

Experiment: 2.1

Measurement Of Three Phase Power

Aim of the experiment:

Three phase power measurement by two wattmeter method.

Theory:

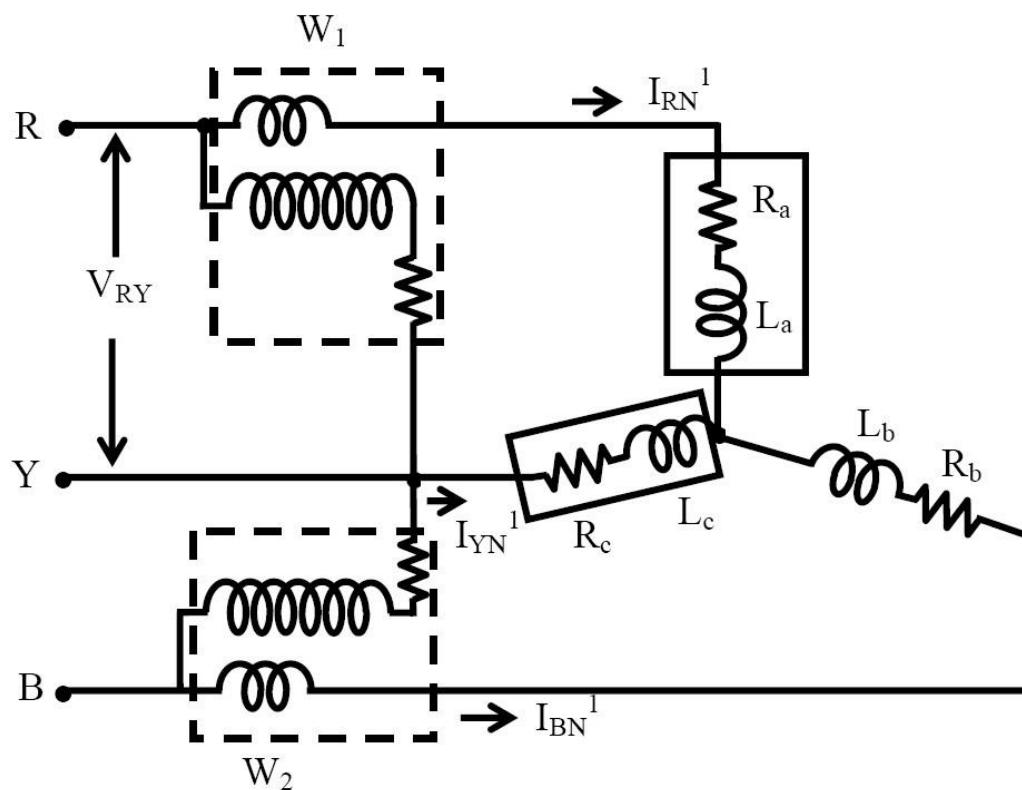


Fig 1: Connection diagram for three phase power measurement using two wattmeter method

The connection diagram for the measurement of power in three phase power measurement circuit using two wattmeter's method is shown in figure 1. This is irrespective of the circuit connection star or delta. The circuit may be taken as balanced or unbalanced one, balanced type

being only a special case. Please note the connection of two wattmeter's. The current coil of the wattmeter's 1 and 2 in series with R and B phase with the pressure voltage coils being connected across R-Y and B-Y respectively. Y is the third phase in which no current coil is connected.

If star connected circuit is taken as an example the total instantaneous power consumed in the circuit is,

Each of the terms in the above expression equation (1) is the instantaneous power consumed by the phases. From the connection diagram, the circuit in and the voltages across the respective (current, pressure or voltage) coils in the wattmeter, W_1 are I_{RN} and.

So, the instantaneous power measured by the wattmeter W_1 is.

Similarly the instantaneous power measured by the wattmeter W_2 is .

Some of the two readings as given above is,

Equation (1) is compared with equation (3) to give the total instantaneous power consumed in the circuit . They are found to be same. The phasor diagram of three phase balanced star connected circuit is shown in figure 2.

