



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) | Define the following terms and state its S I unit. | 04 |
| | | Answer: (Surface Tension- 2 marks ;Viscosity- 2 marks) 1) Surface Tension: The tensile force acting on the surface of liquid such that the contact surfaces behave like membrane under tension. S. I. unit is N/m | 02 |
| | | 2) Viscosity: It is the property of fluid which offers resistance to the movement of one layer of fluid over another adjacent layer. S. I. unit is N-s/m² OR Poise | 02 |
| | ii) | Classification of Control valves | 04 |
| | | 1. Classification of valves based on construction a) Poppet Valve- Cone type , Ball type and Disc type | 01 |
| | | b) Spool valve- Sliding spool type , Rotary spool type | |
| | | 2. Basis of control | 01 |
| | | a) Pressure control valve Pressure relief valve, Counterbalanced valve ,pressure reduce valve, sequence valve | |
| | | b) Flow control valve Pressure compensated valve , Pressure non compensated valve ,Temperature compensated valve | 01 |
| | | c) Direction control valve 2/2,3/2,4/3 valves, Solenoid operated D C valve, check valve, cartridge valve | 01 |



MODEL ANSWER

WINTER- 17 EXAMINATION

Subject Title: Hydraulic and Pneumatic

Subject Code:

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| Q. No. | Sub Q. N. | Answer | Marking Scheme | | | | | | | | | | | | | | | | | | | | | | | | |
|--------|--|--|--|-------------------|------------------|---|------------------------------|-------------------------|---|---|--|---|------------------------------|--------------------------|---|--------------------------------------|-------------------------------|---|-------------|---------------|---|--------------------|--------------------------------------|---|--|---|-------------------------------------|
| | iii) | State difference between poppet and spool type valve | 04 | | | | | | | | | | | | | | | | | | | | | | | | |
| | | <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">S.N</th> <th style="width: 45%;">Poppet Type Valve</th> <th style="width: 45%;">Spool Type Valve</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Construction is complicated.</td> <td>Construction is simple.</td> </tr> <tr> <td>2</td> <td>The valve finishing is difficult and costly</td> <td>The valve spool and bore finishing is simple and less costly</td> </tr> <tr> <td>3</td> <td>Wear and tear is not uniform</td> <td>Wear and tear is uniform</td> </tr> <tr> <td>4</td> <td>Valve Actuation possible is limited.</td> <td>Actuation is easily adaptable</td> </tr> <tr> <td>5</td> <td>Rarely used</td> <td>Commonly used</td> </tr> <tr> <td>6</td> <td>Very minor leakage</td> <td>Leakage inside the valve is possible</td> </tr> <tr> <td>7</td> <td>Suitable for very high pressure applications</td> <td>Suitable for low/medium pressure applications</td> </tr> </tbody> </table> | 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 | 04 Any four points |
| 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 | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 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 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | iv) | Describe function of seals and gasket. State their applications in Hydraulic and pneumatic circuits | 04 | | | | | | | | | | | | | | | | | | | | | | | | |
| | | <p>Seals : A mechanical seal is a device that helps join systems or mechanisms together for preventing leakage.</p> <p>Gasket: A gasket is a mechanical seal which fills the space between two or more mating surfaces, generally to prevent leakage from or into the joined objects while under compression.</p> <p>Application of Seals and gaskets: (Any two)</p> <p>Static Seals: These seals are used in reservoirs, gear boxes, body and casing / cover assembling of storage tanks, pump flanges etc.</p> <p>Dynamic seals: These seals are used in applications where mating parts are having relative motion. Hence the applications like piston and cylinder, rotating shaft and body, oscillating or limited rotary hydraulic motors.</p> <p>General Applications of gasket for different purposes:</p> | 01 01 01 01 | | | | | | | | | | | | | | | | | | | | | | | | |



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| | | Hydraulic pump, hydraulic motors, hydraulic actuators, valves, filter, reservoir | |
| 1 | b) | Attempt any ONE of the following | 06 |
| | i) | Define Cc, Cv , Cd, Cr. State the relation between hydraulic coefficients. | 06 |
| | | <p>Answer:</p> <p>Coefficient of contraction (Cc): It is the ratio of area of jet at vena contracta to the area of Orifice is known as Coefficient of contraction.</p> <p>Coefficient of velocity(Cv): It is the ratio of actual velocity of jet at vena contracta to the theoretical velocity of jet is known as Coefficient of velocity</p> <p>Coefficient of discharge (Cd): It is the ratio of actual discharge through an orifice to the theoretical discharge is known as Coefficient of discharge.</p> <p>Coefficient of Resistance (Cr): It is the ratio of loss of head in the orifice to the head of water available at the exit of orifice is known as Coefficient of resistance.</p> <p>The relation between hydraulic coefficients:</p> <p>$Cd = Cv \times Cc$</p> | <p>01</p> <p>01</p> <p>01</p> <p>01</p> <p>02</p> |
| | ii) | Describe with neat sketch construction and working of piston type air motor | 06 |
| | | <p>Radial piston type air motor</p> <p>Fig. Radial piston type air motor</p> <p>Working: 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</p> | <p>03</p> <p>03</p> |



