Unit-5

Assignment

Ques-1 What do you mean by Measurement and Measurement Error Differentiate between systematic and random error.

Ans- **Measurement**- Measurement is a process of comparing inputs with pre-defined standard and giving the output.

Measurement error- It is defined as a difference between indicated or measured value and true value. It is impossible to made measurement with perfect accuracy.

→	Systematic error	Random error
1.	Repetitive in nature	1. Random in nature
2.	These errors result from improper conditions and procedures.	2. These errors are inherent in the measuring system.
3.	Controlled in mag. and sense.	3. Accident in nature & difficult to control

4	After proper analysis these errors can be reduced or eliminated	4- Can't be eliminated.
5.	eg- Parallax error, Calibration error etc.	5. Slight displacement of measuring joint, friction of mating parts, combined effect etc.

Ques-2 Explain following-

(I) Calibration-

Calibration is an activity of checking the accuracy and precision of measuring instrument by comparing it with standard.

Calibration provides consistancy in reading and reduces errors thus validating the measurement universally. The procedure of calibration involves a comparison of the particular instrument with either.

→ A primary standard
→ A secondary standard with a higher accuracy than the instrument to be calibrated
→ An instrument of known accuracy

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(ii) Accuracy- Accuracy refers to the degree of closeness of measured value to the true value. No instrument is 100 percent accurate, there always occurs some error.

(iii) Precision- Precision of a measuring instrument refers to its ability to reproduce the same result again and again.

(iv) Resolution- After reaching threshold, the minimum change in input which is readable by an instrument is called the resolution of that instrument.

Ques-3 What are various measuring instruments used for pressure? Explain Bourdon tube pressure gauge with diagram.

Ans- There are four different pressure measurement scales-

1. Gauge- Reference to atmospheric pressure

2. Sealed - Reference to sealed chamber closed with atmospheric pressure

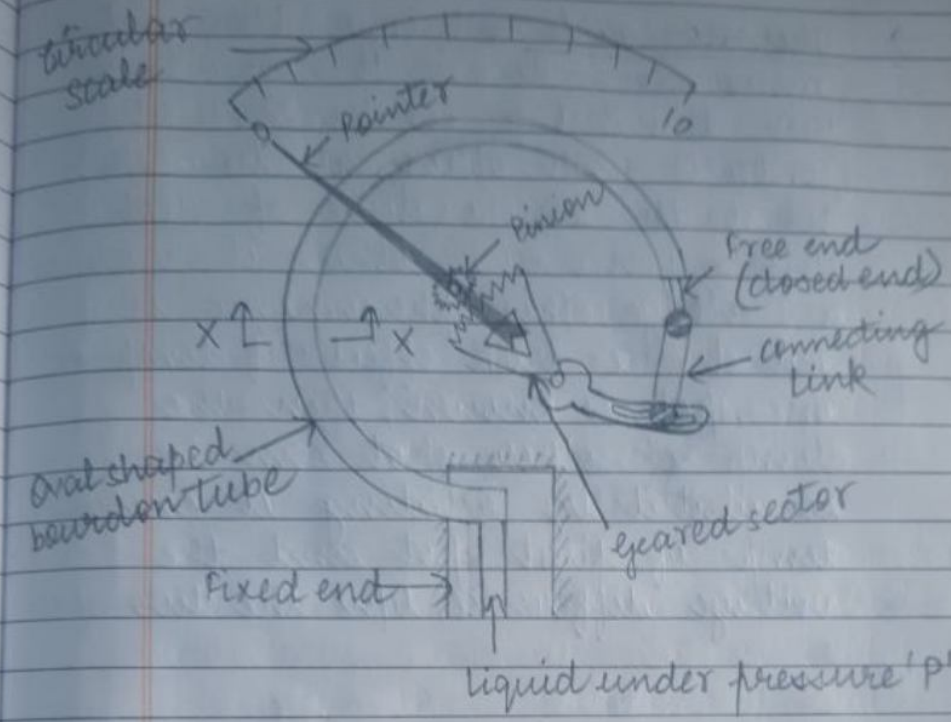
3. Absolute - Reference to vaccum or zero pressure

4 Differential - where sensors has two parts for the measurement of two different pressures.

→ Bourdon tube pressure gauge -

The Bourdon tube pressure gauge works on simple principle that a bent tube will change its shape as pressure is applied internally, the tube straightens and returns to its original form when the pressure is released.