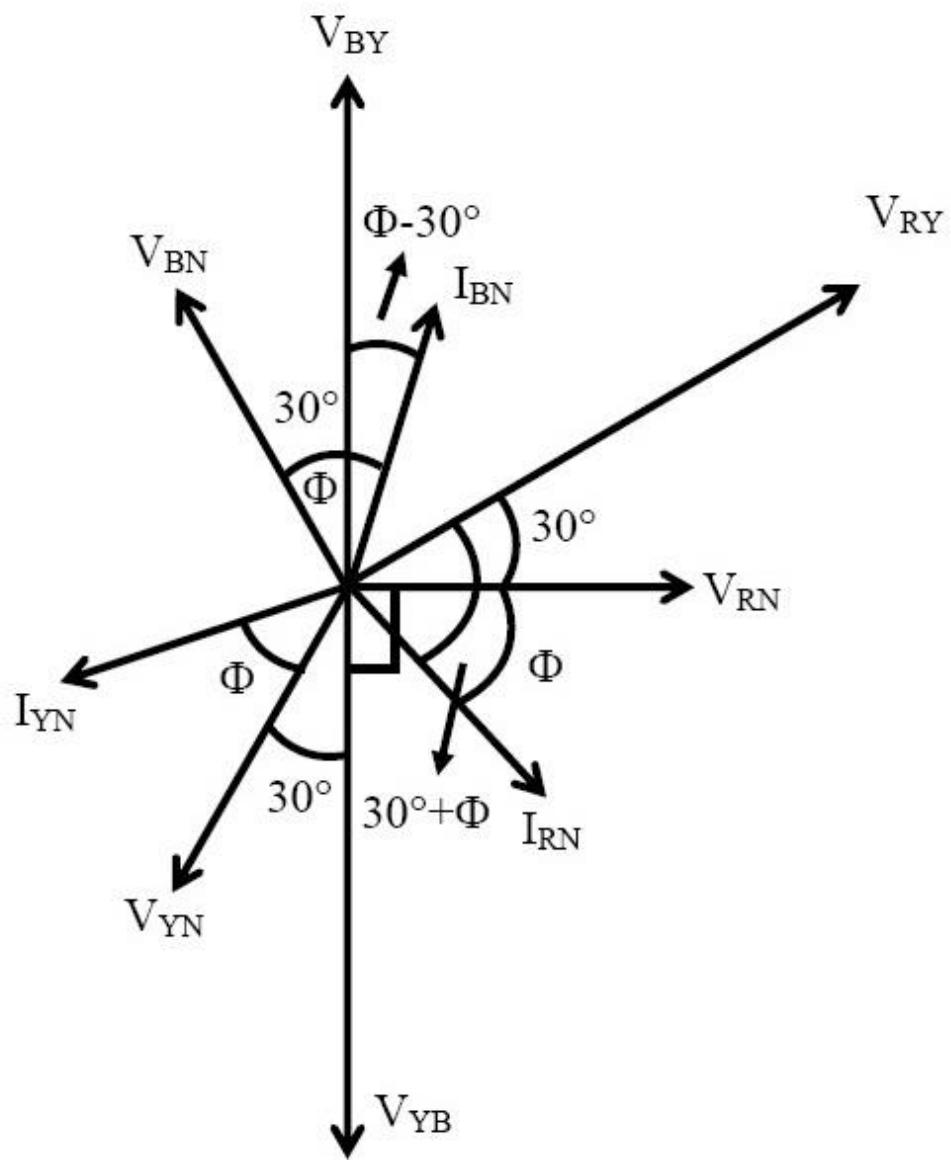


Fig 2: Phasor diagram of three phase balanced star connected circuit

Procedure:

BALANCED LOAD:

