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 ELECTRONICS & COMMUNICATION ENGINEERING

IIYEAR/ III SEMESTER

19ECT201 Electrical Engineering and Instrumentation

unit 5-MEASUREMENT SYSTEMS

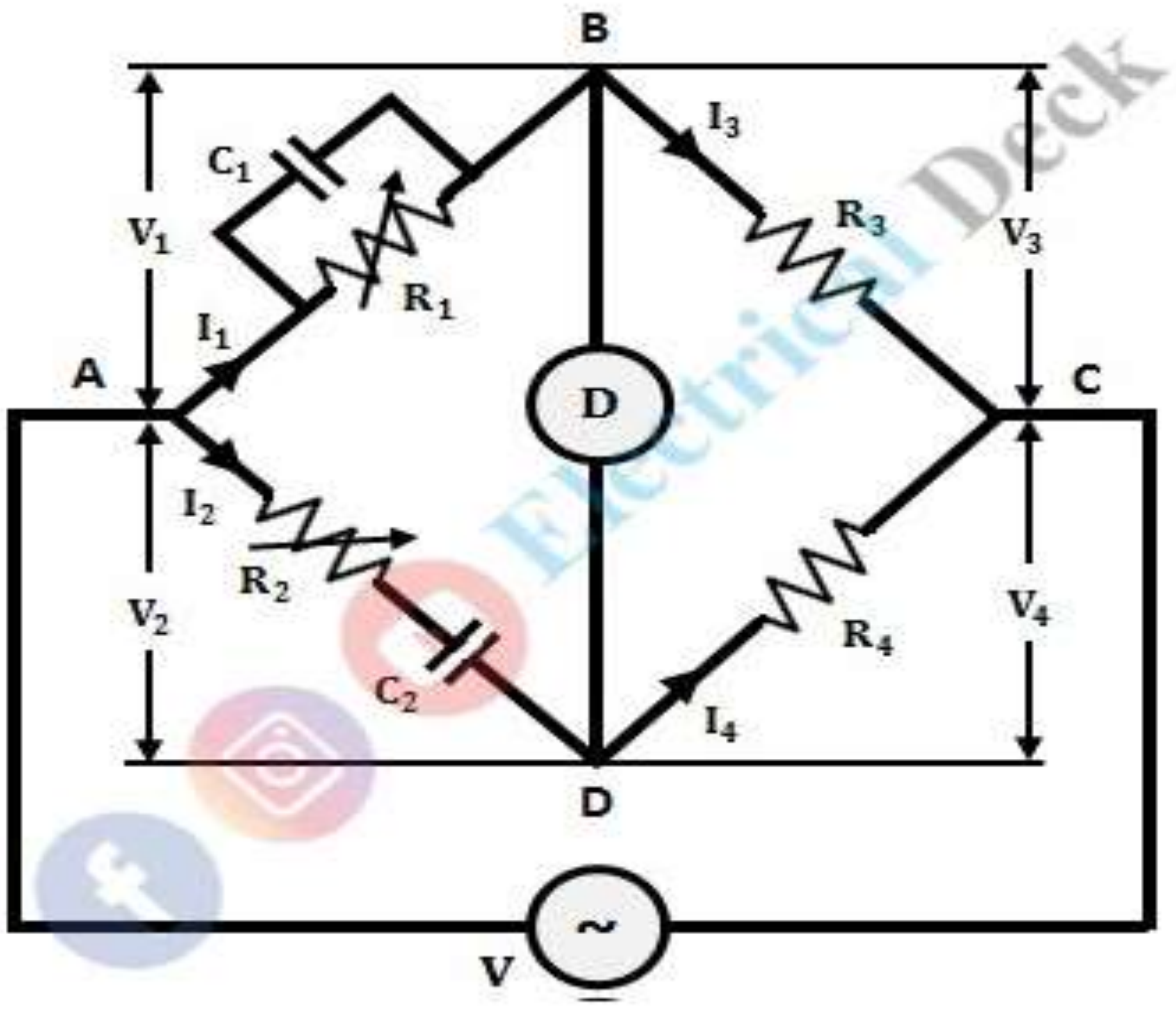
BRIDGES-wein BRIDGE

WIEN BRIDGE

The Wien's bridge is an ac electrical circuit widely used for measuring frequency and can also be used for the measurement of capacitance with high accuracy. The bridge can be used even at high voltages but the circuit is sensitive to frequency. The Wien bridge has a combination of R-C series in one arm and a parallel combination in another arm.

