



**SUMMER – 13 EXAMINATION**

Subject Code: **12242**

**Model Answer**

**Important Instructions to examiners:**

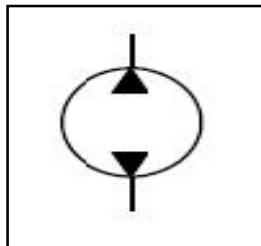
- 1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
- 2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
- 3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills).
- 4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
- 5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
- 6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
- 7) For programming language papers, credit may be given to any other program based on equivalent concept.

**Q1. Attempt any TEN of the following:**

**a) Enlist any four applications of hydraulic system. (any 4 applications 2 Marks)**

- |                                     |                                     |
|-------------------------------------|-------------------------------------|
| 1. Earth Moving equipments          | 2. Broaching machine                |
| 3. CNC/VMC/HMC Machines.            | 4. Hydraulic thread rolling machine |
| 5. Hydraulic press brake.           | 6. Material handling equipments     |
| 7. Hydraulic thread rolling machine | 8. Hydraulic cranes                 |

**b) Represent the symbol of Bi-directional fixed displacement Hydraulic pump. (2 Marks)**



**c) What do you mean by Non-positive displacement Hydraulic pump? (Definition: 2 Marks)**

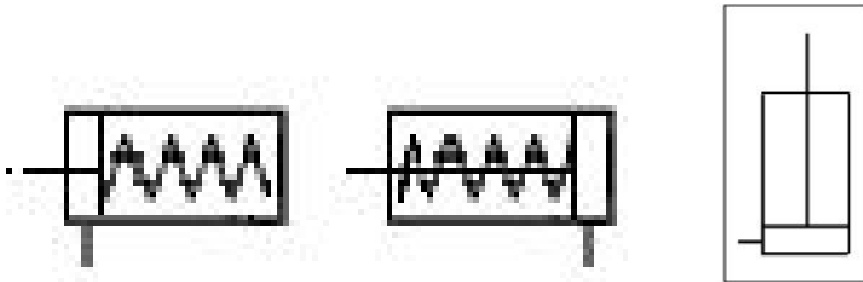
When pumping action is done by rotational inertia then the pump is called as Non-positive displacement Hydraulic pump

**d) State any four functions of 'Actuators' (any 4 functions 2 Marks)**

1. Convert hydraulic/pneumatic energy in to useful work
2. Give Linear, Rotary or oscillatory motion to load.
3. Actuate limit switches.
4. Actuate D C valves.



e) Draw the symbol of 'Single acting cylinder' in Hydraulic circuit. (any 1 Symbol, 2 Marks)



f) Enlist any four materials used for hydraulic pipes. (2 Marks)

1. Steel      2. Copper      3. Aluminium      4. Cast iron      5. Galvanised iron

g) How hydraulics pipes are classified? (2 Marks)

There are three types of pipes used in Hydraulics systems.

- i) Rigid pipes      ii) Semi rigid pipes      iii) Flexible pipes

The pipes are specified in terms of its internal diameter (ID). The outside diameter (OD) of pipe is fixed. The ID varies with its types:

- a) Standard (Schedule 40)      b) Extra strong (Schedule 80)      c) Double extra strong (Schedule 160)

h) Name any four basic elements used in Hydraulic circuit. (4 Basic elements, 2 Marks)

- i) Positive displacement pump      ii) Control Valves  
iii) Actuator      iv) Fluid carriers (piping and tubing)

i) State any two application of sequencing circuit. (2 Applications, 2 Marks)

1. Plastic material feeding and ejecting  
2. Lifting of material and pushing  
3. Clamping of work piece followed by drilling

j) Enlist any four uses of compressed air. (4 types, 2 Marks)

1. Air brakes in heavy automobiles      2. Inflation in tyres  
3. Air jet looms      4. Drilling of rocks in mines.

k) What is mean by FRL in pneumatic circuits and state function of each?

