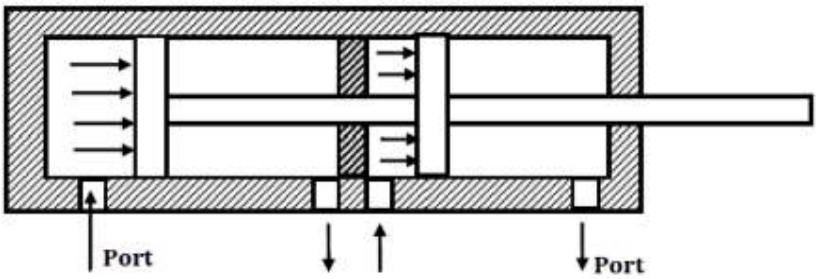


6. What are the important considerations taken while selecting a pump for a particular application?
   Pumps are selected by taking into account a number of considerations for a complete hydraulic system involving a particular application. The main parameters affecting the selection of a particular type of pump are as follows:
   1. Maximum operating pressure.
   2. Maximum delivery.
   3. Type of control.
   4. Pump drive speed.
   5. Type of fluid.
   6. Pump contamination tolerance.
   7. Pump noise.
   8. Size and weight of a pump.
   9. Pump efficiency.
   10. Cost.
   11. Availability and interchangeability.
   12. Maintenance and spares.

   The selection of pump typically entails the following sequence of operations:
   1. Select the actuator (hydraulic cylinder or motor) that is appropriate based on the loads encountered.
   2. Determine the flow-rate requirements. This involves the calculation of the flow rate necessary to drive the actuator to move the load through a specified distance within a given time limit.
   3. Select the system pressure. This ties in with the actuator size and the magnitude of the resistive force produced by the external load on the system. Also involved here is the total amount of power to be delivered by the pump.
   4. Determine the pump speed and select the prime mover. This, together with the flow-rate calculation, determines the pump size (volumetric displacement).
   5. Select the pump type based on the application (gear, vane or piston pump and fixed or variable displacement).
   6. Select the reservoir and associated plumbing, including piping, valving, hydraulic cylinders, and motors and other miscellaneous components.
   7. Consider factors such as noise levels, horsepower loss, need for a heat exchanger due to generated heat, pump wear, and scheduled maintenance service to provide a desired life of the total system.
   8. Calculate the overall cost of the system.

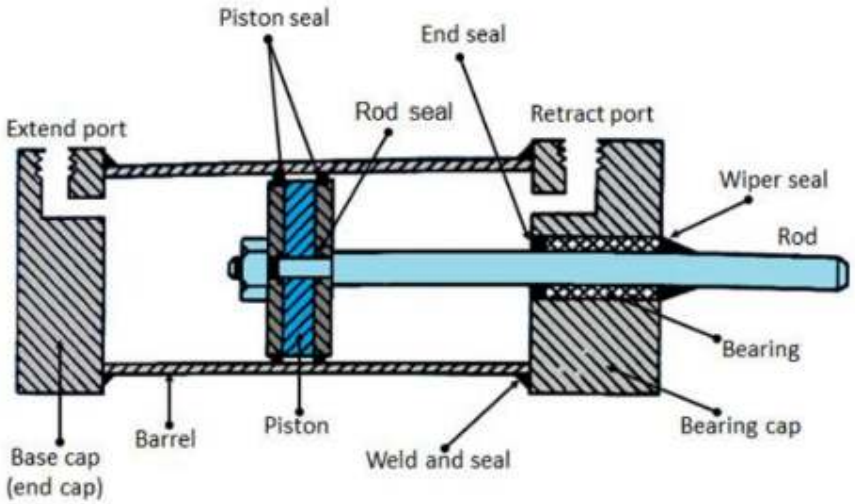
following formula: Where VD is the volumetric displacement in m3/rev and p is the pressure in N/m2. The torque of a rotary actuator can be specified in three ways. Starting torque is the torque available to move a load from rest. Stall torque must be applied by the load to bring a running actuator to rest, and running torque is the torque available at any given speed. The power developed by a frictionless motor is known as theoretical power. It can be calculated by the following formula: Where TT is the theoretical torque in Nm, ω is the speed of the motor in rad/s and where N is the speed of the motor in rev/min. The flow rate a hydraulic motor would consume if there were no leakage is known as the theoretical flow rate QT. Mathematically, theoretical flow rate is given by Where VD is the volumetric discharge in m3/rev, n is the speed of motor in rev/s = N/60 and N is the speed of motor in rpm

