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Program Code:-AO2I,EE2I
Course Name:-Applied Science(Physics)

Course Code : -22211

Course coordinator: Mrs. Deepa Gupte

Date: 1/4/21

Unit No:1
Unit Name: Electricity and Capacitance

Unit Outcomes (UO1d):Explain concept of Wheatsotne’s bridge.
Learning Outcome (LO4) : Students will be able to explain principle of Wheatstone’s bridge

Learning Objective/ Key learning

- Students will be explain principle of Wheatstone’s bridge

Wheatstone's Network

- Wheatstone bridge is a special arrangement of resistors as shown in the figure.
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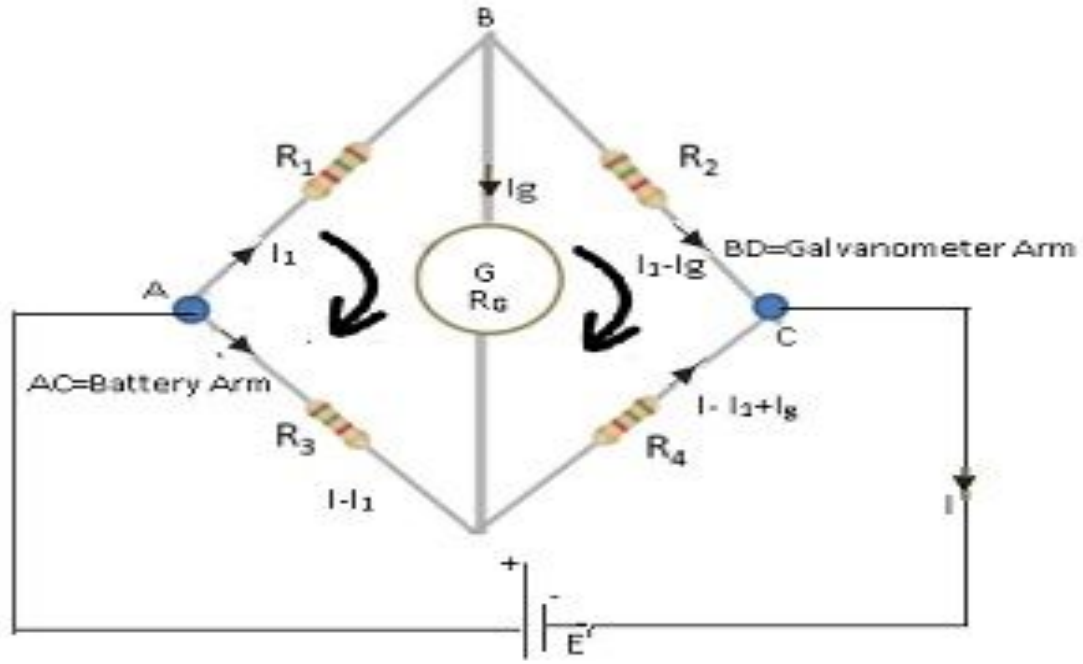

Wheatstone's Network

- There are 4 resistances R_1,R_2,$R_3$and R_4 arranged in such a manner that there is a galvanometer placed between the points B and D.
- The arm BD is known as galvanometer arm. AC is known as battery arm.
- And circuit is connected to the battery across the pair of diagonally opposite points A and C.
- According to Wheatstone bridge principle:-
  - If **$(R_1/R_2)=(R_3/R_4)$,** then Bridge is said to be balanced.
  - If the bridge is balanced there is no current flowing through the galvanometer arm.

Principle of Wheatstone's Network

- Mathematically:-
- Assume current across the galvanometer arm $I_g = 0$;
- To prove:-$(R_1/R_2) = (R_3/R_4)$
- Applying loop law to the loop ABDA,
- There is no Emf, therefore,
- $0= I_1R_1 - (I-I_1)R_3 + IgR_G$ equation (i) where R_G=resistance of galvanometer.
- Applying loop Law to the loop BCDB,
- No Emf, $0=(I_1-Ig)R_2 -(I-I_1+I_g)R_4 +I_gR_G$ equation(ii)
- Putting $I_g=0$ in equation(i) and (ii)
- $I_1R_1 - (I-I_1)\ R_3 = 0 \Rightarrow I_1R_1 = (I-I_1)\ R_3$ equation (iii)
- $I_1R_2 -(I-I_1)R_4 =0 \Rightarrow I_1R_2 =(I-I_1)$ equation(iv)
- Dividing equation(iii) with (iv)
- **$(R_1/R_2) =(R_3/R_4)$ Hence proved.**

