

Q.1(a) Attempt any THREE of the following :

[12]

Q.1(a) (i) Describe essential properties of oils used in oil hydraulic circuits. (Any eight)

[4]

- (A) (1) **Demulsibility:** The ability of a fluid that is insoluble in water to separate from water with which it may be mixed in the form of emulsion. Or it is the oil ability to release water.
- (2) **Lubricity:** it is the measure of the reduction in friction of a lubricant.
- (3) **High flash point:** Flash point is a temperature at which liquid catches fire automatically. The flash point of good hydraulic oil must be as high as possible so that fire possibility nullified.
- (4) **Minimum Toxicity:** Good hydraulic oil must be minimum toxic to human being working with them. Some fire resistance hydraulic oils are highly toxic which can cause occupational diseases.
- (5) **Low Foaming Tendency:** When oil returns to receiver, it comes in contact with air above the liquid surface. The oil has tendency to absorb air or gas which results in foam formation. Good hydraulic oil must release the air/gas very quickly so that it does not form foam.
- (6) **Fire resistance:** Good hydraulic oil must be fire resistant to avoid accidents.
- (7) **Viscosity:** It is the resistance offered by the liquid to flow. It is inherent property of the liquid and this resistance to flow depends on some other physical properties such as temperature, pressure, etc.
- (8) **Compressibility:** It is the ability of a fluid to get compressed and liquids are less compressible. Compressibility is the reciprocal of bulk modulus.

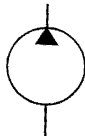
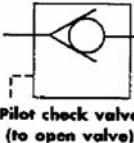
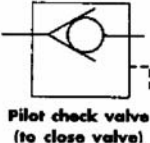
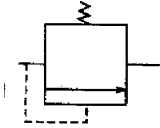

Q.1(a) (ii) Draw symbols of :

[4]

- (1) Unidirectional hydraulic pump  
(3) Sequence valve

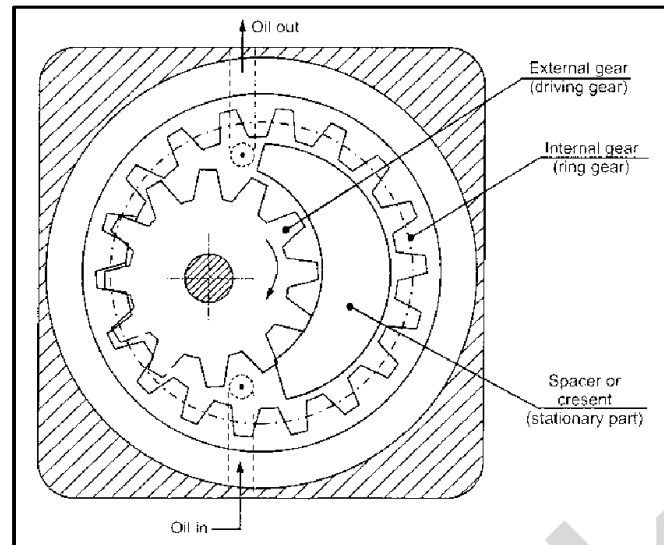
- (2) Pilot operated check valve  
(4) Heater

(A)

	Name	Symbol
(1)	Unidirectional hydraulic pump	
(2)	Pilot operated check valve	 
(3)	Sequence valve	 <p>Sequence valve</p>
(4)	Heater	

Q.1(a) (iii) Explain construction and working principle of Internal Gear pump.  
(A)

[4]