Cavitation occurs when the liquid in a pump turns to a vapor at low pressure. It occurs because there is not enough pressure at the suction end of the pump, or insufficient Net Positive Suction Head available (NPSHa). When cavitation takes place, air bubbles are created at low pressure.

5. With neat sketch explain working of double acting cylinder and tandem type cylinder.

Double acting cylinder

The main parts of a hydraulic double acting cylinder are: piston, piston rod, cylinder tube, and end caps. These are shown in Figure 2.2. The piston rod is connected to piston head and the other end extends out of the cylinder. The piston divides the cylinder into two chambers namely the rod end side and piston end side. The seals prevent the leakage of oil between these two chambers. The cylindrical tube is fitted with end caps. The pressurized oil, air enters the cylinder chamber through the ports provided. In the rod end cover plate, a wiper seal is provided to prevent the leakage of oil and entry of the contaminants into the cylinder. The combination of wiper seal, bearing and sealing ring is called as cartridge assembly. The end caps may be attached to the tube by threaded connection, welded connection or tie rod connection. The piston seal prevents metal to metal contact and wear of piston head and the tube. These seals are replaceable. End cushioning is also provided to prevent the impact with end caps.



Tandem Cylinder A tandem cylinder, shown in Fig. 2.9, is used in applications where a large amount of force is required from a small-diameter cylinder. Pressure is applied to both pistons, resulting in increased force because of the larger area. The drawback is that these cylinders must be longer than a standard cylinder to achieve an equal speed because flow must go to both pistons. Figure 2.9 Tandem cylinder

Mechanical efficiency : $\eta_m = \frac{T_A}{T_T} = \frac{170}{183.82}$

$= 0.9248$

$\therefore \boxed{\eta_m = 92.48}$

Overall efficiency $\eta_o = \eta_v \times \eta_m$

$= 0.9167 \times 0.9248$

$= 0.8477$

$\therefore \boxed{\eta_o = 84.77\%}$

Explain: i) Types of cylinder mountings ii) Theoretical flow rate iii) Pump Cavitation.

Mounting arrangements

Cylinder mounting is determined by the application. Two basic types are shown below. The clamp requires a simple fixed mounting. The pusher requires a cylinder mount which can pivot. Figure 2.5 shows various mounting methods using these two basic types. The effects of side loads should be considered on non-centreline mountings such as the foot mount. Swivel mounting obviously requires flexible pipes.

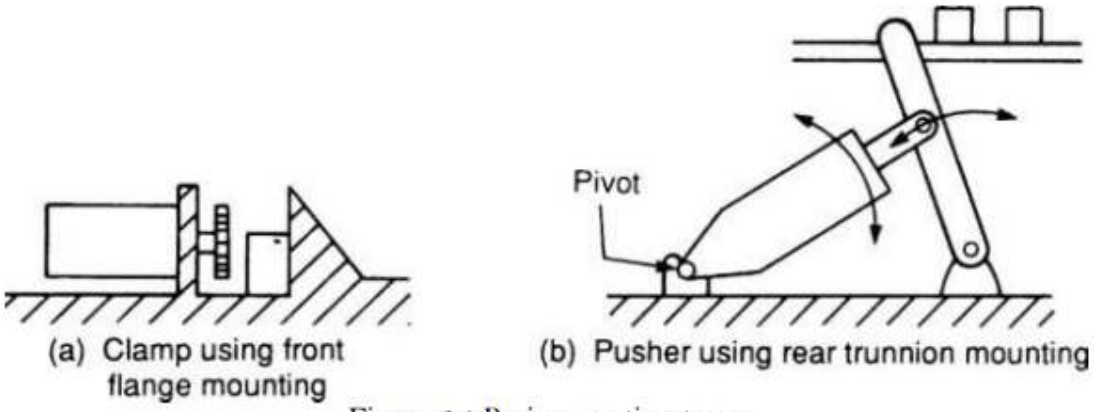
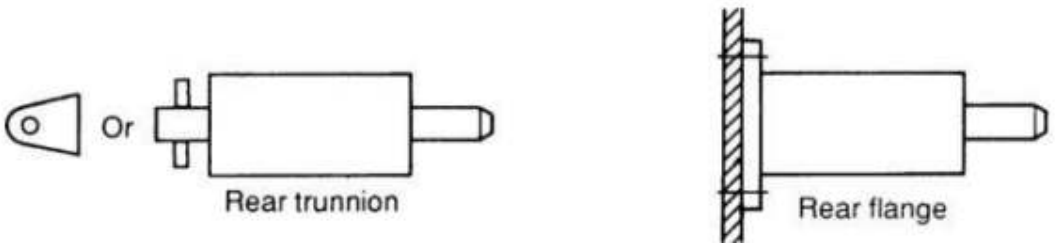