The tipes of the tube moves with the internal pressure change and is easily converted with a pointer onto a scale.

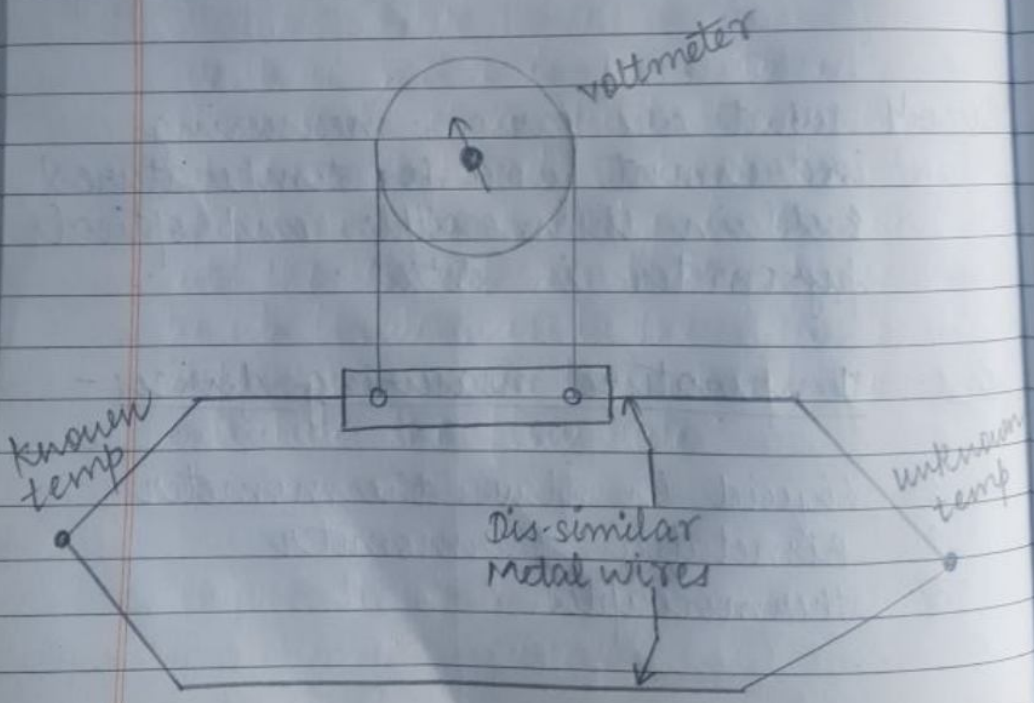


Ques-4 What are various measuring instruments used for temperature? Explain thermocouples and optical pyrometer in detail.

Ans- Temperature measuring devices -

1. Liquid in glass thermometer
2. Bimetallic thermometer
3. Thermocouples

→ **Thermo-couple** - It is a temperature measuring device. It consists of two dissimilar conductors that contact each other at two spots. When the temperature of spots differ from each other it produces a voltage. This phenomena is called See-back effect. If temp of one spot is known, then the temp of other spot can be calculated by relating it known temp of first spot and the voltage difference b/w the two spots.



