Electronic Measurements And Instrumentation (MID II :TASK)

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TASK: Design Wheatstone Bridge Measurement

A Wheatstone bridge is a classic electrical circuit used to measure unknown electrical resistances by balancing two legs of a bridge circuit. Here's a step-by-step guide to designing a Wheatstone bridge measurement system:

Components Needed:

Four resistors (R1, R2, R3, Rx)

A voltage source (V)

A galvanometer or voltmeter

Step-by-Step Design:

1. Circuit Diagram:

Draw a diamond-shaped circuit with four resistors forming the sides.

Connect the voltage source across the top and bottom nodes of the diamond.

Connect the measuring device (galvanometer or voltmeter) across the middle nodes (between R1 and R2, and R3 and Rx).

2. Resistor Configuration:

Let R1 and R2 be known resistors.

Let R3 be a variable resistor (or a known resistor for some configurations).

Let Rx be the unknown resistor you want to measure.

3. Balancing the Bridge:

Adjust R3 until the galvanometer shows zero current (or the voltmeter shows zero voltage).

At this balanced condition, the ratio of the resistances in one leg is equal to the ratio in the other leg:

$$\frac{R1}{R2} = \frac{R3}{Rx}$$

4. Calculate Unknown Resistance:

Once the bridge is balanced, use the relationship:

If R1, R2, and R3 are known, Rx can be easily calculated.

$$Rx = R3\left(\frac{R2}{R1}\right)$$

- $R1 = 1\,k\Omega$
- $R2 = 1\,k\Omega$
- $R3$ is a variable resistor
- $V = 10\,V$

You adjust $R3$ until the galvanometer reads zero. At this balanced condition, suppose $R3$ is adjusted to $2\,k\Omega$. Then, the unknown resistor Rx can be calculated as:

$$Rx = R3\left(\frac{R2}{R1}\right) = 2\,k\Omega\left(\frac{1\,k\Omega}{1\,k\Omega}\right) = 2\,k\Omega$$

Thus, $Rx = 2\,k\Omega$.