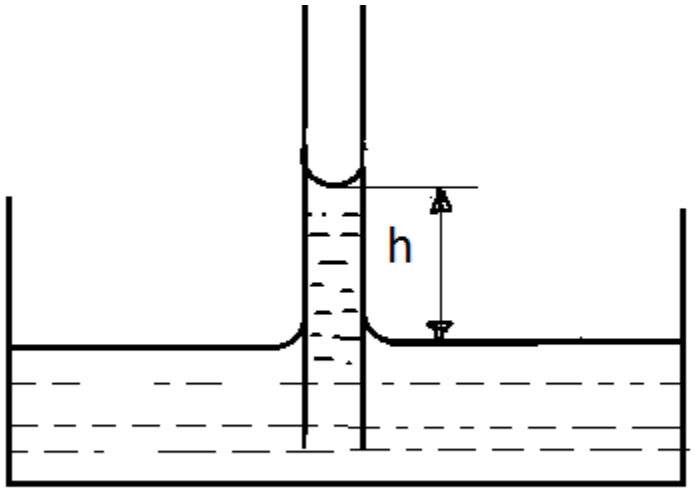
MODEL ANSWER

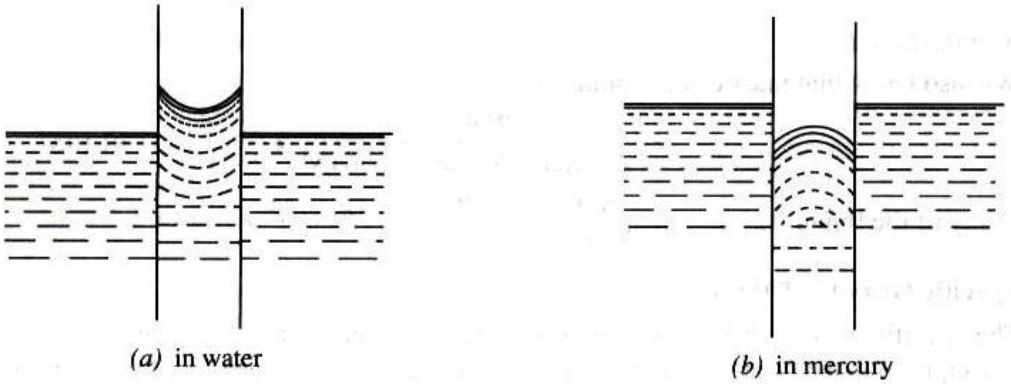
WINTER– 18 EXAMINATION

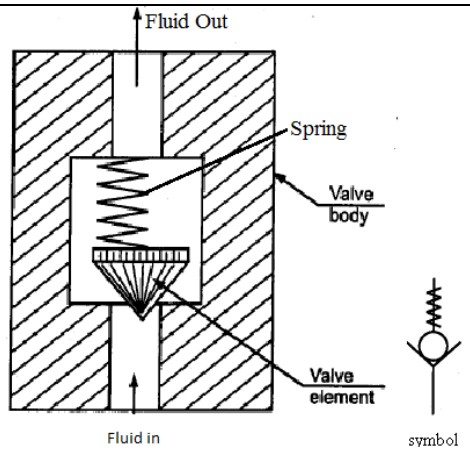
Subject Title: Hydraulic and Pneumatics Subject Code: 17522

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.

Q. No.	Sub Q. N.	Answer	Marking Scheme
1	a)	**Attempt any THREE of the following**	12
	(i)	**What is capillarity? When capillary rise and fall occur?**	04
	Ans	**Capillarity:** Capillarity is defined as a phenomenon of rise or fall of a liquid surface in a small tube relative to the adjacent general level of liquid when the tube is held vertically in the liquid. The rise of liquid surface is known as capillary rise while the fall of liquid surface is known as capillary depression.	01
		 Fig. Capillary Tube	01

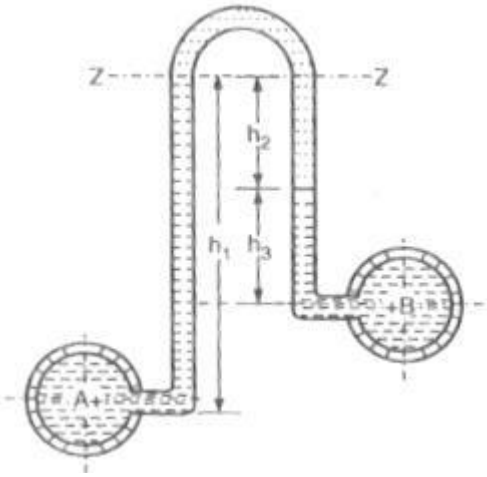
		Capillary rise and fall: I) when the liquid molecules possess relatively greater affinity for solid molecules or, in other words, liquid has adhesion greater than cohesion then it will wet the solid surface in contact and will tend to rise at the point of contact. This results concave upwards and the angle of contact θ which is less than 900. This is also known as Capillary Rise. II) If the liquid has less attraction for solid molecules or, in other words, Cohesion predominates, then liquid will not have tendency to wet the solid surface in contact and this will result in depression of liquid at that point in the concave downward shape and at the angle θ more than 90 0 e.g. glass tube is inserted inside the mercury.  *(a)* in water *(b)* in mercury	**02**
	(ii)	**Define hydraulic and pneumatic actuator give its applications.**	**04**
	Ans	**Hydraulic actuators:** It is defined as Hydraulic actuators are the elements of hydraulic system, which transforms the hydraulic energy into useful work. **Applications of hydraulic actuators:** *(Any one application of each-1 mark)* 1. **Linear Actuators:** Machine tools, Industrial machinery, Earth moving equipments, construction equipment, Space applications etc. 2. **Rotary Actuators:** Hydraulic motors, Engineering vehicles, Manufacturing machinery, Automotive transmission, LPG cylinder filling, Aviation service etc. 3. **Semi-rotary Actuators:** Industrial machinery, marine, subsea and in applications where high strength, corrosion resistance or hygiene are paramount factors. **Pneumatic actuators:** Pneumatic actuators are the elements of pneumatic system used for converting the air pressure delivered by the air circuit into applied force and motion. **Applications of pneumatic actuator:** pneumatic drills, rock drill, pneumatic braking system, pneumatic wrench	**01** **01** **01** **01**

	(iii)	**Explain construction of ball type non return valve with neat sketch**	**04**
	Ans	 **Figure: Non-Return Valve** **Construction:** This valve consists of valve body with inlet and outlet ports having valve element like cone, ball or spherical poppet. The valve element is incorporate with specially designed spring. When pressurized oil comes in through port A it will lift up the cone by overcoming spring force and flow will start from port A to port B .When flow from A stops spring will expand and cone will block the flow hence only one direction of flow is possible.	**02** **02**
	(iv)	**Give the classification of filter and state how it is different than a strainer**	**04**
	Ans	**Classification of filters** **A)Oil filters** 1) Full flow filter 2) Proportion flow filter **B) According to material used** 1) Surface or screen filter 2) Depth type filter **C)According to location of filter** 1) Suction line filter 2) Pressure line filter 3) Return line filter **D) Pneumatic type or air type filter**	**02**