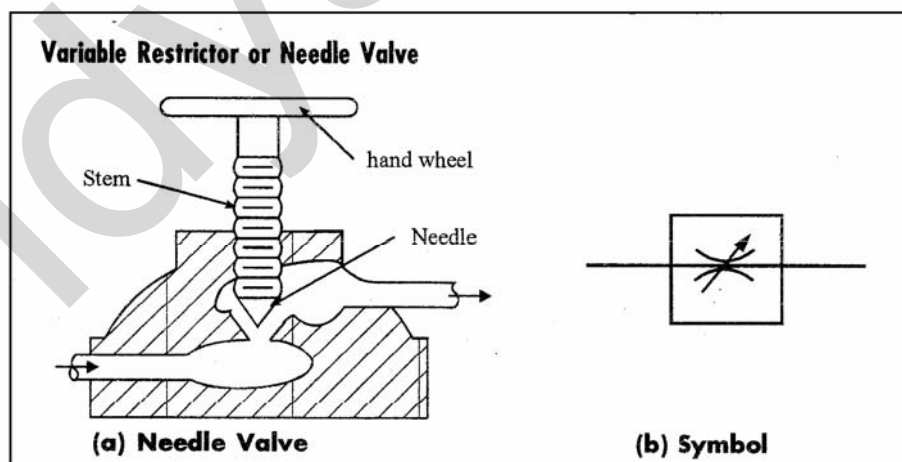


It consists of one external and one internal meshing gear pair. External gear is connected to electric motor and hence is driving gear. Internal gear or ring gear is driven gear which rotates in same direction as that of external gear. Between two gear a spacer called 'crescent' is located which is a stationary piece connected to housing. Inlet and outlet ports are located in end plates.

External gear (driving gear) drives the internal gear (Ring Gear). Portion where teeth start meshing, a tight seal is created near port the vacuum is created due to quick un-meshing and oil enters from oil tank through inlet port. Oil is trapped between the internal and external gear teeth on both sides of crescent (spacer) and is then carried from inlet to outlet port. Meshing of gear near outlet port reduces the volume or gap and oil gets pressurized. These pumps make very less noise.

Q.1(a) (iv) Draw sketch of needle valve and explain its working.  
(A)

[4]



A needle valve is a variable restrictor device which allows the orifice size to vary by adjustments. A needle has a pointed stem that can be adjusted manually to control the rate of fluid flow through the valve. The needle valve is used in hydraulic circuits to vary the flow rate from full flow to complete shut off the flow from one part of circuit to another part.

Generally a needle valve is coupled with a non return valve or check valve enabling regulated flow in one direction and free flow in the reverse direction.

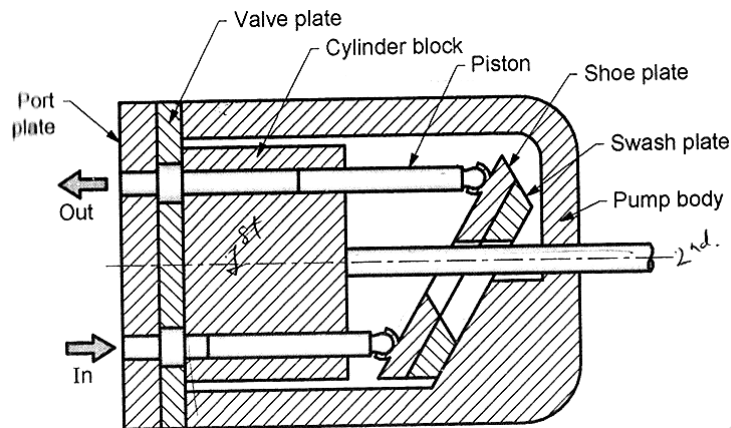
Q.1(b) Attempt any ONE of the following :

[6]

Q.1(b) (i) Explain the working of axial piston pump with neat sketch?

[6]

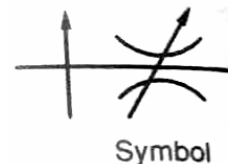
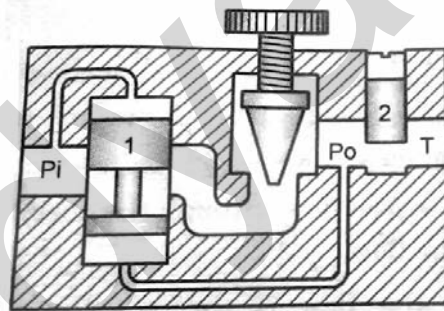
(A)



- An axial piston pump consists of a cylindrical block with axial bores, pistons are inserted in the bores.
- The other end of the pistons is connected to the shoe plate with shoe joints.
- The shoe plate is mounted on a swash plate, which is fixed at an angle to the axis of rotation.
- The rotation of the shaft causes the cylinder block to rotate, thus the shoe plate will also rotate.
- This causes the piston to reciprocate in the bores.
- When the cylinder completes half-rotation it results in suction of oil into a bore and the next half rotation causes discharge.
- By using a swash plate we can change the discharge of the pump i.e. by changing the angle of swash plate.