Construction of Wien's Bridge :

The circuit consists of four arms, one arm with a series combination of resistor and capacitor and another with a parallel combination resistor and capacitor. The other two arms consists of a resistance. The below shows the circuit diagram of Wien's bridge.


B
I3
C1
R3
V1
V3
R1
I1
A
D
C
I2
R2
V2
V4
R4
C2
I4
D
~
V

A balance detector or null indicator is connected across two junctions (i.e., across BD as shown above). The indicator shows null deflection when the bridge is balanced i.e. when the junctions B and D will be at the same potential.

Let Z_1, Z_2, Z_3, and Z_4 be the impedances of the arm AB, AD, BC, and CD respectively and given as,

$$Z_1 = \frac{R_1}{1 + j\omega C_1 R_1}$$

$$Z_2 = R_2 - \frac{1}{j\omega C_2}$$

$$Z_3 = R_3$$

$$Z_4 = R_4$$

When the bridge is balanced, we have,

$$Z_1 Z_4 = Z_2 Z_3$$

$$\left(\frac{R_1}{1 + j\omega C_1 R_1}\right) \times R_4 = \left(R_2 - \frac{1}{j\omega C_2}\right) \times R_3$$

$$\frac{R_4}{R_3} = \left(\frac{1 + j\omega C_2 R_2}{j\omega C_2}\right)\left(\frac{1 + j\omega C_1 R_1}{R_1}\right)$$

$$\frac{R_4}{R_3} = \frac{1}{j\omega C_2 R_1} + \frac{C_1}{C_2} + \frac{R_2}{R_1} + j\omega C_2 R_2$$

Equating the real terms, we get,

$$\frac{R_4}{R_3} = \frac{C_1}{C_2} + \frac{R_2}{R_1}$$

The above equation is used to determine the resistance ratio (R_4/R_3).

Now equating the imaginary terms,

$$\frac{1}{j\omega C_2 R_1} + j\omega C_2 R_2 = 0$$

$$-\omega C_2 R_1 + \omega C_2 R_2 = 0$$

$$\omega = \frac{1}{\sqrt{R_1 R_2 C_1 C_2}}$$

$$2\pi f = \frac{1}{\sqrt{R_1 R_2 C_1 C_2}}$$

$$f = \frac{1}{2\pi\sqrt{R_1 R_2 C_1 C_2}}$$

If suppose the bridge components are chosen such that $R_1 = R_2 = R$ and $C_1 = C_2 = C$. Then the above equation is given as,

$$f = \frac{1}{2\pi RC} Hz$$

ADVANTAGES

The Wien’s bridge has several advantages, some of which are listed below:

Simple Circuitry: Wien’s bridge is formed using easily available electronic components namely resistors and capacitors.

Cost-effective: Since all the components used to design Wien’s bridge are inexpensive, the cost of creating the circuit is meager for the manufacturers.

Quantitative measurements: Wien’s bridge has the capability to measure the frequency and capacitance of the circuit with high accuracy.

Disadvantages of the Wien’s Bridge

There are also some disadvantages of Wien’s Bridge:

Limited Frequency Generation: As Wien’s bridge is very sensitive to large frequency values and the circuit may get destructed at high-frequency values, hence the frequency generated by the bridge is limited between 100 Hz and 100 kHz.

High Output distortion: Due to the susceptibility of the Wien’s bridge circuit to large frequency values, the resultant output signal is highly distorted.

Not Purely Sinusoidal AC Input Voltage: Due to the presence of harmonic distortions at the input AC voltage source, the balance condition of the bridge is disrupted.

Applications of the Wien’s Bridge

The following are some applications of Wien’s bridge circuit:

Wien’s bridge is used for the purpose of measuring the frequency of the input voltage and capacitance of the circuit.

It is used for analyzing distortion due to harmonic disturbances.

Wien’s bridge also finds its application as a high-frequency oscillator.

It is also used for estimating the frequency values in audio and radio oscillators.