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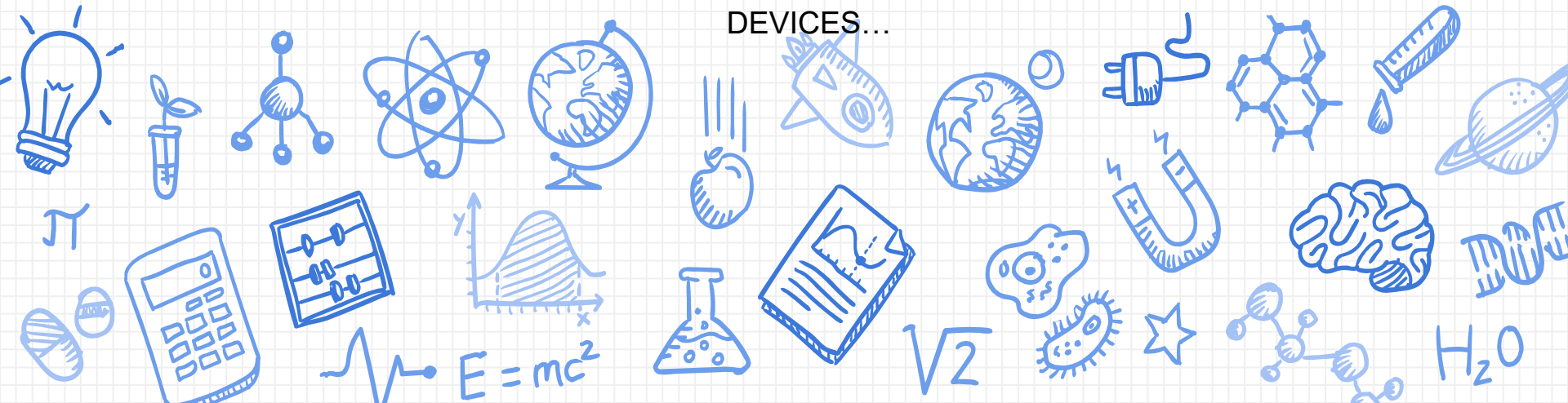
DEPARTMENT OF MECHANICAL ENGINEERING

19MEB201–FLUID MECHANICS AND MACHINERY

II YEAR /III SEM.