Q.1(b) (ii) With neat sketch describe pressure compensated flow control valve? Also show the symbol of the same? [6]

(A)



- A pressure-compensated flow control valve is used to compensate any change in flow rate which happens due to changes in pressure.
- The valve has a pressure-sensitive spool mounted inside the valve body.
- Whenever the pressure at the inlet i.e.  $P_i$  increases, the flow rate will also increase.
- To compensate this, in the mechanism, inlet pressure acts on the spool from the top, and the spool moves down.
- This reduces the area of flow and hence the flow reduces to normal.
- If the outlet pressure ( $P_o$ ) increases, then the rate of flow decreases.
- To compensate this, in the mechanism, outlet pressure acts on the spool from the bottom, and the spool moves up.
- Thus increasing the area of flow and hence the rate of flow comes to normal.

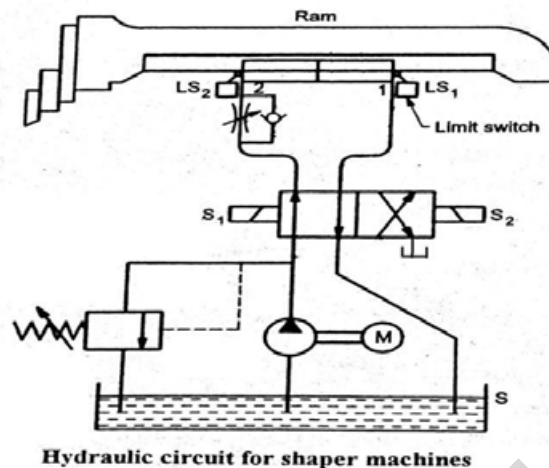
Q.2 Attempt any TWO of the following :

[16]

Q.2(a) Explain with neat sketch the working of hydraulic circuit for shaping machine.

[8]

(A)



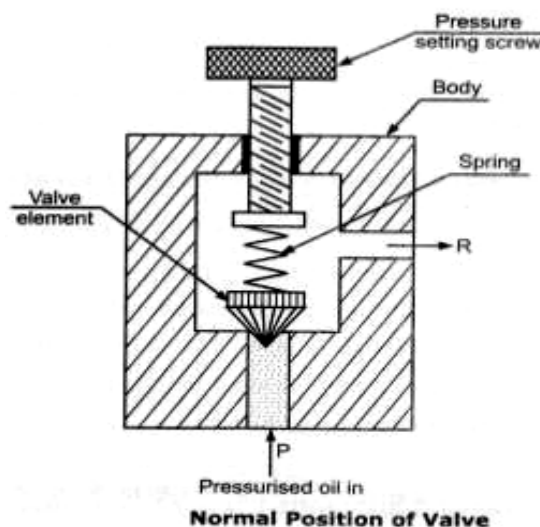
#### Hydraulic circuit for Shaper Machines

- The Fig shows the hydraulic circuit for shaping machine. In which the double acting cylinder with through piston rod and 4/2 direction control valve is used.
- Hydraulic power pack supplies the pressurised oil to the 4/2 valve.
- A pressure relief valve is provided in circuit to avoid over loading of circuit.
- In first position the oil is flowing through opening '2' of cylinder through check valve. This is free flow hence return stroke is fast.
- At the end of stroke, the piston actuates the limit switcher LS<sub>2</sub>. Due to this solenoid 'S<sub>2</sub>', it shift the spool to other position.
- In second position of 4/2 DC valve oil flow to opening 1 of cylinder oil present at rod side of piston flows out through flow control valve.

Q.2(b) State the functions of pressure relief valve for pneumatic system. Explain its working with neat sketch. [8]

(A) In pneumatic system, pressure regulator is used to regulate the pressure supplied which is one of the element in FRL unit. Also a pressure switch provided in compressor acts as a safety device when the pressure goes above the set pressure. Pressure relief valve is also used in hydraulic system.

- 1) To relieve excessive pressure of air for safety working of system.
- 2) To maintain the constant pressure of air in the system.
- 3) To protect the system against over pressure.



**Working:**

The compressed air pressure from FRL unit acts against the poppet (valve element) through inlet of pressure relief valve. When the force of air is greater than the spring force then poppet gets lifted from the valve seat and valve opens. Thus the excessive pressurized air will get release to the atmosphere through port R.

