PROJECT 6

AIM

To compare the Young's modules of elasticity of different specimen of rubber and compare them by drawing their elastic hysteresis curve.

APPARATUS AND MATERIAL REQUIRED

Two samples of rubber bands of about 10 cm length, a rigid support, number of slotted weights (10 g), a hanger (10 g), a scale and a fine pointer.

TERMS AND DEFINITIONS

1. **Elastic hysteresis:** When the stress-strain curve is not retraced on reversing the strain, the phenomenon is known as elastic hysteresis.
2. **Residual strain:** On removing the deforming force, if the length of the specimen does not reduce to its original length, this results in residual strain.

PRINCIPLE

1. The graph of stress versus strain (or elongation) for rubber is not a straight line. Hence, the Young's modules of elasticity for rubber cannot be defined uniquely. For a given stress, it is defined as the slope of the stress-strain curve at particular stress-strain point.
2. The area enclosed by the hysteresis curve is a measure of energy loss during the loading and unloading cycle.

PROCEDURE

1. Suspend a rubber band from a rigid support and attach a hanger of mass (10 g) along with a fixed pointer at the lower end.
2. Fix a scale S vertically such that the pointer moves freely on the scale and note the reading on the scale.
3. Place 10g slotted weight in the hanger and wait till the rubber band becomes stationary. Read the position of the pointer.

4. Repeat Step 3 by increasing load in Steps of 10 g till the total weight is 80-100 g.

5. Start removing the weight in Steps of 10 g and note the corresponding reading of the pointer (Give time for the rubber to stabilise before taking the reading).

6. Repeat Steps 1 to 5 for different samples of rubber bands.

OBSERVATIONS

(i) Least count of the scale = ... cm

(ii) Original length of unstreched rubber band, L = ... cm

Table P 6.1: Extension of rubber band on loading

	S. No.	Load suspended = applied force = F (N)	Reading of pointer r (cm)		Extension	
			Loading	Unloading	Loading	Unloading
Specimen A	1					
	2					
	3					
Specimen B	1					
	2					
	3					

CALCULATIONS

1. Plot a graph between the load and extension by taking extension along x-axis and load along y-axis for loading and unloading.

2. The area of hysteresis loop for specimen A = ...

   The area of hysteresis loop for specimen B = ...

   (This can be done by counting the squares enclosed in the hysteresis loop).

RESULT

Hysteresis of specimen A ... is (greater or less than the) hysteresis of specimen B.

PRECAUTIONS

1. The weights must be added or removed gently.
2. One should wait for some time after adding or removing the weights before reading is taken.

EVALUATION

1. What does the area of hysteresis curve depict?
2. Interpret the hysteresis curves obtained for the specimen A and B.
3. When do the curves obtained while loading and unloading coincide?
4. When do the curves obtained while loading and unloading not coincide?
5. For which purpose is the rubber with large hysteresis loop used?
6. For which purpose is the rubber with small hysteresis loop used?
7. Is the stress-strain graph for rubber a straight line as expected by Hooke's law? What would happen if the elastic limit is exceeded?
8. How would you known that elastic limit has been crossed?