Unit 1 -FLUID PROPERTIES

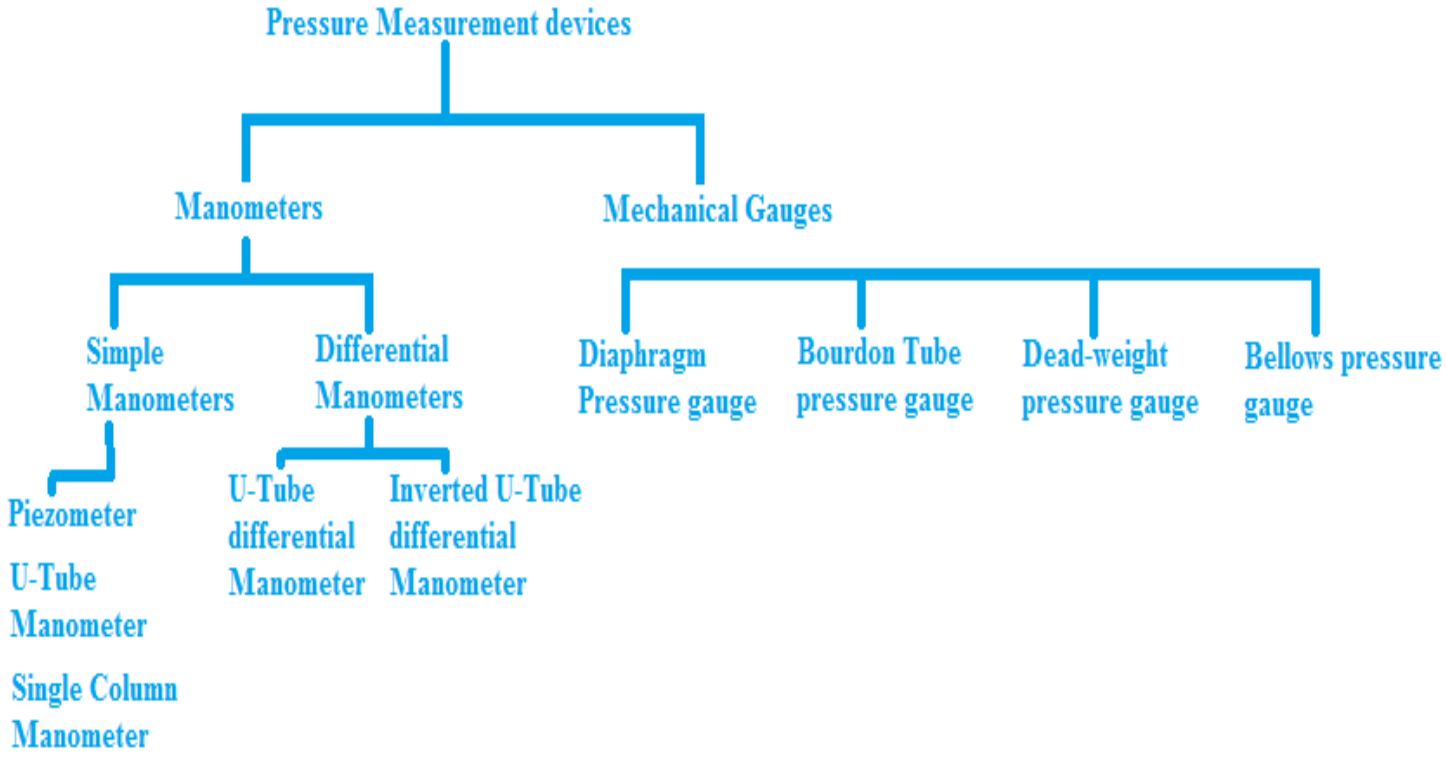
TOPIC 4- PROPERTIES & MEASURING DEVICES…



ORGANISATION

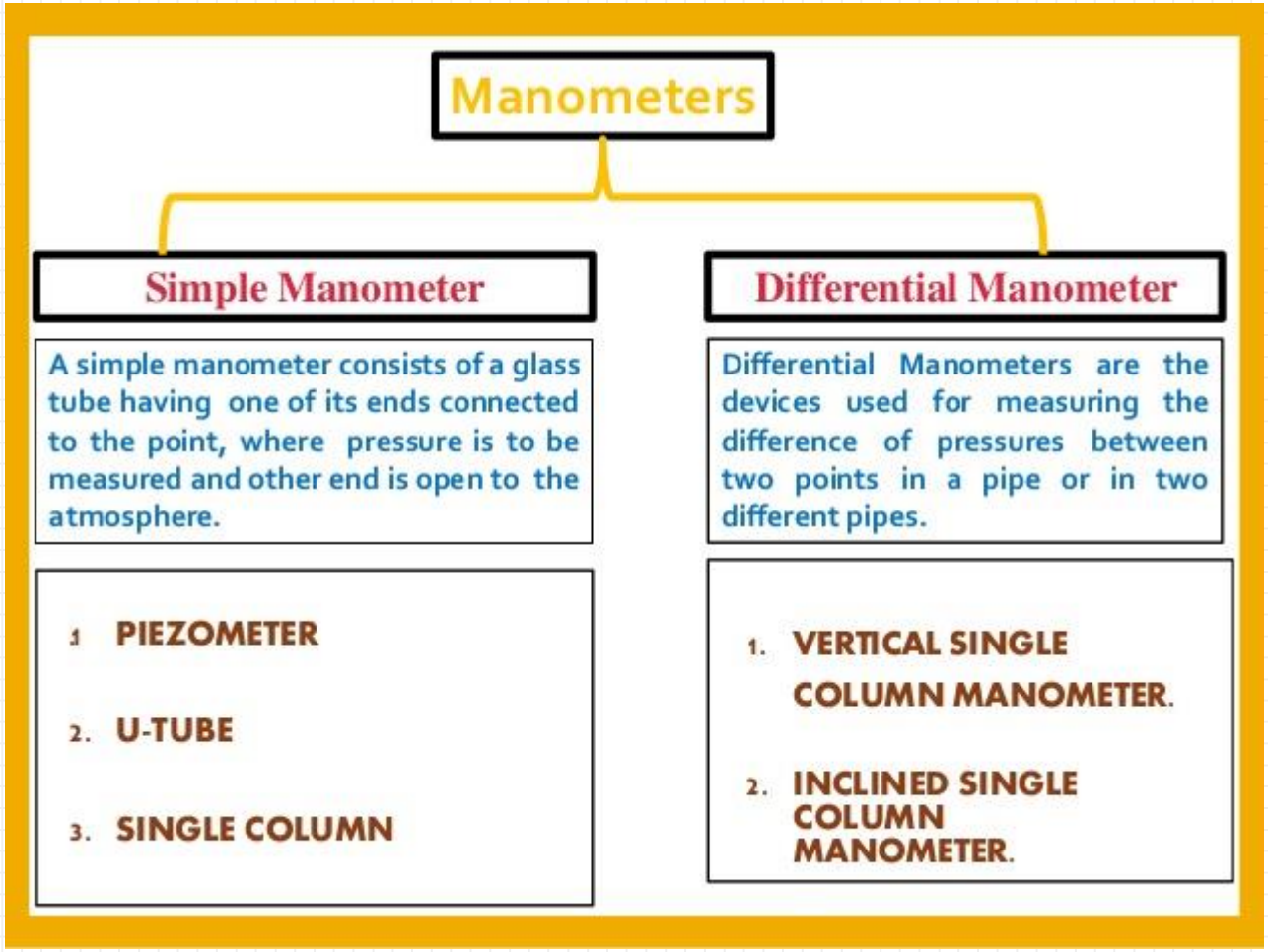
- Pressure measurement devices -U-tube manometers,
- Pressure gauges.
- Flow characteristics
- Concept of control volume
- Application of continuity equation
- Assessment