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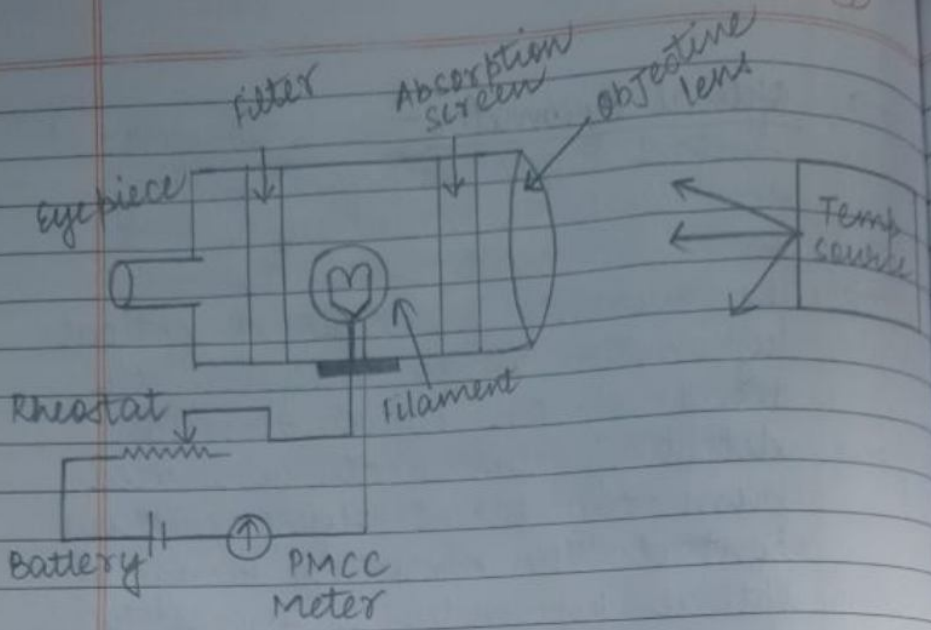
→ Optical Pyrometer — It is a non-contact type temp measuring device.

→ The working principle of optical pyrometer is to measure the temp of an object through detecting the heat generated from the target object without contact. The operating range of optical pyrometer is from 700°C to 4000°C. It includes a lens to focus the heat generated from the object to aim it at the filament of a lamp.

The current within the lamp is regulated until the brightness of filament of the lamp becomes equal to the image brightness generated through the source of temp. The image generated through lens has an intensity depending upon the temp of the heat radiating object. Hence the current through the filament becomes a measure of the temp of the target object.



Ques-5 write short notes on-

(i) Venturi-meter-

Venturi-meter is used to calculate flow rate of a fluid. It consists of two tapered sections in the pipeline. The velocity is increased at the throat and the pressure head is decreased. The pressure head difference occured is used to calculate the flow rate.

(ii) Orifice

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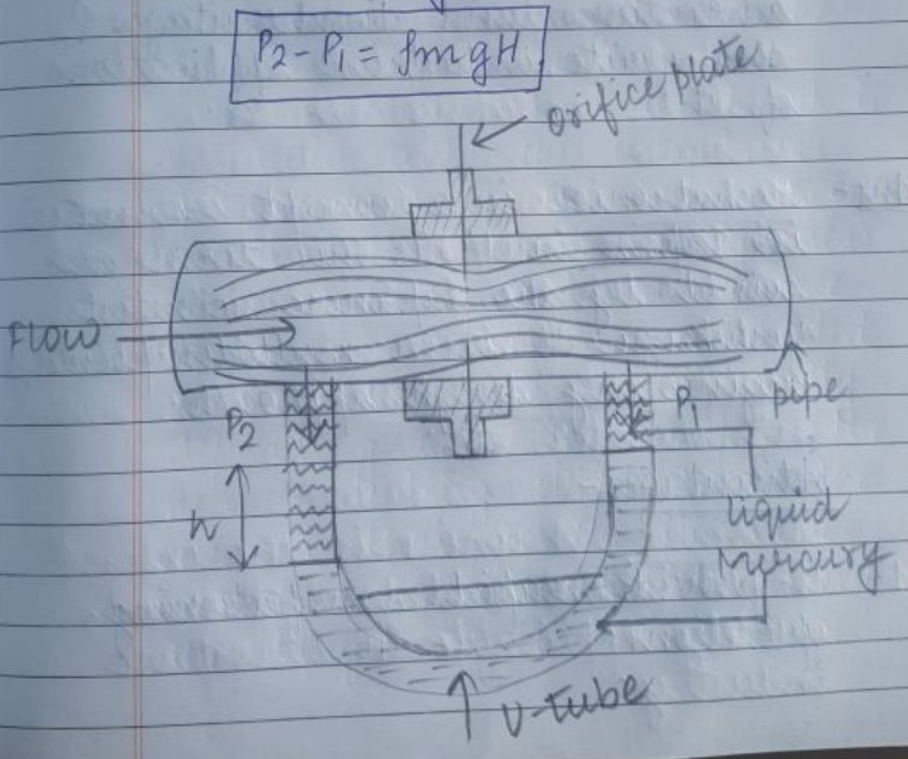
(ii) Orifice Meter -

