SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35

Accredited by NBA-AICTE and Accredited by NAAC – UGC with A++ Grade

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE NAME: 23EET206/ Measurements and Instrumentation

II YEAR / IV SEMESTER

UNIT 2 - COMPARATIVE METHODS OF MEASUREMENTS

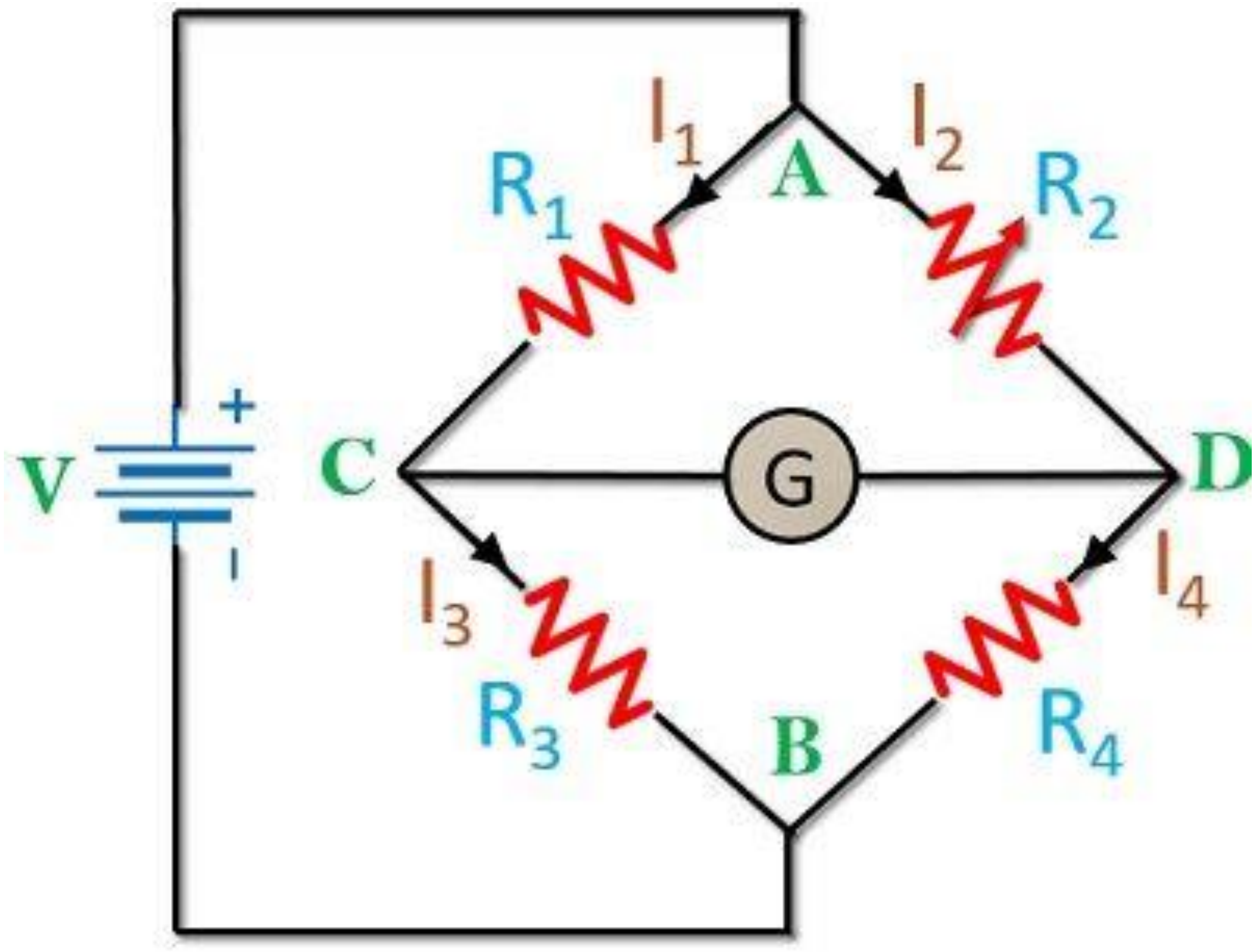
Topic 2 – DC Bridges: Wheatston

SUCCESSFUL STUDENT

Positive Attitude	Professionally Groomed	Socially Interactive	Technically Skillful

Wheatstone Bridge

Definition: Wheatstone bridge is a type of **dc bridge that is used for the measurement of unknown resistance**. It is a series-parallel combination of 4 resistances that provides zero difference voltage at the balanced condition. The principle of **null indication** is the basis of working of Wheatstone bridge and thus provides high accuracy in measurements.



