EXPERIMENT NO. 1

Objective:
To draw the load-extension curve of a metallic wire and hence determine the modulus of elasticity of the material of the wire.

Apparatus:
Young's Modulus of Elasticity apparatus, Hangers and Weights, Meter Rod, Micrometer

The Young's Modulus of Elasticity apparatus consists of a wire attached to a fixed support.

The lower end of the wire is attached to the hanger with the help of a metallic plate. The extension of the wire on loading can be measured from the scale present on metallic plate.

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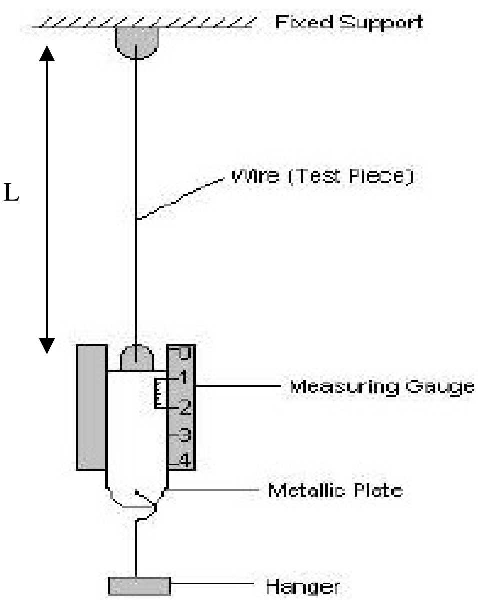

Figure (a): Young's Modulus of Elasticity Apparatus

Theory:
Normal stress in a solid body is defined
"The internal resistance force per unit area against the applied load or external force." It is denoted by **σ**. It can be tensile or compressive.
Mathematically,

Stress = Force/Area ---------- (i)

Units of stress: *Newton per square meter* (N/m^2) = *Pascal* (Pa) or *pounds per square inch (psi)*

Normal strain in a solid body is defined as: "Change of length per Original Length." It is denoted by the symbol **ε**.
Mathematically,

Normal Strain = Change in length/Original length ---------- (ii)

Strain is measured as inch/inch.

By Hooke's law, we know that stress is directly proportional to the strain, whenever a material is loaded within its proportionality limit. It is denoted by **E**.

Mathematically,

Stress α Strain (within proportionality limit) ---------- (iii)

Units of E: *Newton per square meter* (N/m^2) = *Pascal* (Pa) or *pounds per square inch (psi)*

Consider a body (wire) subjected to a tensile stress as shown in figure (a).

Let,

P = Load or force acting on the body
L = Length of the body
A = Cross-sectional area of the body
σ = Stress induced in the body
E = Modulus of elasticity for the material of the body
ε = Strain produced in the body
δl = Deformation of the body

From (i), (ii), and (iii)

$$\sigma \propto \varepsilon$$

$$\sigma = E \times \varepsilon$$

or

$$\mathbf{E = \sigma/\varepsilon}$$

$$\mathbf{E = (p/\delta l)(L/A)}$$

Load-Extension Curve:

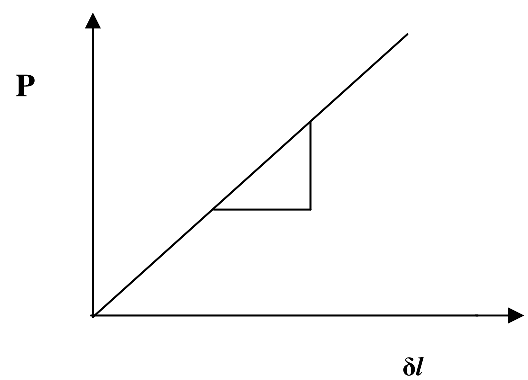

Figure (b)

Procedure:

1. Put the initial load of 10 N to remove wrinkles in wire.
2. Measure length of wire using meter rod.
3. Measure diameter of the wire using micrometer.
4. Adjust main scale so that zeros of two scales coincide with each other.
5. Put a load of 5 or 10 N in the hanger and measure extension.
6. Take a set of at least five readings of increasing value of load and then take readings on unloading.
7. Check the zeros at no load.
8. Calculate the "Young's Modulus of Elasticity (**E**)" of the material of the Wire.

Observations and Calculations:

Least Count of the scale of apparatus = __________ mm

Least Count of micrometer = __________ mm

Least Count of meter rod =__________ mm

Length of wire (L) =__________ mm

Dia of wire (d) =__________ mm

Initial Load =__________ N

X-area of wire ($A = \pi d^2/4$) =__________ mm^2

No. of Obs.	**Effective Load-P (N)**	**Extension-δl (mm)**			**$P/\delta l$ (N/mm)**	**Modulus of Elasticity $E=(P/\delta l)(L/A)$ (N/m^2)**
		Loading	**Unloading**	**Average**	*From Graph*	
1.						
2.						
3.						
4.						
5.						
6.						
7.						

Name: ________________________ **Reg. #** ____________________

Date:

Report:

The laboratory report should contain the following:

1. Plot of curve between Load **P** (Y-axis) and Extension **δl** (X-axis) as shown in figure (b). Calculate the slope of the graph.
2. Hand calculations showing all results in (8) under procedure above.
3. A discussion / comments of factors affecting the results of the experiment.
4. Practical Applications