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| | | 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. | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|--|---|--|--|----|--------|----------|---|---------------------------------|--|---|---|--|---|---|----------------------|---|--|-------------------------|---|----------------------------------|---|---|---|---|-----------|
| 2 | | Attempt any FOUR of the following | 16 | | | | | | | | | | | | | | | | | | | | | | | | |
| | a) | Describe classification of fluids and write one example of each | 04 | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Classification of fluids (Any four points) 1. Ideal fluid- zero viscosity 2. Real fluid- having viscosity 3. Newtonian fluid- water, kerosene, air 4. Non-Newtonian fluid- solutions or suspensions (slurries), bloods 5. Ideal Plastic fluid- sewage sludge, drilling muds | 04 | | | | | | | | | | | | | | | | | | | | | | | | |
| | b) | State any two faults of centrifugal pump and state two causes and two remedies of each of the faults. | 04 | | | | | | | | | | | | | | | | | | | | | | | | |
| | | NOTE :any two faults maybe considered <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="3" style="text-align: left;">Fault no. 1. Fails to start Pumping: (Any two- 2marks)</th> </tr> <tr> <th style="width: 5%;">Sr</th> <th style="width: 45%;">Causes</th> <th style="width: 50%;">Remedies</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1</td> <td>Pump may not be properly primed</td> <td>Fill the suction valve, suction pipe, impeller and delivery pipe up to delivery valve with liquid to be pumped</td> </tr> <tr> <td style="text-align: center;">2</td> <td>Total head against which the pump is working may be more than the designed head</td> <td>Reduce the head or change pump with pump having higher total head.</td> </tr> <tr> <td style="text-align: center;">3</td> <td>Impeller, strainer or suction line may be clogged</td> <td>clean the pump parts</td> </tr> <tr> <td style="text-align: center;">4</td> <td>Suction lift may be excessive Reduce the suction lift</td> <td>Reduce the suction lift</td> </tr> <tr> <td style="text-align: center;">5</td> <td>Speed of impeller may be too low</td> <td>Check and compare it with design speed, if found low, increase the speed.</td> </tr> <tr> <td style="text-align: center;">6</td> <td>The impeller might be rotating in the wrong direction</td> <td>Check the direction of the impeller with that marked on the casing. Change the direction of rotation by changing electric connections, if required</td> </tr> </tbody> </table> | Fault no. 1. Fails to start Pumping: (Any two- 2marks) | | | Sr | Causes | Remedies | 1 | Pump may not be properly primed | Fill the suction valve, suction pipe, impeller and delivery pipe up to delivery valve with liquid to be pumped | 2 | Total head against which the pump is working may be more than the designed head | Reduce the head or change pump with pump having higher total head. | 3 | Impeller, strainer or suction line may be clogged | clean the pump parts | 4 | Suction lift may be excessive Reduce the suction lift | Reduce the suction lift | 5 | Speed of impeller may be too low | Check and compare it with design speed, if found low, increase the speed. | 6 | The impeller might be rotating in the wrong direction | Check the direction of the impeller with that marked on the casing. Change the direction of rotation by changing electric connections, if required | 02 |
| Fault no. 1. Fails to start Pumping: (Any two- 2marks) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sr | Causes | Remedies | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | Pump may not be properly primed | Fill the suction valve, suction pipe, impeller and delivery pipe up to delivery valve with liquid to be pumped | | | | | | | | | | | | | | | | | | | | | | | | | |
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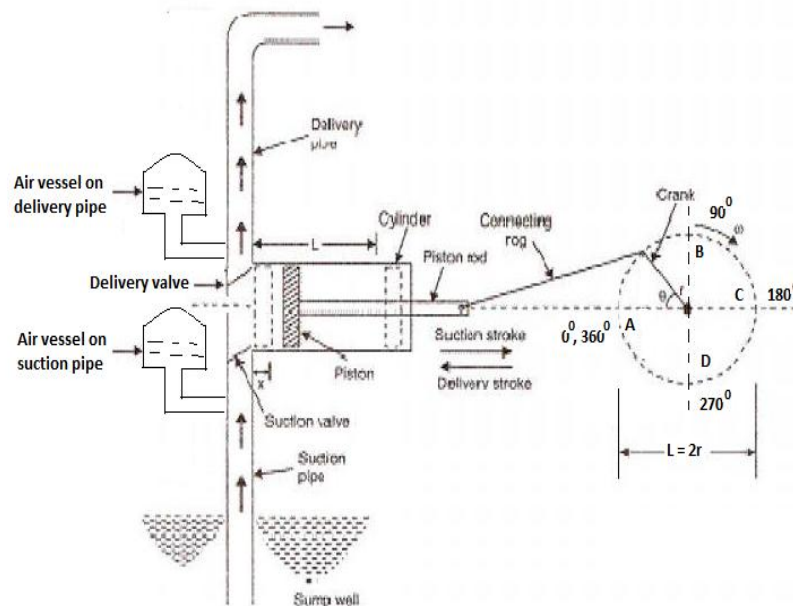
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| | | Fault no. 2. Low efficiency: (Any 2- 2 marks) | | | |
|--|-----------|--|--|---|-----------|
| | | Sr | Causes | Remedies | |
| | | 1 | Speed may be high. | Reduce the speed. | |
| | | 2 | Head may be low and discharge may be more. | Reduce the discharge or change the pump | |
| | | 3 | Pump may be operating in the wrong direction. | Correct the direction of the impeller. | |
| | | 4 | The impeller may be touching the casing, stuffing box may not be working properly, shaft may not be properly aligned or there may be excessive wear. | Repair the affected parts. | |
| | c) | Explain cavitations in centrifugal pump suggest steps to prevent it. | | | 04 |
| | | <p>Cavitations: Formation of vapour bubbles of a flowing liquid in a region where the pressure of the liquid falls below its vapour pressure and sudden collapsing of these vapour bubbles in a region of higher pressure. The metallic surfaces, above which these vapour bubbles collapse is subjected to high pressure which causes pitting action on surfaces. Thus cavities are formed on metallic surface and also produce noise and vibrations.</p> <p>The steps to prevent cavitations:</p> <ol style="list-style-type: none"> 1. Restricted suction 2. Higher runner speed 3. Too high specific speed for optimum design parameters 4. Too high temperature of the flowing liquid | | | 02 |
| | d) | Draw a labeled sketch of any one positive displacement pump. | | | 04 |
| | | <p>Construction:</p> <p>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.</p> <p>Working:</p> <p>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</p> | | | 01 |