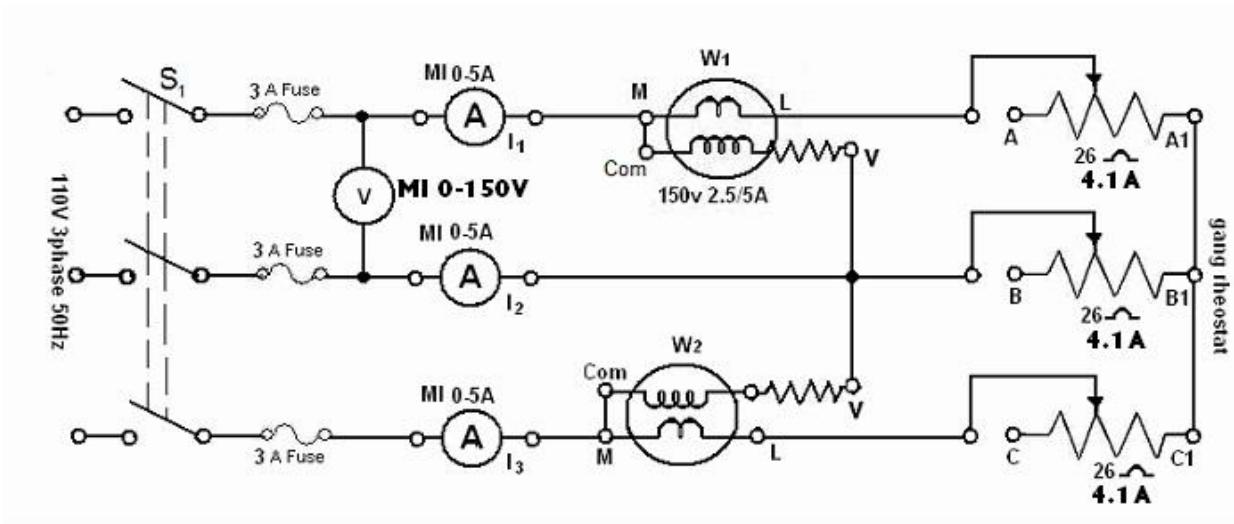


Fig. 1. Three phase power measurement circuit under balance condition

1. Connect the circuit as shown in Fig. 1.
2. Adjust the ganged rheostat for the maximum resistance.
3. Switch on the supply.
4. Close switch S_1 .
5. Read the meters to obtain V_L , I_1 , I_2 and I_3 . Note the wattmeter reading W_1 and W_2 (Note the multiplying factor on the wattmeter).
6. Vary the load resistance and obtain at least five sets of observations, the current should not exceed the limit (4.1 A).

UNBALANCED LOAD:

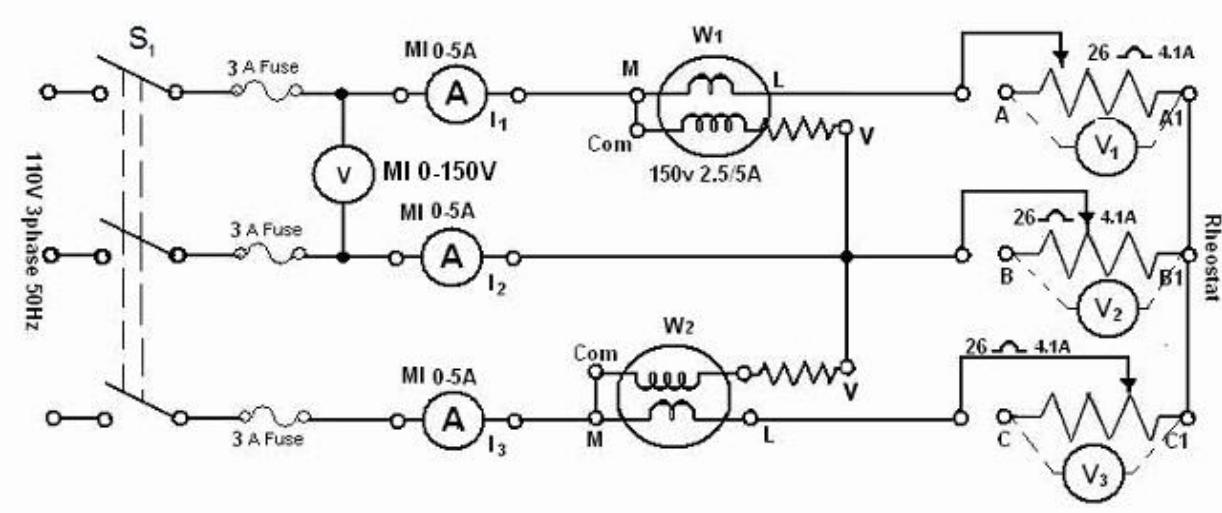
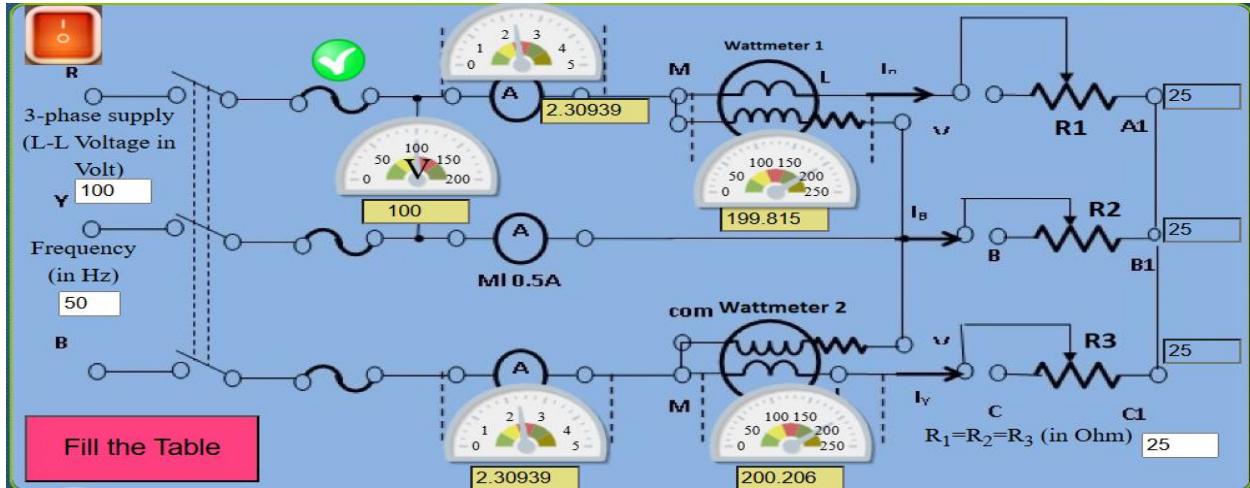


