

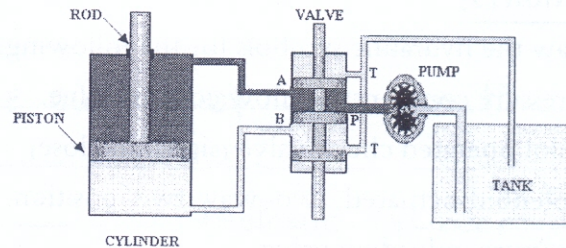


FINAL EXAMINATION PAPER

**Question (1)**

a) Study the simple hydraulic system shown below and fill in answers to the questions With the in position shown.

1. Which way is the cylinder moving, Up or Down?
2. Which way must the valve be moved in order to reverse the motion of load cylinder, Up or Down?
3. What will happen to the pressure on the outlet of the pump when the load piston reaches the end of the travel? Will it Increase or Decrease?
4. Redraw the circuit with hydraulic symbols with installing relief valve and controlling the speed of retraction only.



[4 marks]

b) Which cylinder stroke creates high speed and which creates big force in single rod cylinder (Extension stroke or Retraction stroke). Prove that by laws. [2 marks]

c) Design a car crushing system. The crushing force required is such that a 15 cm diameter cylinder is required at a working pressure of 124 bar. Time for crushing is about 10 s and the stroke required is 254 cm. Calculate the power required by the circuit. [4 marks]

**Question (2)**

a) How to increase the pump flow rate of both variable displacement pump (like Swash plate piston pump), and fixed displacement pump (like gear pump)? Draw the symbol for each pump type. [2 marks]

b) Draw graphic symbols representing fluid power pumps for the following cases:

i) Uni-directional variable displacement vane pump.

ii) Bi-directional gear pump.

[2 marks]

c) What is the difference between positive pump and Non positive pump (Dynamic pump)? Draw the (P-Q) curve for each type. [2 marks]





d) A hydrostatic transmission, operating at 70 bars pressure, has the following characteristics

Pump		Motor	
$V_D =$	82 cm <sup>3</sup>	$V_D =$	?
$\eta_v =$	82%	$\eta_v =$	92%
$\eta_m =$	88%	$\eta_m =$	90%
$N =$	500 rpm	$N =$	400 rpm

Find: a - Displacement of the motor. b - Motor output torque

[4 marks]

### Question (3)

a) Draw the hydraulic symbols for the following:

- Pressure compensated flow control valve.
- Pilot operated check valve (signal to close).
- Solenoid-actuated, two-way, two-position, spring-offset directional control valve.
- Pressure unloading valve

[4 marks]

b) A hydraulic motor has a displacement of 164 cm<sup>3</sup> and operates with a pressure of 70 bars and a speed of 2000 rpm. The actual flow rate consumed by the motor is 0.006 m<sup>3</sup>/s and the actual torque delivered by the motor is 170 N.m. Find the volumetric, mechanical, and overall efficiencies and the actual power delivered by the motor.

[6 marks]

### Question (4)

a) Identify with drawing the difference between both relief valve and reducing valve.

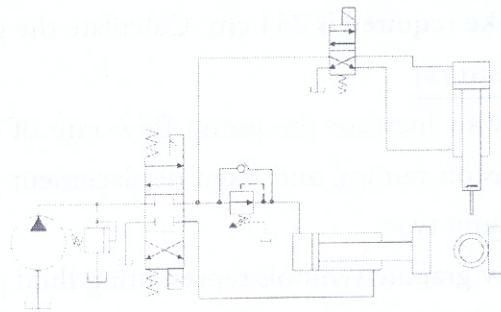
[2 marks]

b) In order to control cylinders, a hydraulic system, shown below is used.

i). Write down the name and the function of each component and explain the operation of the hydraulic circuit.

ii). Modify the previous hydraulic circuit to include the following improvements:

1. Control the extension speed of the drill cylinder and let retraction speed maximum.
2. Eliminate the power-lost in the relief valve during the locked position.
3. Reinstall a filter in the return line. This filter may be blocked with oil contamination at any instant during operation.



To accomplish these modifications, you can change an existing valve, add new valves and/or modify the connecting way between the components. Draw the modified hydraulic circuit and write the name and function of each component.

[8 marks]