**Q.2(c) What is hose? Enlist factors affecting on selection of hose in hydraulic system. [8]**  
**State different layers of hose.**

(A) Hoses are flexible connecting tubes or pipes to connect actuators, control valves.

**Factors affecting selection of hose**

- 1) Flexibility to change the shape it helps to reduce the fittings required in piping layout.
- 2) It should have easy installation
- 3) It should be flexible in nature
- 4) Should have quick connecting & disconnecting ends.
- 5) Should be available in standard lengths.
- 6) It should absorb pressure shocks & vibrations.

**Different layers of hose**

- 1) Inner tube
- 2) Reinforcement
- 3) Outer protective cover

**Q.3 Attempt any FOUR of the following : [16]**

**Q.3(a) State advantages and disadvantages of poppet type directional control valve. [4]**

(A) **Advantages of Poppet DC control**

- 1) This type of valves tends to hold the valve tightly closed.
- 2) A slight force applied to the poppet stem opens the poppet.
- 3) The poppet stem usually has an O ring seal to prevent leakage.
- 4) Number of poppets in a valve can be used.
- 5) Poppets can be held in the seated position by springs which gives reliability.
- 6) Suitable for high pressure systems.

**Disadvantages of Poppet type DC control**

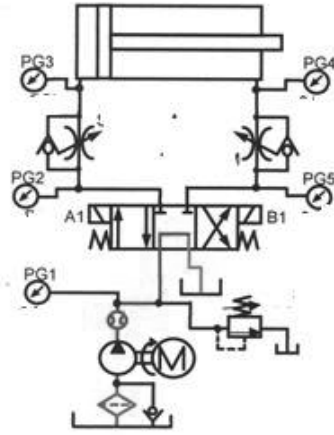
- 1) Due to poppet type construction wear & tear is more.
- 2) Initial cracking moment of the poppet is difficult.
- 3) Internal construction is complicated.
- 4) Fine finishing of the seat is difficult.
- 5) Less suitable for large valve sizes.

**Q.3(b) What are the various materials used for pipes in hydraulic circuit? [4]**

(A) In hydraulic system iron pipe may be used for low to medium pressure range as they are widely available and economical. Steel pipes are commonly used in hydraulics system. Cuprous nickel alloys and stainless steel are also used. Copper pipes are also used in low pressure application. Zinc coated galvanized pipes and copper tubes are used when oil does not react with them. Other material includes aluminum, carbon steel, other ferrous nonferrous metals.

**Q.3(c) Explain with neat sketch the working and applications of meter-in hydraulic circuit. [4]**

(A) Figure shows the components in a meter-in flow-control circuit. Notice that a bypass check valve forces fluid through an adjustable orifice just before it enters the actuator by extending hydraulic cylinder and indicates the pressures and flows in various parts of the circuit. With a meter-in circuit, fluid enters the actuator at a controlled rate. If the actuator has a resistive load, movement will be smooth and steady with a hydraulic circuit. This is because oil is almost non-compressible. On return line fluid passes through the check valve without any resistance. Therefore this circuit is called meter-in circuit



**Q.3(d) Enlist any four applications of oil hydraulic system.**

[4]

- (A)
- 1) Construction equipments
  - 2) Machine tools
  - 3) Material handling devices
  - 4) Automobile
  - 5) Agriculture Equipment's
  - 6) Mining
  - 7) Earth moving equipment

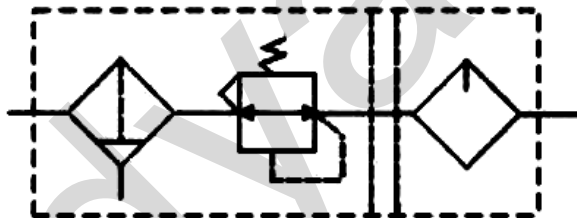
**Q.3(e) What is FRL? State its importance.**

[4]

(A) **Filter:** To enable the supply of clean, pure and contamination free compressed air, the air is required to be filtered. **Regulator:** The system performance and accuracy depends on the pressure stability of the air supply. The regulator maintains this pressure.

**Lubricator:** The air is supplied with a lubricating film of oil which helps in lubricating the various parts in the downstream.

