# 3rd Semester EE and EEE Network Devices laboratory Manual

Under BPUT Odisha

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## AIM OF THE EXPERIMENT:-Verification of Maximum Power Transfer Theorem

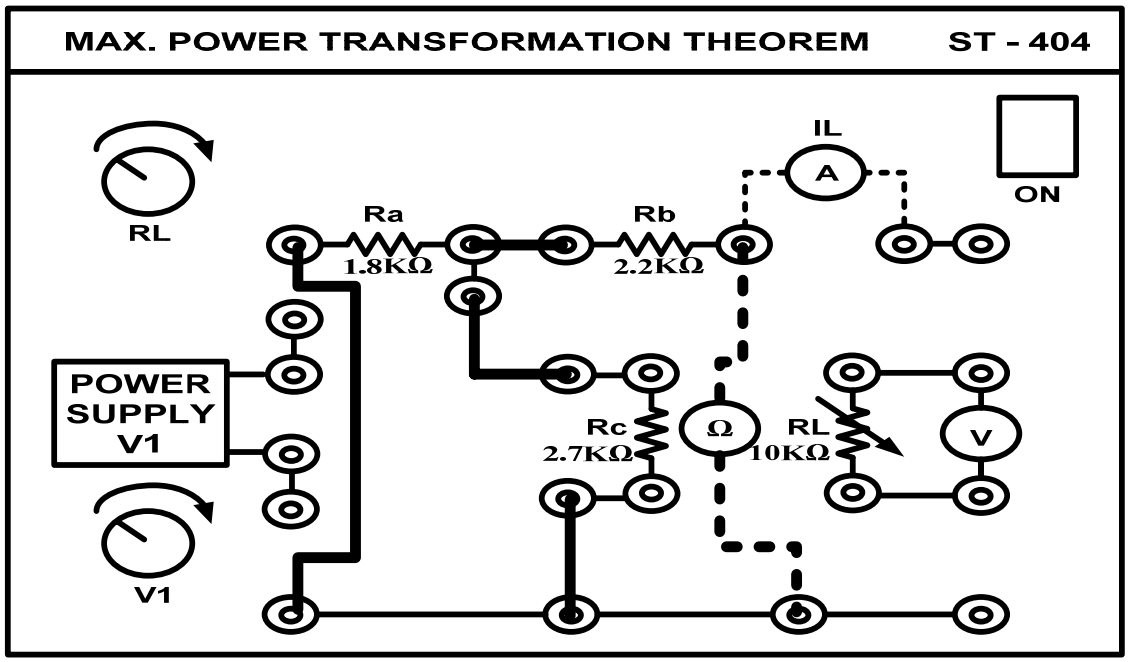
**APPARATUS REQUIRED:-**

| Sl No. | Name of the apparatus | Specifications | Type | Quantities |
|---|---|---|---|---|
| 1 | Ammeter | (0-2)A | MI | 1 |
| 2 | Voltmeter | (0-300)V | MI | 2 |
| 3 | Rheostat | 100Ω,5A | single tude | 1 |
| 4 | Rheostat | 125Ω,5A | single tude | 1 |
| 5 | Connecting wire | $1.5mm^2$ | - | As per required |

**THEORY:-**

In a linear, active, bilateral network, the Maximum Power is transferred from source to load when the load resistance is equal to the internal resistance of the source. Such as, $R_L = R_s$ where $R_L$ = Load resistance and $R_s$=Source resistance

**CIRCUIT DIAGRAM:-**




**PROCEDURE:-**

- Let us connect the circuit as per circuit diagram.
- Let us keep the variable point of rheostat, $R_L$ is maximum position
- Let us vary the $R_L$ and note the voltmeter & ammeter reading till $R_L$ reaches as low value

❖ Let us calculate the power at various value of $R_L$ (i.e. $p=I^2 R_L$) & see that at $R_{s=} R_L$ then the power will be maximum.

**OBSERVATION TABLE:-**

| Sl No. | $V_S$ | $V_L$ | I | $R_S= V_S/I$ | $R_L =V_L/I$ | $P=I^2 R_L$ |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |

**CALCULATION:-**

**PRECAUTION:-**

- ❖ All connections should be tight.
- ❖ The connection of rheostat terminal should be made carefully & correctly.
- ❖ Don't touch any bare part of circuit.
- ❖ Take the reading carefully& properly.

**CONCLUSION:-**

From the above experiment I concluded that Maximum Power can be transferred from source to load when $R_L = Rs$.