Filter Regulator Lubricator (FRL). (1+1 Mark)

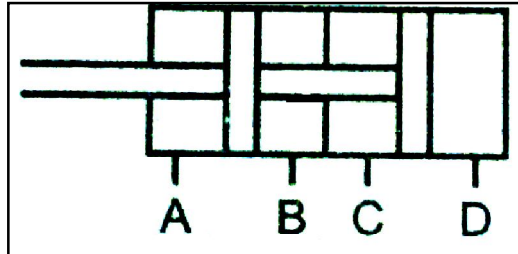
Filter- Filters the air



Regulator- Regulates the compressed air according to the requirement of the circuit

Lubricator- Adds Lubricant to the compressed air before going to the system.

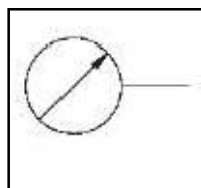
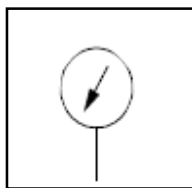
**l) Draw the symbol of tandem cylinder. (2 Marks)**



**m) Enlist any four types of Pneumatic cylinder mountings. (4 Mountings, 2 Marks)**

- i) Tie rod extension Rigid Mountings    ii) Front Flange Rigid Mountings    iii) Rear Flange Rigid Mountings  
iv) Central Trunnion Swivel mounting    v) Rear Clevis Swivel mounting    vi) Rod Clevis Swivel mounting

**n) Draw a symbol of 'Regulator' (any 1 Symbol, 2 Marks)**



**o) What are the various types of hoses used in Pneumatic system? (any 4 Hoses, 2 Marks)**

- 1) Polyurethane (PUR) hoses
- 2) Polyvinylidene fluoride (PVDF) hoses
- 3) Spiral pneumatic hoses
- 4) Low pressure hoses
- 5) High pressure hoses
- 6) General purpose hoses

**Q2. Attempt any FOUR of the following:**

**a) Define following term (4 Marks)**

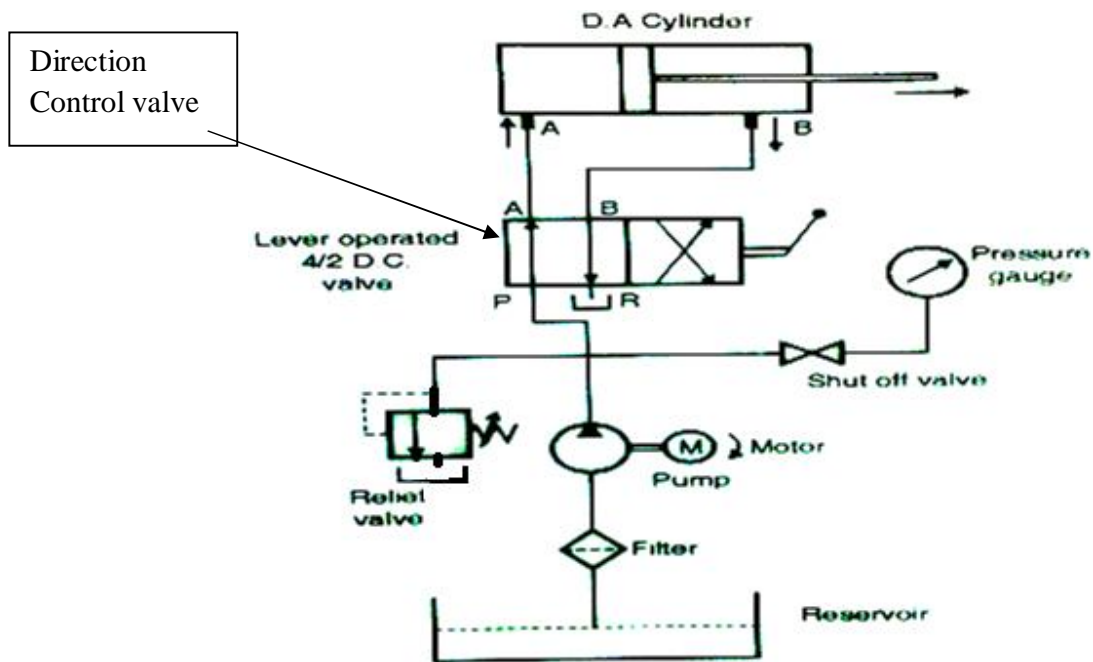
**i) Viscosity**- It is the resistance offered by liquid to flow. As temperature of a liquid decreases, its viscosity increases.

