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Practical Manual

Lab: Basic Electrical Engineering (ESC-EE-102)

1st yr (CSE/EE/ME/CV/ECE)

Designed by

Department of ECE & EE

RAO PAHALD SINGH COLLEGE OF ENGINEERING & TECHNOLOGY

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List of Experiments

1. Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Practical resistors, capacitors and inductors.
2. To verify KCL and KVL.
3. To verify Thevenin's and Norton theorems.
4. To verify Maximum power transfer and Superposition theorems.
5. To perform direct load test of a transformer and plot efficiency Vs load characteristic.
6. To perform O.C. and S.C. tests of a transformer.
7. Measurement of power in a 3-phase system by two wattmeter method.
8. Measurement of power by 3 voltmeter/3 Ammeter method.
9. Measuring the response of R-L, R-C, and R-L-C circuits to a step change in voltage. Sinusoidal steady state response of R-L, and R-C circuits – im pedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
10. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
11. Torque Speed Characteristic of shunt dc motor.
12. Speed control of dc motor.

Laboratory Outcomes

- Get an exposure to common electrical components and their ratings.
- Make electrical connections by wires of appropriate ratings.
- Understand the usage of common electrical measuring instruments.
- Understand the basic characteristics of transformers and electrical machines.

Basics Electrical Engineering Lab

SEM -1ST

EXPERIMENT NO.1

AIM-To Verify KCL.

APPARATUS REQUIRED-Network Theorem kit, Connecting Wires, Power Supply (220,50HZ).

THEORY- It States that the algebraic sum of currents meeting at a junction is zero. In other words, the sum of the currents flowing away from a junction is equal to the sum of current entering in to the junction.

For example-

There are six currents I_1, I2, I3, I4, I5and I_6 meeting at a junction. Assuming that the currents entering into the junction, as positive and current leaving the junction, as negative.

According to KCL

$$I_1+I_2+I_3+I_4-I_5-I_6=0$$

OR

$$I_1+I_2+I_3+I_4=I_5+I_6$$

CIRCUIT DAIGRAM-

Case 1- To find total current, let I

Case2-To find current across 450ohm Resistor let, I_1

Case3-To find current across 250 ohm Resistor, let I_2

Case4-To find current across 300 ohm Resistor, let I_3

PROCEDURE:-

(1) First, connect the main lead of the kit on AC source 230V, 50 HZ and switched on.
(2) After it connects the Positive 9V supply on Positive point of ammeter and negative point of ammeter connect on point A.
(3) Negative supply of battery on point D.
(4) Connect the point C&D and E&F by connecting leads.
(5) Note down the total current of circuit in mA meter i.e; I=86mA.
(6) Connect the positive Supply on point A and measured the current I_1,across 450ohm by ammeter on point C&D and point E&F will be open.
(7) After that connect the ammeter in series b/w point E&F and find the current I_2 across 250 ohm and point C&D will be open.
(8) In third Stage we connect the ammeter in series with the 300ohm and point C&D and E&F both will open.

$$I=I_1+I_2+I_3$$

$$I=20+36+30=86mA$$

OBSERVATION TABLE

Sr. No.	Applied voltage	Total Current (I)	I_1	I_2	I3	$I=I_1+I_2+I_3$

SAFETY PRECAUTIONS-

(1). All the connections should be tight.
(2). before connecting the instrument, check their zero reading.
(3). don't touch any terminal or switch without ensuring that it is dead.
(4). Use sufficient long connecting wires.
(5). Make sure that the electrical connections are right and tight.
(6). the circuit should be switched off before changing any connections.

RESULT-

Hence KCL is verified.

EXPERIMENT NO-2

AIM-To Verify KVL.

APPARATUS-Network Theorem kit, Connecting Wires, Power Supply(220V,50HZ).

THEORY- It States that for any closed path in a network, the algebraic sum of the voltages is zero. In another words, the algebraic sum of the product of currents and resistances(voltage drop) in any closed path in a network is equal to the algebraic sum of all emf sources in the network .
For example-There is a voltage source and two resistors. while travelling the path, voltage rise is given a positive sign and voltage drop by negative sign. So, If we go from negative terminal of a battery to its positive terminal, there is a voltage rise and positive sign is assigned. But in case of resistance, If we go through a resistor in the same direction of the current, then this fall in potential is taken as negative.

$$E-IR_1-IR_2=0$$

OR

$$E=IR_1+IR_2$$

CIRCUIT DAIGRAM-

Case 1-

Case2-

Case3-

PROCEDURE-

(1) First, connect the main lead of the kit on AC source 230V, 50 HZ and Switched on.
(2) After it connect the Positive 9VSupply on Positive point of voltmeter and negative point of ammeter connect on point D.
(3) Connect the point B&D by connecting leads.
(4) Now measure the voltage across R1&RL.Find their voltage V1+V3.
(5) Connect the positive terminals and negative terminals on point E&F.
(6) Calculate the voltage across R_2&R_L.