**DISCUSSION QUESTIONS:-**

## AIM OF THE EXPERIMENT:- Verification of Norton's Theorem

**APPARATUS REQUIRED:-**

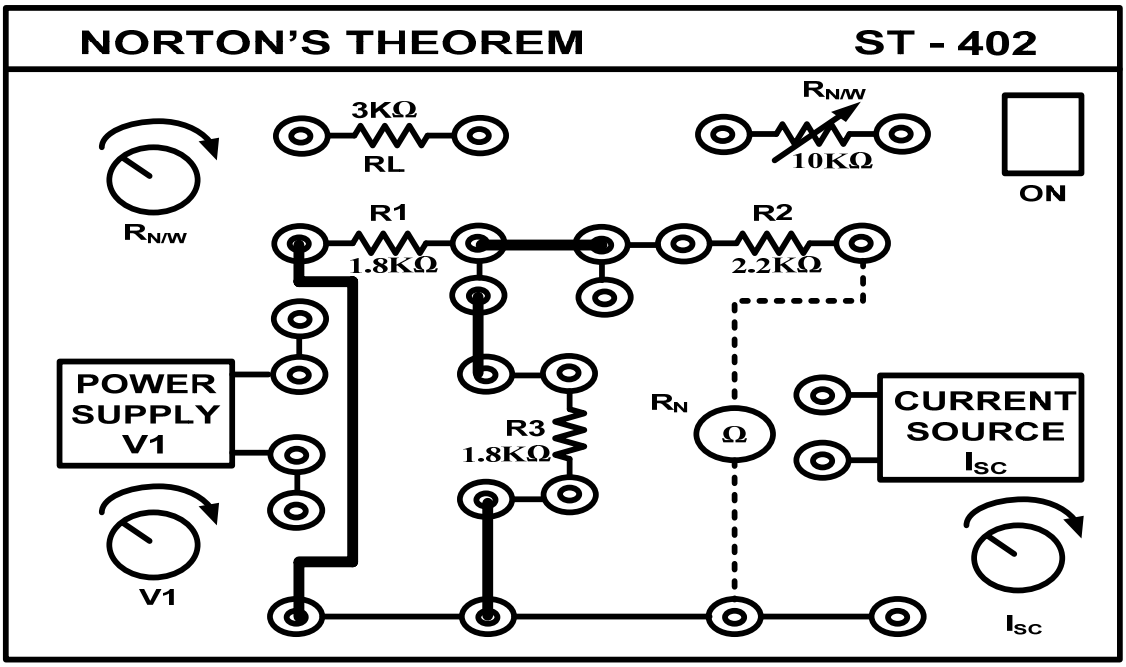
| Sl No. | Name of the apparatus | Specifications | Type | Quantities |
|---|---|---|---|---|
| 1 | Ammeter | (0-5)A | MI | 1 |
| 2 | Voltmeter | (0-300)V | MI | 2 |
| 3 | Rheostat | 125Ω,5A | Single tube | 3 |
| 4 | Connecting wire | $1.5mm^2$ | _ | As per required |

**THEORY:-**The theorem states that the linear bilateral network containing at least one source the current in any branch can be found out by considering the Norton's equivalent ckt which is the parallel combination of short ckt current & Norton's resistance.

$$I_L = I_{SC} \times \{R_N/( R_N+R_L)\}$$

Where $I_L$=Load current, $I_{SC}$=Short circuit current, $R_N$=Norton's resistance and $R_L$=Load resistance

**CIRCUIT DIAGRAM:-**




**PROCEDURE:-**

- Let us connect the ckt as per ckt diagram.
- Let us supply to the given network & take the reading of voltmeter& ammeter
- Let us in similar ways for $R_{TH}$& $I_{SC}$ reading by using the circuit diagram

**OBSERVATION TABLE:-**

| Sl.No | V | $V_L$ | $I_l$ | $R_L= V_L/I_L$ | $I_{SC}$ | $R_N=V/I$ |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |

**CALCULATION:-**

**PRECAUTION:-**

- All connection should be tight
- Don't touch any bare part of circuit
- Take the reading carefully& properly

**CONCLUSION**:- From the above experiment I concluded that Norton's theorem is the equivalent ckt which is the parallel combination of short ckt current & Norton's resistance.