**ii) Lubricity**- It is the measure of ability of liquid to Lubricate/ reduce the friction in mating parts.

**b) State the use of directional control valve, showing its position in the circuit.**

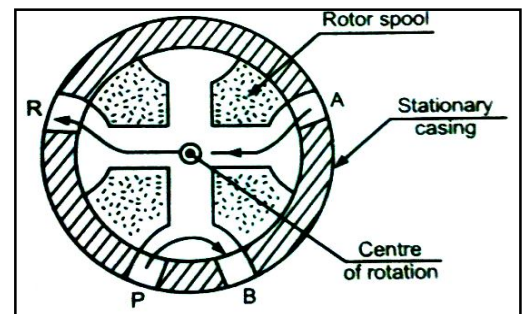
**(Use 2 marks, circuit diagram 2 marks)**

**Use:** Directional Control valve is used to give the desired direction to the actuator. The direction of the actuator may be lifting/ lowering or Left/ Right depending upon the application of the hydraulic circuit. Direction Control valve can be used to give some pilot signal to the next direction control valve for its actuation.



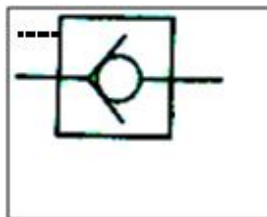
c) Explain the working of Rotary spool type valve with diagram. (Working 2 marks, fig. 2 marks)

A rotary spool valve consists of a rotating spool which aligns with ports in stationary valve casing, so that fluid is directed to required port. A/B/P/R are the ports in casing. The port 'P' is a pressure port through which pressurised oil is coming in the valve. 'R' port is the port through which used oil is returning to oil tank. From fig port P is connected to port B and port A is connected to port R

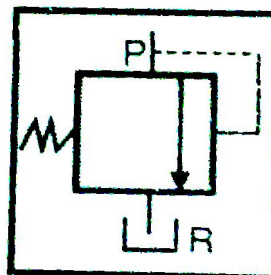


c) Draw the symbol of- (2 marks each symbol)

i) Pilot operated check valve

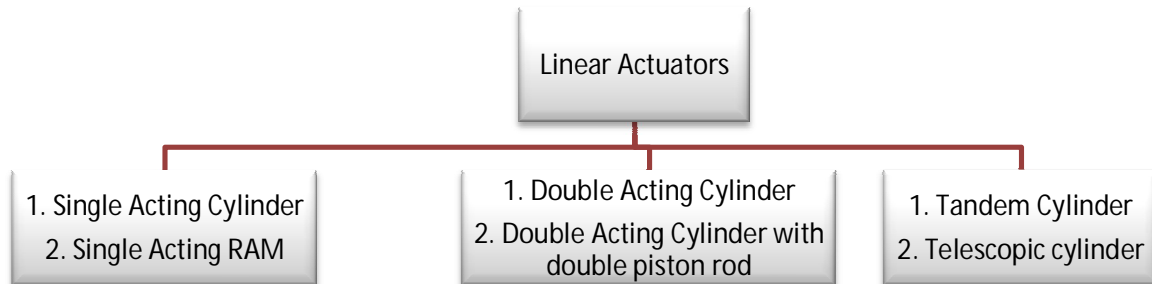


ii) Pressure Relief valve



**e) How Hydraulic cylinders are classified? (Classification 4 marks)**

Hydraulic cylinders are nothing but Linear Actuators and classified as follows:

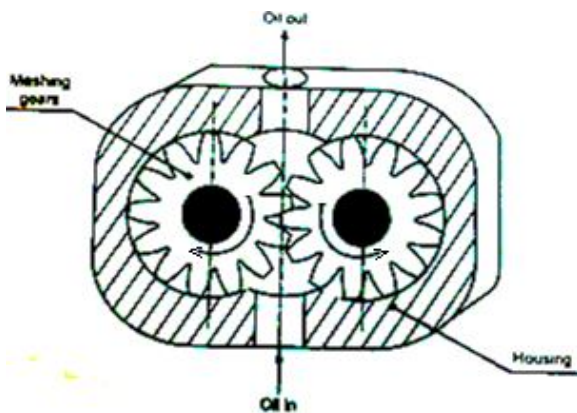


**f) Enlist various factors to be considered while selecting the motor for Hydraulic circuit. (4 marks)**

1. Torque required for the actuator.
2. Speed of the rotating element.
3. Pressure requirement depending on the load.
4. Unidirectional/ Bi-directional requirement of the actuator