Fig. 2. Three phase power measurement circuit under unbalance condition

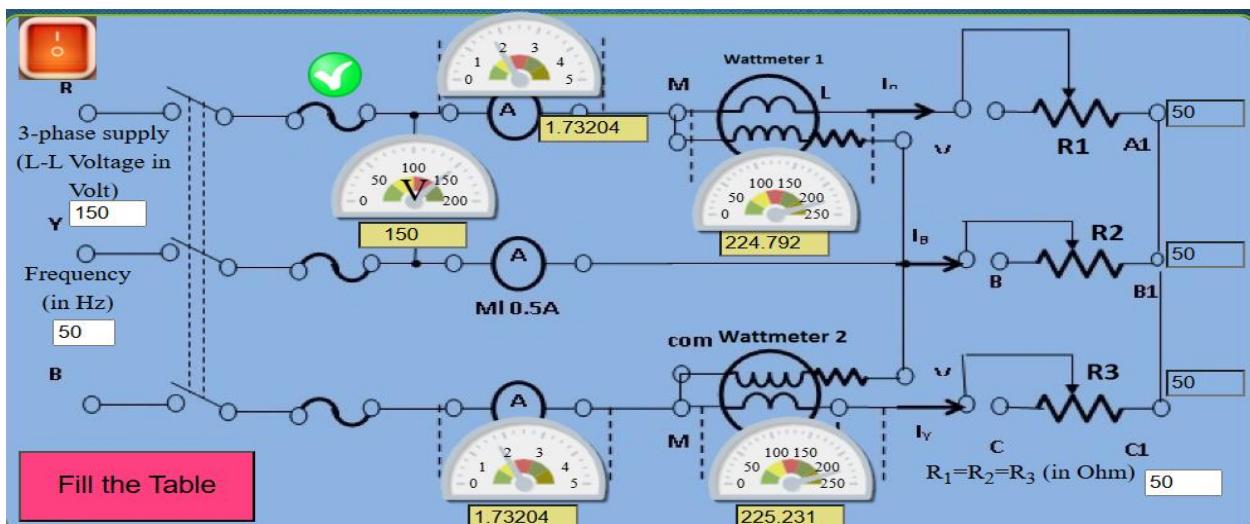
- Connect the circuit as shown in Fig. 2.
- Replace the ganged rheostat by three separate rheostats of 26Ω , 4.1 A and connect in a star.
- Adjust the three rheostats at the maximum values.
- Switch on the supply and set the autotransformer to 110 V.
- Close switch S_1 and take five sets of observation for different rheostat settings such that the reading of I_1 , I_2 and I_3 in each set is appreciably different to create unbalanced loading condition. The current should not exceed the limits in each arm.

Simulation:

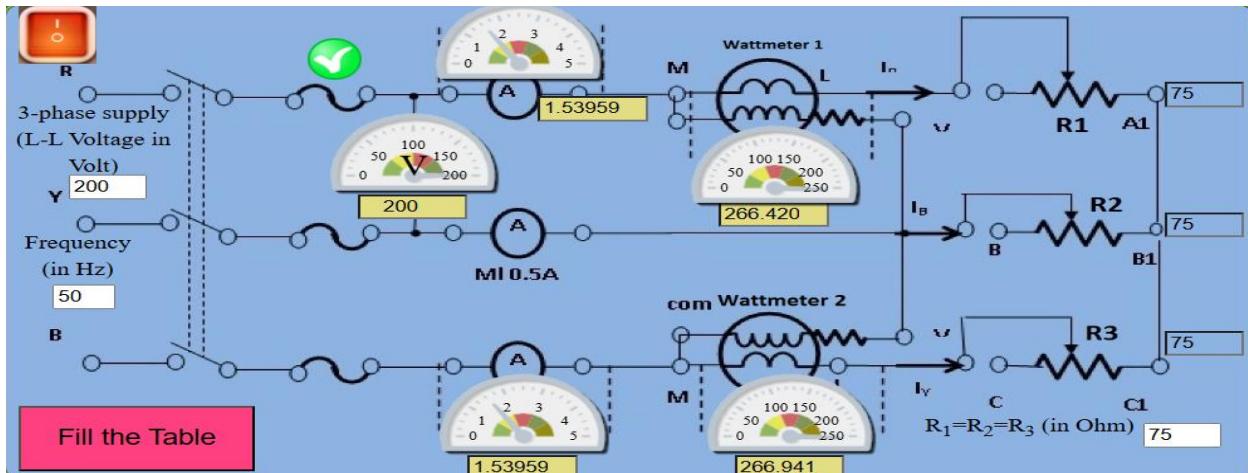
Balanced load (1):