**DISCUSSION QUESTIONS**

## AIM OF THE EXPERIMENT:- Verification of Thevenin's Theorem

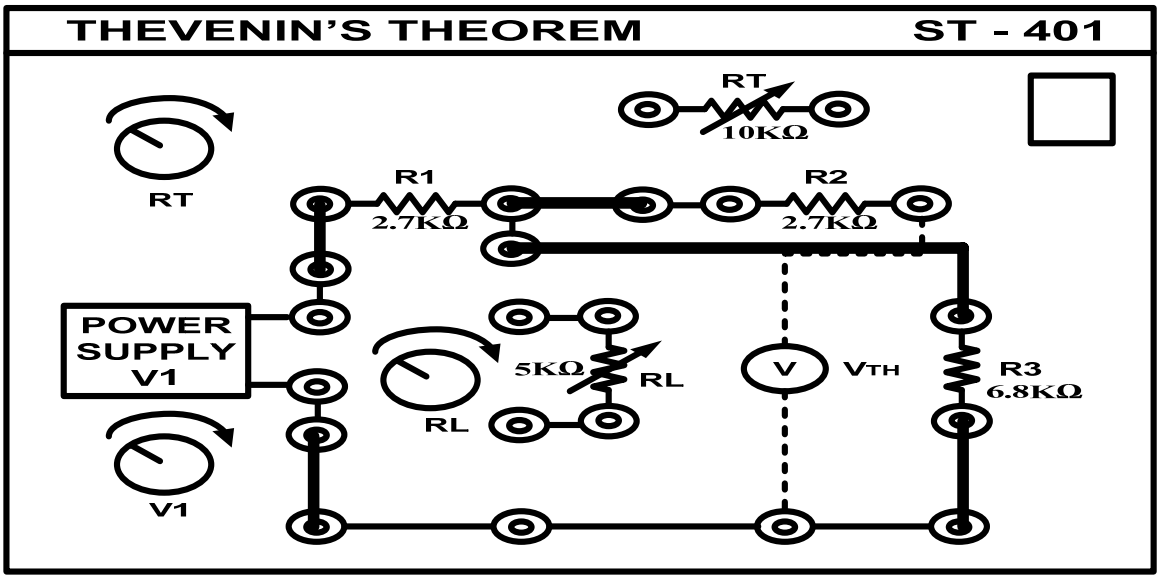
## APPARATUS REQUIRED:-

| Sl.No | Name of the apparatus | Specification | Type | Quantities |
|---|---|---|---|---|
| 1 | Ammeter | (0-5)AMP | M.I | 1 |
| 2 | Voltmeter | (0-300)V | M.I | 2 |
| 3 | Rheostat | 125Ω,5A | Single tube | 4 |
| 4 | Connecting wire | $1.5mm^2$ | $1.5mm^2$ | As per required |

## THEORY:-

In a linear active bilateral network the load current is given by $I_L = V_{TH}/(R_{TH}+R_L)$ when $V_{TH}$=the venin's voltage=open circuit voltage across the load terminals when $R_L$ is removed, $R_{TH}$=equivalent resistance between the open circuit terminal AB looking sources by their internal impedance.

## CIRCUIT DIAGRAM:-




## PROCEDURE:-

- Let us connect the ckt as per ckt diagram.
- Let us supply to the given network & take the reading of voltmeter& ammeter
- Let us in similar ways for $R_{TH}$& $V_{TH}$ reading by using the circuit diagram

## OBSERVATION TABLE:-

| Sl.No | $V_L$ | $I_l$ | $V_{TH}$ | V | I |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |

**CALCULATION:-**

**PRECAUTION:-**

- All connection should be tight
- Don't touch any bare part of circuit
- Take the reading carefully& properly

**CONCLUSION:-**

From the above experiment I concluded that the Thevenin's theorem is equivalent resistance between the open circuit terminal AB looking sources by their internal impedance.

