/min calculate the flow rate of the selected pumps as well as the setting of the relief valves used. Calculate also the retract speed if the retract force is i) 2 kN and ii) 7 kN (8 Marks)

3.c) Complete the circuit shown in Fig. 1 to fulfill the following: (5 Marks)

Process	Extend	Pressing	Retract
Flow rate to cylinder	Pump A+ Pump B	Pump A	Pump B

3.d) Figure 2 shows fluid power steering control system for transportation vehicles. Draw the hydraulic circuit using symbolic representation. (4 Marks)

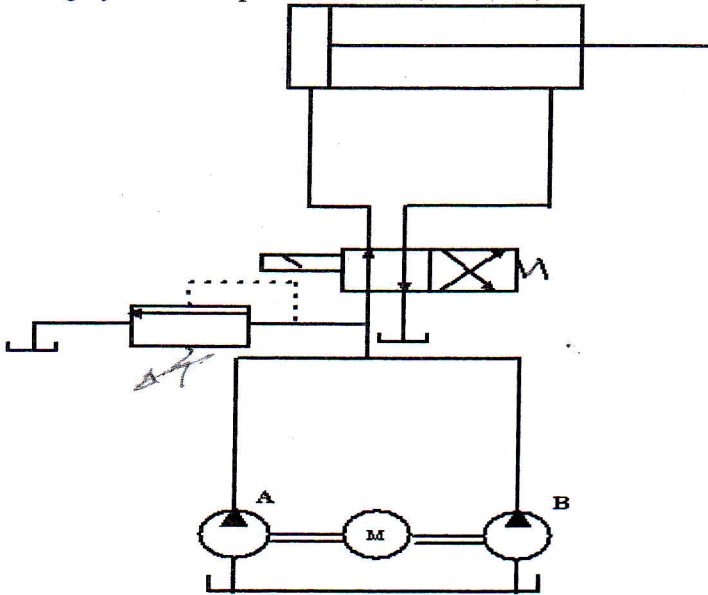


Fig. 1 (3.c)

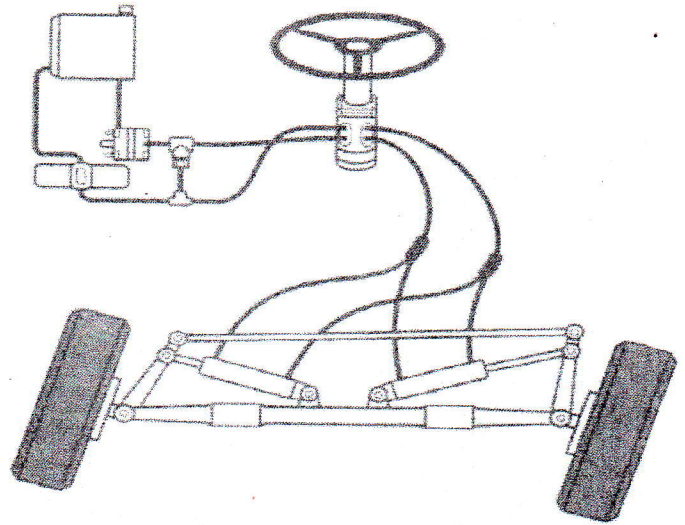


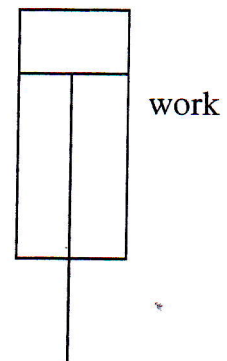
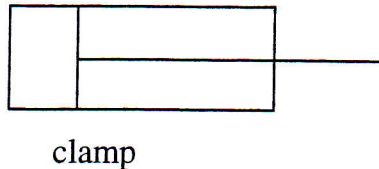
Fig. 2 (3.d)

Question (4) (20 Marks)

4-a) Why positive displacement pumps are preferred in fluid power systems? (3 Marks)

4.b) Explain using sketches the operation of pressure compensated vane pump. (4 Marks)

4.c) Complete the circuit shown in the figure. The clamp cylinder is to extend first, and then the work cylinder extend by the action of 4/3 DCV. By further action of the DCV the work cylinder retracts, and then the clamp cylinder retract. (6 Marks)



4.d) A hydraulic press operated according to the following requirements: extends in 5 sec at a pressure of 30 bars and a flow rate of rate of 150 lit/min, remains fully extended for 25 sec at a pressure of 150 bars, retracts in 6 sec at a pressure of 30 bars and a flow rate of rate of 150 lit/min, remains fully retracted for 24 sec at pressure of 150 bars. When the cylinder is fully extended and retracted the leakage past the piston is 5 lit/min. by fixed pump with accumulator at maximum accumulator pressure of 250bars (7 Marks)

- Draw the hydraulic circuit required.
- Draw the system characteristics (Q-time, P- time, Power- time).
- Calculate the pump flow rate.
- Calculate accumulator volume.
- Calculate the system efficiency.

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