**Symbol OR equivalent fig of FRL**



Symbol OR equivalent fig of FRL

#### Importance of FRL

Air leaving a compressor is hot, dirty, and wet—which can damage and shorten the life of downstream equipment, such as valves and cylinders. Before air can be used it needs to be filtered, regulated and lubricated. Dry air may increase the system pressure and seal the moving components so lubrication is essential FRL unit is used for this purpose.

**Q.4(a) Attempt any THREE of the following :**

[12]

**Q.4(a) (i) What is the use of direction control valve? Explain with sketch.**

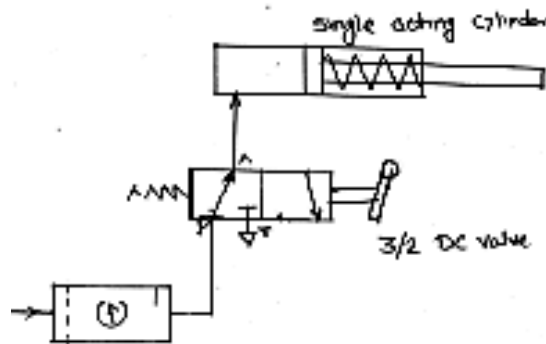
[4]

- (A)
1. DC valves are used to release, stop or redirect the fluid that flows through it.
  2. DCV is used to control the direction of fluid flow in any hydraulic system and changing the position of internal movable parts.
  3. To start, stop, accelerate, decelerate and change the direction of motion of a hydraulic actuator.
  4. To permit the free flow from the pump to the reservoir at low pressure when the pump's delivery is not needed into the system.
  5. To vent the relief valve by either electrical or mechanical control.
  6. To isolate certain branch of a circuit.

The following circuit shows use of 3/2 DC valve.

When the lever is operated, port A is connected to exhaust port ,i.e change in direction of the piston.

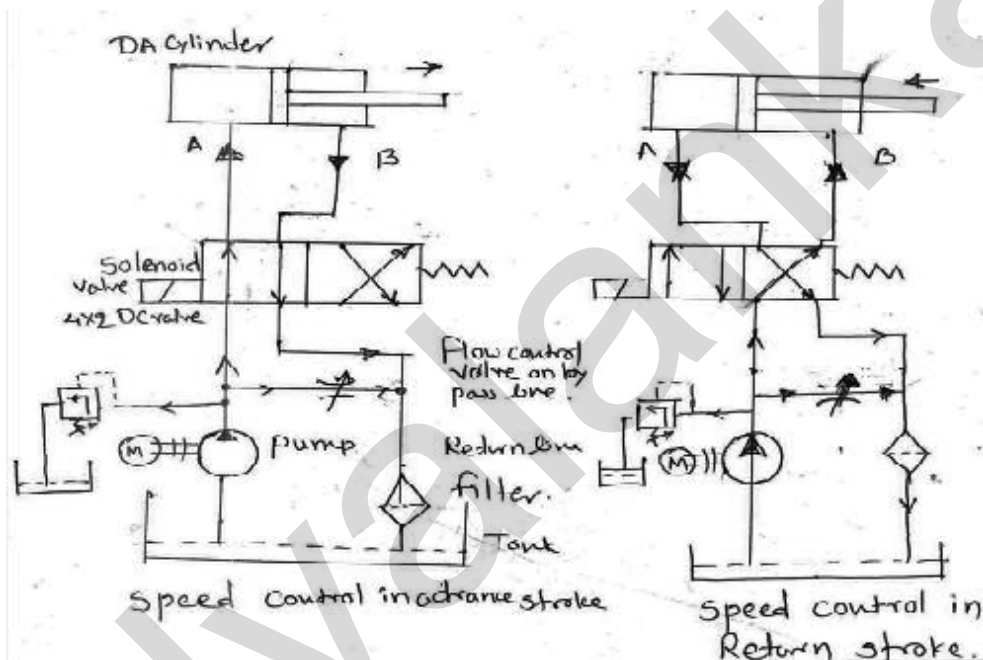
(Alternative sketch can be considered)



Q.4(a) (ii) Draw bleed off circuit and label it.

[4]

(A)



Q.4(a) (iii) What are the limitations of pneumatic system?