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 amount of water will be stored in air vessel.

01

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.



02

Figure: Reciprocating pump

NOTE :

Any one of the following positive displacement pumps consider:

Gear pump, Screw pump, vane pump, Lobe pump, axial piston pump and radial piston pump



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| | | | | | | |
|---|----|---|-----------------|--|--|--|
| | e) | Compare between Gear Pump and Vane pump | | | | |
| | | Sr. No | On the basis of | Gear Pump | Vane Pump | 04 (One mark for each point) |
| | | 1 | Constru ction | More robust type- internal external type, positive displacement type | Less robust type- balance/unbalance, fixed/variable displacement | |
| | | 2 | Pressur e | 125 to 175 bar | Above 200 bar | |
| | | 3 | Speed | 200 – 300 r.p.m. | Upto 25000 r.p.m. | |
| | | 4 | Applica tions | Oil pump, hydraulic pack, earthmover | In light air craft to drive gyroscopic flight instruments, Vacuum pump, as automatic transmission pumps in power steering, during the installation of air conditioner. | |
| 3 | | Attempt any <u>FOUR</u> of the following: | | | | 16 |
| | a) | Explain construction and working of hydraulic lift with neat sketch. | | | | 04 |
| | | <p style="text-align: center;">Direct acting hydraulic lift.</p> | | | | 02 |