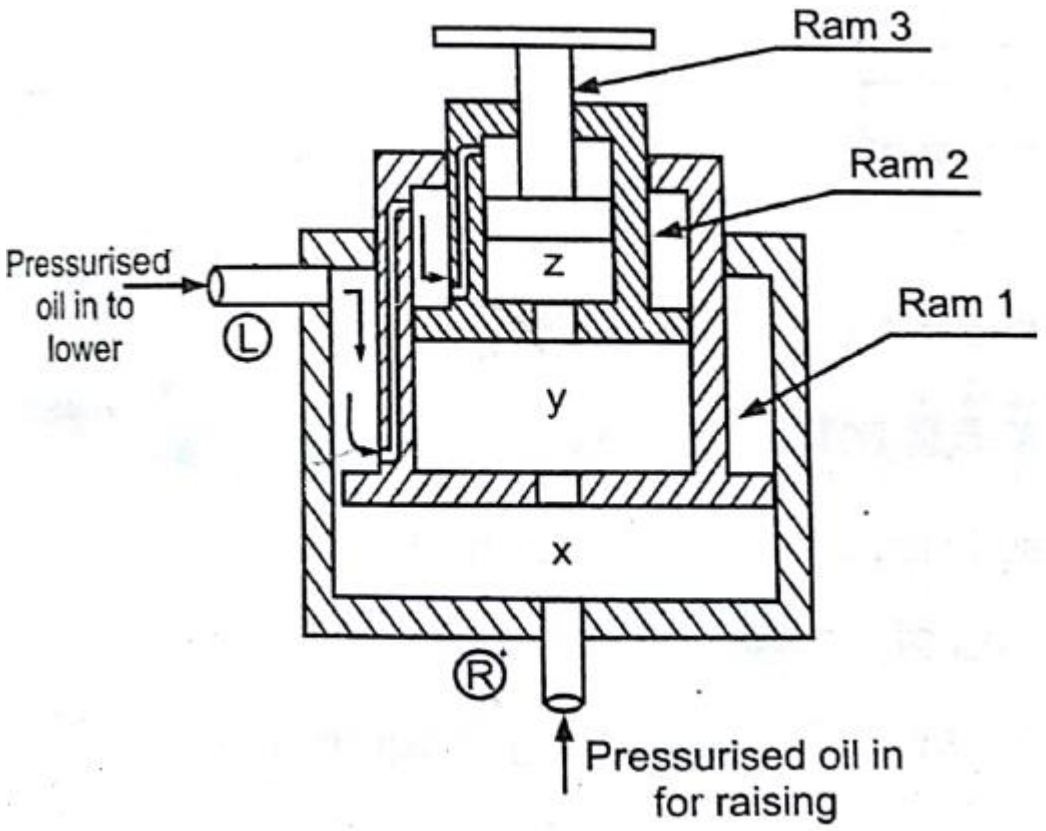
Sr.No.	Filters	Strainers
1	Filters remove particulates that are smaller than 40 microns	Strainers remove particulates that are larger than40 microns.
2	If the particulate is too small to see with the naked eye the term "filter" is used.	Word "strainer" is typically used if the particulate being removed is visible to the naked eye
3	Filters have a screen that can be used once until it is clogged.	Strainer incorporates various screens which are reused.
4	If the screen is clogged, it must be changed. Filter screens are not re-used.	If the screen is clogged, it can be cleaned out and used again.
5	Filters are much more flow restrictive	Strainers are much less flow restrictive.
6	Filters are much better applied where positive pressure exists and where constant flow exists i.e. in return line	In most cases, strainers are connected in suction lines into a pump

Any four points -02 marks

	b)	**Attempt any THREE of the following**	**06**
	(i)	**List different manometers used for measurement of pressure. Explain with neat sketch inverted 'U' tube differential manometer.**	
		Types of manometers: a) Simple manometers: 1.Piezometer 2.U-Tube manometer 3. Single column manometer. b)Differential manometers: 1.U-tube differential manometer 2.Inverted U-tube differential manometer	**02**

		 An inverted differential manometer is used for measuring difference of low pressure, where accuracy is the prime consideration. It consists of an inverted U tube, containing light liquid. One end is connected to A and other is connected to B. Let us assume that the pressure at point A is more than that at point B. Let us take Z-Z as the datum line in this case h1=Height of liquid in the left limb below Z-Z h2=Reading of the manometer h3= Height of liquid in the right limb in cm S1 S2 and S3=Specific gravities of liquids in the left limb light limb and liquid in the right limb respectively. hA= pressure in pipe A hB=pressure in pipe B with reference to the Fig hA – S1h1 = hB-S2h2-s3h3 hA-hB=S1h1-S2h2-S3h3 m of water	**02** **02**
	(ii)	**Explain with neat sketch construction and working of telescopic cylinder**	**06**
		Construction: figure shows three ram assembled in each other like telescope. This arrangement provides relatively long stroke with good mechanical strength. There are two inlet ports through which pressurized hydraulic oil enters. Port (R) is for raising the cylinder or extending the cylinders while (L) is for cylinder lowering. **Working:** (I) Raising or extending the cylinders: hydraulic oil under pressure will enter through port (R). space "X" will be filled by oil and Ram 1 will start raising upwards. When its raising stops, the oil now will start entering through and occupy space "Y". Due to this Ram 2 will raise. When raising of Ram 2 stops, the oil will start entering through and will occupy space "Z". This will raise final Ram 3.	**2** **02**

(II) Lowering the Rams: when pressurized oil will enter through port (L), then Ram 1 will come down. After its lowering Ram 2 will lower and then Ram 3 will lower.



02

(Note: Credit shall be given to any equivalent sketch and relevant description)

OR

Most telescopic cylinders are single acting. The telescopic cylinder is equipped with a series of nested tubular rod segments called sleeves. These sleeves work together to provide longer working stroke than possible with a standard cylinder. Up to four to five sleeves can be used. The maximum load is exerted when the cylinder is collapsed. In the extended position, the load is in function of the diameter of the smallest sleeve.

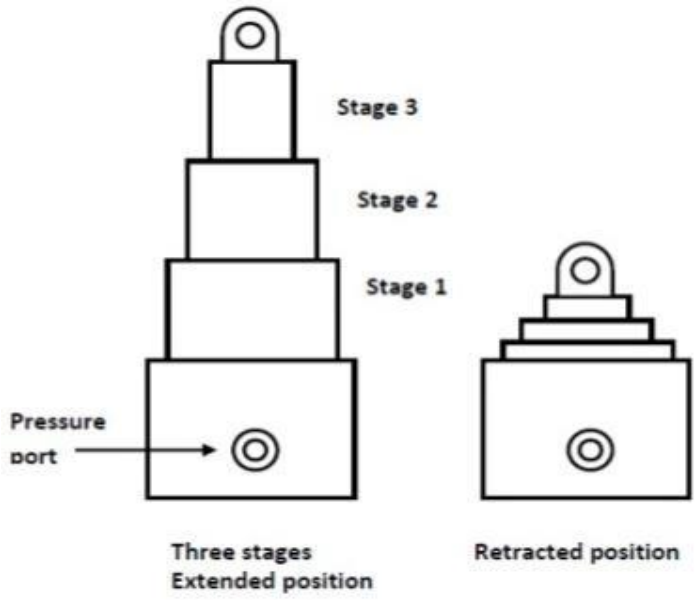
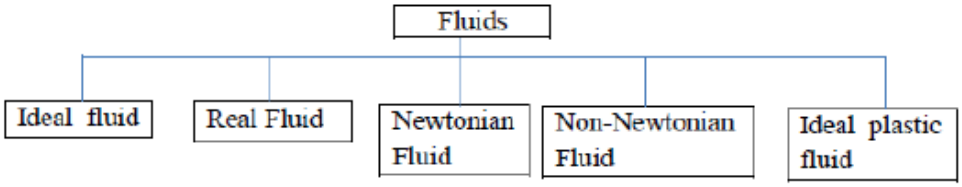


