LAB MANUAL
OF
POWER SYSTEM ENGINEERING LAB

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EXPERIMENT NO.1

AIM:-To find the ABCD Parameters of a model of transmission line.

APPARATUS REQUIRED: - Model of a transmission line, AC voltmeter, AC ammeter, auto transformer, connecting leads.

THEORY:-

ABCD Parameters are widely used in analysis of power transmission engineering where they are used for calculating the regulation and efficiency of a transmission line.

ABCD Parameters are also known as transmission parameters. In these parameters the voltage and current at the sending end terminals can be expressed in terms of voltage and current at the receiving ends.

$$Vs = Avr + B (-Ir)$$

$$Is = Cvr + D (-Ir)$$

Here,

A is reverse voltage ratio.
B is transfer impedance.
C is transfer admittance.
D is reverse current ratio.

% Regulation = (Vs – Vr)*100 / Vs

% Efficiency = Pr *100 / (Pr + 3IrR)

CIRCUIT DIAGRAM:-

PROCEDURE:-

1) Connect the circuit as shown in diagram.
2) Open the output terminal and gives the 220V supply to the input terminal. And measure the terminal voltage.
3) Now, short the output terminal and calculate the output terminal current.

CALCULATION:-

1) when output is open circuited i.e Ir =0

   Then, A= Vs / Vr and C = Is / Ir

2) when output is short circuited i.e Vs =0

   Then B = -Vs / Ir and D = -Is / Ir

RESULT: - ABCD Parameters of transmission line has been calculated and verified.

EXPERIMENT NO.2

AIM:-To observe the Ferranti effect in a model of transmission line.

APPARATUS REQUIRED: - Model of a transmission line, AC voltmeter, AC ammeter, auto transformer, all types of load, power factor meter, connecting leads.

THEORY:-

When a load line is operating under no load condition, the receiving end voltage is greater than the sending end voltage. This is known as Ferranti effect.

Usually the capacitive reactance of the line is quite large as compare to the inductive power factor. The charging current produces drop in the reactance of line which is in phase opposition to the receiving end voltage and hence the sending end voltage becomes smaller than the receiving end voltage.

Ferranti effect is based on the net reactive power follow on line.

If the reactive power generated at a point is more than the reactive power observed the voltage at the higher becomes sending end voltage. This is known as Ferranti effect.

PROCEDURE:-

1) Connect the circuit as shown in diagram.
2) Measure the secondary and receiving end voltage at no load.
3) Switch on the all types of load one by one.
4) Measure the sending end voltage, receiving end voltage and load current.
5) Observe the Ferranti effect.

CIRCUIT DIAGRAM:-

OBSERVATION TABLE:-

Types of Load	Vs(Sending voltage)	Vr(Receiving voltage)	A(Load current)
Resistive load			
Capacitive			
Inductive			

PECAUTIONS:-

1) Connect the circuit diagram carefully.
2) All the connections should be Tight.
3) Don't touch the naked wire.

RESULT:- The Ferranti effect in model of a transmission line have been observed.

EXPERIMENT NO.3

AIM:-To study the Buchholz relay.

APPARATUS REQUIRED: - Buchholz relay, voltmeter, ammeter, conservator, connecting pipes.

THEORY:-

This relay is a gas actuated relay which is meant for the protection of oil immersed transformer from insulated failure, core heating etc.

the relay is situated in the pipe connected between the transformer and conservator.

It consists of a case in which two spherical float A and B are provided. Each assembly of float is arranged in such a way that when the transformer oil is completely filled and ready for the service. The contacts of both the switches are open when a minor fault occurs, example some insulation breakdown between the turns, one core is overloaded or transformer has been overloaded and raising the temperature of oil. Small bubbles of gas due to vaporization of oil will pass through the relay and go in the assembly of float A move downwards and complete the circuit of the alarm. Thereby the operators know that, there is some fault has incident in the transformer and gas sample is tested.

The testing of gas gives a clue regarding the type of insulation fault.

PROCEDURE:-

1) Connect the Buchholz relay between the conservator and transformer by connecting pipes.
2) Make the connection of Buchhloz relay and panel.
3) Switch on the supply and run the system and slowly increases the load.
4) Do overload the system by varying the load by rheostat.
5) Decrease the load and switch off the system.

EXPERIMENT NO.4

AIM:-To draw the operating characteristic of IDMT relay.

APPARATUS REQUIRED: - IDMT relay, autotransformer, AC voltmeter, AC ammeter, Time interval meter, phantom fault creation load, alarm etc.

THEORY:-

Inverse definite minimum time current relay is one in which the operating time is approximately inversely proportional to the fault current near pick up value and becomes substantially constant slightly above the pick up value of the relay.

This is achieved by using a core of the electromagnet which gets saturated for current slightly greater than the pick up current.

IDMT relay are directional relay and are used for protection of feeders, transmission line, transformer, machines etc.

Plug setting multiplier of relay =

PSM = fault current / relay operating current * CT ratio

Relay operating current = relay rating * relay plug setting .

A plug setting bridge is provided with IDMT relay. plug setting refers to the reference value of operating quantity at which the relay start operating.