PRESSURE MEASURING DEVICES

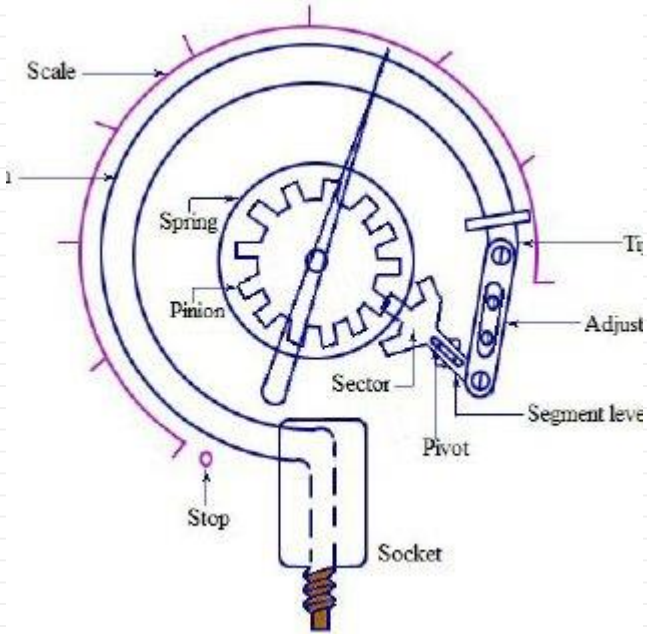


Courtesy :hkdivedi.com

MANOMETERS


Manometers
Simple Manometer
A simple manometer consists of a glass tube having one of its ends connected to the point, where pressure is to be measured and other end is open to the atmosphere.
1 PIEZOMETER
2. U-TUBE
3. SINGLE COLUMN
Differential Manometer
Differential Manometers are the devices used for measuring the difference of pressures between two points in a pipe or in two different pipes.
1. VERTICAL SINGLE COLUMN MANOMETER.
2. INCLINED SINGLE COLUMN MANOMETER.

PRESSURE GAUGE



Courtesy : google.co.in

Pressure gauge is designed to measure the internal pressure

Pressure Gauges are designed to measure the special measurement in a local place in the system.