Figure: Telescopic cylinder

02		**Attempt any THREE of the following**	**12**
	a)	**Give the classification of fluids and write the example of each.**	**04**
	Ans	Answer: **Classification of fluids**  **Example of fluids** *(Consider any one example of each fluid type)* 1. **Ideal fluid:** An Ideal Fluid is a fluid that has no viscosity. It is incompressible in nature. Practically, no ideal fluid exists. These are only imaginary fluid. The fluids which have low viscosity such as air, water, etc., may however be treated as ideal fluids without much errors. 2. **Real Fluid:** Those fluids which are actually available in nature possess properties like viscosity, surface tension and compressibility. Kerosene, Petrol, Castor oil 3. **Newtonian Fluid:** Water, Air, Mercury, Emulsions 4. **Non-Newtonian Fluid:** Paints, polymers, blood 5. **Ideal plastic fluid:** Printers ink and other thixotropic substance	**02** **02**
	b)	**What factors will you consider while selecting a selecting a centrifugal pump?**	**04**
	Ans	**Factors to be considered while selecting a centrifugal pump:** *(Any four)* **1. Speed of Pump:** When the specific speed is low and it is possible to increase the pump speed it is better to use multi stage pump. The number of stages is decided on the basis of the head and the type of the pump to be used.	

		2. Flow of pressurized Fluid: From the values of discharge (Q), head (H) and speed (N), values of specific speed of the pump is calculated and subsequently the type of the pump can be decided. **3. Availability and Cost of Pump:** There is different variety of pumps available in market according to application we can choose it by economical aspect cost of the pump and its spare should be less. **4. Compatibility with working medium:** The meaning of compatibility is nothing but acceptance or familiar. Due to lack of proper working medium, pump will not give a good performance. **5. The type of impeller :** i) Impeller shrouded type - for pumping fresh clean water ii) Impeller un-shrouded or propeller type for pumping solid - liquid mixture or near plastic material iii) Mixed flow impellers with diffuser vanes used for deep well or submersible pumps. **6. Head available.**	**04**
	c)	**Define: (i) Mechanical efficiency and (ii) hydraulic efficiency of centrifugal pump**	**04**
	Ans	**1. Mechanical efficiency of a centrifugal pump (η_m):** Mechanical efficiency of a centrifugal pump (η_m) is the ratio of theoretical power that must be supplied to operate the pump to the actual power delivered to the pump. Mechanical efficiency can be used to determine the power loss in bearings and other moving parts of a centrifugal pump. It determines the actual power that must be supplied to a centrifugal pump for desired result. $\text{Mechanical efficiency } (\eta m) = \frac{\text{Theoretical power that must be delivered to a pump}}{\text{Actual power delivered to the pump}} \times 100\ \%$ **2. Hydraulic efficiency of a centrifugal pump (η_H):** Hydraulic efficiency of a centrifugal pump (η_-) is defined as the ratio of the useful hydrodynamic energy in fluid to Mechanical energy supplied to rotor. $\text{Hydraulic efficiency } (\eta H) = \frac{\text{Useful hydrodynamic energy in fluid}}{\text{Mechanical energy supplied to rotor}} \times 100\ \%$	**02** **02**
	d)	**Explain construction and working of hydraulic Ram with neat sketch**	**04**
	Ans	**Construction:** It is a type of pump which can lift a small quantity of water to a greater height when large quantity of water is available at smaller height. It consists of large reservoir A at smaller height, chamber E consists of waste valve C and delivery valve F.	**01**

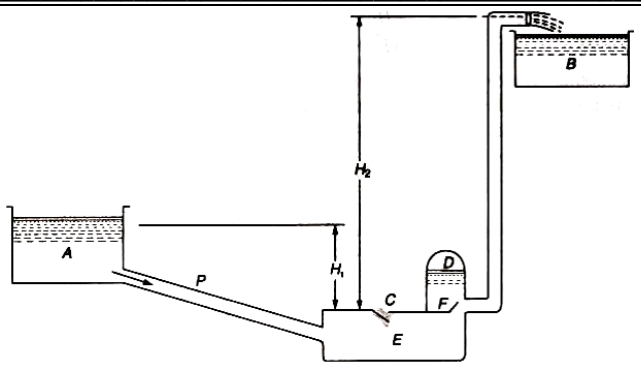


Figure: Hydraulic Ram — **02**

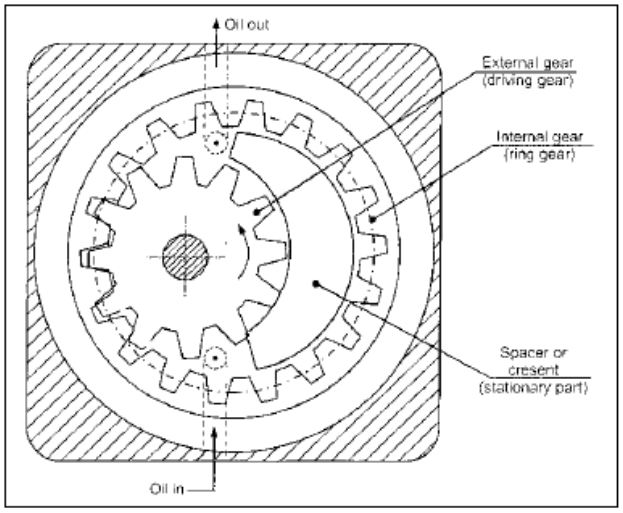
Working: The working of hydraulic ram is based on the principle of water hammer or inertia pressure developed in a supply pipe. When water starts flowing from tank A to chamber E through supply pipe P, it starts flowing through waste valve C as it is open. As the speed of water increases, the pressure on the valve lid increases thereby closing the waste valve. This sudden closing of waste valve brings the water in supply pipe to rest, causing further increase of pressure in valve chamber due to development of inertia pressure. Due to this increase of pressure in the valve chamber the delivery valve is forced to open. The water starts flowing in air vessel and delivery pipe which supply to delivery tank. When the momentum of water in the chamber is destroyed, the waste valve is opened again causing flow of water from tank A to recommence. — **01**

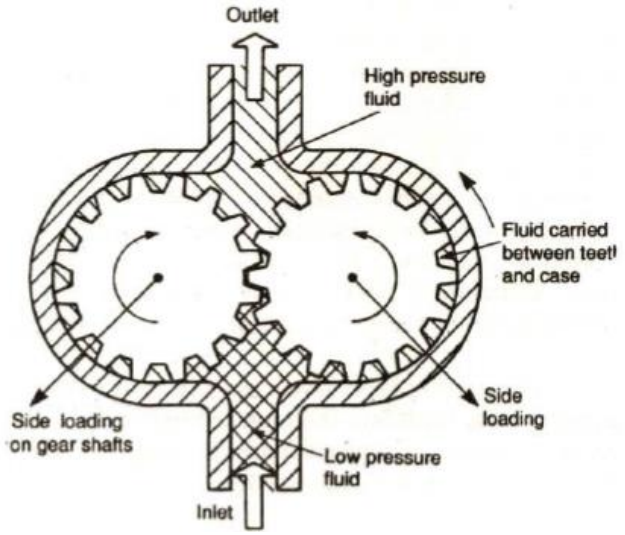
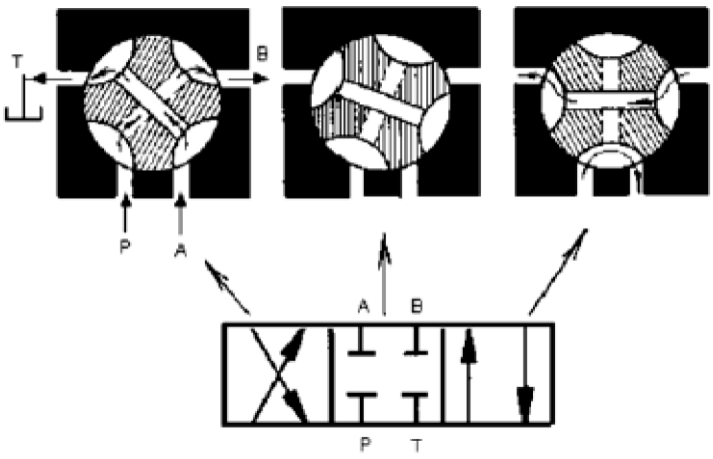
e) Compare gear pump and vane pump (four points) — **04**