Orifice Meter is used to calculate flow rate of a fluid. When fluid stream is suddenly allow to pass through the narrow construction called Orifice, the velocity of the fluid at Orifice Meter increases. Hence, the pressure head is decreased at the Orifice. The difference of pressure head between the points at the Orifice and in the upstream may be calculated by a manometer.

$$P_2 - P_1 = \rho_m g H$$



→ **Proving Ring**- A ring used for calibrating tensile testing machines. It works on the principle of LVDT which sense the displacement cause by the force resulting in proportional voltage. When the forces are applied through the integral external force bosses A and B, the diameter of ring changes depending upon the application which known as ring deflection.

Ques-6 Define mechatronics. what are its advantages and disadvantages? Also write industrial applications of it.

Ans- Mechatronics is a concept originated in Japan in 1969. This term was coined by the Japanese scientist Yoshikaza. It is a multidisciplinary engineering design approach.

Advantages-

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2. It helps in optimizing performance and quality
3. It provides high degree of flexibilities in operations & processes
4. It enhances plant utilization.
5. Mechatronics results in greater productivity.

Disadvantages -

1. Mechatronics requires knowledge of different disciplines.
2. The design cannot be finalized easily and it is usually complex.
3. Mechatronic systems require highly skilled man powers.
4. Initial costs of the systems are usually high.
5. Repairing and maintainence of mechatronic system is costly.

Industrial applications of Mechatronics -

Mechatronics is extensively used in modern industries. specifically, automobile industry, bio-medical system industry and aviation

industry have been benefitted through mechatronics. The application of mechatronics in these industries have created specialized disciplines of -

(i) Autotronics
(ii) Bionics
(iii) Avionics

Ques-7 write short notes on-

(i) Autotronics - Autotronics is the combination of Automobile engineering & Mechatronics, resulting in more comfortable, safe, fuel efficient and less polluting vehicles.

(ii) Bionics - Bionics involves integration of Biomedical / Biological sciences and Mechatronics; resulting in enhanced functionality of biomedical equipments / machines, better control for operators etc.

(iii) Avionics - Avionics is the integration of Aviation and Mechatronics, widely applicable in aerospace industry.

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Ques-8 Explain sensors and transducers with their classification. Explain static and dynamic characteristics of sensors and transducers.

Ans. Sensors – Sensors is the first element which is directly coupled to the system under study for measurement purpose. Sensor may be defined as an element that senses a variation in input energy to produce a proportional variation in another or same form of energy is called sensors.

→ sensor may be classified as-

Internal sensors-

Internal sensors are for internal feedback control loop within a system. They are used to monitor & control the various elements in the mechatronic system.