FLOW CHARACTERISTICS

Steady vs **unsteady flow**

- ✓**Steady flow** -A flow that is not a function of time.
- ✓**Steady-state flow -** Properties of fluid at a point in the system do not change over time.
- ✓**Unsteady flow** -A flow that is a function of time.

Courtesy : web sources-G suit

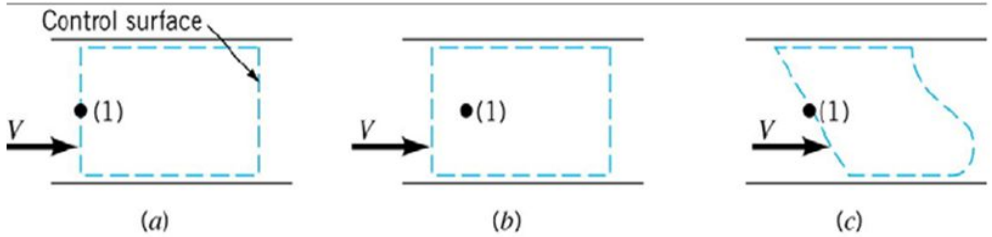
CONTROL VOLUME(CV)

- ✓A fluid dynamic system can be analyzed using a CV
- ✓Imaginary surface, enclosing a volume of interest
- ✓CV can be fixed or moving, and it can be rigid or deformable
- ✓laws of mechanics is being used to analyse the CV

CONCEPT OF CONTROL VOLUME

How to choose a control volume?

- CV is arbitrarily chosen by fluid dynamicist, however, selection of CV can either simplify or complicate analysis;
- Clearly define all boundaries. Analysis is often simplified if CS is normal to flow direction;
- Only CS conditions needed! Do not require detailed information inside CV.
- Clearly identify all fluxes crossing the CS;
- Clearly identify forces & torques *of interest* acting on the CV and CS.

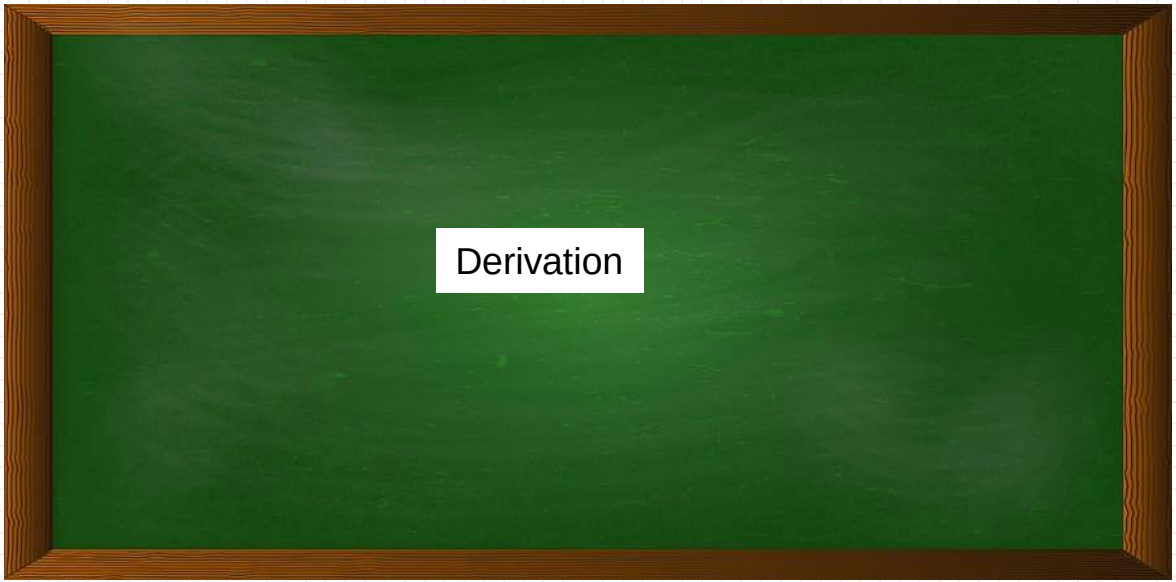


Courtesy : web sources-G suit

APPLICATIONS OF EQUATION OF CONTINUITY

- Common applications where the equation of continuity is used are:
- Pipes, tubes and ducts with flowing fluids or gases
- Rivers
- Overall processes as power plants
- Diaries
- Logistics in general
- Roads
- Computer networks
- Semiconductor technology

CONTINUITY EQUATION



ASSESSMENT

1.As we go upwards, at height there is slight decrease in pressure variation.

a) True

b) False

Answer: a

Explanation: There is slight decrease in pressure as value of g (acceleration due to gravity) decreases slightly as we go higher.