Figure 2.4 Basic mounting types



Hydraulic Motor: Theoretical Torque, Power and Flow Rate The torque generated by a frictionless hydraulic motor is known as a theoretical torque. Theoretical torque can be calculated by the

Given data: Hydraulic motor

Volumetric displacement = $V_D = 165\ cm^3/rev$

$= 165 \times 10^{-6}\ m^3/rev$

pressure, $p = 70 \times 10^5\ N/m^2$

Speed, $N = 2000$ rpm

Actual flow rate = $Q_A = 6 \times 10^{-3}\ m^3/s$

Actual torque = $T_A = 170\ N.m$

Find i) η_v ii) η_m iii) η_o &

To find Theoratical ~~torque~~ flow rate

$$Q_T = V_D \times N$$
$$= 165 \times 10^{-6} \times \frac{2000}{60}$$
$$= 0.0055\ m^3/s$$

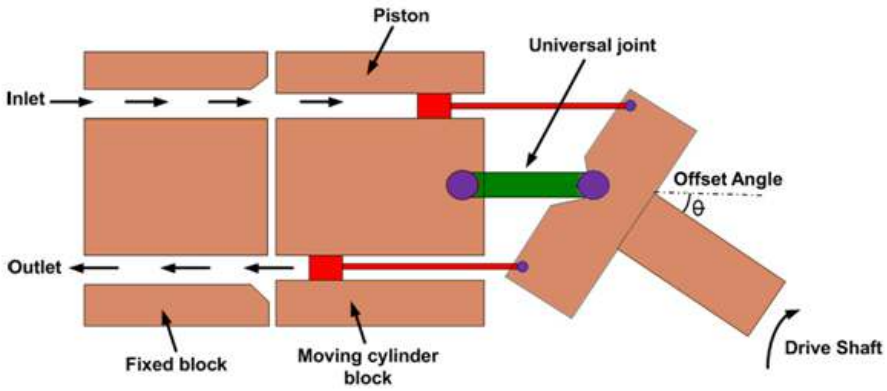
∴ Volumetric efficiency = $\eta_v = \frac{Q_T}{Q_A} = 0.9166$

$$\therefore \boxed{\eta_v = 91.67\ \%}$$

To find theoratical torque

$$T_T = \frac{V_D \times p}{2\pi}$$
$$= \frac{165 \times 10^{-6} \times 70 \times 10^5}{2\pi}$$
$$T_T = 183.82\ N.m$$

are forced in and out of their bores as the distance between the drive shaft flange and the cylinder block changes. A universal link connects the block to the drive shaft, to provide alignment and a positive drive.



The volumetric displacement (discharge) of the pump is controlled by changing the offset angle. It makes the system simple and inexpensive. The discharge does not occur when the cylinder block is parallel to the drive shaft. The offset angle can vary from 0° to 40°. The fixed displacement units are usually provided with 23° or 30° offset angles while the variable displacement units are provided with a yoke and an external control mechanism to change the offset angle. Some designs have arrangement of moving the yoke over the center position to reverse the fluid flow direction. The flow rate of the pump varies with the offset angle θ. There is no flow when the cylinder block centerline is parallel to the drive shaft centerline (offset angle is 0°).