[4]

(A)

1. Relatively low accuracy: As pneumatic systems are powered by the force provided by compressed air, their operation is subject to the volume of the compressed air. As the volume of air may change when compressed or heated, the supply of air to the system may not be accurate, causing a decrease in the overall accuracy of the system.
2. Low loading: As the cylinders of pneumatic components are not very large, a pneumatic system cannot drive loads that are too heavy.
3. Processing required before use: Compressed air must be processed before use to ensure the absence of water vapour or dust. Otherwise, the moving parts of the pneumatic components may wear out quickly due to friction.
4. Uneven moving speed: As air can easily be compressed, the moving speeds of the pistons are relatively uneven.
5. Noise: Noise will be produced when compressed air is released from the pneumatic components.
6. Lubricator: Lubricator is required to add lubricant oil to compressed air to reduce friction.

Q.4(a) (iv) Draw symbol of :

[4]

(1)  $2 \times 2$  DC valve

(2) Fixed type flow control valve

(3) Pressured relief valve

(4) Muffler

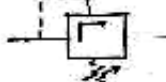
(A)

1)  $2 \times 2$  DC valve.

2) Fixed type flow control valve.



3) pressure relief valve.



4) Muffler



Q.4(b) Attempt any ONE of the following :

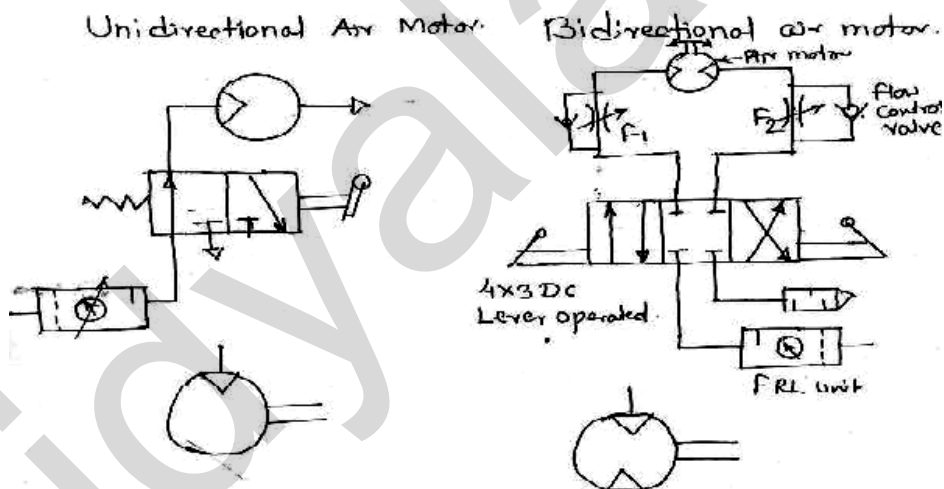
[6]

Q.4(b) (i) What is the meaning of unidirectional air motor and bi directional air motor? [6]

Explain with sketch and draw symbol of both.

(A) Operating or moving or allowing movement in one direction only. It runs in one direction only. It does not run in the other direction. Unidirectional motor can be operated by using  $3/2$  DC valve as shown in fig.

Bidirectional air motor: Functioning or allowing movement in two usually opposite directions. It can runs in both direction. Bi-directional motor can be operated by using  $4/3$  DC valve as shown in fig.



Q.4(b) (ii) Compare linear actuators and rotary actuators.

[6]

(A)

	Linear Actuators	Rotary actuators
1.	These actuators reciprocates in a cylinder	These actuators rotate about center.
2.	Linear speed measured in m/sec	Rotary speed measured in RPM
3.	Example-Single acting cylinders, double acting cylinders, Tandem cylinder	Example-Vane motors, gear motors, piston motors, air motors
4.	Used for pushing ,pulling types of tasks	Used where rotary motions are required. Straight grinders, pistol drills.
5.	Provide motion along straight line	provide motion along center
6.	Manufacturing cost is High	Manufacturing cost is low



**Q.5 Attempt any TWO of the following :**

**[16]**

**Q.5(a) What is function of filter? How filters are classified? Name any four advantage of bypass filter?**

**[8]**

**(A)** The main function of the hydraulic filter is to remove the dust particles from the high pressure hydraulic oil.

**Following are the ways to classify a filter**

**A) Classification according to function**

- 1) Surface type
- 2) Edge type
- 3) Depth type.