PROCEDURE:-

1) Connect the circuit as shown in the circuit diagram.
2) Set the plug setting bridge for relay coil.
3) Switch on the supply and maintain by autotransformer according to the system required.

4) Create the fault in the circuit by phantom fault creation load.
5) Note down the relay operating time interval meter, relay operating current by applying PSM value of relay.
6) Remove the fault creation of load and switch off the supply.
7) Again set PSM at different value and repeat the steps 4 and 5.
8) Switch off the supply and disconnect the connection.

OBSERVATION TABLE:-

Fault current (A)	Relay operating time

- Take at least 4-5 readings.
- Draw Graph between relay operating time and fault current.

CIRCUIT DIAGRAM:-

EXPERIMENT NO.5

AIM:-To study the Directional over current relay.

APPARATUS REQUIRED: - Directional over current relay, selector switch, ammeter, time totalizer meter, reversible switch variable loading arrangement, and lamp indicator.

THEORY:-

In a circuit at a point the current can flow in one direction at a particular instant. Let us say this is normal direction of flow of current. Under this condition the direction unit develops negative torque and relay will restrain to operate. Now if due to certain changes in the circuit condition, the current flow in opposite direction. The relay will develop torque and will operate.

Directional protection responds to flow of power in a definite direction with reference to location of CT's and PT.

Directional relay respond to the magnitude and sign (direction) of power applied to their terminal.

Directional relay are used in protective system as a elements which judge the direction of power flow.

Relay is provided with two actuating coil called current coil and voltage coil.

PROCEDURE:-

1) Connect the circuit as shown in the diagram.
2) Keep the selector switch at current set position and set the load current.
3) Put the reversible switch at reverse connection position and selector switch on directional relay position and start the contactor by push to on position.
4) Observe relay must be remaining at off position.

5) Change the position of reversible switch and again start the contactor by push to on button. Relay should be on at positive direction of current.
6) Now for various TMS (Time multiplier setting) and PSM (plug setting multiplier) the time taken by the relay to operate at various fault voltage should be note down.

OBSERVATION TABLE:-

Relay operating current	Fault current	Time

- Take 4-5 readings
- Draw graph between time and fault current.

Result: - Directional relay sense the power and responds of the power is positive.

EXPERIMENT NO.6

AIM:-To study Electro-mechanical type under voltage relay and hence to obtain its increase time voltage characteristics.

APPARATUS REQUIRED: -

- Under voltage relay
- autotransformer
- Toggle switch
- voltmeter (0-600v)
- Time Totalizer.
- Control circuit.

DETAIL OF RELAY:-

- Voltage rating – 110v
- Setting range – 50% to 90% adjustable in 5equal steps of 10%

THEORY:-

The purpose of Electro-mechanical under voltage relay is to protect the equipment by low voltage. The voltage relay element is with high internal resistance. It is connected to the secondary of voltage transformer under voltage relay are set such that for voltage below lowest permissible voltage. The alarm is sounded and after certain delay breaker are and after certain delay breaker are tripped to protect important equipment likely to be affected by under voltage.

PROCEDURE:-

1) Connect the circuit as shown in the diagram.
2) Switch on the MCB, and then push on green button.
3) Now to set the desired fault set the rotary switch towards off position.

4) Now move the toggle switch on –off position and the green push button and time counting will start and counting will stop once relay is operated.
5) Now, for various TMS and PSM the time taken by the relay to provide operation at various fault voltage is noted down.
6) Now plot graph between times taken for relay to operate verses plug setting multiplier.

CIRCUIT DIAGRAM:-

OBSERVATION TABLE:-

Incoming voltage(v)	Break over time

- Take 4-5 readings.
- Plot a graph between time and the voltage.

EXPERIMENT NO.7

AIM:-To find out break down strength of transformer oil.

APPARATUS REQUIRED: - One insulating test set of transformer oil.

THEORY:-

Liquid dielectric are mainly used as impregnator in high voltage cable, capacitor and for filling up of transformer and circuit breaker etc. They also act as a heat transfer agent in transformer. Breakdown strength of transformer oil is conducted by using oil testing set. The testing set operates at 230v, 50Hz supply. The electrodes used for breakdown voltage measurement are usually of sphere shaped. The test set consist of an over load relay which trips and disconnect the HT transformer. When the break down occurs across the gap, the electrodes shall be mounted on a horizontal axis and shall be 2.5mm or 4mm apart. The axis of the electrodes shall be immersed to a depth of 40mm.

PROCEDURE:-

1) Check the gap of electrodes with gauge provided in the experiment.
2) Fill the oil under test in oil cup.
3) Close the plastic top of testing set and check if the micros switch beneath closes.
4) Connect the main plug to AC main supply 230V, 50Hz.
5) Push ON HT and keep toggle switch in increase position.
6) The HT voltage shall increase by motorized action till the breakdown of insulation.
7) Note down the break down voltage of oil from voltmeter.

CIRCUIT DIAGRAM:-

RESULT:-

The break down strength of transformer oil is _____ Kv at 2.5mm / 4mm gap.