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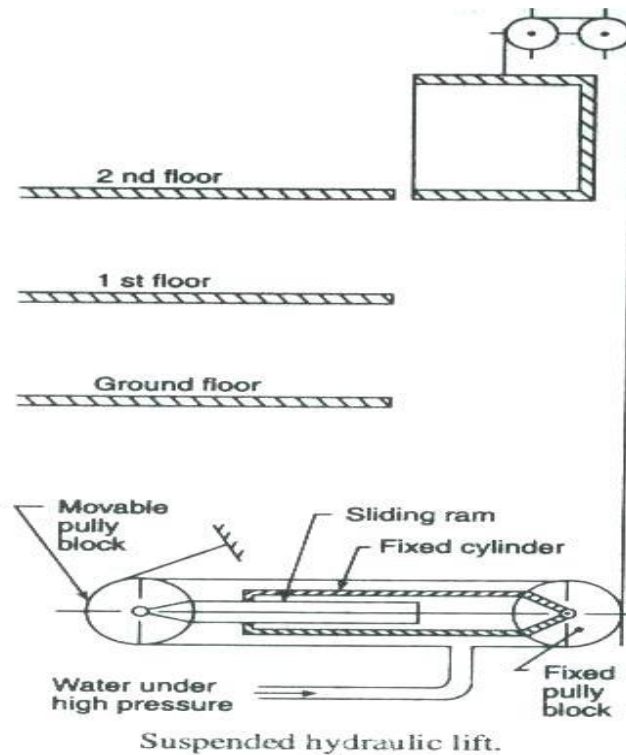
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Working of direct acting hydraulic lift: Hydraulic lift is a device which is used for carrying goods as well as persons from one floor to another in a multi-storied building. It consists of a ram sliding in a cylinder. At the top of the ram a platform or cage is fitted on which the goods may be placed or the persons may be stand. The liquid under pressure is admitted into the cylinder which pushes the ram vertically upwards thus raising the platform or the cage to the required height. The platform or cage can be made to stay in level with each floor so that goods can be transferred to that floor or persons can walk over to that floor. Again removing the liquid from the cylinder, the ram and hence the platform or cage can be made to move downwards.

02

OR



OR

02

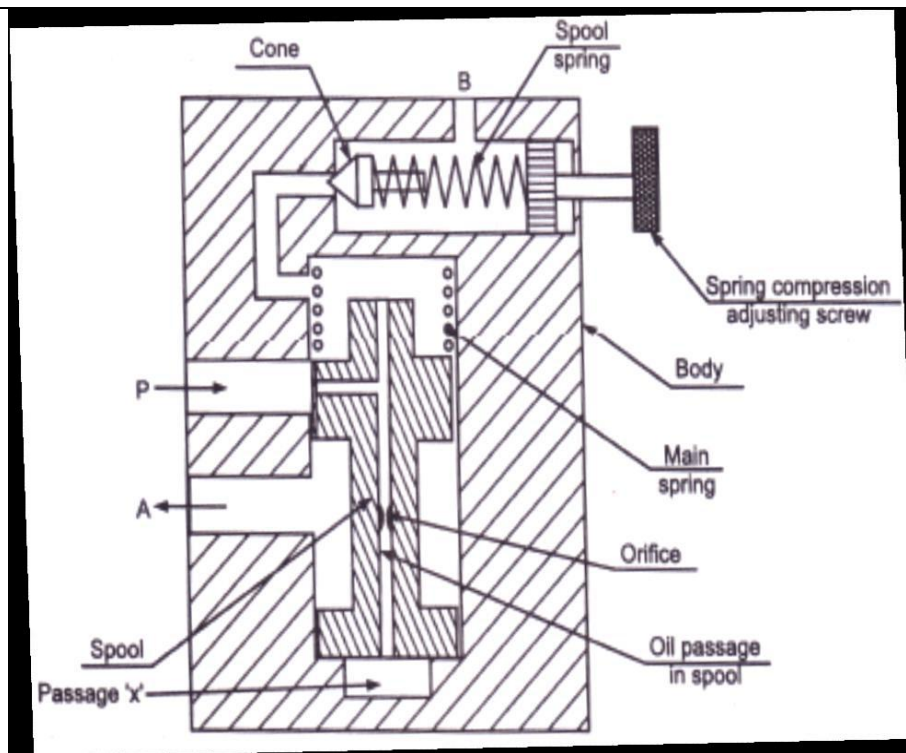
Working of suspended hydraulic lift: Hydraulic lift is a device which is used for carrying goods as well as persons from one floor to another in a multi-storied building. It consists of a cage which is suspended from a wire rope. The hydraulic lift obtains its motion from the jigger. The jigger consists of a fixed cylinder, having pulley block and containing a sliding ram. One end of ram is in contact with the water and the other carries a pulley block. A wire rope with one of its end fixed is taken around all the pulleys of the two blocks and finally over the

02

guide pulleys. The cage is suspended from the other end of the rope. The load to be lifted is placed in a cage. The water under pressure is admitted into the cylinder of the jigger. This water forces the sliding ram to move towards the left. This outward movement of the sliding ram makes the pulley block to move outward. Due to increased distance between the two pulley blocks, the wire rope is pulled and the cage is lifted up.

b) Draw a labeled sketch of sequence valve and describe its working.

