UNIT IV

BRIDGES

Introduction:

A bridge circuit in its simplest form consists of a network of four *resistance arms* forming a closed circuit. A source of current is applied to two opposite junctions. The current detector is connected to other two junctions.

The bridge circuits use the comparison measurement methods and operate on null-indication principle. The bridge circuit compares the value of an unknown component with that of an accurately known standard component. Thus *the* accuracy depends on the bridge components and not on the null indicator. Hence high degree of accuracy can be obtained.

Advantages of Bridge Circuit:

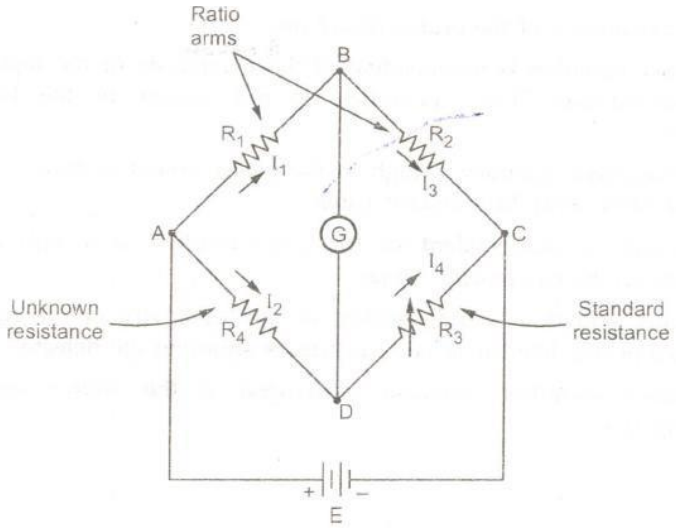
The various advantages of the bridge circuit are,

1) The balance equation is independent of the magnitude of the input voltage or its source impedance. These quantities do not appear in the balance equationexpression.
2) The measurement accuracy is high as the measurement is done by comparing the unknown value with the standardvalue.
3) The accuracy is independent of the characteristics of a null detector and is dependent on the componentvalues.
4) The balance equation is independent of the sensitivity of the null detector, the impedance of the detector or any impedance shunting thedetector.
5) The balance condition remains unchanged if the source and detector areinterchanged.

Wheatstone's bridge:

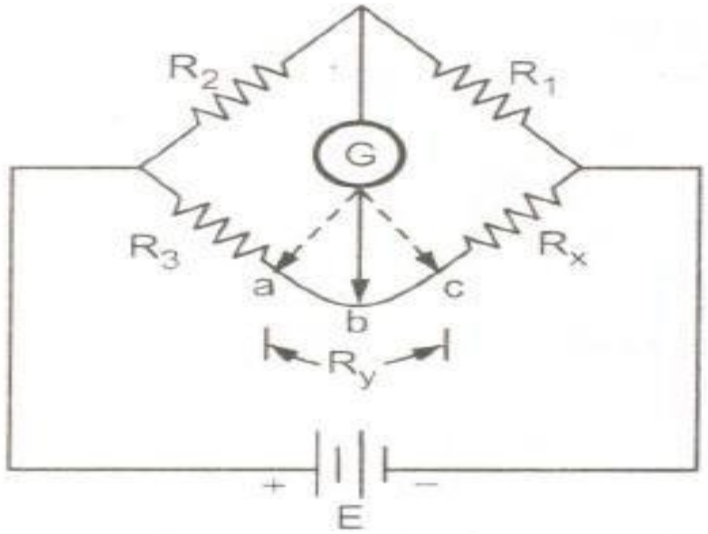
The bridge consists of four resistive arms together with a source of e.m.f. and a null detector. The galvanometer is used as a null detector.

1 www.jntufastupdates.com



The arms consisting the resistances R] and R2 are called ratio arms. The arm consisting the standard known resistance R3 is called standard arm. The resistance R4 is the unknown resistance to be measured. The battery is connected between A and C while galvanometer is connected between Band D.

Kelvin bridge:



In the Wheatstone bridge, the bridge contact and lead resistance causes significant error, while measuring low resistances. Thus for measuring the values of resistance below 1 -n, the modified form of Wh~tstone bridge is used, known as Kelvin bridge. The consideration of the effect of contact and lead resistances is the basic aim of the Kelvin bridge**.**

The resistance Rv represents the resistance of the connecting leads from R., to R,. The resistance Rx is the unknown resistance to be measured.

The galvanometer can be connected to either terminal a, b or terminal c. When it is connected to a, the lead resistance Rygets added to Rx hence the value measured by the bridge, indicates much higher value of Rx.

If the galvanometer is connected to terminal c, then Ry gets added to R3. This results in the measurement of Rx much lower than the actual value.

The point b is in between the points a and c, in such a way that the ratio of the resistance from c to b and that from a to b is equal to the ratio of R] and R2.