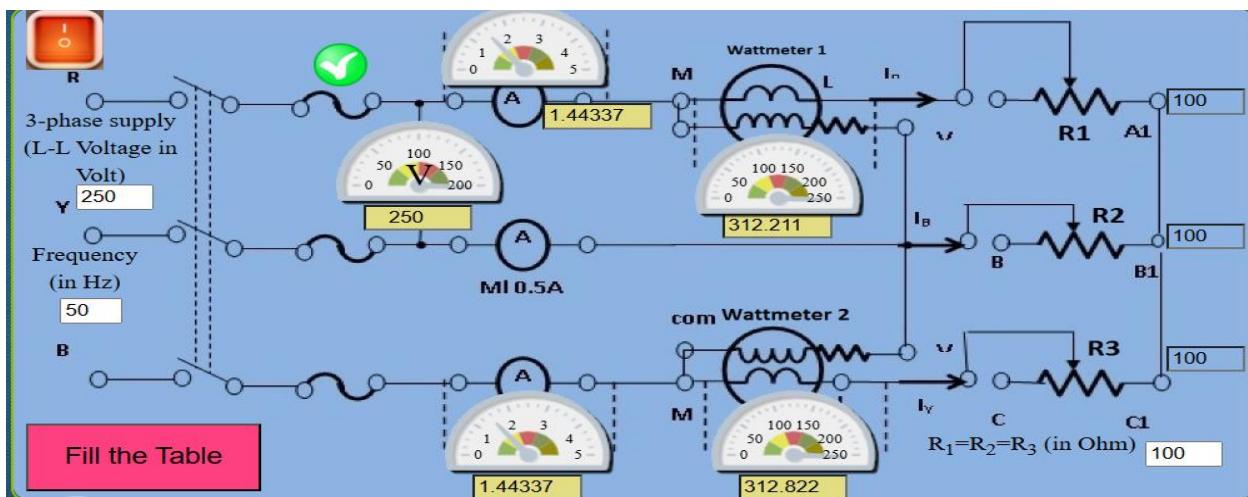
Balanced load (2):



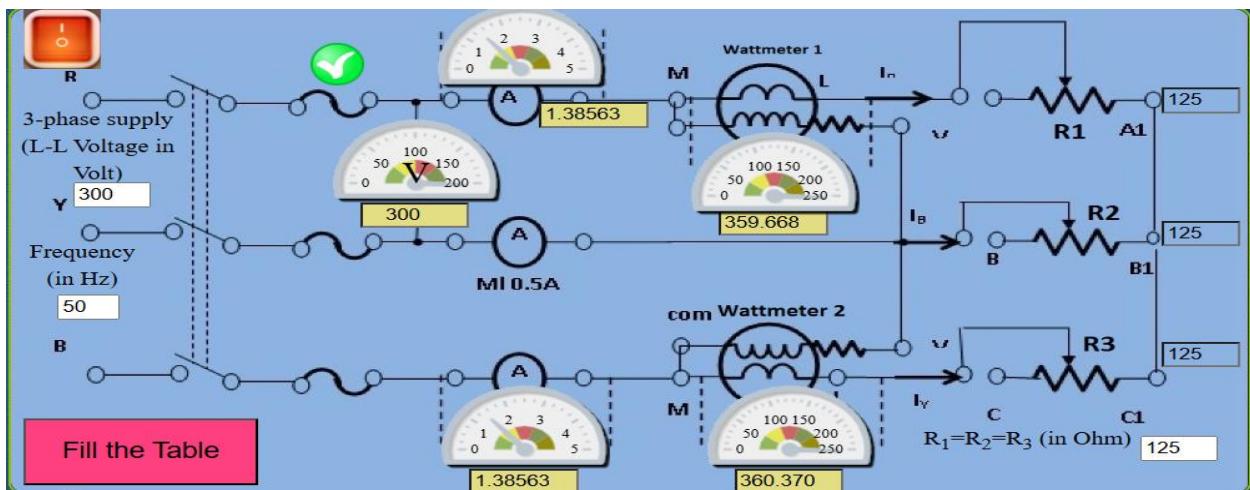
Balanced load (3):