Wheatstone bridge circuit

In order to determine the bridge balance equation,

$$I_1 R_1 = I_2 R_2$$

The following condition must be fulfilled in order to have null current through the galvanometer.

$$I_1 = I_3 = \frac{V}{R_1 + R_3}$$

$$I_2 = I_4 = \frac{V}{R_2 + R_4}$$

On substituting the above value in previously defined equation

$$\frac{V \, X \, R_1}{R_1 + R_3} = \frac{V \, X \, R_2}{R_2 + R_4}$$

$$R_1 X \, (R_2 + R_4) = R_2 X \, (R_1 + R_3)$$

$$R_1 R_2 + R_1 R_4 = R_2 R_1 + R_2 R_3$$

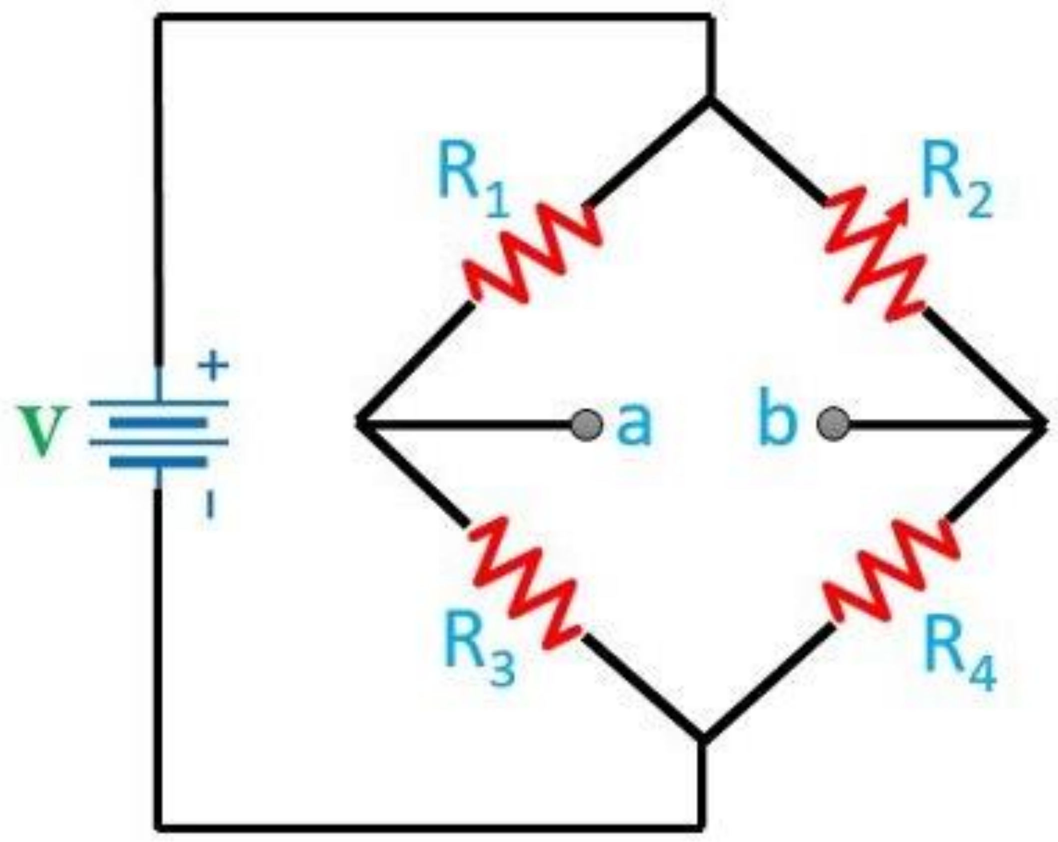
Thus, on cancelling like terms from both the sides, we will have,

$$R_4 = \frac{R_2 R_3}{R_1}$$

Unbalanced condition of a Wheatstone bridge

At the unbalanced condition of the bridge, by applying general circuit analysis we can conclude the extent of deflection. However, Thevenin's theorem shall be used here.