04



02

Working : Sequence valve is nothing but pilot operated relief valve. It has a special spool having specially drilled oil passage with internal orifice drain is directed to main drain. In normal position sequence valve is closed when the operation of consumer 1 is completed pressure starts building and when reaches set value of pilot relief valve fluid flows through spool to drain/ tank. As the fluid flows through spool the orifice causes pressure difference between spring side and spool side. This pressure difference results in differential force which lifts the spool causing it to uncover the port 'A' thus supplying fluid to another consumer 'A'.

02



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| | | <p>& braided cloth or wire. Hose pipes are in 3 layers.</p> <p>Layer A This is inner tube through which oil or fluid flow. This layer comes direct contact with pressurized hydraulic fluid. This layer is called Hose Material layer.</p> <p>Layer B This layer is called Hose reinforcement. This increases strength of inner layer. It provides structural strength to entire hose to withstand against hydraulic pressure of oil which is very high in hydraulic system.</p> <p>Layer C This is outer layer called as protective layer. It protect middle layer from corrosion, abrasion & other damages which can occur accidents.</p> <p>Materials for hoses : Layer A :- Plastic, Nylon, braided nylon, PVC, Teflon, synthetic elastomers, natural rubber. Layer B:- Cotton, nylon, wires, synthetic yarn, Rayon. Layer C:- Neoprene, synthetic QRS rubber, cotton /synthetic yarn.</p> <p>Applications: 1. In earth moving equipments 2. Robots 3. In machine tools 4. To carry the working medium like oil in hydraulic system 5. In material handling equipments 6. In CNC/VMC</p> | <p>01</p> <p>01</p> |
| | e) | Classify Filters and state their Application. | 04 |
| | | <p>Classification: A)According to quantity of Oil to be filtered 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.</p> <p>Application:-1) In Automobile vehicles,2) In process Industry 3) In oil refinery 4) In construction equipment.</p> | <p>02</p> <p>02</p> |
| 4 | a) | Attempt any THREE if the following. | 12 |
| | i) | Draw the labeled sketch of Swash plate type pump. | 04 |
| | | Answer: (02 marks for sketch & 02 marks for labeling) | 04 |

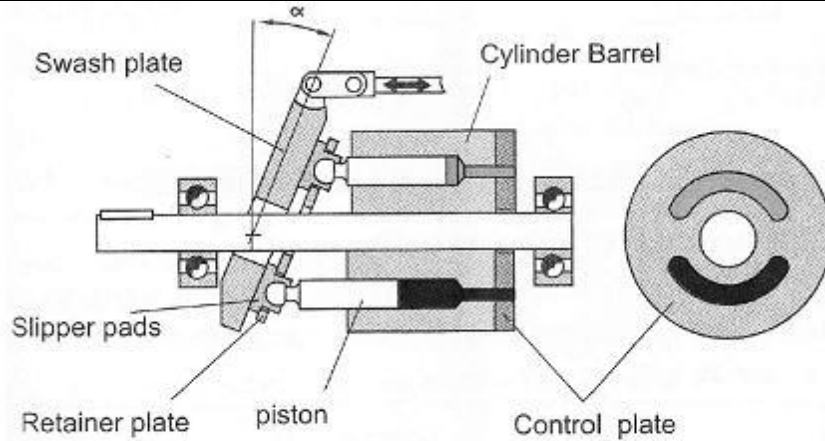


Figure: Swashplate Pump

OR

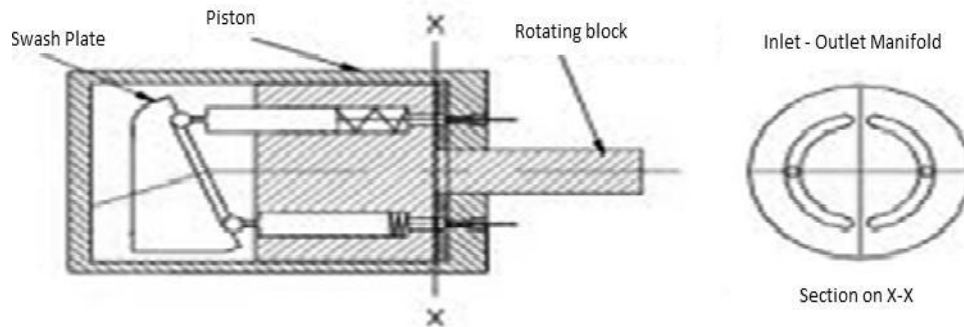


Figure: Swashplate Pump

ii) Explain construction and working of safety valve with neat sketch.

