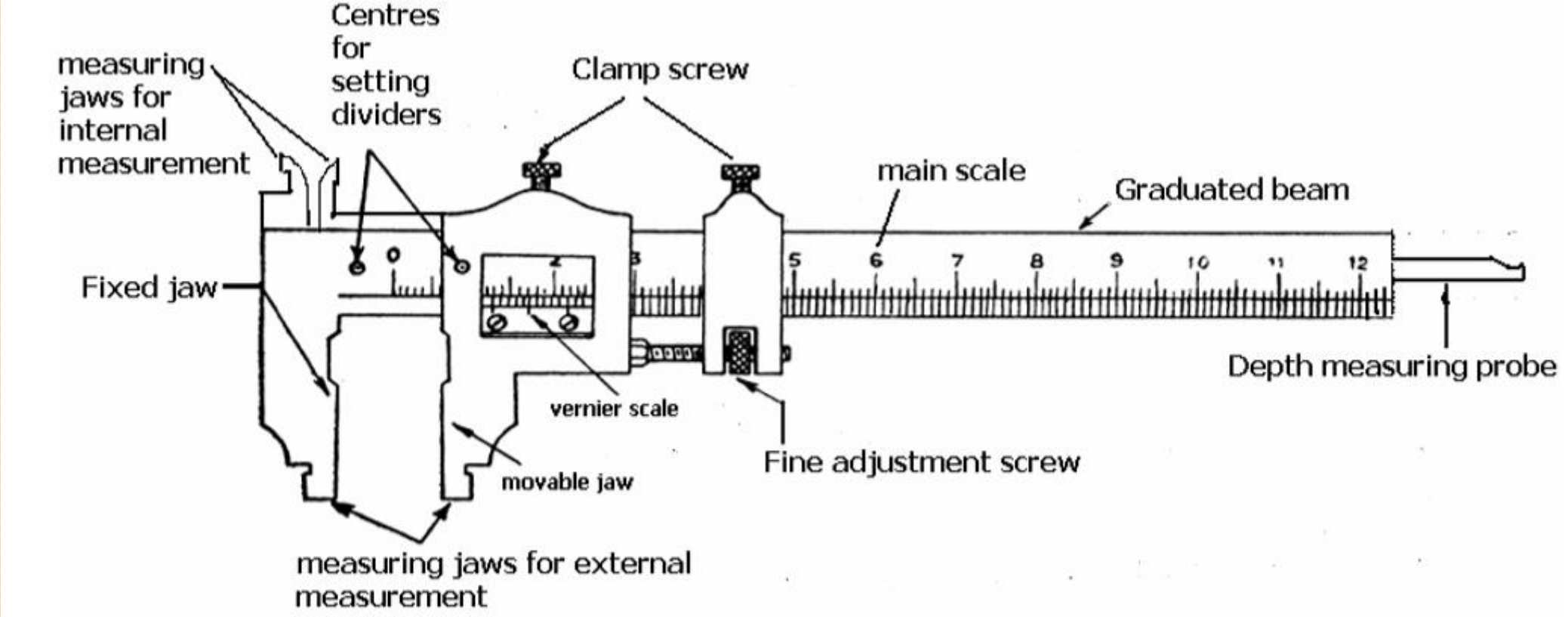
METROLOGY AND GAUGING

LAB 1:

- Title: To understand construction of Vernier Caliper and calculate its least count.
- Objectives:
- i. Understand the constructional parts of Vernier Caliper,
- ii. how to calculate least count of vernier caliper,
- iii. how to take measurement with the help of vernier calipe

Introduction:

- Metrology means science of measurement.
- Engineering metrology is the measurement of dimensions: length, thickness, diameter, taper angle, flatness, profiles, etc.
- In engineering, there are various stages during which inspection and measurement is required.
- Metrology becomes useful while raw material inspection, during production and after the parts are manufactured i.e. final inspections of parts.
- Measurand is the physical quantity or property like length, angle, diameter, thickness etc to be measured.
- The various precision linear measuring instruments are vernier caliper, outside micrometer, vernier height gauge, vernier depth gauge, inside micrometer, micrometer depth gauge etc. Such linear measuring instruments measure linear measurements such as length, height, depth, diameter and thickness.


measuring jaws for internal measurement
Centres for setting dividers
Clamp screw
main scale
Graduated beam
Fixed jaw
vernier scale
Depth measuring probe
movable jaw
Fine adjustment screw
measuring jaws for external measurement

PARTS:

- Fixed scale and movable scale: The Vernier Caliper consists of two scales: one is fixed and the other is movable.
- (2) Fixed and movable jaw: The fixed scale is called as main scale which is calibrated on L-shaped frame and carries a fixed jaw. The movable scale, called vernier scale slides over the main scale and carries a movable jaw. The movable jaw as well as the fixed jaw carries measuring tip. When the two jaws are closed the zero of Vernier scale coincides with the zero of main scale. For precise setting of the movable jaw an adjusting screw is provided.
- (3) Lock nut: An arrangement is provided to lock the sliding scale on the fixed main scale.
- (4) Graduated beam: Main scale markings are there on graduated beam.
- (5) Blade or Depth probe: Measures depth.