Balanced load (4):



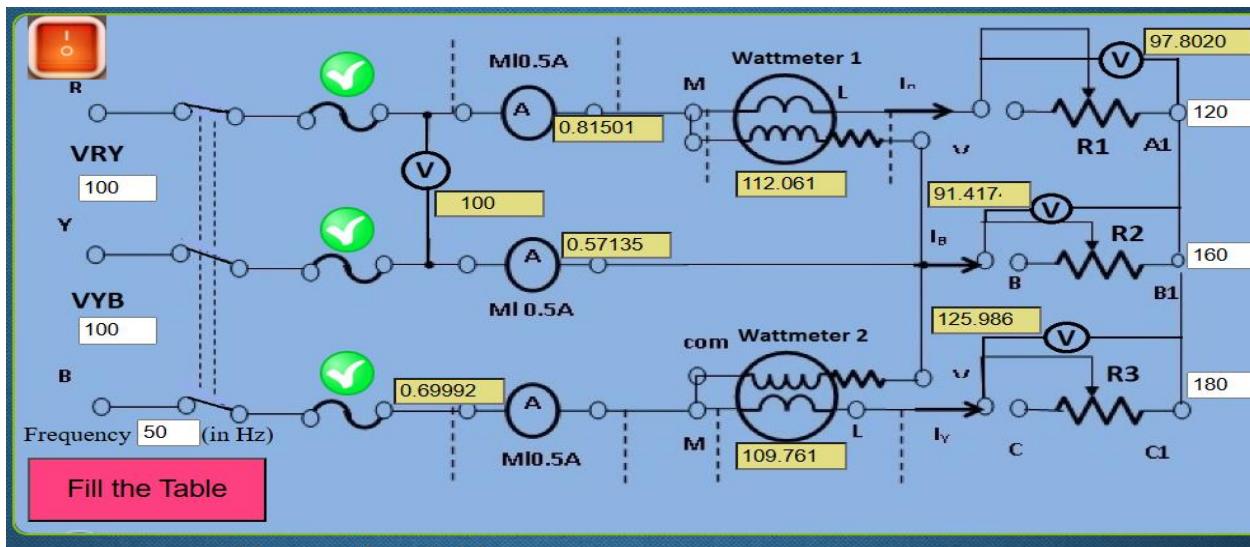
Balanced load (5):