**Q 3. Attempt any TWO of the following:**

**a) Explain working of 'external gear pump' (Fig: 4 marks, Construction & Working 4 marks)**

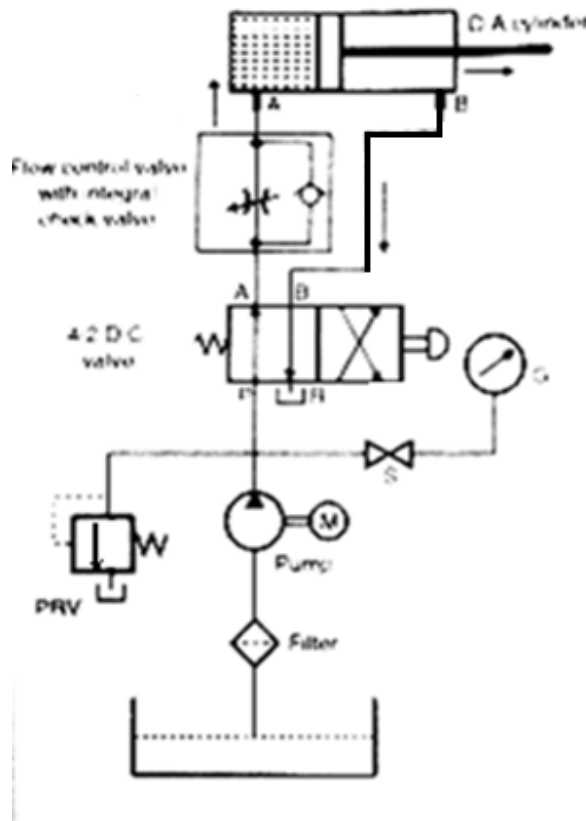


**Construction:** It consists of two closely meshing gears, housing, two cover plates, bearings and shaft for gear mounting and a drive motor. The housing is having two ports (inlet and outlet). Gears are either spur or helical, if pressure angle is  $14\frac{1}{2}^{\circ}$  then minimum numbers of teeth are 16.

**Working:** Tooth space of one gear is filled by tooth of other gear. Motor drives one gear which in turn rotates other gear. As meshed gears start rotating, one tooth space after another is evacuated resulting in vacuum. Atmospheric pressure in the tank forces the oil into the tooth space is full of oil. Due

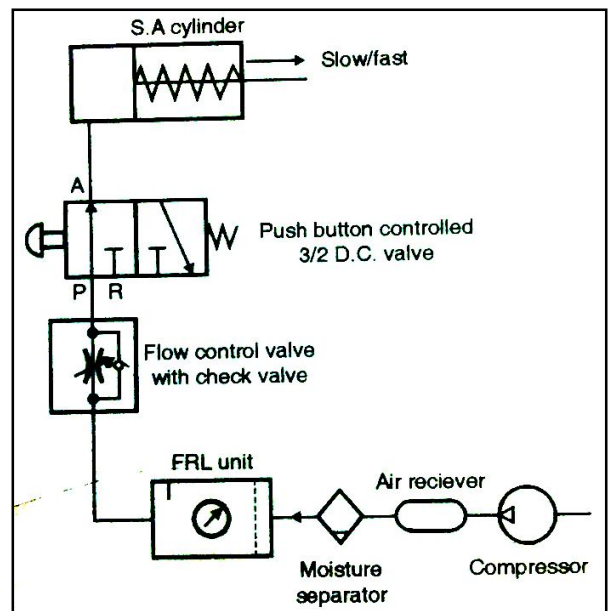
to rotation of gear, oil is carried around the periphery of the gear until the teeth again mesh and the oil is forced out through delivery port location on opposite side of suction port. This pump can create pressure up to 300 bar.

b) Draw a circuit diagram of speed control when piston moves forward in Reciprocating Hydraulic Cylinder. (8 marks)