Ans

Sr. No.	On the basis of	Vane pump	Gear pump
1	Construction	Less robust type- balance/unbalance, fixed/variable displacement	More robust type- internal external type, positive displacement type
2	pressure	Above 200 bar	125 to 175 bar
3	Speed	Upto 25000 r.p.m.	200 – 300 r.p.m.
4	applications	In light air craft to drive gyroscopic flight instruments, Vacuum pump, as automatic transmission pumps in power steering, during the installation of air conditioner.	Oil pump, hydraulic pack, earthmover

Any four points -04 marks

3		**Attempt any FOUR of the following.**	**16**
	a)	**Explain with neat sketch construction and working of gear pump.**	**04**
	Ans	**construction and working of gear pump:** **1) Internal Gear pump:** 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 pieces 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.  **OR** **2) External Gear Pump:** One of the gears is connected to drive shaft which in turn is coupled with prime mover. Second gear gets driven because of meshing (spur gears). Suction side teeth gets unmeshed and discharge side teeth gets mesh. Vacuum generation takes place due to evacuation of teeth. Line contact of the gear teeth over one another prevents flow through the mesh & the close fitting of the housing prevents flow back around the periphery.	**02** **02** **02**

			**02**
	b)	**Explain 4/3 rotary spool DC valve with neat sketch**	**04**
	Ans	**4/3 rotary spool DC valve** : The rotary spool directional control valve has a round core with one or more passages or recesses in it. The core is mounted within a stationary sleeve. As the core is rotated within the stationary sleeve, the passages or recesses connect or block the ports in the sleeve. The ports in the sleeve are connected to the appropriate lines of the fluid system. Figure shows three different position of the core when the handle is rotated. Left most envelope of DCV connects P to B and A to T. Middle envelope of DCV blocks all ports. Right most envelope of DCV connects P to A and T to B.  **Fig: 4/3 rotary spool DC valve**	**02** **02**

c) Differentiate between spoke and poppet type valves. (minimum four points) **04**

Ans

S.N	Poppet Type Valve	Spool Type Valve
1	Construction is complicated	Construction is simple
2	The valve finishing is difficult and costly	The valve spool and bore finishing is simple and less costly
3	Wear and tear is not uniform	Wear and tear is uniform
4	Valve Actuation possible is limited.	Actuation is easily adaptable
5	Rarely used	Commonly used
6	Very minor leakage	Leakage inside the valve is possible
7	Suitable for very high pressure applications	Suitable for low/medium pressure applications

1 mark for each

d) Classify seals and state function of each type. **04**

Ans

Seals are classified as follows:

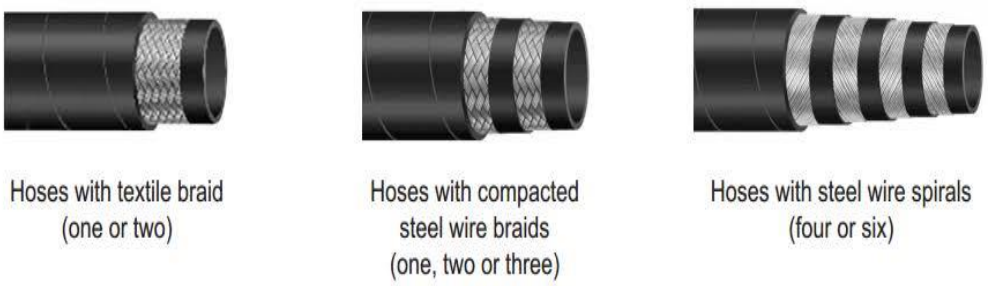
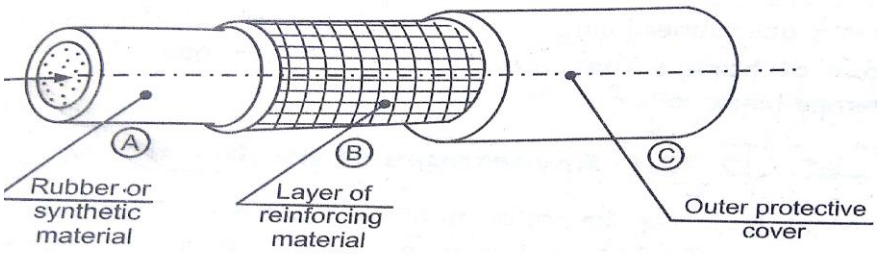
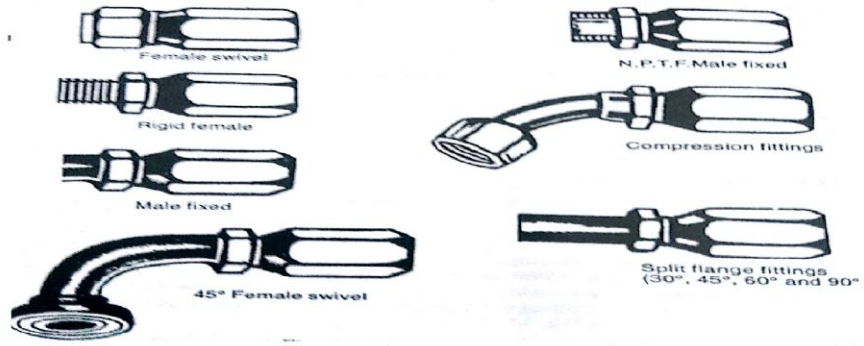
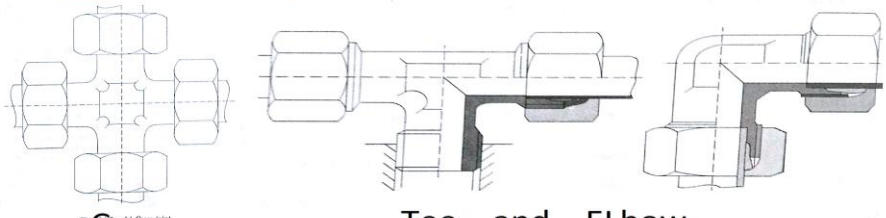
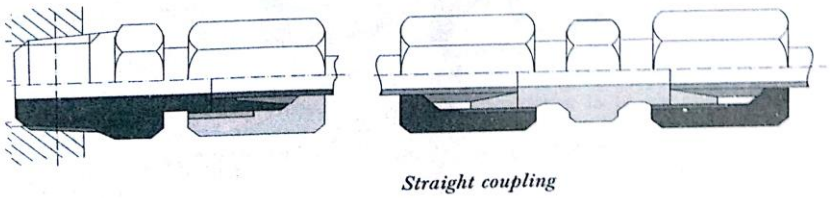
1) Based on Sealing – Positive and Non-Positive Seals
2) Based on Applications – Static seals and Dynamic Seals
3) Based on shape of seal- i) 'O' Ring, ii) Quad ring seals, iii) V- Packing, iv) U-Packing, v) Cup Packing, vi) Composite seals.