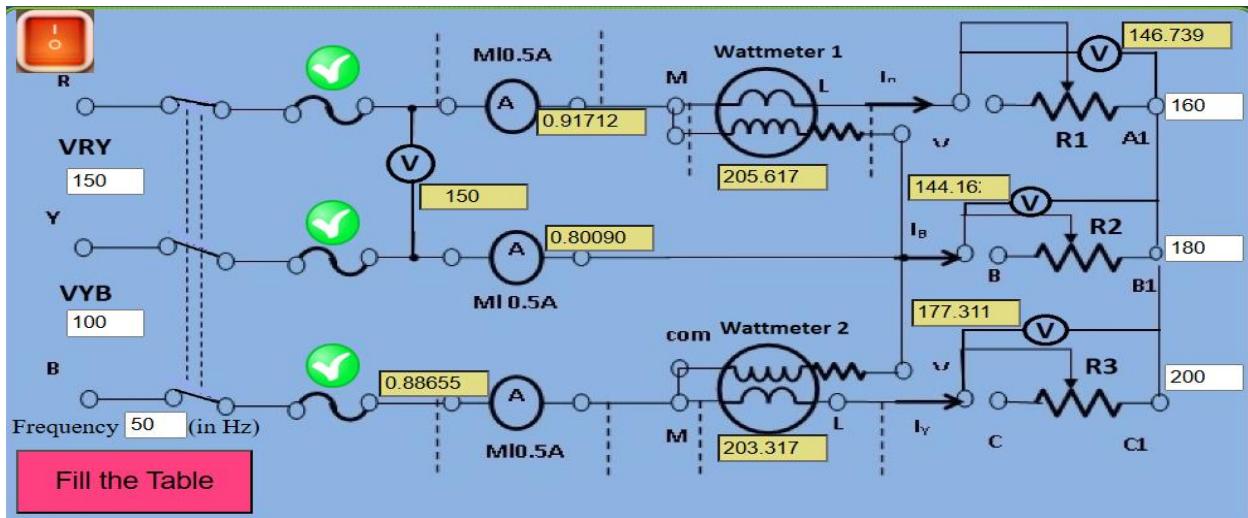
Observation Table

Serial no. of Observation	V_{RY}	I_R (Amp)	$\cos(V_{RY}, I_R)$	V_{BY}	I_B (Amp)	$\cos(V_{BY}, I_B)$	I_3 (Amp)	W_1	W_2	W_C (Calculated power)	W_M (Measured Power = $W_1 + W_2$)
1st	100	2.3093977	0.865228C	100	2.3093977	0.866919C	2.3093977	199.81557	200.2060E	399.99885	400.02166
2nd	150	1.7320483	0.865228C	150	1.7320483	0.866919C	1.7320483	224.79251	225.2318E	449.99871	450.02437
3rd	200	1.5395985	0.865228C	200	1.539598E	0.866919C	1.539598E	266.42076	266.9414E	533.3318C	533.36222
4th	250	1.4433736	0.865228C	250	1.4433736	0.866919C	1.4433736	312.21182	312.82202	624.99821	625.03385
5th	300	1.385638E	0.865228C	300	1.385638E	0.866919C	1.385638E	359.66802	360.3709E	719.99794	720.0389E

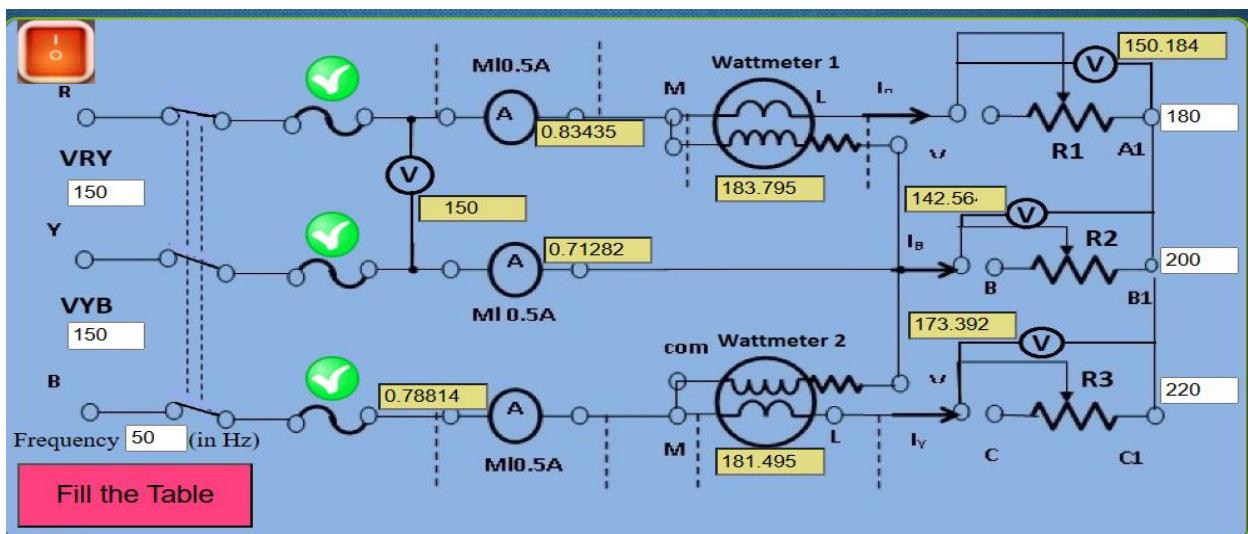
Unbalanced load (1):