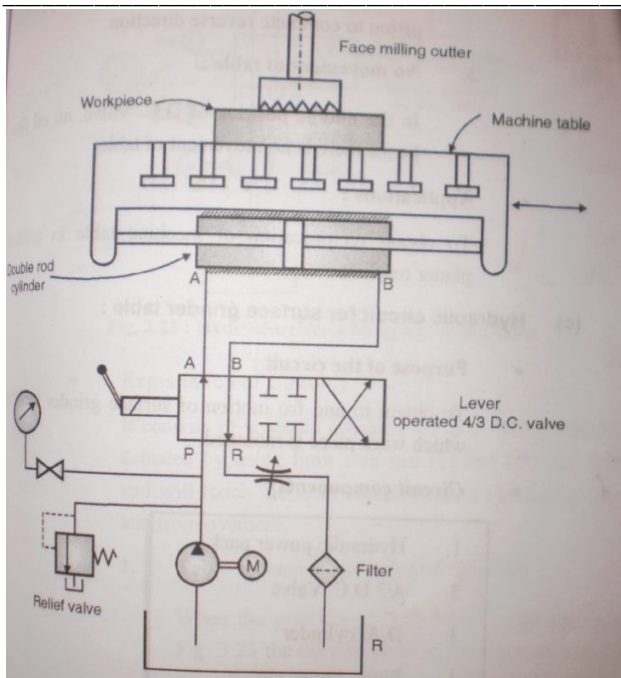


c) State any two applications of 3 X 2 DC pneumatic valve with any circuit diagram. (application 4 marks, Circuit diagram 4 marks )

1. To actuate single acting cylinder/ unidirectional motor.
2. To actuate pilot control of D.C. valves.



Q .4 a) Draw a hydraulic circuit diagram for milling machine to control its table movement.