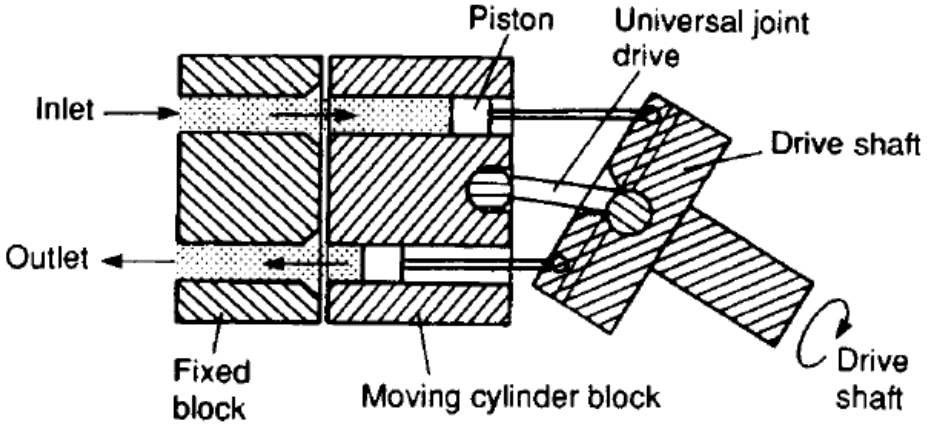
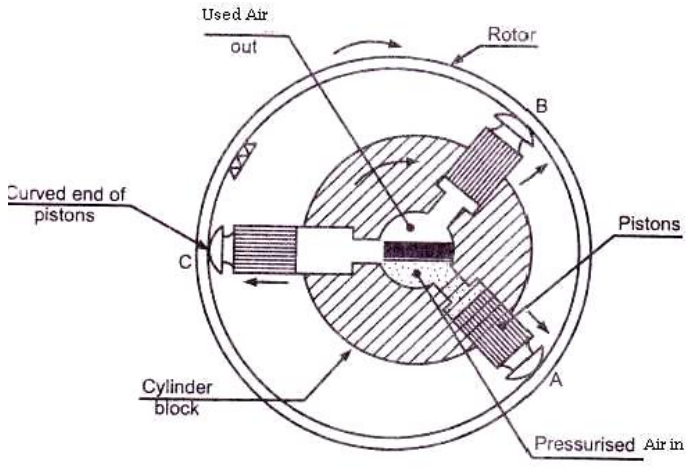
02

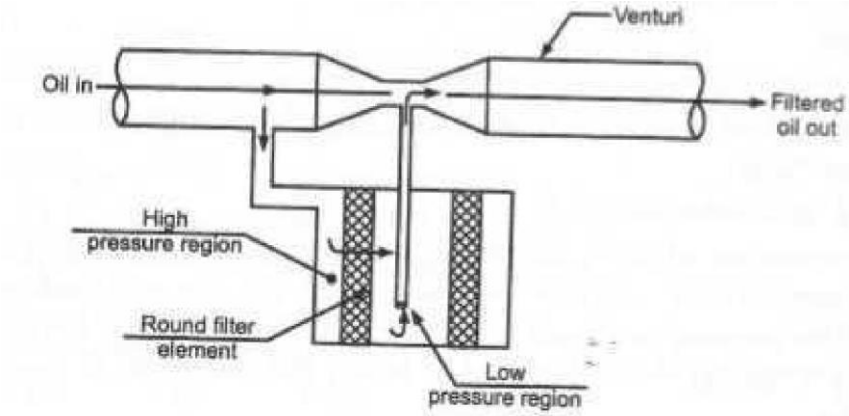
Function of each type of seal:

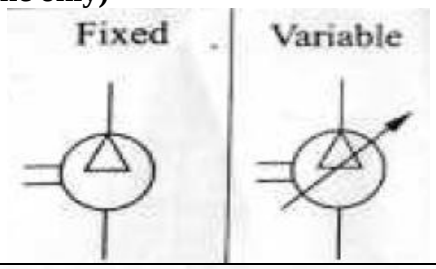
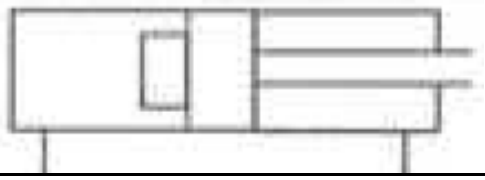
1) Positive seals do not allow any leakage whereas non positive seal permits a small amount of internal leakage.
2) 'O' ring is a static seal gives very effective sealing at high pressure.
3) Quad ring seal is quite versatile and can be used as static seal as well as for rotary and reciprocating motion.
4) V- Packing seal is capable of holding almost all pressure .
5) U-Packing seal is used in various dynamic sealing.
6) Cup Packing seal is exclusively used to seal pistons in both low-and high pressure hydraulic and pneumatic applications.
7) Composite seals is a combination of various types and are available in the form of sets used for special application.

02

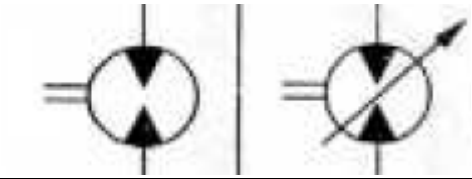
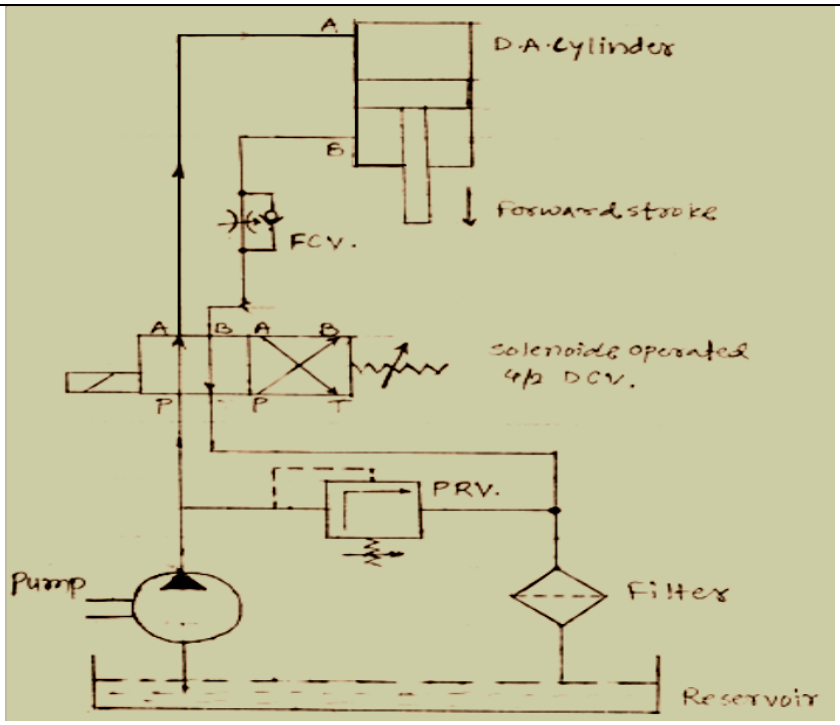
	e)	**Draw different type of hoses and connectors**	**04**
	Ans	**(Due credit shall be given to equivalent suitable answer)**  Hoses with textile braid (one or two) — Hoses with compacted steel wire braids (one, two or three) — Hoses with steel wire spirals (four or six) **Fig. Types of Hoses**  Hydraulic hose   Cross — Tee and ELbow  *Straight coupling*	**02** **02**