The flow rate of the pump can be given as:

3. $$V_d = nADN\tan\theta$$

here,

4. $$\tan\theta = \frac{S}{D}$$

Where S is the piston stroke, D is piston diameter, n is the number of pistons, N is the speed of pump and A is the area of piston.

3. A hydraulic motor has a displacement of 165cm^3/rev and operates with a pressure of 70 bar and a speed of 2000rpm. If the flow rate consumed by the motor is 6 LPS and the actual torque delivered by the motor is 170N-m. Find: i) volumetric efficiency ii) mechanical efficiency iii) overall efficiency

	b.	A hydraulic motor has a displacement of 165cm^3/rev and operates with a pressure of 70 bar and a speed of 2000rpm. If the flow rate consumed by the motor is 6 LPS and the actual torque delivered by the motor is 170N-m. Find: i) volumetric efficiency ii) mechanical efficiency iii) overall efficiency.

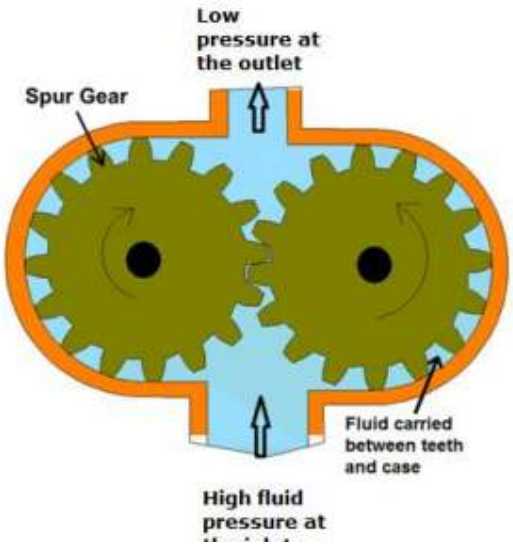
ROLL NO. | | - | | |

Solution :

Sub:	Fluid Power systems	Sub Code:	17ME72	Branch :	ME

1. With a neat sketch, explain the construction and working of an external gear pump

   Gear Motors: Gear motors are very similar in design to the gear pumps, but motors are usually designed to have a case drain port and a reversible direction of rotation. A gear motor develops torque due to hydraulic pressure acting against the area of one tooth. There are two teeth trying to move the rotor in the proper direction, while one net tooth at the center mesh tries to move it in the opposite direction. In the design of a gear motor, one of the gears is keyed to an output shaft, while the other is simply an idler gear. Pressurized oil is sent to the inlet port of the motor. Pressure is then applied to the gear teeth, causing the gears and output shaft to rotate. The pressure builds until enough torque is generated to rotate the output shaft against the load. The side load on the motor bearing is quite high, because all the hydraulic pressure is on one side. This limits the bearing life of the motor. Schematic diagram of gear motor is shown in Fig.2.13.



   Gear motor Most of the gear motors are bidirectional. Reversing the direction of flow can reverse the direction of rotation. As in the case of gear pumps, volumetric displacement is fixed. Due to the high pressure at the inlet and low pressure at the outlet, a large side load on the shaft and bearings is produced. Gear motors are normally limited to 150 bar operating pressures and 2500 RPM operating speed. They are available with a maximum flow capacity of 600 LPM. The gear motors are simple in construction and have good dirt tolerance, but their efficiencies are lower than those of vane or piston pumps and they leak more than the piston units. Generally, they are not used as servo motors. Hydraulic motors can also be of internal gear design. These types can operate at higher pressures and speeds and also have greater displacements than external gear motors.