- Least count: The smallest value that can be measured by the instrument is known as its least count.
- (a) First Method (Principle of Vernier)
- Length of 49 divisions on main scale = Length of 50 divisions on Vernier scale
- It means it follows that for the same length if there is n division on main scale then there should be n+1 division on Vernier Scale for the same distance.
- Value of smallest division on main scale = 1 mm and

- Value of smallest division on Vernier scale = 49/50 = 0.98 mm
- **Least count** = Value of smallest division on main scale – value on smallest division on Vernier scale

  = 1 – 0.98 = 0.02 mm

(b) Second Method:

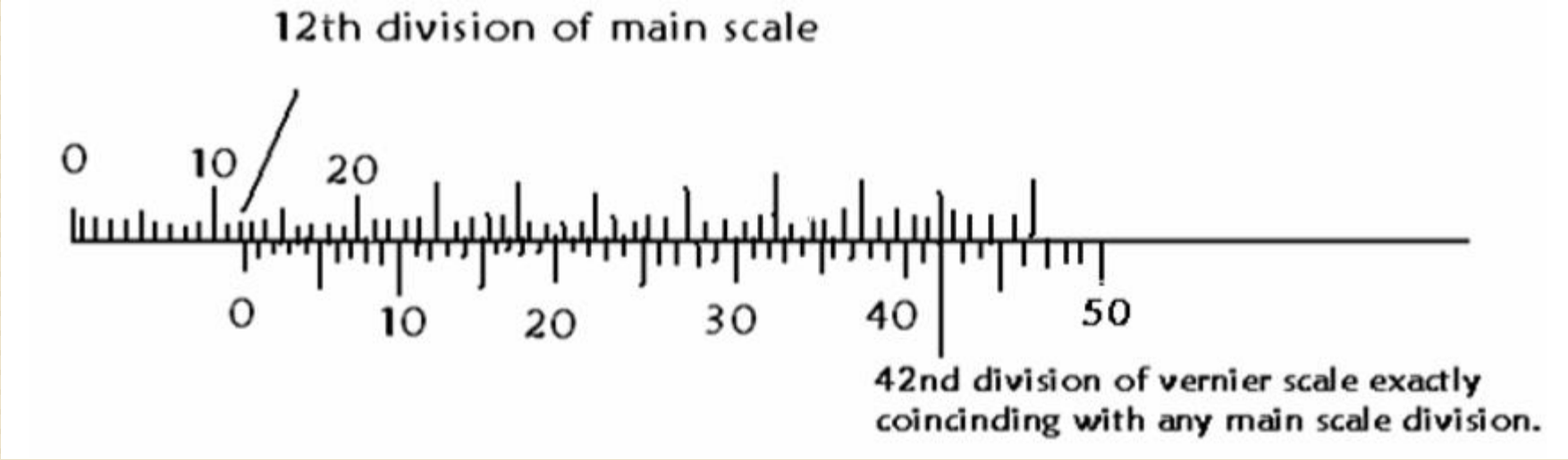
- Least Count = Value of smallest division on Main Scale / Total no. of divisions on Vernier Scale
- Smallest division on Main scale = 1 mm Total no. of divisions on Vernier Scale = 50 markings So for this type of Vernier Caliper L.C. = 1/50 = 0.01mm

Observation Table:

Vernier caliper

SrNo.	Range	Smallest division value of main scale	No. of divisions on Vernier	Least count
1				
2				
3				
4				
5				

Reading a vernier caliper:



Formulae for calculating total reading with the help of Vernier caliper is

- *Total reading = (Main scale reading) + (Least count of V.C. X Vernier division exactly coincides with main scale division)*

- The main scale reading is 12
- We know that the usual least count of V.C. is 0.02 m

12 + (0.02 X Vernier division coinciding with main scale division)

42nd division of Vernier scale exactly coincides with main scale division.

- =12 +(.02X 42)
- =12.84

Measurements with vernier caliper: (All readings in mm)

Range: Least count: Make:

Sr. No	Main scale reading A	No of vernier scale division in coincidence	Vernier scale division X Least count B	Total Reading A + B
1				
2				
3				
4				
5				

Precautions in use of Vernier caliper

- 1. Line of measurement must coincide with line of scale i.e. following Abbe's principle correctly.
- 2. While measuring outside diameters with Vernier caliper, caliper should not be tilted or twisted.
- 3. Do not apply unnecessary extra pressure while taking measurements.
- 4. Handle and grip the instrument near or opposite to the jaws while taking the measurement.
- 5. Accuracy of measurement primarily depends on two senses – sense of sight (eyes) and sense of touch (feel). Imperfect vision and improper eyesight can cause error so use of proper magnifying glass should be done.

Possible errors in Vernier caliper:

- Errors in taking reading by use of Vernier caliper are mainly due to manipulation or mishandling of instrument. Various causes of errors are :-
- 1. Error if the line of measurement does not coincide with the line of scale i.e. parallax error.
- 2. Error due to wear and warping of jaws, where the zeros of two scales will not coincide i.e. zero error.
- 3. Error due to play between sliding jaws on the scale i.e. backlash error.
- 4. If sliding jaw frame becomes worn or warped, it will not slide squarely on main scale and will cause error in measurement.
- 5. It is difficult to find the Vernier scale division exactly coinciding with main scale division. Error caused by incorrect reading as scales are difficult to read.