OBSERVATION TABLE

Sr.No.	**Apply Voltage**	**V_1**	**V_2**	**V_3**
1 **2** **3** **4** **5** **6**				

SAFETY PRECAUTION-

(1). All the connections should be tight.
(2). Before connecting the instrument, check their zero reading.
(3). Don't touch any terminal or switch without ensuring that it is dead.
(4). Use sufficient long connecting wires.
(5). Make sure that the electrical connections are right and tight.
(6). The circuit should be switched off before changing any connections.

RESULT-

Hence KVL is verified.

DICUSSION:-

EXPERIMENT NO 3

AIM-To Verify Thevenin's and Norton's Theorem.

APPARATUS-Network Theorem kit, Connecting Wires, Power Supply(220,50HZ).

THEORY:-

CIRCUIT DAIGRAM:-

Case 1-

Case2-

Case3-

PROCEDURE-

(1) . First, connect the main lead of the kit on AC source 230v, 50 HZ and Switched on.
(2) .Connect the milliammeter in series the load resistance RL & switch on the supply, note the reading of IL.
(3) . Remove the RL and connect Voltmeter across the point from whichRL is removed. Note the reading of Vth.
(4) .Remove the voltage source & put short circuit across the point from where RL was removed and connect Ohmmetre across point where RL was removed. Note the reading o Rth.

OBSERVATION TABLE

SAFETY PRECAUTION:-

(1). All the connections should be tight.
(2). Before connecting the instrument, check their zero reading.
(3). Don't touch any terminal or switch without ensuring that it is dead.
(4). Use sufficient long connecting wires.
(5). Make sure that the electrical connections are right and tight.
(6). The circuit should be switched off before changing any connections.

RESULT:-

Hence Thevenin's Theorem is verified.

EXPERIMENT NO-4

AIM:-To Verify Norton's theorem.

APPARATUS:-Network Theorem kit, Connecting Wires, Power Supply(220,50HZ).

THEORY:-Thevenin's theorem reduces a two terminal active network of linear resistance to an equivalent voltage source and series resistance, whereas Norton's theorem reduces the network to an equivalent current source and a parallel resistance.

Norton's theorem states that any linear active network with output terminals AB as shown in fig. can be replaced by a signal current source I_N In parallel with a single resistance R_N.

CIRCUIT DAIGRAM-

PROCEDURE-

(1) . First, connect the main lead of the kit on AC source 230v, 50 HZ and Switched on.
(2) .connect the milliammeter in series with the load resistance RL, and note the reading.
(3) .Set 1.5 by using multimeter & give the supply on point C&D.
(4) .Short the point B&D by connecting wire.
(5) .Measure the Voc on point E&F.
(6) .Connect th load resistance R_L(200ohm) on point E&F put the voltmeterin parallel of R_L &take reading.
(7) . Now remove the voltage source E_1, short it by connecting wires.
(8).Measure resistance using multimeter.
(9).Similarly repeat the process more than 4times using 3V, 4.5V, 6V.
(10).Measure the current in series of R_L also four time.

OBSERVATION TABLE

SAFETY PRECAUTION-

(1) All the connections should be tight.
(2). before connecting the instrument, check their zero reading.
(3). don't touch any terminal or switch without ensuring that it is dead.
(4). Use sufficient long connecting wires.
(5). Make sure that the electrical connections are right and tight.
(6). the circuit should be switched off before changing any connections.

RESULT-

Hence Norton's theorem is verified.

EXPERIMENT NO-5

AIM-To Verify Superposition Theorem.

APPARATUS-Network Theorem kit, Connecting Wires, Power Supply(220,50HZ).

THEORY- According to this theorem if two or more than two voltage sources or current source both are acting simultaneously in a linear bilateral network then the current flowing in any branch of the circuit is the algebraic sum of current produced by each source acting individually when all other voltage source are replaced by their internal resistace and current source by open circuit.

CIRCUIT DAIGRAM-

Case 1-

Case2-

Case3-

PROCEDURE-

(1) First, connect the main lead of the kit on AC source 230V, 50 HZ and Switched on.
(2) Note down the reading of milliammetre as I.
(3) Remove voltage source V_2 and put short circuit between the points from where V_2 is remove again note down the reading of milliammetre as I_1.
(4) Connect sourceV_2 at its original position.
(5) Now Remove voltage source V_1 and put short circuit between the points from where V_1 is remove again note down the reading of milliammetre as I_2.
(6) According to superposition theorem $I=I_1+I_2$.
(7) Repeat the same procedure at least five times by changing the value of voltage source V_1&V_2.