ASSESSMENT

2.A simple U tube manometer connected to a pipe in which liquid is flowing with uniform speed will give which kind of pressure?

a) Absolute Pressure

b) Vacuum Pressure

c) Gauge Pressure

d) None of the mentioned

Answer: c

Explanation: A simple U tube manometer will give pressure with respect to atmosphere. Hence, it is gauge pressure.

ASSESSMENT

3.Why can’t the density be assumed as constant for compressible fluids?

a) It shows variation with temperature and pressure

b) It remains constant with temperature and pressure

c) It becomes almost constant at very high temperature

d) None of the mentioned

Answer: a

Explanation: Volume and hence density changes with change in temperature and pressure.

ASSESSMENT

4.The continuity equation is based on the principle of

a) conservation of mass

b) conservation of momentum

c) conservation of energy

d) conservation of force

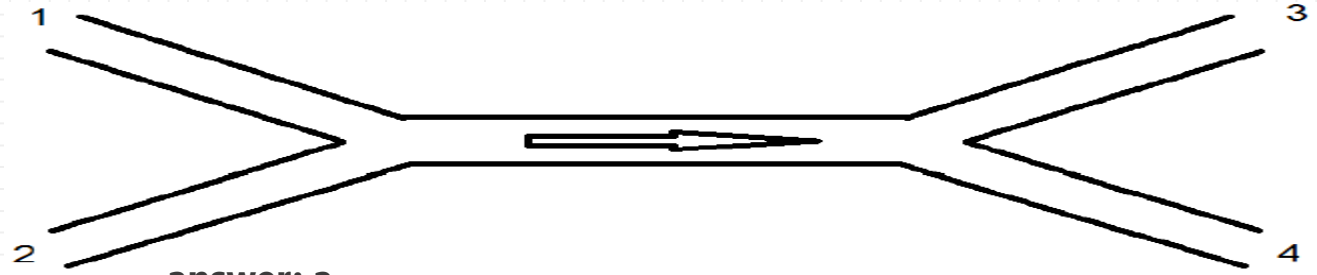
Answer:a

Explanation: According to the Continuity Equation, if no fluid is added or removed from the pipe in any length then the mass passing across different sections shall be the same. This is in accordance with the principle of conservation of mass which states that matter can neither be created nor be destroyed.

ASSESSMENT

5.In a water supply system, water flows in from pipes 1 and 2 and goes out from pipes 3 and 4 as shown. If all the pipes have the same diameter, which of the following must be correct?

a) the sum of the flow velocities in 1 and 2 is equal to that in 3 and 4
b) the sum of the flow velocities in 1 and 3 is equal to that in 2 and 4
c) the sum of the flow velocities in 1 and 4 is equal to that in 2 and 3
d) the flow velocities in 1 and 2 is equal to that in 3 and 4



answer: a

Explanation: According to the Continuity Equation,

ASSESSMENT

6.In a stationary fluid, how does the local pressure of the fluid vary?

a) With depth only
b) In the horizontal direction only
c) Both with depth and along horizontal direction
d) Neither with depth nor along horizontal direction

Answer:a

Explanation: Fluids (liquids and gases) cannot resist even a small shear force and gets permanently deformed. Hence, the element must be a solid element.

REFERENCES:

WEB RESOURCES

- ✓ https://nptel.ac.in/courses/105101082/
- ✓ https://www.youtube.com/watch?v=fa0zHI6nLUo&list=PLbMVogVj5nJTZJHsH6uLCO00I-ffGyBEm
- ✓ https://nptel.ac.in/courses/112105183/

REFERENCES

- ✓ Rajput. R. K, “A text book of Fluid Mechanics and Hydraulic Machines”, S. Chand & Company Ltd., New Delhi, sixth edition, 2010
- ✓ Google search engine

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