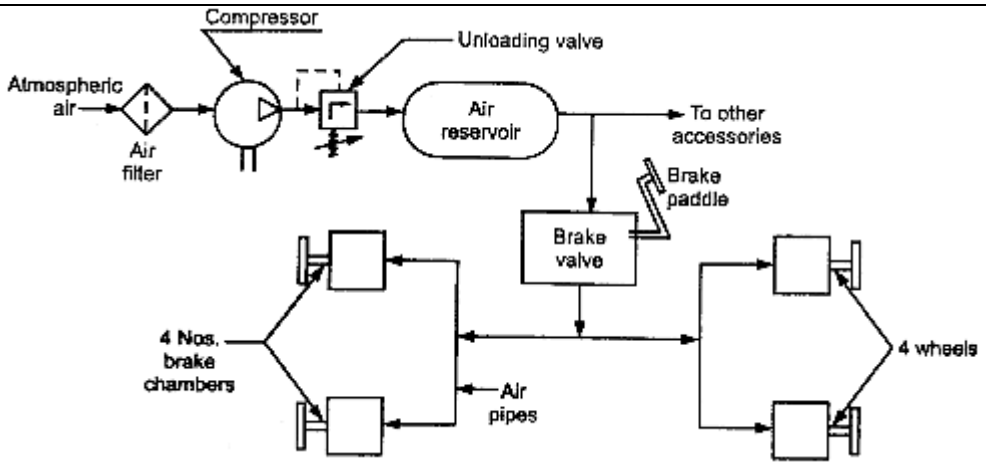
4	**a)**	**Attempt any THREE of the following.**	**12**
	(i)	**Draw the labelled sketch of bent axis swash plate pump**	**04**
	Ans	 **Fig. Bent Axis Swash Plate Pump**	**04**
	(ii)	**Explain with neat sketch radial piston motor**	**04**
	Ans	**Radial piston type air motor**  **Fig. Radial piston type air motor** Here three pistons fitted in cylinder block. The curve ends of Pistons can rest on smooth surface of rotor. Cylinder block and rotor are rotating member of motor. If compressed air is introduced in cylinder under pressure, piston will pushed outward this principle is used in this motor, suppose compressed air is under pressure is admitted to cylinder No A piston will move outward in its cylinders. Now curved end of piston will slide inside the rotor with force and rotor will turn in clockwise direction Then the cylinder B will occupy the position of A since cylinder block also starts rotating and same cycle will starts which results in rotational motion of rotor.	**02** **02**

	(iii)	**Explain proportional type filter with neat sketch**	**04**
	Ans	**Proportional flow filter:** By reducing cross sectional area of flow passage, a pressure difference is created, due to which proportionate quantity of oil passes through filter element. Main parts of Proportional flow filter are: Venturi passage, Filtering element. In this filter main oil flow passes through venturi, which create localize low pressure area inside the filter element. Outside of the filter element there is high pressure oil, due to the pressure difference crated across filter element. The propionate quantity passes through filter element. In this filter the pressure drop is very low hence is having wide application.  **Proportional Flow Filter**	**02** **02**
	(iv)	**Draw the symbol for :** **(1) Air compressor** **(2) Cylinder with end cushioning** **(3) 4/2 DCV** **(4) Bidirectional hydraulic motor**	**04**
	Ans		

(1) Air compressor	**(Any one only)** 
(2) Cylinder with end cushioning	

1 mark for each

		(3) 4/2 DCV		
		(4) Bidirectional hydraulic motor	**(Any one only)** **Fixed** **|| Variable** 	
	b)	**Attempt any ONE of the following.**		**06**
	(i)	**Draw and explain hydraulic press circuit**		**06**
	Ans	 **Figure: Hydraulic Circuit for Hydraulic Press** In this circuit, double acting cylinder is used. The flow control valve is connected in secondary line directly after load. In this operation, retraction stroke should be rapid one, but for achieving forward stroke it should be controlled. So that flow is metered after coming out from cylinder. For forward stroke port 'P' is connected to 'A' and after completion of stroke 'B' is connected to 'R', but in return line flow control valve with check valve is placed in parallel with throttle valve. So the flow is metered before going to reservoir. In this forward stroke is controlled stroke. for return stroke 'P' is connected to 'B' and flow is taken into cylinder directly opening spool of check valve without restriction of flow control valve ; hence return stroke is uncontrolled stroke.	**03** **03**

	(ii)	**Draw circuit diagram air braking system. Explain its working.**	**06**
	Ans		**03**
		Figure: Air Brake System Figure shows complete layout of Air Brake System. It consists of Air filter, unloading valve, Air compressor, Air reservoir, Brake valve and 4 numbers brake chamber. The compressor takes atmospheric air through air filter, and compresses the air. This air is stored under pressure in air reservoir. From this reservoir air goes to various accessories of vehicle which operates on compressed air. Part of air goes to brake valve. The control of brake valve is done by driver who controls the intensity of braking according to emergency.	**03**
05	**a)**	**Attempt any TWO of the following:**	**16**
	Ans	**State Bernoulli's theorem and give its assumption. Derive an expression for measurement of velocity of flow by pitot tube.**	**08**
		Bernoulli's theorem: This theorem states that 'whenever there is a continuous flow of liquid, the total energy at every section remains the same provided that there is no loss of addition of the energy. Mathematically, Where, $Z+v^2/2g + P/w = \text{constant}$ Z = Potential energy $v^2/2g$ = Kinetic energy P/w = Pressure energy	**02**

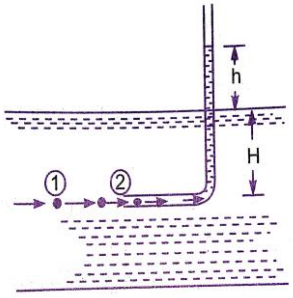
Assumptions :

Following are the assumptions made in the derivation of Bernoulli's equation:

(i) The fluid is ideal, i.e. viscosity is zero.
(ii) The flow is steady
(iii) The flow is incompressible
(iv) The flow is irrotational

02

Expression for measurement of velocity of flow by pitot tube.



Pitot-tube

01

Consider two point (1) and (2) at the same level in such a way that point (2) is just at the inlet of the pitot tube and point (1) is far away from the tube.

Let,

p_1 = intensity of pressure at point (1)
v_1= velocity of flow at point (1)
p_2 = intensity of pressure at point (2)
v_2= velocity of flow at point (2)
H = depth of tube in liquid
h = rise of liquid in the tube above free surface.

Applying Bernoulli's equation at points (1) and (2), we get

$$\frac{p_1}{\rho g} + \frac{v_1^2}{2g} + z_1 = \frac{p_2}{\rho g} + \frac{v_2^2}{2g} + z_2$$

01

But $Z_1 = Z_2$ as point (1) and (2) are on the same line and $v_2 = 0$.