**B) Classification according to construction**

- 1) By pass type filter
- 2) full flow filter
- 3) Proportional flow filter
- 4) Indicator type filter

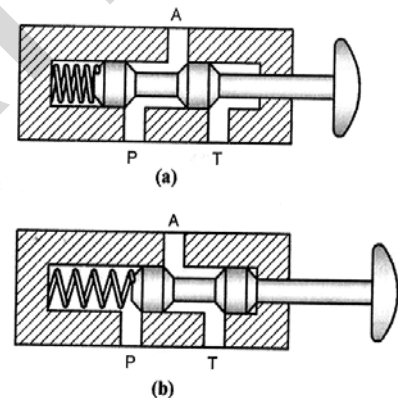
**Following are the main advantage of By-pass type filter**

- 1) The filter element is safe guarded against any damage due to high pressure.
- 2) It passes the fuel to the system even after the filter is saturated.
- 3) The filter can be reused.
- 4) The valve can be used to make Direct connection when filter is racked up.

**Q.5(b) Sketch the two positions of sliding spool type 3/2 DCV and explain in brief?**

**[8]**

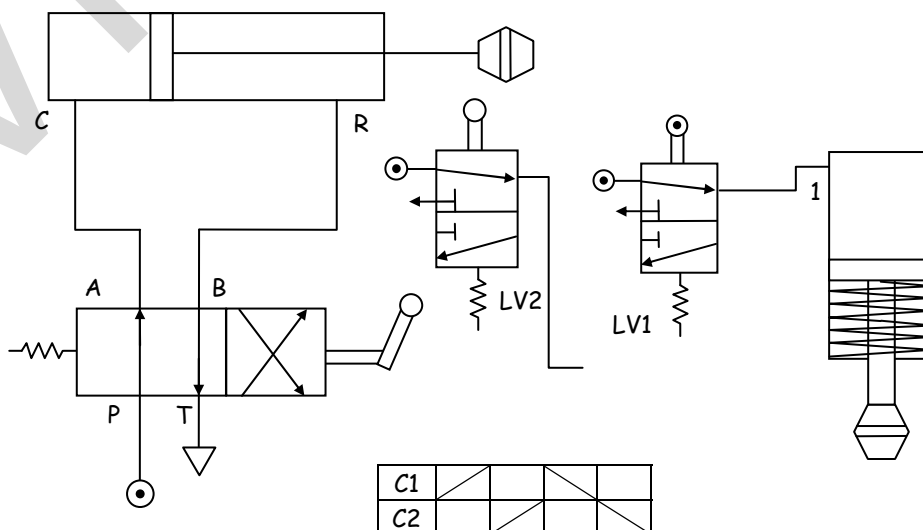
- (A)**
- i) 3/2 DCV are mostly to operate single acting cylinder and unidirectional motors.
  - ii) In the first position a spool there is a connection from port-P to part-A, oil flows from pump to single acting cylinder.
  - iii) Thus extending a single acting cylinder and port-T is closed.
  - iv) The spool is shifted in 2<sup>nd</sup> position by using a push button.
  - v) In its second position there is a connection from port-A to port-T.
  - vi) Thus oil starts flowing from single acting cylinder to tank.
  - vii) Hence the single acting cylinder retracts and inlet port-P is closed



**Q.5(c) Develop a pneumatic circuit for operation of two DAC such that one operator after another.**

**[8]**

**(A)**



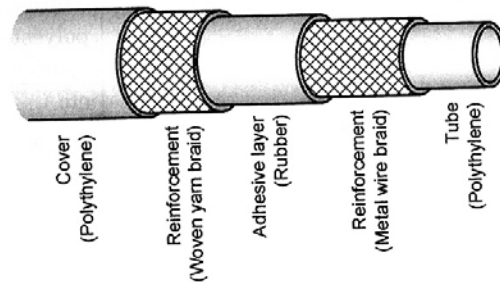
**Q.6 Attempt any FOUR of the following :**

[16]

**Q.6(a) Describe with neat sketch the construction and function's of pneumatic hose?**

[4]

(A)



- i) The construction of pneumatic hose consist of several layers with metal wire braiding between them.
- ii) Those metal wire reinforcement increase the strength of the pipe.
- iii) These layers are having various functions as follows.
- iv) Tube : It is used to covey hydraulic compressed air.
- v) First reinforcement :- It is used to protect and increase the strengthens of the tube.
- vi) Adhesive layer : Hold the reinforcement layer together and protects against vibration.
- vii) Second reinforcement :- used to protect first reinforcement.
- viii) Outer cover :- Used to protect from abrasions dust, vibrations, sunrays.