**DISCUSSION QUESTIONS:-**

## AIM OF THE EXPERIMENT:- Verification of Superposition's theorem.

## APPARATUS REQUIRED:-

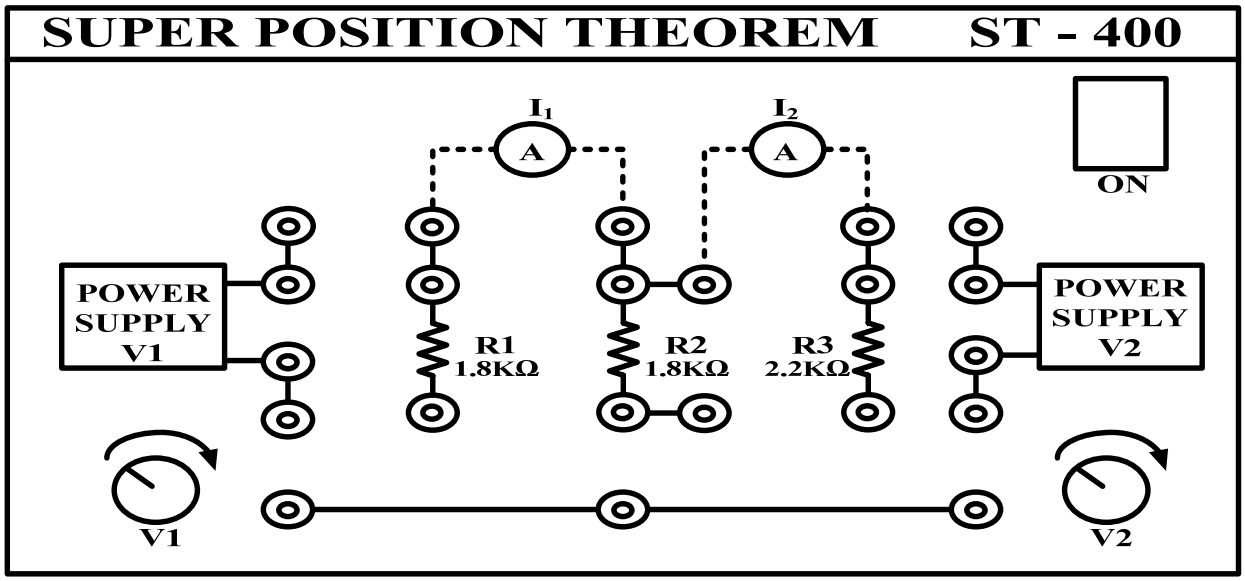
| Sl.No | Name of the apparatus | specification | Type | Quantity |
|---|---|---|---|---|
| 1 | Ammeter | (0-5)A | M.I | 1 |
| 2 | Voltmeter | (0-300)V | M.I | 2 |
| 3 | Rheostat | 125Ω,5A | Single tube | 3 |
| 4 | Connecting wire | $1.5mm^2$ | - | As per required |

**THEORY:-**

In a linear active bilateral network containing more than one energy source, the current in any branch is equal to the sum of individual current considering one energy at a time where all other energy sources replaced by their internal impedances.

So, $I=I_1+I_2$

**CIRCUIT DIAGRAM:-**




**PROCEDURE:-**

- Let us connect the ckt as per ckt diagram.
- Let us supply to the given network & take the reading of voltmeter& ammeter.
- Let us one voltage source should be short circuited & other voltage source should be connected to the network & ammeter reading should be taken.

**OBSERVATION TABLE:-**

| Sl.No | $V_1$ | $V_2$ | I | $I_1$ | $I_2$ |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |

**CALCULATION:-**

**PRECAUTION:-**

- All connection should be tight.
- Don't touch any bare part of circuit.
- Take the reading carefully& properly.

**CONCLUSION:-**

From the above experiment I concluded that the Superposition theorem suggests the current in any branch is equal to the sum of individual current considering one energy at a time where all other energy sources replaced by their internal impedances.

**DISCUSSION QUESTIONS:-**

**AIM OF THE EXPERIMENT:-**

Determination of self inductance, mutual inductance &co-efficient of coupling of a single phase transformer representing a couple circuit.

**APPARATUS REQUIRED:-**

| Sl No | Name of the apparatus | Specification | Type | Quantity |
|---|---|---|---|---|
| 1. | Variac | (0-260)V,10A | AC and Induction | 1 |
| 2. | Ammeter | (0-1)A | M.I | 1 |
| 3. | Voltmeter | (0-300)V | M.I | 1 |
| 4. | 1-φ transformer | 3KVA,230/115V | AC and Induction | 1 |
| 5. | Connecting wire | $1.5mm^2$ | - | As per required |

**THEORY:-**

The interconnected loops of an electric network through magnetic fields is called coupled ckt

**Self inductance:-**When the current changes in a circuit, the magnetic flux linking the same ckt changes & an emf is induced in the ckt. This induced emf is proportional to the rate of change of current i.e. $V=L(di/dt)$

Where, V=Induced voltage, di/dt=rate of change of current,
L=Constant of proportionality called self inductance.

**Mutual inductance:-**Let two coils carry currents $i_1$&$i_2$ .Each coil will have leakage flux ($\varphi_1$ & $\varphi_2$)as well as mutual flux ($\varphi_{12}$& $\varphi_{21}$)where the flux of the coil-2 links coil-1or flux of a coil-1 links coil-2. The induced voltage of coil -2 is given by $V_{L2}=N_2(do/dt)$.