OBSERVATION TABLE:-

SAFETY PRECAUTION:-

(1) All the connections should be tight.
(2) Before connecting the instrument, check their zero reading.
(3) Don’t touch any terminal or switch without ensuring that it is dead.
(4) Use sufficient long connecting wires.
(5) make sure that the electrical connections are right and tight.
(6) The circuit should be switched off before changing any connections.

RESULT:-
Hence Superposition Theorem is verified.

EXPERIMENT NO-6

AIM- To Verify Maximum power transfer Theorem.

APPARATUS-Network Theorem kit, Connecting Wires, Power Supply(220,50HZ).

THEORY- It deals with the transfer of maximum power from source to load line theorem in D.C. circuit states that the relationship between load resistance and internal resistance of the source for maximum power transfer from source to load.
This condition is also reffered as resistance matching and is very in important in electronics and comm. Circuit for obtaining maximum Output for transfer of maximum power, from source to load the internal resistance of the source is equal to R_L.

$$R_i = R_L$$

CIRCUIT DAIGRAM:-

PRECAUTION:-

(1) First, connect the main lead of the kit on AC source 230V, 50 HZ and Switched on.
(2).Connect milliammeter in series with Ri and a voltmeter in parallel with R_L.
(3). Now give a constant value of Ri resistor.
(4).Now vary the value of Ri and note down the reading of milliammeter and voltmeter respectively.
(5).Now calculate power P_L across Ri.
(6).R_L=R_i when is max.

OBSERVATION TABLE:-

Sr.No	**Applied voltage(V)**	**R_i**	**R_L**	**I_L**	**V_L**	**$P_L=V_L I_L$**

SAFETY PRECAUTION:-

(1). All the connections should be tight.
(2). before connecting the instrument, check their zero reading.
(3). don't touch any terminal or switch without ensuring that it is dead.
(4). Use sufficient long connecting wires.
(5). Make sure that the electrical connections are right and tight.
(6). the circuit should be switched off before changing any connections.

RESULT-

Hence Maximum power transfer Theorem is verified.

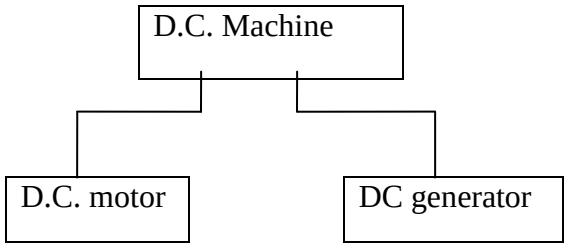
EXPERIMENT NO 7

AIM

To study the construction of D.C. machine

APPARATUS: D.C. machine assembly

THEORY:



Following are the main parts of D.C. machines:

1. Magnetic Yoke
2. Pole core and pole shoes
3. Pole coils
4. Armature core
5. Armature coils
6. Commutator
7. Brushes and bearings

D.C. Machine Construction Diagram:

PROCEDURE:

The assembly of D.C. machine is observed and following parts are studied in detail as described below

1. **Magnetic Yoke**: Magnetic Yoke serves the double purpose:

a) It carries the magnetic flux produced by the poles.

b) It provides the mechanical support for the pole and acts as a protecting cover for the whole machine.

2. **Pole Core & Pole Shoes**: Pole core & pole shoes serve the following purpose:

a) Pole core spreads the flux in the air gap to reduce the reluctance of magnetic path

b) Pole shoes provide the support for the pole coils.

They are made up of thin laminations of steel with thickness 0.25mm to 1mm.

3. **Pole Coils**: Pole coils are made up of copper wire. These are placed on pole core.

4**. Armature Core:** It houses armature coils & causes them to rotate, hence cuts the flux produced by field winding. It is cylindrical & made up of laminations of approx 0.5mm Thickness. It is keyed to the shaft laminations are used to reduce the eddy currents.

5. **Armature Windings**: These are usually former wound. Various conductors are placed in armature slots, which are lined with insulating material.

6**. Commutator**: The function of commutator is to collect the current from the armature conductors. It converts the a.c. of armature conductor into unidirectional current in external load. It is cylindrical structure with wedge shaped segments insulated from each other by thin sheets of mica. Number of segments is equal to number of armature conductors.

7. **Brushes & Bearings**: Brushes collect the current from commutator. They are made of carbon & are of rectangular shape. Brush holder is mounted on spindle & brushes can slide. Ball bearings are used for less wear and tear.

DISCUSSION:

D.C. generator converts the mechanical energy in to d.c. electrical output and D.C. motor converts the d.c. electrical input into mechanical energy output.