Applications of Wheatstone's bridge

- The Wheatstone bridge is used for the precise measurement of low resistance.
- Wheatstone bridge along with operational amplifier is used to measure physical parameters such as temperature, light, and strain.
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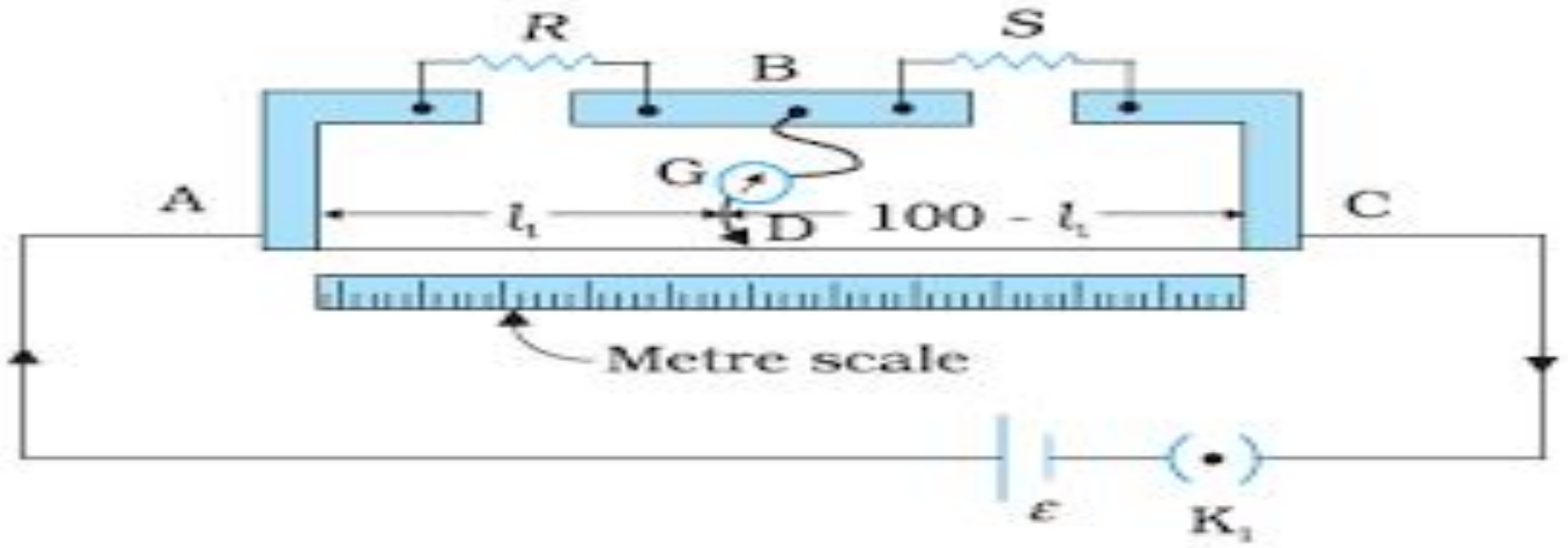
Meter Bridge

A **meter bridge** also called a slide wire **bridge** is an instrument that works on the principle of a Wheatstone **bridge**. A **meter bridge** is used in finding the unknown resistance of a conductor as that of in a Wheatstone **bridge**.



Formula to determine unknown resistance by meter bridge

R1/R2=R3/R4

Now can be written as

R/S=l1/100-l1

If R is unknown

then R=S (l1/100-l1)

Numerical on Wheatstone's bridge

Four resistances 4 ohm, 8 ohm, 6 ohm and x ohm are connected in a cyclic order so as to form Wheatstone's network. If the network is balanced, find the value of 'X'.

Solution: Given: R1 = 4 ohm, R2 = 8 ohm, R3 = 6 ohm To find: Unknown resistance (X).

Formula:R 1/R2=R4/R3

4/8=X/6

X=(4/8)X6

x=3 Ohm

Numerical on meter bridge

An unknown resistance ‘X’ is placed in the left gap and a known resistance of 60 ohm is placed in the right gap of a metre bridge. The null point is obtained at 70 cm from the left end of the bridge. Find the unknown resistance.

Solution: Given: R = 60 , 1 = 70 cm, 2 = 100 70 = 30 cm To find: Unknown resistance (X) Formula: X/ R =L1 /L2

Calculation: From formula, X /60 = 70/ 30

X = 140 ohm

Ans: The unknown resistance is 140 ohm.