Again since $\varphi_{12}$ is related to the current of coil & the induced voltage is proportional to the rate of change of current i.

$$V_{L2}=m(di/dt).$$

where, m= constant of proportionality formed as mutual inductance between the two coils.

Again, $m(di/dt)=N_2(d\varphi_{12}/d_{11})$

$m= N_2(d\varphi_{12}/d_{11})$

$m= N_1(d\varphi_{21}/d_{12})$

**Co-efficient of coupling:-** It is defined as the fraction of total flux that links the coil.

i.e. K= Co-efficient of coupling $= \varphi_{12}/ \varphi_1= \varphi_{21}/\varphi_2$

$m=K \sqrt{L_1L_2}$

$K=m/\sqrt{L_1L_2}$.

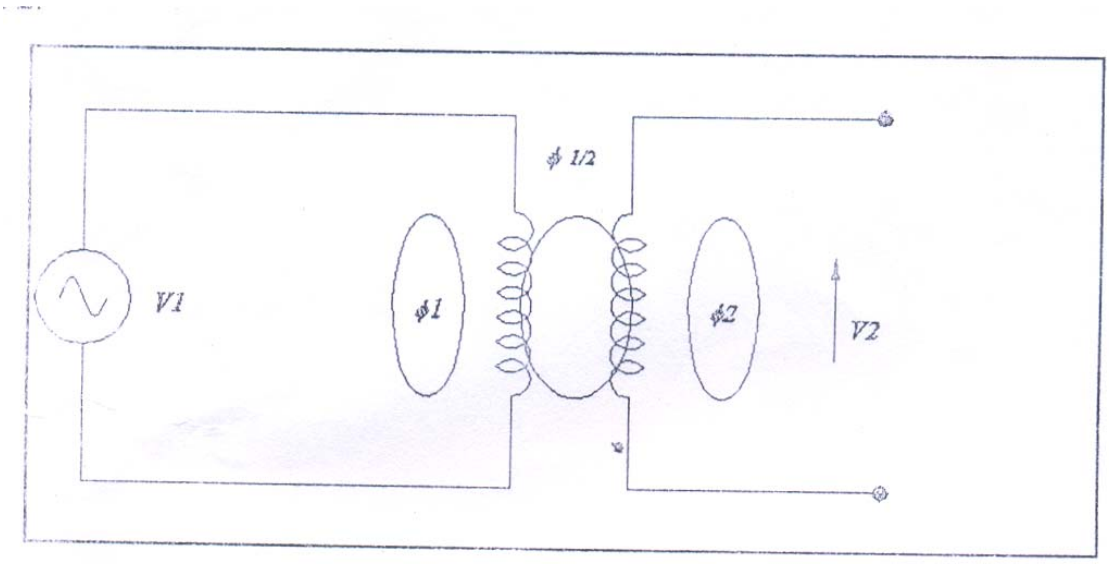
**Series connection of coupled coils:-** In case of series connection where the flux of both the coils mutually assist each other the total inductance

$$L_{eq}=L_1+L_2+2m$$

However where the coil are still series connected but the flux both the coil oppose each other the total inductance is

$$L_{eq}=L_1+L_2-2m$$

**CIRCUIT DIAGRAM:-**




**PROCEDURE:-**

- Let us connect the circuit as per circuit diagram.
- Let us give the supply & take the ammeter & voltmeter readings. calculate $L_1$&$L_2$.
- Let us the short circuiting the primary & secondary of the transformer (+,+) it sell be subtractive polarity.
- Let us the short circuiting the reverse end of the transformer of primary & secondary (+,-) it sell be additive polarity.

**OBSERVATION TABLE:-**

**For self inductance:-**

| Sl.No | Voltmeter reading in (Volt) | Ammeter reading in (Amp) |
|---|---|---|
| 1 | | |
| 2 | | |

**For additive method:-**

| Sl.No | Voltmeter reading in (Volt) | Ammeter reading in (Amp) |
|---|---|---|

| | | |
|---|---|---|
| 1 | | |

**For subtractive method:-**

| Sl.No | Voltmeter reading in (Volt) | Ammeter reading in (Amp) |
|---|---|---|
| 1 | | |

**CALCULATION:-**

**PRECAUTION:-**

- All connection should be tight
- Don't touch any bare part of circuit
- Take the reading carefully& properly

**CONCLUSION:-**

From the above experiment I concluded that the co-efficient of coupling is less than one which is found out self inductance & mutual inductance.

**DISCUSSION QUESTIONS:-**