2. With a neat sketch, explain the operation of bent axis type piston pump

   In bent-axis piston pumps, the reciprocating action of the pistons is obtained by bending the axis of the cylinder block. The cylinder block rotates at an angle which is inclined to the drive shaft. The cylinder block is turned by the drive shaft through a universal link. The cylinder block is set at an offset angle with the drive shaft. The cylinder block contains a number of pistons along its periphery. These piston rods are connected with the drive shaft flange by ball-and-socket joints. These pistons

Scheme of Evaluation
Internal Assessment Test 1 – Nov. 2021

Sub:	Industrial Safety					Sub Code:	18ME72	Branch:	ME
Date:	11/11/2021	Duration:	90 min's	Max Marks:	50	Sem / Sec:	7B		

Note: Answer any 5 question

Question #	Description	Max. MARKS	
1	With a neat sketch, explain the construction and working of an external gear pump system. ➢ **Sketch** ➢ **Explanation**	**5M** **5M**	10M
2	With a neat sketch, explain the operation of bent axis type piston pump ➢ **Sketch** ➢ **Explanation**	**5M** **5M**	10M
3	A hydraulic motor has a displacement of 165cm^3/rev and operates with a pressure of 70 bar and a speed of 2000rpm. If the flow rate consumed by the motor is 6 LPS and the actual torque delivered by the motor is 170N-m. Find: i) volumetric efficiency ii) mechanical efficiency iii) overall efficiency ➢ **Formulas** ➢ **Answer**	**2M** **2M** **6M**	10M
4	Explain: i) Types of cylinder mountings ii) Theoretical flow rate iii) Pump Cavitation. ➢ **Mounting** ➢ **Theoritical flow rate** ➢ **Cavitation**	**4M** **3M** **3M**	10M
5	➢ With neat sketch explain working of double acting cylinder and tandem type cylinder. ➢ ➢ **Explanation** ➢ **sketch**	**5M** **5M**	
6	What are the important considerations taken while selecting a pump for a particular application? ➢ **Definition** ➢ **Explanation**	**2M** **4M** **4M**	10M

ROLL NO. | | - | | |

Internal Assessment Test II

Sub: Fluid Power systems Sub Code: 17ME72 Branch: ME

Date: 17/012/2021 Duration: 90 min's Max Marks: 50 Sem / Sec: 7th B

		MARKS	OBE CO	OBE RBT
	Answer any Five Questions			
1	With a neat sketch, explain the construction and working of an external gear pump	10	CO2	L2
2	With a neat sketch, explain the operation of bent axis type piston pump	10	CO2	L2
3	A hydraulic motor has a displacement of 165cm^3/rev and operates with a pressure of 70 bar and a speed of 2000rpm. If the flow rate consumed by the motor is 6 LPS and the actual torque delivered by the motor is 170N-m. Find: i) volumetric efficiency ii) mechanical efficiency iii) overall efficiency	10	CO2	L3
4	Explain: i) Types of cylinder mountings ii) Theoretical flow rate iii) Pump Cavitation.	10	CO2	L2
5	With neat sketch explain working of double acting cylinder and tandem type cylinder.	10	CO2	L2
6	What are the important considerations taken while selecting a pump for a particular application?	10	CO2	L2

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ROLL NO. | | - | | |

Internal Assessment Test II

Sub: Fluid Power systems Sub Code: 17ME72 Branch: ME

Date: 17/012/2021 Duration: 90 min's Max Marks: 50 Sem / Sec: 7th B

		MARKS	OBE CO	OBE RBT
	Answer any Five Questions			
1	With a neat sketch, explain the construction and working of an external gear pump	10	CO2	L2
2	With a neat sketch, explain the operation of bent axis type piston pump	10	CO2	L2
3	A hydraulic motor has a displacement of 165cm^3/rev and operates with a pressure of 70 bar and a speed of 2000rpm. If the flow rate consumed by the motor is 6 LPS and the actual torque delivered by the motor is 170N-m. Find: i) volumetric efficiency ii) mechanical efficiency iii) overall efficiency	10	CO2	L3
4	Explain: i) Types of cylinder mountings ii) Theoretical flow rate iii) Pump Cavitation.	10	CO2	L2
5	With neat sketch explain working of double acting cylinder and tandem type cylinder.	10	CO2	L2
6	What are the important considerations taken while selecting a pump for a particular application?	10	CO2	L2

CI CCI HOD