$\frac{p_1}{\rho g}$ = pressure head at (1) = H

$\frac{p_2}{\rho g}$ = pressure head at (2) = (h + H)

Substituting these values, we get

$$H + \frac{v_1^2}{2g} = (h + H)$$

$$\therefore h = \frac{v_1^2}{2g} \quad \text{or } v_1 = \sqrt{2\,g\,h}$$

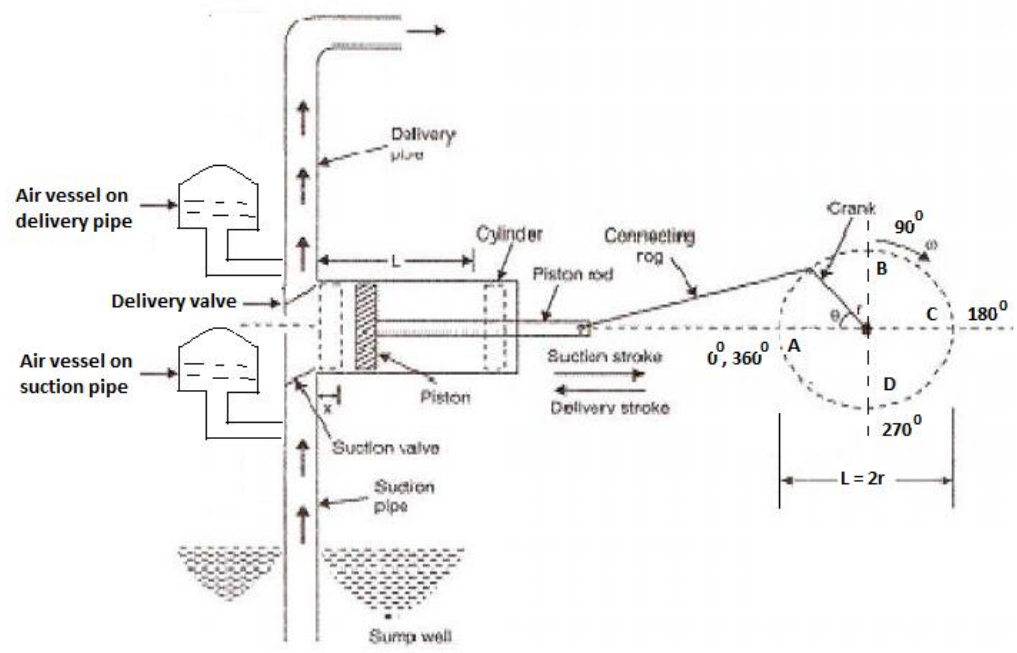
This is theoretical velocity. Actual velocity is given by

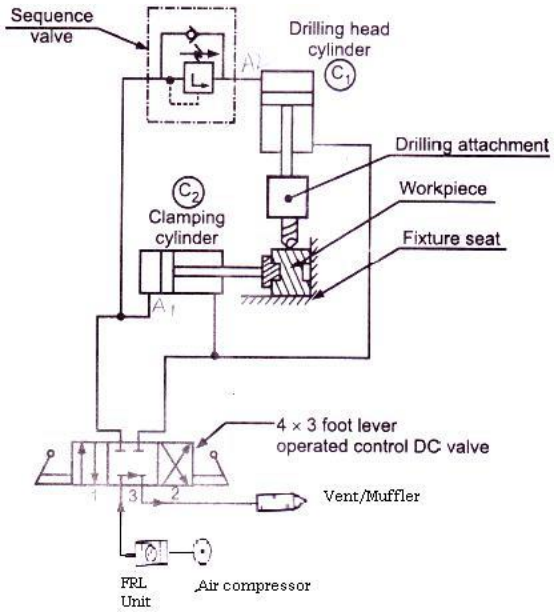
$$(v_1)_{\text{actual}} = C_v \cdot \sqrt{2\,g\,h}$$

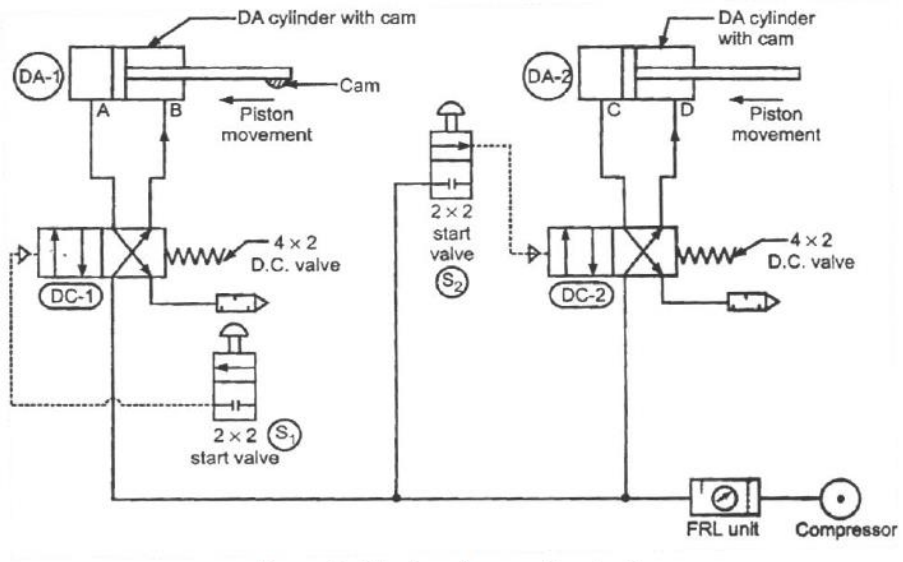
Where C_v = Co-efficient of pitot tube

∴ Velocity at any point $v = C_v \cdot \sqrt{2\,g\,h}$

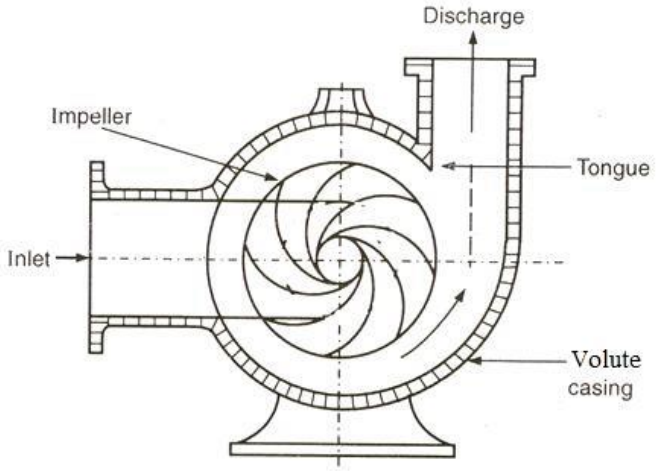
02

	b)	**Explain construction and working of single acting reciprocating pump.**	**08**
	Ans	**(Figure – 04 mark, Construction – 02 mark, Working – 02 Mark)**  Fig. Single Acting Reciprocating Pump **Construction:** Figure shows a single acting reciprocating pump, which consist of a piston which moves forwards and backwards in a close fitting cylinder. The movement of the piston is obtained by connecting the piston rod to crank by means of connecting rod. The crank is rotated by means of an electric motor. Suction and delivery pipe with suction valve and delivery valve are connected to the cylinder .The suction and delivery valves are one way valves or non-return valves, which allow the water flow in one direction only. Suction valve allows water from suction pipe to the cylinder which delivery valve allows water from cylinder to delivery pipe only. Air vessel is also fitted on suction pipe and delivery pipe as shown in figure. **Working:** When crank starts rotating, the piston moves to and fro in the cylinder. When crank is at A, the piston is at the extreme left position in the cylinder. As the crank is rotating from A to C, the piston is moving towards right in the cylinder. The movement of the piston towards right creates a partial vacuum in the cylinder. But on the surface of the liquid in the sump atmosphere pressure is acting, which is more than the pressure inside the cylinder. Thus the liquid is forced in the suction pipe from the sump. This liquid opens the suction valve and enters the cylinder. During first half of suction stroke, piston accelerates and extra water is supplied from air vessel. During second half of suction stroke, piston retards and extra	**04** **02** **02**