**Q.6(b) State the application of Pneumatic System?**

[4]

(A) Following are the application of pneumatic systems :

- 1) Pneumatic tools : drilling machine, screw driver, nut runner, jack hammer etc.
- 2) Packing systems : Used in packaging industry
- 3) Machine Tools : Pneumatic Press, Pneumatic drilling Machine, Clamps, vices etc.
- 4) Automobiles :- Air Brake, Air Suspension.
- 5) Medical and dental equipment :- dental chair, operating table.
- 6) Agriculture equipment: Shears
- 7) Mining: Pneumatic hand tools are extensively employed in mines

**Q.6(c) Distinguish between pressure relief valve and unloading valve?**

[4]

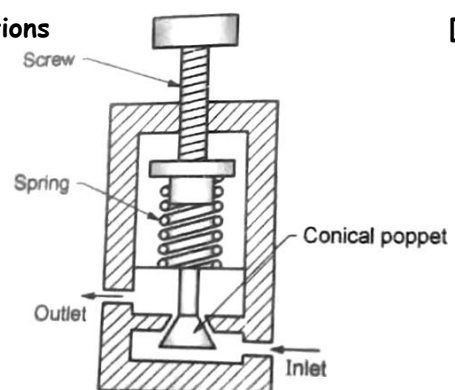
(A)

	Pressure relief	Unloading valve
1)	Its inlet itself is its pilot connection.	It has a separate pilot connection.
2)	It is set for maximum pressure required for operation of the system.	It is set for the minimum pressure required during idle period of the system.
3)	It opens when its inlet pressure (maximum system pressure) increases above preset value.	It opens when the pilot pressure (minimum idle-period pressure) increases above preset value.
4)	It is safety valve which avoids damage to the system components due to high pressure.	It avoids over heating of oil, and It saves power to a greater extent.

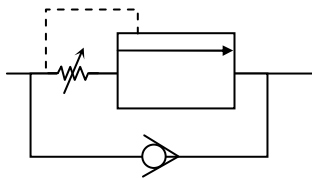
**Q.6(d) For the given component answer the following questions**

[4]

- (i) Write the name of shown component
- (ii) Name the parts denoted by around
- (iii) Give it's application
- (iv) Draw the symbol.

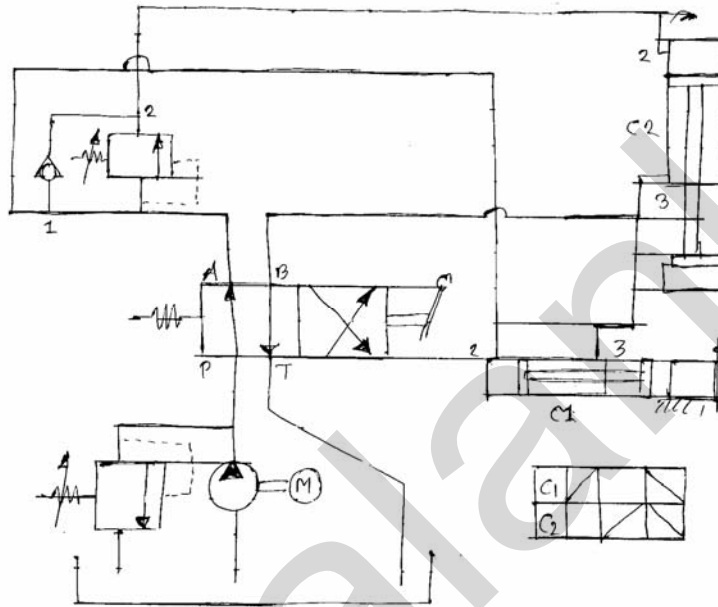


- (A) i) Sequence valve.  
 ii) 1) Adjusting screw  
 2) Conical Copper  
 iii) To operate DAC in a sequence.  
 iv)



Q.6(e) Draw a Sequencing Circuit for two DAC. Stamping Circuit. [4]

(A)



□ □ □ □ □