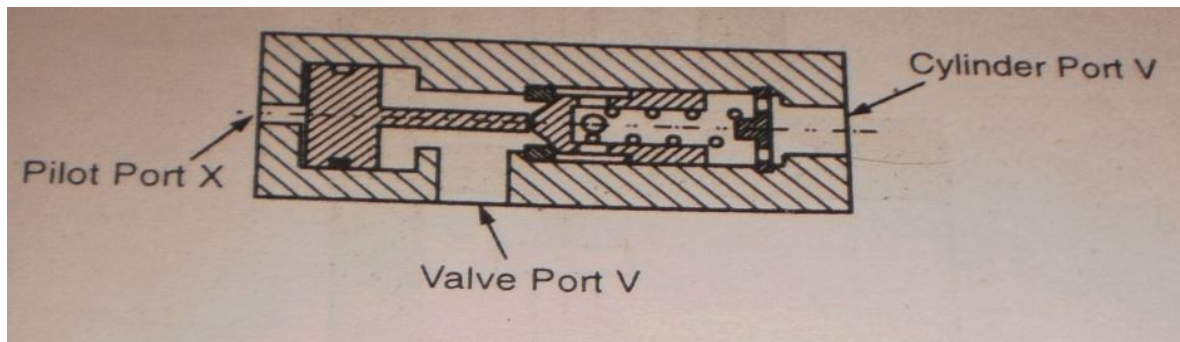


3marks

2marks

3marks

**Q .4 b) Explain with neat sketch the construction of pilot operated check valve (4+4 marks)**

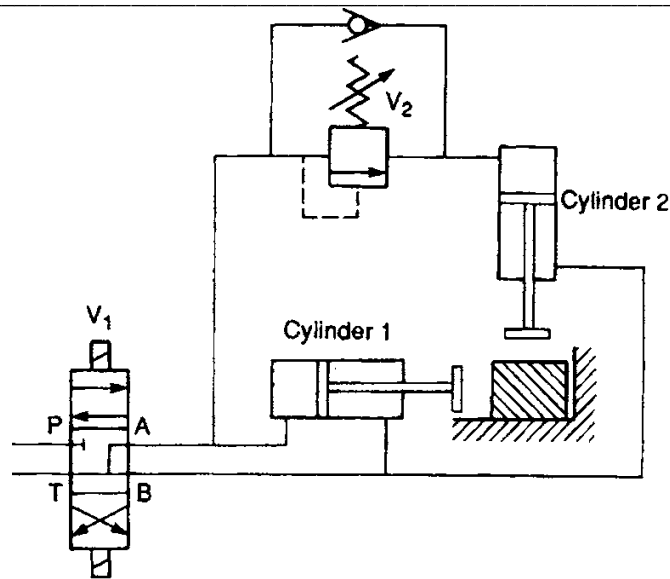


Pilot operated check valve

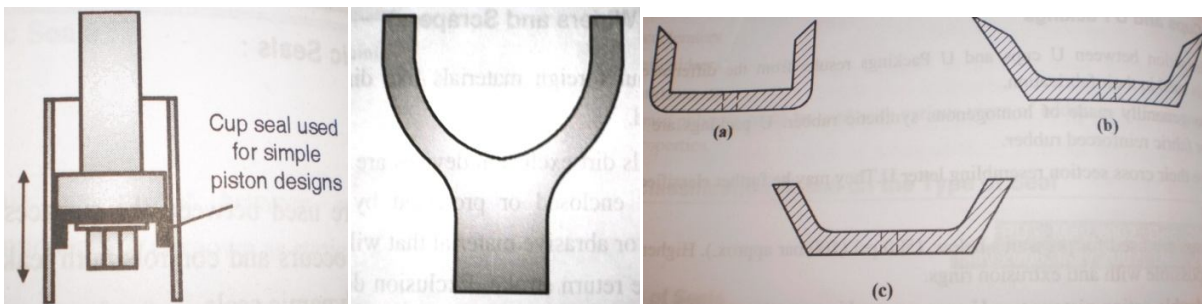
- This is NC type check valves which can be changed to NO status by a pilot signal.
- This valve behaves like an ordinary check valve and permits flow in one direction and blocks the flow in reverse direction.
- However it is additionally provided with a pilot port (X) to allow reverse flow when pilot pressure is applied. The pilot pressure pushes the pilot piston which opens the valve poppet by means of a rod.
- The pilot pressure required to open the check valve against a load pressure is determined from the ratio of areas of pilot piston and check valve.

**Q .4 c) Draw sequencing circuit of two double acting cylinders. (4 marks)**





**Q.5 a) Sketch the Cup seal and state any four uses of it.(any one sketch 2+uses 2 Marks)**



Uses:

1. In low and high pressure cylinders
2. In hydraulic press ram
3. In pistons of reciprocating pump
4. In plunger pump

**Q.5 b) Explain any four advantages and disadvantages of Gas pressurized accumulator.**

(2+2 marks)

Advantages:

1. The accumulator is compact in design and simple in construction.
2. Quick response for loading and unloading of accumulator.
3. Can absorb shocks and fluctuations since gas is easily compressible.
4. Reduces power requirement, pump size and space required.
5. Low operating cost

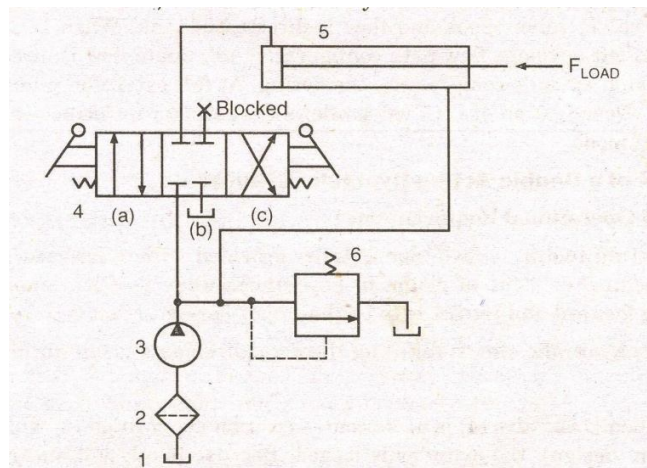
Disadvantages:

1. Constant pressure cannot be maintained due to compressible nature of gas.



2. Higher pressure ratio and higher temperature may cause failure of bladder. In accumulators without separator, the gas may be absorbed in the oil leading to jerky motion of actuators. It must be kept in vertical position to confine the gas at the top.
3. Special care required to prevent air/ oxygen to enter in the accumulator which may cause danger of explosion
4. Limited capacity
5. It is possible for high pressure to exist in the circuit even though the pump has been stopped

**Q.5 c) What is Regenerative hydraulic circuit? State any two applications of it. (2+2 marks)**



- Some energy is consumed to force out the fluid from piston rod end when cylinder is extending. If the return line of the actuator is connected to the pressure line with the help of D.C. Valve, this part of the energy can be reutilized which would have otherwise wasted. This is called as regenerative circuit.