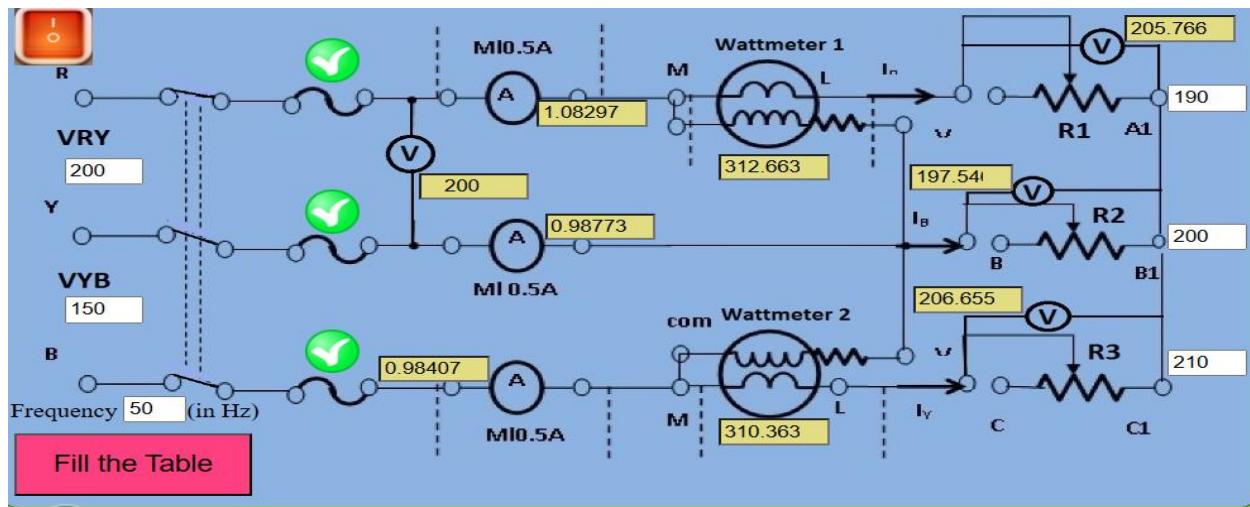
Unbalanced load (2):



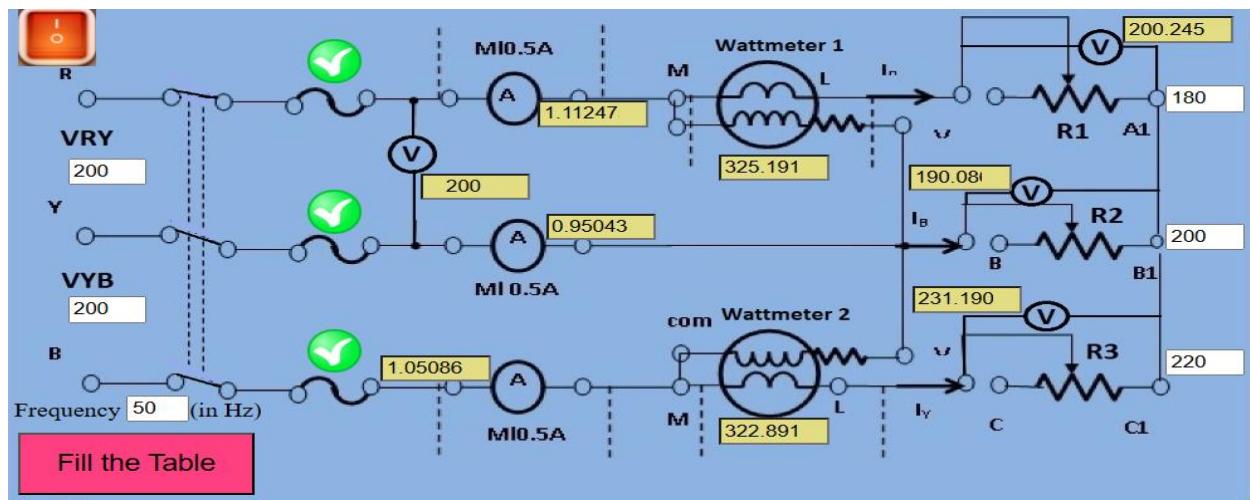
Unbalanced load (3):



Unbalanced load (4):



Unbalanced load (5):



Observation Table

Serial no. of Observation	V _R	V _y	V _b	I _R (Amp)	I _y (Amp)	I _B (Amp)	W _C (Calculated power)	W ₁	W ₂	W _M (Measured Power=W ₁ +W ₂)
1st	97.802081	91.417450	125.98662	0.8150173	0.5713590	0.6999256	220.1238E	112.06192	109.76192	221.8238E
2nd	146.73944	144.16244	177.31173	0.9171215	0.8009024	0.886558E	407.23521	205.61760	203.31760	408.93521
3rd	150.18414	142.56498	173.3929E	0.8343563	0.712824E	0.788149E	363.59062	183.79531	181.49531	365.29062
4th	205.76611	197.54647	206.65522	1.0829795	0.9877323	0.9840724	621.3272E	312.66363	310.36363	623.0272E
5th	200.24552	190.08666	231.19062	1.1124751	0.9504333	1.0508664	646.3833E	325.19166	322.89166	648.0833E

Result:

Thus, the power of instrument is simulated and calibrated