		amount of water will be stored in air vessel. When crank is rotating from C to A , the piston from its extreme right position starts moving towards left in the cylinder. The movement of piston towards left increases the pressure of the liquid inside the cylinder more than atmosphere pressure. Hence suction valve closes and delivery valve opens. The liquid is forced into the delivery pipe and is raised to required height. During first half of delivery stroke, piston accelerates and extra amount of water is stored in air vessel. During second half of delivery stroke piston retards and extra amount of water will be start flowing into delivery pipe maintaining uniform discharge of water.	
	c)	**Explain pneumatic sequencing circuit with neat sketch.**	**08**
	Ans	**Sequencing pneumatic circuit:** *(Description- 4 marks, Sketch -4 marks)*  **Figure: Pneumatic Circuit Using sequence valve** **1. Pressure dependent sequencing circuit:** The circuit is used for drilling a hole in work piece. The sequence of operation is - a) Clamping of work piece, b) Drilling, c) Decamping and drill taken out from hole. The DC valve takes centre position (no 3.) no compressed air supplied to either of cylinder C1 or C2. Now undrilled work piece is kept on fixture seat. The compressed air from compressor is going to vent via DC valve so no movement of cylinder C1 or C2. At position 1, compressed air starts supplying directly to C2 and through sequence valve to C1. When compressed air enters through port A2 of cylinder C2, piston will advance and immediately clamps the work piece. At the same time compressed air flow towards port A1 of cylinder C1 but through the sequence valve. Some higher pressure is set at pressure relief valve of sequence valve. When the pressure of flowing air reaches this set value the sequence valve opens and air enters through port A1 into cylinder C1. Due to this piston advances and comes	**04** **04**

		down, so that drilling starts. When operator again operate foot lever of DC valve it takes position 2 and both piston retracts and work piece de-clamps and drill comes out of drilled hole. **OR** **Position based sequencing circuit:** When air is admitted at port B of DA-1 cylinder and port D of DA-2 cylinder. Both pistons move from right to left. When push button of start valve (S1) is operated (as shown in figure), the air signal (Impulse) will be supplied to DC valve (DC-1). The air will be admitted through port 'A' of DA-1 and piston will move towards right. The cam is attached to end of piston rod. This cam will push the push button of start valve (S2). Due to this air signal (Impulse) will be supplied to direction control valve (DC-2) and it will operate. Now, air will be admitted through port 'C' of (DA-2) and the piston will move from left to right. The sequence is achieved by cam of (DA-1). Unless and until (S2) will not be operated with the help of cam, the piston of (DA-2) cannot move from left to right.  Figure: Position based sequencing circuit	
06)	**a)**	**Attempt any TWO of the following:**	**16**
	Ans	**200mm X 100mm venturimeter is mounted in a vertical pipe carrying water the flow being upwards. The throat section is 200 mm above the entrance section of the venturimeter for a certain flow through the meter the differential gauge between throat and entrance indicates a deflection of 250mm of Hg. Assuming venturi coefficient as 0.98. Find Discharge.**	**08**
	Ans	**Given data:** Diameter at inlet, D1 = 200 mm = 0.2 m	**01**

		∴ area at inlet $A1 = \frac{\pi}{4}\ 0.2^2 = 0.0314\ m^2$ Diameter at throat , D2 = 100 mm = 0.1 m ∴ area at throat $A2 = \frac{\pi}{4} \times 0.1^2 = 0.00785\ m^2$ Sp. Gravity of heavy liquid (in the manometer), S_{hl} =13.6 Sp. Gravity of liquid flowing through pipe i.e. water, S_p = 1 Coefficient of discharge , C_d =0.98 Reading of the differential manometer, y = 250 mm of Hg = 0.25 m of Hg. Rate of flow, Q: Differential head, $\mathbf{h} = (\frac{p_1}{w} + z_1) - (\frac{p_2}{w} + z_2) = y\ |\frac{S_{hl}}{S_p} - 1|$ ∴ $h = 0.25\ (\frac{13.6}{1} - 1) = 3.4$ Using the relation, $\mathbf{Q} = C_d \cdot \frac{A_1 A_2}{\sqrt{A_1^2 - A_2^2}} \sqrt{2\ g\ h}$ ∴ $\mathbf{Q} = 0.98 \times \frac{0.0314 \times 0.00785}{0.0314^2 - 0.00785^2} \times \sqrt{2 \times 9.81 \times 3.4}$ ∴ $\mathbf{Q} = \frac{0.000241}{0.0304} \times 8.17$ ∴ **Q = 0.0647 m^3/s** ……(Ans)	**01** **02** **02** **02**
	b)	**Explain construction and working of centrifugal pump with neat sketch.**	**08**
	Ans	**Construction of centrifugal pump:** Main parts of centrifugal pumps are: 1. Impeller. 2. Casing. 3. Suction pipe with foot valve and strainer. 4. Priming cup and delivery pipe with delivery valve. 5. Prime mover (Electric motor or engine) to drive the pump. **Working of centrifugal pump:** The first step in the operation of a centrifugal pump is priming so that no air pocket is left. After pump is primed, the electric motor is started to rotate the impeller. The rotation of impeller forces the water in	**02**

		radially outward direction in delivery pipe with high velocity. This high velocity water gets converted into high pressure when it passes through spiral casing. At the eye of the impeller due to centrifugal action partial vacuum is created. This causes liquid from the sump to rush through suction pipe to the eye as sump is at atmospheric pressure. This high pressure of liquid leaving the impeller is utilized in lifting the liquid to the required height through the delivery pipe.  Figure: Centrifugal Pump	**02** **04**
	c)	**Differentiate between :** **(i) Meter in and Meter out circuit. (ii) Hydraulic and Pneumatic system.**	**08**
	Ans	**(i) Comparison between Meter in and Meter out circuit.** **Compare between meter in and meter out circuit.**	**Any four- 04 marks**

Sr. no	Meter in circuit	Meter out circuit
1	Flow control valve is place in primary line	Flow control valve is place in Return line
2	Relatively small friction (due to pressure on one side)	Due to continued pressure on both side there is more friction.
3	Piston sealing having more life	Piston sealing having less life.
4	Uniform motion of the piston rod even at very slow speed.	Jerk motion of the piston rod is occur.
5	Special counter balance measures are required.	No special counter balance measures are required.
6	Use when load characteristics are	Use when load characteristics are

	constant and positive.	not constant.
7	Heat is given to the actuator.	Heat is given to the reservoir.
8	Pressure drop at inlet of the actuator.	Pressure drop at outlet of the actuator.
9	Application:-surface grinder, milling machine etc.	Application:-Drilling machine, reaming machine etc.

(ii) Comparison between Hydraulic and Pneumatic system.

Sr. No.	Hydraulic System	Pneumatic System
1	Energy carrying medium is oil.	Energy Carrying medium is air.
2	Pump pressurizes the fluid.	Compressor compresses the air.
3	Oil after pressurizing need to be used immediately. Storage of pressurized oil is not possible.	Pressurized air can be stored in pressure vessel called air receiver.
4	Can be used upto 700 bar pressures.	Can be used upto 10 bar pressure.
5	Return lines are essential to transport the used oil back to oil tank.	Return lines are not required. Used air is vented to atmosphere.
6	These systems are having high cost.	These systems are having low cost.
7	Motion accuracy is great, Hence used in CNC/VMC machine for tool movements.	Due to uncontrolled expansion of air motion accuracy is not good, hence used in clamping like operations.
8	Since hydraulic oil heats during operation there is possibility of fire hazards.	No fire hazards.
9	Due to leakage of oil overall system and space nearby is not cleaned.	Cleaned system.

Any four- 04 marks