Applications:

1. To obtain equal force in both forward and reverse directions.
2. To obtain rapid advancement of the cylinder with same discharge of pump.

**Q.5 d) State the functions of i) Moisture separator ii) Air actuator**

i) Moisture separator (2 marks)

1. To avoid the corrosion of components like valves, actuators made from ferrous metals
2. To increase the performance of system, moisture reduces the performance due to corrosion, noisy operations and increased wear and tear of component
3. To increase life of component, moisture decreases the life of the component due to corrosion, poor surface finish etc.

ii) Air actuator (2 marks)

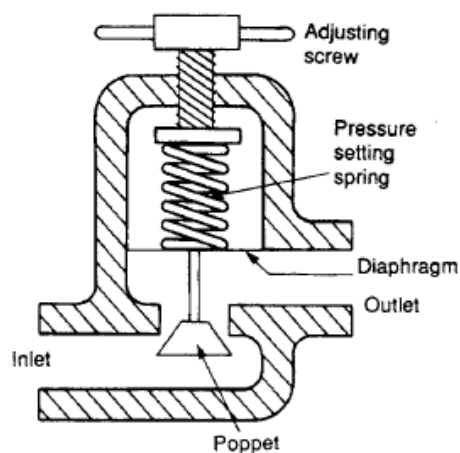
1. The pneumatic actuator converts energy of compressed air into applied force and motion (linear or rotary).
2. Pneumatic cylinders are used for clamping operations, lifting of load, cutters etc.

3. Air motors are used for pneumatic hand tools like grinders, drilling machines, nut runners etc.

**Q.5 e) State the types of Rotary Air Compressor with their applications. (4 marks)**

1. Sliding Vane Compressor (for efficient performance over wide range of pressure and flow rates and without receiver)
2. Lobe Compressor (high flow at comparatively low pressure)
3. Liquid ring Compressor (for pressure about 5 bar)
4. Screw Compressor (in modern plants with sophisticated controls, pulse free delivery)

**Q.5 f) Explain with neat sketch the construction of Non-Relieving Pressure Regulator. (2+2 marks)**



1. Figure shows construction of a typical non-relieving pressure regulator.
2. Outlet pressure is sensed by a diaphragm which is preloaded by a pressure setting spring.
3. If outlet pressure is too low, the spring forces the diaphragm and poppet down, opening the valve to admit more air and raise outlet pressure.
4. If the outlet pressure is too high, air pressure forces the diaphragm up, reducing air flow and causing a reduction in air pressure as air vents away through the load.
5. In a steady state the valve will balance with the force on the diaphragm from the outlet pressure just balancing the preset force on the spring.

**Q6. a) Differentiate between Air motor and Hydraulic motor on the basis of fluid used, material, capacity, application.**

Points	Air motor	Hydraulic motor
1. Fluid Used	Compressed air	Pressurized oil
2. Material	Light weight e g Aluminium alloys	High Strength e g Cast Steels
3. Capacity	For high speed applications output power is 0.05KW to 20 KW and rpm ranges up to 2000	For high speed applications up to 4000 r.p.m and output power is up to 10KW
4. Applications	Hand tools, operate trolleys & conveyors, tooth cleaning	Winding/rewinding reel, feed drives etc

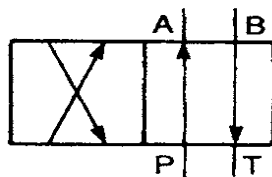
**Q.6 b) How good piping system is designated? State their tips. (3+1 marks)**

1. Pipes specified by a nominal bore size and wall thickness. That means for a given internal diameter (ID) it can be various outer diameter (OD)
2. Pipes must be rigid and they are not generally bent.
3. Iron pipes are economical and suitable for low pressure applications. Their major drawbacks are inability to sustain pressure surges, their high wall thickness and lack of toughness.
4. Cast iron pipes are restricted for use on return line only due to their limited burst pressure.
5. The metals include steel, stainless steel and cuprous nickel, zinc coated advanced iron, copper based pipes are suitable for low pressure system requiring small bore sizes.
6. Pipes need threading for connectivity
7. Use minimum pipe fittings to reduce the number of joints which may cause leakage