04

Construction and working of safety valve:-

This type of valves has two ports; one of which is connected to the pump and another is connected to the tank. It consists of a spring chamber where poppet is balanced with a spring force. Generally, spring is adjustable to set the maximum pressure limit of the system.

The poppet is held in position by combined effect of spring force and dead weight of spool. As the pressure exceeds this combined force, the poppet raises and excess fluid by passed to the reservoir. The poppet again resets as the pressure drops below the pre-set value. A drain is also provided in the control chamber. It sends the fluid collected due to small leakage to the tank and there by prevents the failure of the valve.

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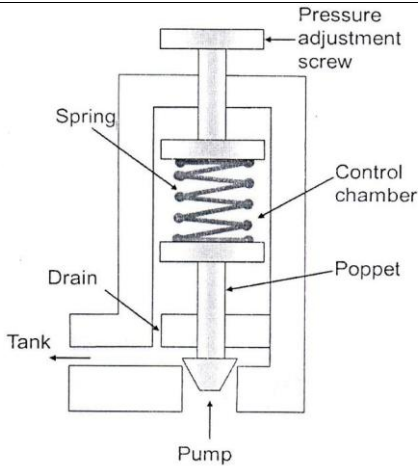


Fig. safety valve

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iii)

Why FRL unit is used in pneumatic system? State the function of each components of FRL unit

04

FRL unit used in pneumatic system: We know that FRL unit nothing but service unit which is normally installed between air compressor and direction control valve for the preparation of air, in which filtration, pressure regulation and lubrication takes place. By using FRL unit it increases efficiency and life of pneumatic system.

Functions of components of F.R.L Unit:-

1) Filter: It is a important element through which initially air gets filters which separators (or) arrest very small dust particles these particles are arrested in filter and air gets cleaned This filtered compressed air then enter into Regulator.

2) Regulator: It is nothing but pressure reducing valve it is used to regulate pressure of air required by pneumatic system suppose pressure of compressed air is say 8 bar and pneumatic system required 3 bar working pressure then regulator is used to reduce the pressure from 8 bar to 3 bar.

3) Lubricator: For lubrication purpose in pneumatic system it is used because after filtration of air this air become dry which harmful for mechanicals parts like a actuators valves etc. so for smooth operation as well as increase the life of components it played very important role here during working condition fine oil droplets are mixed with air.

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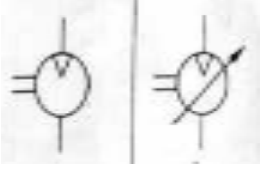

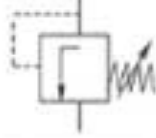
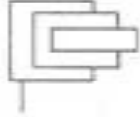
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|----------|------------|---|--|--|-------------------------------|
| | iv) | Draw a symbol for:1) Unidirectional air motor 2) Muffler 3)RPV 4) Telescopic Cylinder. | | 04 | |
| | | 1) Unidirectional air motor |  | one mark for each symbol | |
| | | 2) Muffler |  | | |
| | | 3)PRV |  | | |
| | | 4) Telescopic Cylinder |  | | |
| 4 | b | Attempt any ONE if the following. | | 06 | |
| | (i) | Compare between meter in and meter out circuit. | | 06 | |
| | | Sr. no | Meter in circuit | Meter out circuit | 1 mark for each, any 6 |
| | | 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 | |



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| | | 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) | Draw and explain pneumatic circuit to control the speed of bidirectional air motor. | | 06 |
| | | <p style="text-align: center;">Figure: Speed control of bidirectional air motor</p> <p>Above circuit shows 4/2 D.C valve, FRL unit, compressor used for controlling speed of bi directional motor. Compressed air coming from compressor is taken to motor through connection of port "P" and port "A". This incoming air rotates motor in clockwise direction. Its speed can be controlled by flow control valve and check valve. Port B of the motor is connected to the exhaust from which the air will be removed. In this speed will be controlled in clockwise direction.</p> | | 03 |
| 5 | | Attempt any TWO of the following | | 16 |
| | a) | i) State law of continuity and write its applications. | | 04 |
| | | <p>Answer: i) Law of continuity: For a fluid flowing through the pipe at all cross section, the quantity of fluid per second is constant.</p> <p>OR</p> <p>It states that if an incompressible liquid is continuously flowing through a pipe or a channel whose cross sectional area may or may not be constant then quantity of liquid passing through it per second is same at all sections.</p> <p>Applications (Any two) : i) Flow through branching of pipe. ii) Steady and unsteady flow iii) Uniform and non-uniform flow iv) Compressible and</p> | | 02 |
| | | | | 02 |

c) Give the application of hydraulic and pneumatic in automobiles. Explain any one of them with neat sketch. 08

