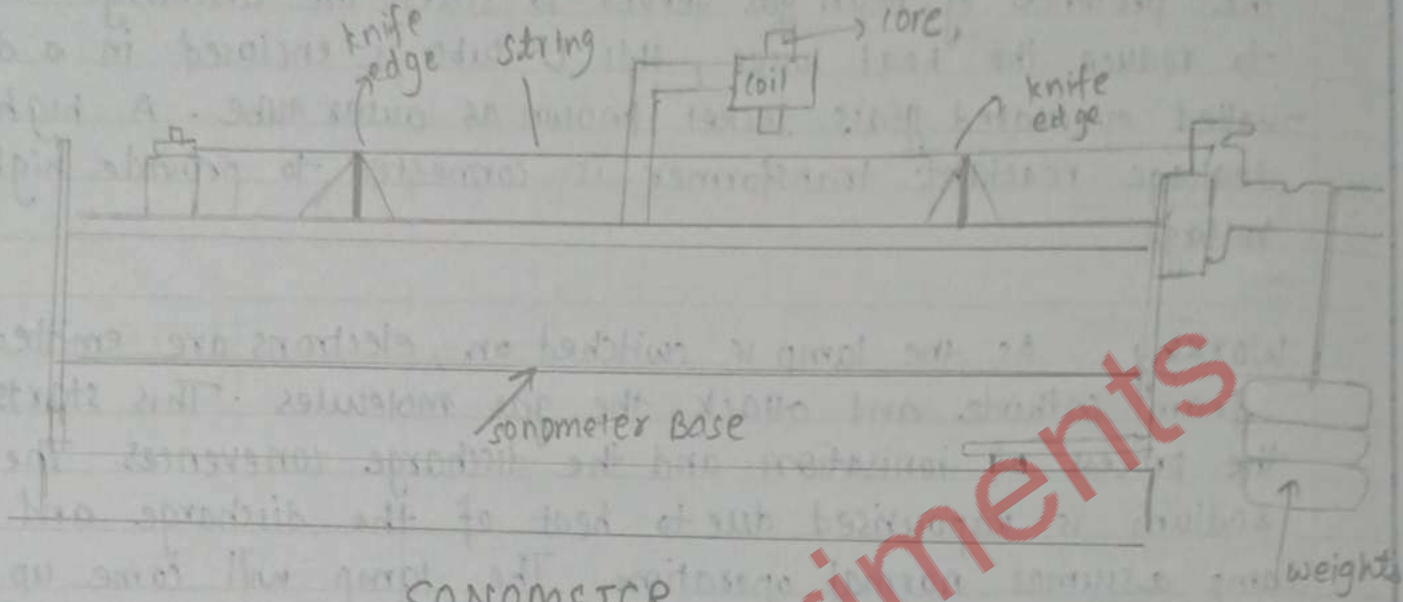

SONOMETER.

AIM: To determine the frequency of AC mains using sonometer.

APPARATUS USED: sonometer with metallic wire, inbuilt AC supply, electromagnet, meter scale, slotted half kg weights, two knife edges

THEORY AND FORMULA USED: A sonometer is a device used which consists of a thin wire stretched over two bridges that are usually mounted on a soundboard and which is used to measure the vibration frequency, tension, density, or diameter of the wire, or to verify relations between these quantities.

Electromagnet is a magnet in which the magnetic field is produced by the flow of electric current. The magnetic field disappears when the current ceases. The main advantage of an electromagnet is that the magnetic field can be rapidly manipulated over a wide range by controlling the amount of electric current.

Frequency of AC mains: To find the frequency of AC mains using an electromagnet and a sonometer, the AC is passed through the primary of a step-down transformer (220-230 to 4-6 volts). The natural frequency of the sonometer wire (f) is double the frequency (n) of the A.C. mains.

The natural frequency of the wire is given by

$$f = \frac{1}{2l}\sqrt{\frac{T}{m}}$$

where, l = length of the sonometer wire between two knife edges when it is thrown into resonant vibrations.

T = tension in the wire

OBSERVATIONS:

length of wire = 66 cm = 0.66 m.

mass per unit length of wire (m) = 0.002 kg/m

S. NO.	load 'M' (kg)	Tension T = Mg	length of wire at relonance			$f = \frac{1}{4L}\sqrt{\frac{T}{m}}$
			l_1 (m)	l_2 (m)	mean (m)	
1.	0.5	4.9	0.270	0.271	0.270	45.50
2.	1.0	9.8	0.343	0.345	0.344	50.40
3.	1.5	14.7	0.415	0.413	0.414	51.43
4.	2.0	19.6	0.480	0.485	0.482	51.47
5.	2.5	24.5	0.495	0.496	0.495	55.33

∴ mean frequency of AC mains = 50.827 Hz

standard frequency of AC mains = 50 Hz

Percentage error = $\frac{\text{Difference}}{\text{Actual value}} \times 100 = 1.54\%$

m = mass per unit length of the wire

The frequency of the AC mains is given by $n = f/2 = \frac{1}{4l}\sqrt{\frac{T}{m}}$

PROCEDURE:

1. Assemble the setup as shown in the figure. Firstly tie the wire, as its one end fixed and other end passing over pulley, carrying a hanger of weights.

2. Mount the L-clamp of coil with the screws of sonometer base at a distance 2-3 mm above the wire. Now connect mains cord between mains and sonometer.

3. Take two patch cords from the accessory box and connect the 6 V AC supply from sonometer to the coil with polarity

4. Now hang the weight of 1000 gms to the hanger connected with one end of steel wire. switch on the AC supply.

5. Now adjust two knife edges by slowly increasing the distance between them so that you get some vibrations in wire.

6. Now slowly adjust both knife edges for maximum vibration in the wire. Note the length (l_1) of wire between two knife edges by given metre scale. Also note load (w) in kg (including weight of hanger)

7. Now increase load by 500 gms and again get the position of maximum vibration by adjusting both knife edges. Note length (l_1) of wire.

8. Repeat the same procedure by increasing weight by 500 gms and

take reading of l_1 for maximum vibration

9. Note all values in observation table. Repeat the steps 4-8, adjusting two knife edges by slowly decreasing the distance between them so that you get maximum vibrations in wire.

10. Note the values of length l_2 for respective loads and compute mean length, l.

RESULT: The frequency of AC mains = 50.83 Hz. with percentage error of 1.54 %.

PRECAUTIONS AND SOURCES OF ERROR:

(i) The wire should be of a uniform area of cross-section, free from kinks and should be tight.

(ii) The observation should start with minimum distance between the two knife edges

(iii) The weight of hanger should be free from friction.

(iv) The pulley should be free from friction

(v) The resonance position should be obtained by first slowly increasing the distance between knife edges and then slowly decreasing it.