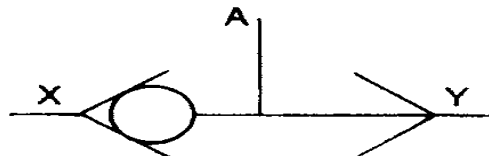
**TIPS:**

- If too small ID is selected, it could lead to excessive turbulence.
- In case too high ID is selected, it would mean over sizing and higher cost
- Horizontal pipeline should be sloped one or two percent towards flow direction

**Q.6 c) Draw symbol of i) 4 x 2 DC valve ii) Double check valve (2+2 marks)**



(a) Symbol

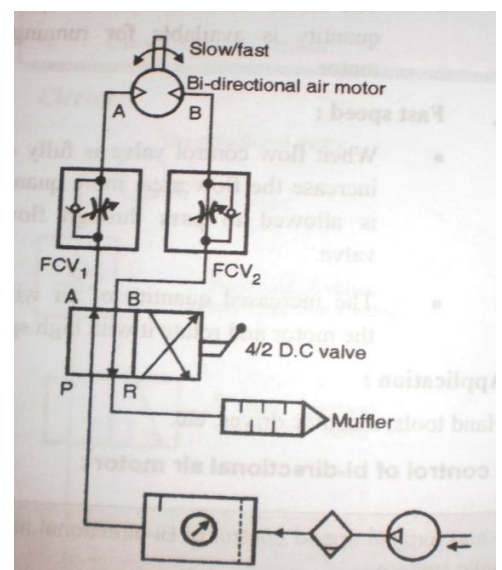


(b) Symbol

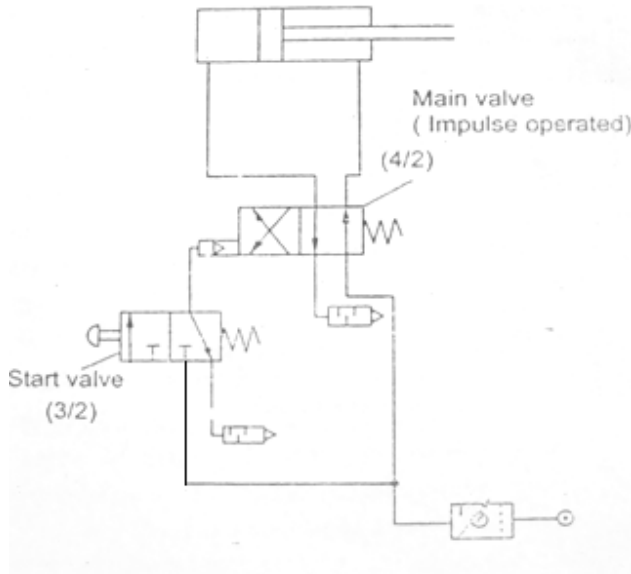
**Q.6 d) Sketch a circuit and explain speed control of bi-directional air motor in pneumatic circuit.**

(2+2 marks)

Figure shows the speed control circuit for a bi-directional motor. Both forward and reverse motion of the motor can be individually controlled with the help flow control valve connected in meter-out style. The 4/2 DC valve, in its normal position, passes the pressurized air to A port of motor through check valve. The speed of the motor is controlled by adjusting FCV<sub>2</sub>. When the main DC valve is actuated, its position changes and the pressurized air is now admitted at the B port of the motor through check valve. Thus the direction of motion of the air motor gets reversed and is controlled by FCV<sub>1</sub>. The 4/3 DC valve with central neutral position can be used to keep the motor in hold position.



**Q.6 e) What is Impulse circuit? Explain. (2+2 marks)**



Impulse circuit consists of a DC valve which is actuated by an impulse or air pressure as shown in figure. In other words it is a pilot (pneumatic) operated DC valve. When a start valve (3/2 DC valve) is pressed, the pressurized air passes through it and exerts an impulse on the main DC valve (4/2) causing it to shift. This causes the pressure port to be connected to the head side of the piston leading it to extend. On release of start valve, the spring pushes it to initial position causing air in the pilot line to drain, thus the impulse vanishes and the main DC valve also returns to normal position leading to retraction of piston.

**Q.6 f) Draw symbol of Time delay valve. ( 1+1+1+1)**