Answer:

Application of hydraulics and pneumatics in automobile:

- 1) Hydraulic brakes, 2) Air brake systems, 3) Hydraulic power steering, 4) Oil or gas filled shock absorber, 5) Air suspension system, 6) air bag etc.

Working of Hydraulic steering system: In this system, Pump is driven by engine of vehicle. Pump supplies pressurized oil through specially designed direction control valve. When steering wheel is almost steady and there are very low manual effort at steering wheel the hydraulic oil enters into double acting cylinder through port A and B in equal amount and applies equal and opposite pressure on piston, hence piston is steady. As soon as the driver applies more efforts than predetermined value, the steering arm actuates the direct control valve. This valve senses the input pressure at steering wheel and directs the pressurized oil to double acting cylinder through port A. Naturally piston will move towards left. The piston rod will move the rack towards left and pinion will rotate to help the driver. Due to additional efforts driver can easily turn the steering wheel. The oil from double acting cylinder will return via port B and direction control valve to oil reservoir. If oil is supplied through port B then piston will move towards right and oil will return to oil tank through port A.

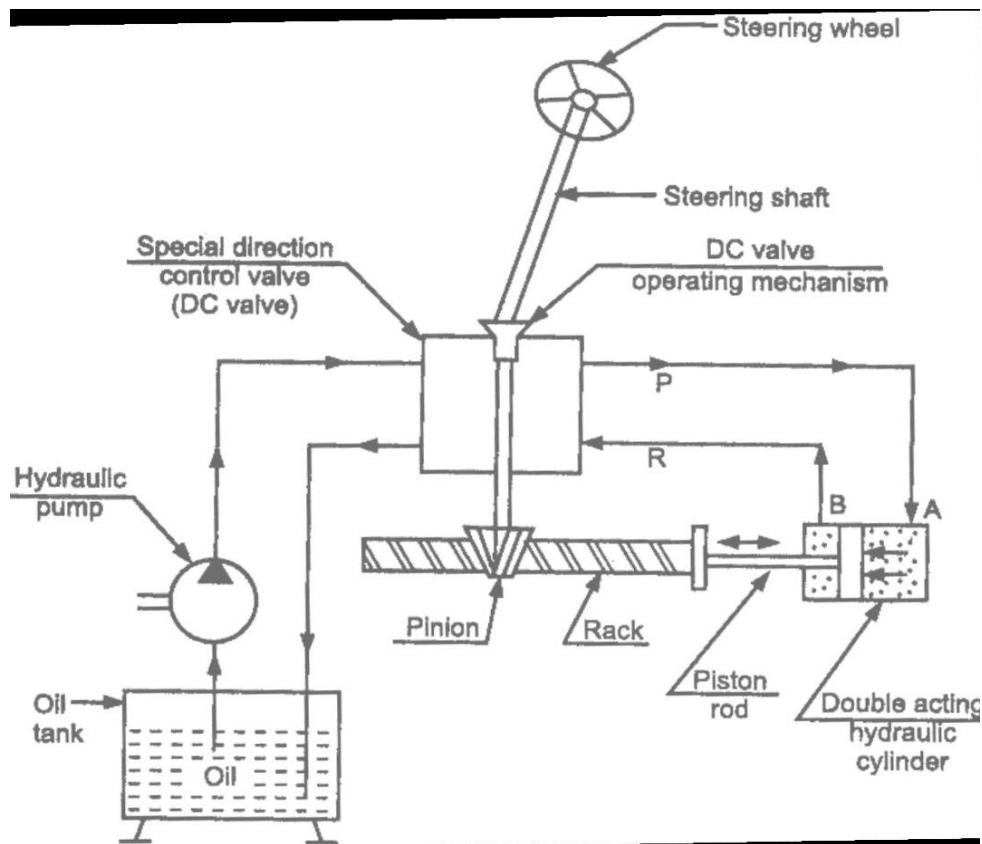


Fig. Layout of hydraulic steering system.