Examples of internal sensors are-

1. Potentiometer
2. Tachometers
3. Resolvers
4. Optical encoders
5. Hall effect sensors
6. Moire's fringes.

External sensors -
These are peripheral devices used in mechatronic systems. External sensors are used when we wish to ~~not~~ control or measure various parameters affecting the system examples of external sensors are-

1. Proximity
2. Range
3. Force
4. Tactile sensors
5. Machine vision

Transducers - Transducer is a device which affects the transformation of information from one form of energy to another it uses a transduction principle to convert a specified measurand into usable output

Types of Transducers -

Based on quantity to be measured -

1. Temperature Transducer
2. Pressure Transducer
3. Displacement Transducer

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Based on principle of operation-

1. Capacitive
2. Resistive
3. Inductive
4. Photoelectric
5. Chemical

Based on need of an external power source-

1. Active Transducer
2. Passive Transducer

Static characteristics- static performance characteristics is the criteria considered when the system is used to measure a quantity that is either constant or vary slowly with time. Static characteristics parameters define the quality of measurement-

1. Accuracy
2. Precision
3. Sensitivity
4. Threshold
5. Dead zone
6. Error
7. Resolution
8. Hysteresis
9. Hysteresis Error
10. Drift.

Dynamic Characteristics - The set of criteria which are defined on the basis of input-output relation when the input changes rapidly with time, are called dynamic characteristics. The main dynamic characteristics of an instrument are -

1. Speed of Response
2. Lag
3. Fidelity
4. Dynamic Error

Ques-9 Explain different types of mechanical actuation system?

Ans - **Bearings**-

A bearing is a device which supports, guides & restrains motion between two mating parts of a machine to provide the desired motion. They also reduce the friction between the mating parts.

Types of Bearings - Bearings may be classified into 2 categories.

(i) Sliding Contact Bearings -

A type of bearing, where relative sliding is seen b/w the mating parts

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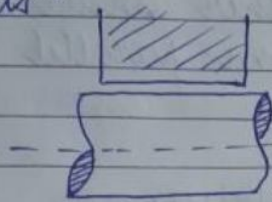
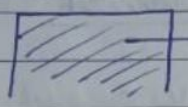


→ shaft (moving in a housing)



→ Journal Bearing (mounted b/w shaft & Housing)

(ii) Rolling Contact Bearings -

A type of bearing, where there is rolling b/w the mating parts.

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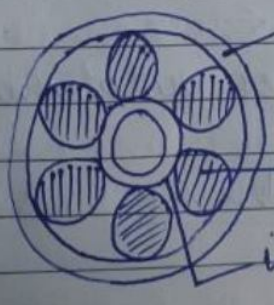
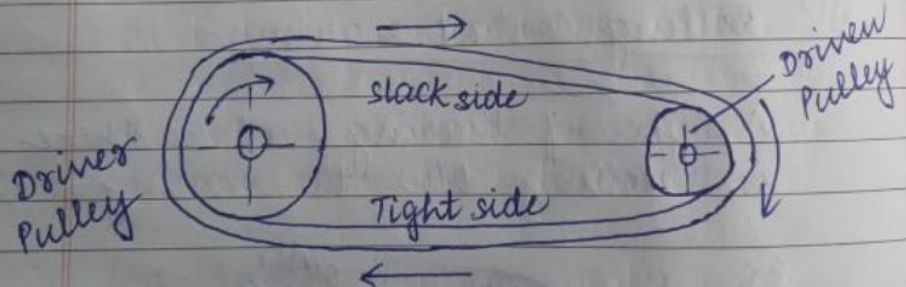


Belt - A belt is a loop of flexible but resistant body used to link two or more rotating shafts to transmit power from one place to another.

Belts may transmit power from a shaft to another shaft which is parallel or non-parallel to the 1st shaft.

Types of Belt drives -

1) Open - Belt Drive -



It provides rotation in same dir^n.

2) Cross - Belt drive -

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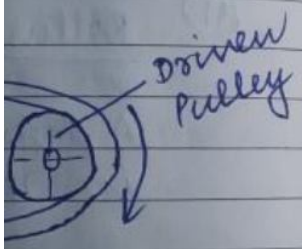