The figure below shows the unbalanced condition of the Wheatstone bridge.



Unbalanced wheatstone bridge

Electronics Coach

As we can see that galvanometer is not present in the circuit because in Thevenin's equivalent voltage is determined by detaching the galvanometer. Thus, terminal 'a' and 'b' are open circuit here in order to find the circuit voltage between the two terminals.

The potential at point a is given as

$$V_a = \frac{V\ X\ R_3}{R_1+R_3}$$

and

The potential at point b is given as

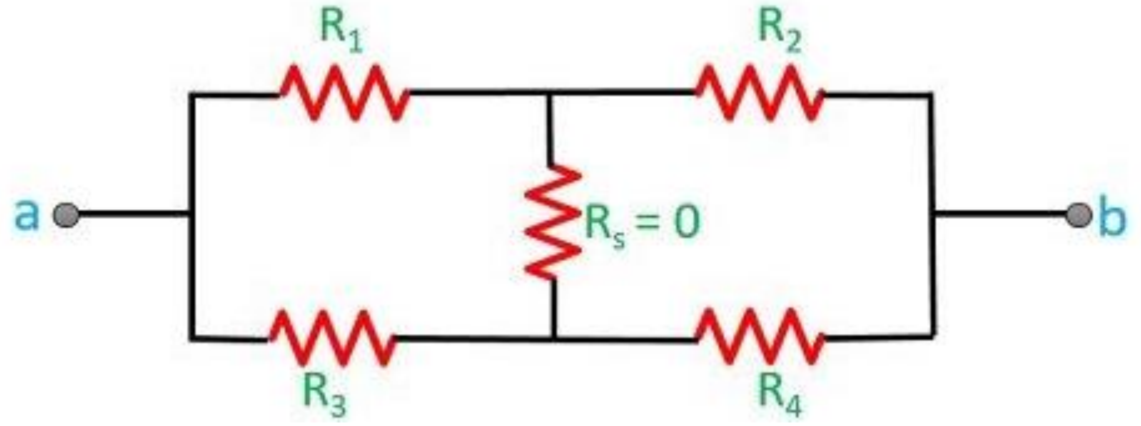
$$V_b = \frac{V\ X\ R_4}{R_2+R_4}$$

Thus, Thevenin's equivalent voltage is represented by the potential between a and b which is the difference between V_a and V_b

$$V_{th} = V_a - V_b$$
$$V_{th} = V\left(\frac{R_3}{R_1+R_3} - \frac{R_4}{R_2+R_4}\right)$$

Furthermore, by replacing the voltage source with internal impedance, one can evaluate Thevenin's equivalent resistance.

As the internal resistance is considered to be very low, we assume it as 0Ω.



ASSESSMENT

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TEXT BOOKS

T1 A. K. Sawhney, “A Course in Electrical & Electronic Measurements & Instrumentation”, Dhanpat Rai & CO., New Delhi, 2022.

T2 S. Gupta and J. John , "Virtual Instrumentation using Lab VIEW", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2010.

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R2 Bouwens A J, “Digital Instrumentation”, Tata Mc Graw Hill, New Delhi2016

R3 Martin U. Reissland, “Electrical Measurement – Fundamental Concepts and Applications”, New Age International (P) Ltd., 2015

R4 J. B. Gupta, “A Course in Electronic and Electrical Measurements and Instrumentation”, S. K. Kataria & Sons, Delhi, 2013

R5 M. S. Anand, “Electronics Instruments and Instrumentation Technology”, Prentice Hall India, NewDelhi, 2012.

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W2 https://www.vssut.ac.in/lecture_notes/lecture1423813026.pdf

W3 https://hombredelamancha.com/products/ebook-electrical-and-electronic-measurements-and-instrumentation?srsltid=AfmBOorTb5k9Ga1rsImj69-l3SximYYra7U8VhGcqYahqsfk9BR9rC7k

THANK YOU!!