MODEL ANSWER

WINTER- 17 EXAMINATION

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| | | |
|---|--|----------------------|
| 6 | | 16 |
| | <p>a) A horizontal venturimeter with inlet diameter 20 cm and throat diameter 10cm is used to measure the flow of water the pressure at inlet is 15 N/cm² and vacuum pressure at the throat is 40 cm of mercury, find the discharge of water through venturimeter. Take Cd=0.98.</p> | 08 |
| | <p>Answer: Given: Inlet Dia d1= 20cm $a1 = \pi r^2 = 314.16\text{cm}^2$ Throat Dia d2= 10cm $a2 = 78.54\text{cm}^2$ $P1 = 15\text{ N/cm}^2$</p> <p>$h1 = \frac{P1}{\rho g} = \frac{15 \times 10000}{9.81 \times 1000} = 15.3\text{ m of water}$</p> <p>$h2 = \frac{P2}{\rho g} = -40\text{ cm of mercury} = -0.40 \times 13.6 = -5.44\text{ m of water}$</p> <p>Differential head $h = h1 - h2$ $h = 20.74\text{ m of water} = 2074\text{ cm of water}$</p> <p>Discharge through venturimeter Q is given by equation,</p> <p>$Q = C_d \times \frac{a1 \times a2}{\sqrt{a1^2 - a2^2}} \times \sqrt{2gh}$</p> <p>$= 0.98 \times \frac{314.16 \times 78.54}{304.19} \times 28773.5 = 0.98 \times 81.11 \times 2017.22$</p> <p>$= 160352.67\text{ cm}^3/\text{s} = 160.35\text{ lit/s}$</p> | 02 01 02 03 |
| | <p>b) Explain negative slip in reciprocating pumps and justify use of air vessels in reciprocating pump.</p> | 08 |
| | <p>Answer: Negative slip in reciprocating Pump: Slip of pump means difference between the theoretical discharge and actual discharge of the pump. i.e. Slip = Q_{th} - Q_{act}. If actual discharge is more than the theoretical discharge, in which case C_d will be more than one and the slip of pump will be negative. In that case slip of the reciprocating pump is known as negative slip. Negative slip occurs when delivery pipe is short, suction pipe is too long and pump is running at high speed. This is so because for such pumps the inertia pressure in the suction pipe will be large in comparison to the pressure on the outside of the delivery valve, which may cause delivery valve to open before the suction stroke is completed. Some liquid is thus pushed directly into the delivery pipe even before the delivery stroke is commenced, which results in making the actual discharge more</p> | 02 02 |



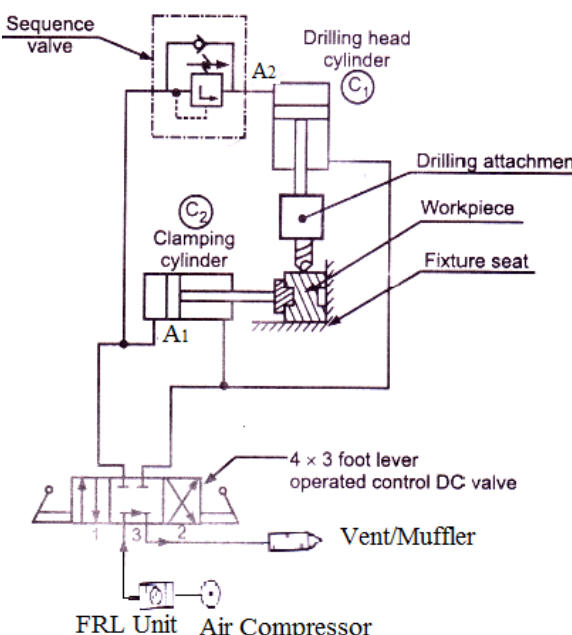
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| | <p>than the theoretical discharge. Use of Air vessel used in the pump: An air vessel is fitted to the suction pipe and to the delivery pipe at a point close to the cylinder of reciprocating pump for the purpose of:</p> <ol style="list-style-type: none"> 1. To obtain a continuous supply of liquid at uniform rate. 2. To save a considerable amount of work in overcoming the frictional resistance in the suction and delivery pipes. 3. To run the pump at high speed without separation and cavitations. 4. Large amount of power is saved due to low acceleration head | 04 |
| c) | <p>Construct pneumatic circuit using sequence valve to control two applications performed in a proper sequence and describe its working</p> | 08 |
| | <p>Answer:</p>  <p>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. Now compressed air start 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 comes 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</p> | 04 |