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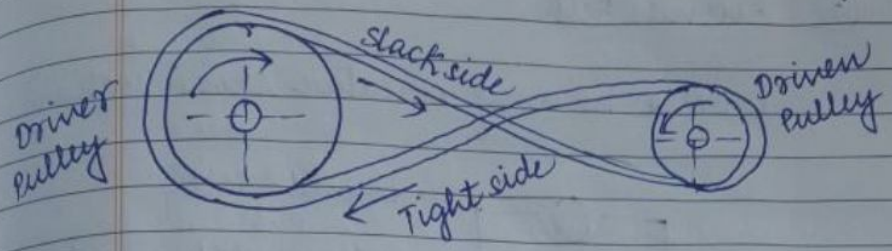
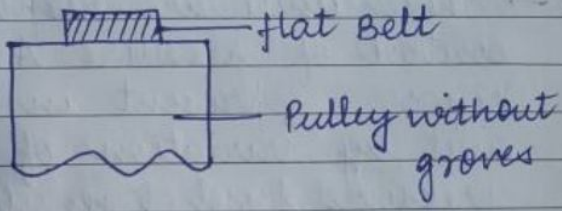


Types of Belts-

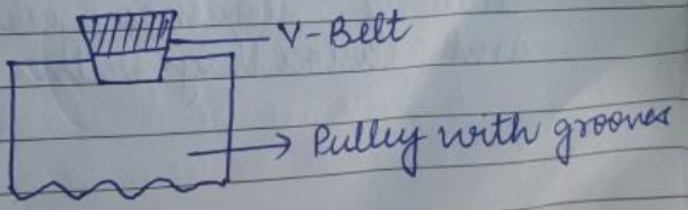
① Flat Belts-

(Belts having rectangular cross-section)



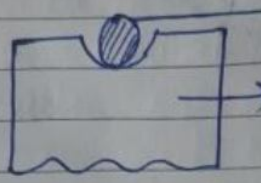
② V-Belts-

(Belts having trapezoidal cross-section)



③ Round-Belts -

(Belts having circular cross-section)



Ques-10 Write short notes on-

(1) Pressure Control valves

Ans → These units are responsible for control of pressure. A throttling Orifice is present in the valve and by variation of orifice, the pressure level can be controlled or at a pressure, a switching action can be influenced

→ The most common values for controlling pressure include relief, reducing, sequence, counter balance and unloading values.

(ii) Direction control valves.

Ans - Direction control valves mainly perform three functions -
1) stop fluid flow
2) Allow fluid flow
3) Change direction of fluid flow

→ Direction control valves can be classified in a no of ways -

1. Acc to types of construction
→ Poppet valve
→ spool valve

2. Acc to no of working parts
→ Two way valves
→ Three way valves
→ Four way valves

3. Acc to no of switching position
→ Two position
→ Three position

Ques-11 What do you mean by actuator? Explain linear and rotary actuators.

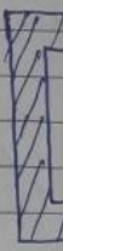
Ans- The actuator are output devices which convert energy from pressurized hydraulic or compressed air into the required type of action or motion.

Linear actuators-

All hydraulic cylinder create linear movement but there are different varities which have their own unique effects.

1) Single acting hydraulic cylinder

Single acting cylinder operate in one direction only. They have a single port at one end of the cylinder, so when the fluid is pumped into the port, it pushes the rod causing it to extend, the rod returns because of an external force such as the load or a spring