EXPERIMENT NO. 8

AIM:

To perform the speed control of D.C. shunt motor by:

- Field current control method

- Armature voltage control method

APPARATUS

: D.C. shunt motor ,ammeter ,voltmeter and rheostat

THEORY:

The speed of D.C. shunt motor can be controlled by two methods:

- By changing the field flux

It can be done by connecting a rheostat in the field circuit of a motor .By varying the rheostat we can get the different values of field current or flux and hence different speeds of motor.

By changing the armature voltage:

It can be done by connecting a rheostat in the armature circuit of a motor.By varying the rheostat we can change the armature voltage ,hence we get the different motor speeds.

CIRCUIT DIAGRAM:

PROCEDURE:

1 Connect the circuit as shown in the diagram.

2 Keep the armature rheostat to maximum and field rheostat to minimum value.

3 Switch on the D.C. supply and motor will start running at slow speed.

4 Note down the speed ,field current and armature voltage.

5 Repeat step4 for various positions of rheostat,till armature rheostat reaches to its minimum value.

6 Now increase the field rheostat in steps and note down the readings as in step 4 till the field rheostat reaches its maximum value.

7 Bring the field rheostat to its maximum value and switch off the motor.

OBSERVATION TABLE:

RESULT:

The speed of the motor can be changed by field flux and armature voltage control

method.

PRECAUTIONS:

1 All connections should be clean and tight.

2 Keep the position of armature and field rheostat at the required position .

3 The range of meters should be selected carefully .

4 The zero setting of meters should be checked before starting the experiment.

EXPERIMENT NO. 9

AIM: To perform direct load test. On D.C shunt motor and D.C. series **motor**.

APPARATUS: D.C. shunt motor, D.C. series motor with brake arrangement, ammeter,

voltmeter and rheostat.

THEORY: Brake test is carried out on a D.C. shunt motor and D.C. series motor to determine its parameters including efficiency.In this test a belt is wound round a pulley and two ends are attached to two springs.The force acting on pulley is equal to the difference between readings of two spring balances If R is the radius of the pulley and $W_1$and W_2 are weights on two springs then shaft torque is given by :S

Shaft torque Tsh= (W_1-W_2)*R Kgm

Motor output Poutput=2*3.14*N*T*9.81/60 watts

Motor input= V*I watts

Efficiency= Poutput/Pinput*100%

CIRCUIT DIAGRAM:

PROCEDURE:

D.C. shunts Motor:

1 connect the circuit as shown in the figure

2 Apply rated voltage of 200v D.C. to the motor.

3 Increase the load on the motor slowly to it's full capacity.

4 Note down the reading of ammeter, voltmeter, W1, W2 and diameter of pulley.

5 Using above formula calculate shaft torque, input power, output power and efficiency of

the motor.

D.C. series motor:

1 connects the circuit as shown in the figure.

2 Apply some load on the motor.

3 Switch on the D.C. mains and start the motor.

4 Increase the load slowly to the rated value.

5 Note the readings of all meters, speed and both spring balances.

6 Remove the load slowly and switch off the motor.

7 Measure the diameter of pulley.

OBSERVATION TABLE:

RESULT:

The efficiency of D.C. shunt motor is = and D.C. series motor is =

PRECAUTIONS:

1 Increase the load on the motor slowly

2 While measuring RPM keep the tachometer in line with the pulley.

3 Take the readings of ammeter and voltmeter accurately.

4 Give a gap of sometime between two tests to avoid overheating of motor.

5 Do not touch any naked connection of the circuit.

EXPERIMENT NO: 10

AIM: Star-Delta starting of three phase induction motor.

APPARATUS: Three phase induction motor, star delta starter.

THEORY:

NEED FOR STARTER:

At the standstill the motor behaves as the short circuit secondary transformer and it draws heavy current from mains, which can cause the damages at the starting. It can cause the heavy drops in power line. So direct online starting of motor is not desirable. The motor has to be started at reduced voltage. For heavy duty motors some starting methods are used or resistance has to be included in the circuit at starting.

CIRCUIT DIAGRAM:

PROCEDURE:

Star Delta method of starting:

All the six terminals of stator winding are brought out and are connected as shown in Fig. In the starting the stator winding is connected in start and full voltage is applied across these terminals. The voltage of each phase is 1/3 of normal value. As the motor picks up the speed, the change over switch disconnects the winding of motor. Now it connects the winding in delta across supply terminals.

This method reduces the current taken by the motor to one third the current it would have

Drawn if it was directly connected in delta. However, the starting Torque is also reduced to one third. This method is cheap, but it should be used when high starting torque is not Required like machine tools, pumps, motor generator etc.

DISCUSSION:

Star Delta method is a safe method for starting of induction motor as the inrush Current in the starting is very high without the starter. This is due to the absence of Back emf at the starting.

PRECAUTIONS:

1. Make sure that all connections are tight.
2. The connections should be according to circuit diagram.
3. Don’t touch the naked connection, it may give shock.