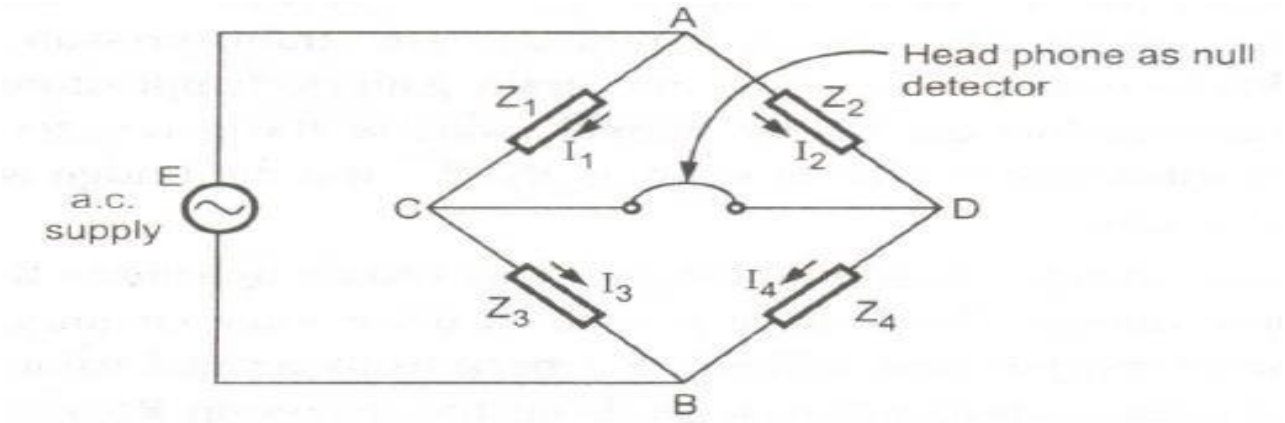
$$\frac{R_{cb}}{R_{ab}} = \frac{R_1}{R_2}$$

AC Bridges:

An a.c. bridge in its basic form consists of four arms, a source of excitation and a balance detector. Each arm consists of an impedance. The source is an a.c. supply which supplies a.c. voltage at the required frequency. For high frequencies, the electronic oscillators are used as the source. The balance detectors commonly used for a.c. bridge are head phones, tunable amplifier circuits or vibration galvanometers. The headphones are used as detectors at the frequencies of 250 Hz to 3 to 4 kHz. While working with single frequency a tuned detector is the most sensitive detector. The vibration galvanometers are useful for low audio frequency range from 5 Hz to 1000 Hz but are commonly used below 200 Hz. Tunable amplifier detectors are used for frequency range of 10 Hz to 100Hz.

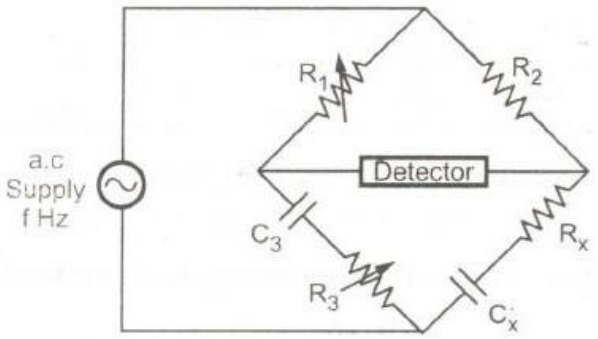
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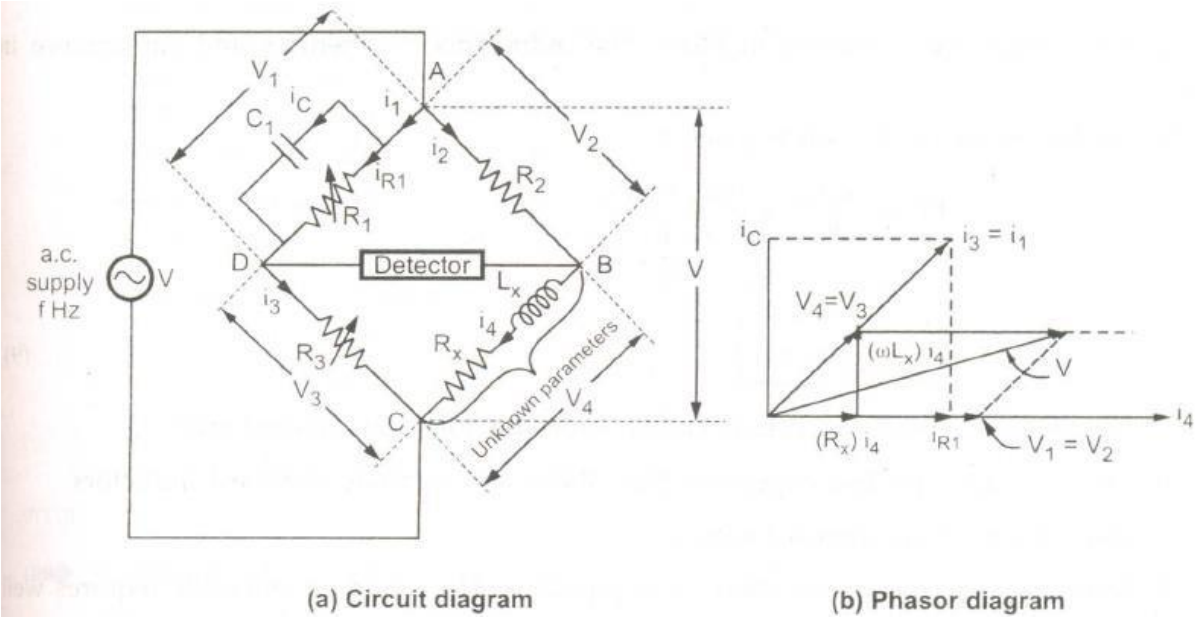
Capacitance Comparison Bridge:

In the capacitance comparison bridge the ratio arms are resistive in nature. The impedance Z 3 consists of the· known standard capacitor C3 in series with the resistance R3. The resistance R3 is variable, used to balance the bridge. The impedance Z4 consists of the unknown capacitor Cx and its small leakage resistanceRx.



Maxwell's Bridge :

Maxwell's bridge can be used to measure inductance by comparison either with a variable standard self inductance or with a standard variable capacitance. These two measurements can be done by using the Maxwell's bridge in two different forms.



(a) Circuit diagram (b) Phasor diagram

Maxwell's inductance capacitance bridge