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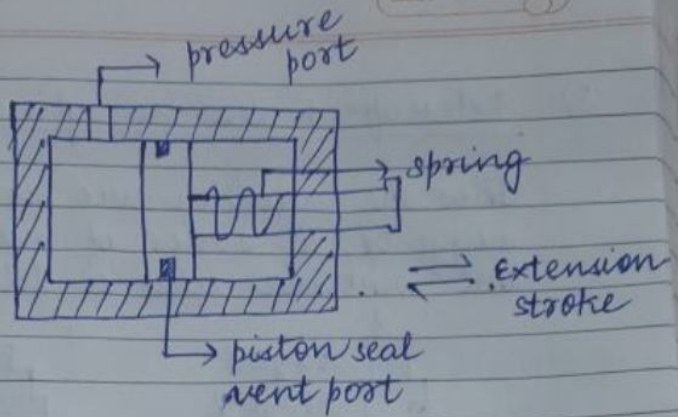
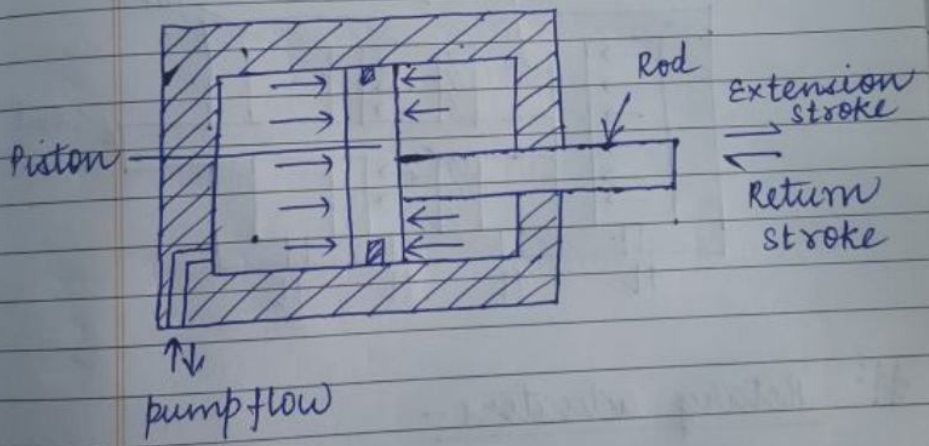


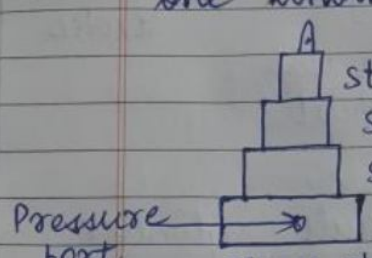
2) Double acting hydraulic cylinder –

Unlike single acting cylinders which can only push or pull, double acting cylinders do both



3) Telescope hydraulic cylinder-

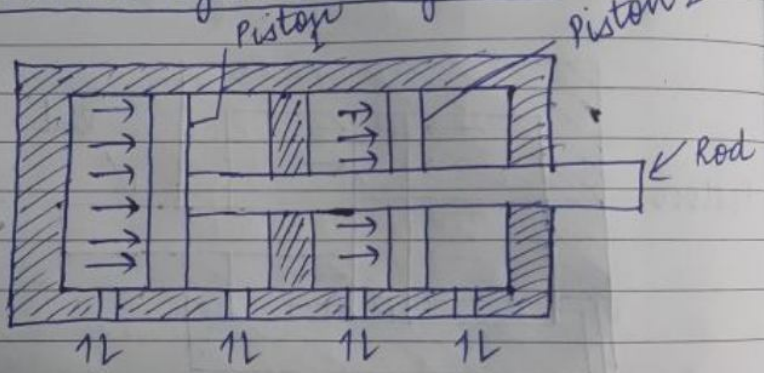
Telescope cylinder are as their name suggests, a series of name inside one another like a telescope



Three stage extended posn.

(Retracted posn)

4) Tandem hydraulic cylinder-



Rotary actuators -

Rotary actuators convert energy of pressurized fuel into rotary motion

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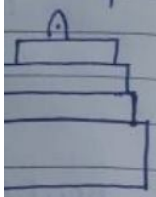

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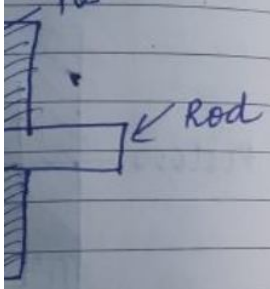

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are similar to electric motors but run on hydraulic or pneumatic power.

Gear Motor-

1) It consists of two intermeshing gears inside a housing with one gear attached to the drive shaft.

2) The air enters from the inlet, causes the rotation of the meshing gear due to differentiate in the pressure and produces.