# GOVT CO-ED POLYTECHNIC

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**LAB MANUAL**

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*2024563(024) – Power System Operation & Protection (Lab)*

# CONTENTS

## Experiment – 1

**Aim: To draw the operating characteristics of IDMT relay**

**Objective:** *The aim of the experiment to investigate the operation, inverse characteristics and to determine the purpose of time and plug settings for over current relay in electrical supply system.*
By configuring these settings correctly, and by coordinately the operations of the relays, it is possible to isolate the smallest section of the system in the shortest time possible, thereby minimizing unnecessary disruption to other consumers whilst preventing damage the equipment within the fault section.
In the radial feeder configuration, supply from one end only, discrimination of faults can be achieved by incorporating time delays at each relay point. This enables the relay closest to the fault to trip, isolating the fault circuit without affecting the other non-faulty circuits. A disadvantage of this system is that for faults near the source, the fault current can be much greater than at the opposite end of the feeder due to the impedance. For a fault at point F in figure (1), the circuit breaker at point C opens before those at point A and B, leaving most of the feeder operational. The relays have a time grading of 0.5s (to allow for relay and circuit breaker operation plus error allowance), illustrating discrimination by time grading only.
The disadvantage can be overcome by employing relays with an inverse current / time characteristic – i.e. the time delays are reduced for higher currents. These relays are known as IDMT relays (Inverse Definite Minimum Time). A minimum time of operation is incorporated to ensure co-ordination between the relays when the fault level does not vary along the feeder.

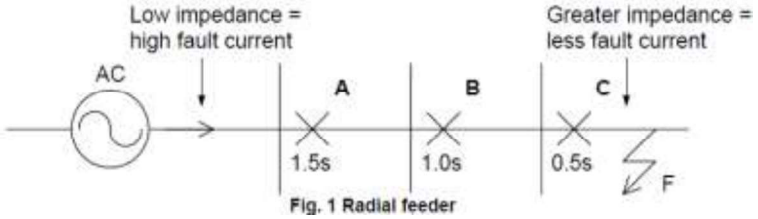
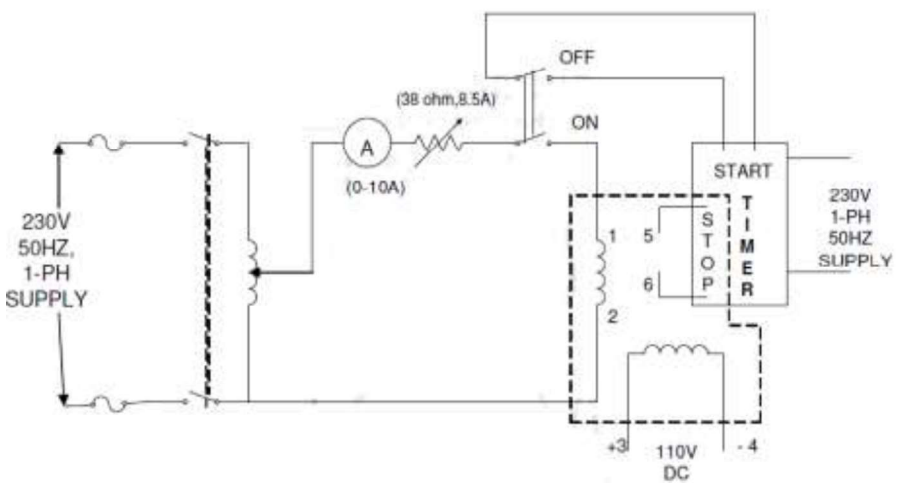


Fig. 1 Radial feeder

**Apparatus Required:**

1) Timer
2) IDMT relay (MODEL NO.ICM-21NP))
3) Auxiliary D.C. supplies = 110V
4) 1 phase Dimmer stat = 230V, 10A
5) Ammeter AC (0-15A)
6) Rheostat (38 ohm, 8.5 Amp)
7) Experiment Kit
8) Connecting wires

**Circuit Diagram:**




**Procedure:**

1. Make the connection as shown in the circuit diagram.
2. Select current setting (set phase trip) less than 100%, keeping phase TMS at maximum position.
3. Select any time setting.
4. Switch on variac and check power ON indication provided on relay front panel.
5. Vary dimmer stat and observe current value till Pick-Up will show 'Red' indication when current value exceeds set phase trip position.
6. Switch OFF dimmer stat without disturbing its position with the help of DPT switch. Also reset time.
7. Measure the relay time from timer by switching on DPT switch.
8. Now increase the fault current and note down timer time after switching 'OFF' and 'DPT' switch every time with same time setting.
9. Repeat same procedure for different time setting keeping current setting same.

**Observation Table:**

| Sr. No. | Fault Current (A) | PSM | Timer time for TSM= | Timer time for TSM= | Timer time for TSM= |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**Result:**For lower values of current the "time current " characteristics are inverse and for higher value for current observed times are constant

## Experiment No. 2

**Aim: To study the performance of Earth fault relay**

**Objective:** To study the protection of equipment and system by relays in conjunction with switchgear.

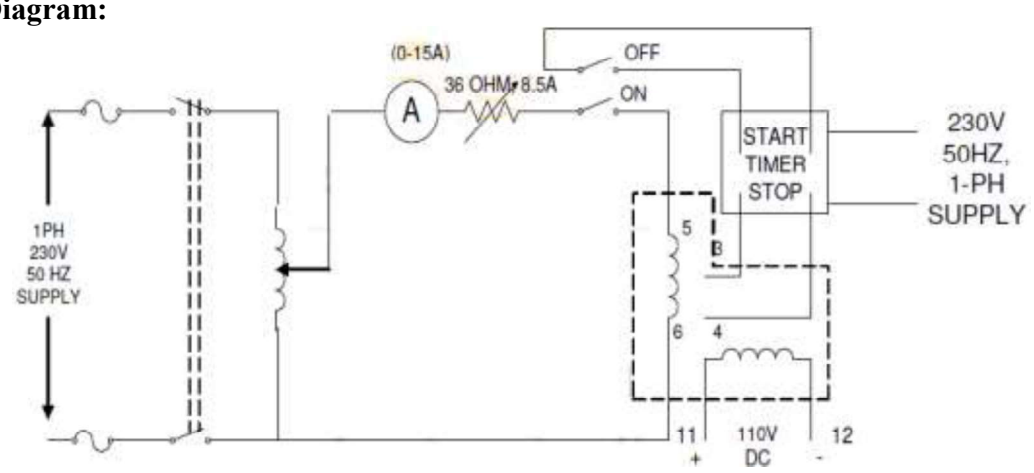
**Theory:** The function of a relay is to detect abnormal conditions in the system and to initiate through appropriate circuit breakers the disconnection of faulty circuits so that Interference with the general supply is minimized.

***Earth fault protection can be provided with normal over current relays***, if the minimum earth fault current is sufficient in magnitude. The design of a comprehensive protection scheme in a power system requires the detailed study of time-current characteristics of the various relays used in the scheme. Thus it is necessary to obtain the timecurrentcharacteristics of these relays. The over current relay works on the induction principle. The moving system consistsof an aluminum disc fixed on a vertical shaft and rotating on two jeweled bearings between the poles of an electromagnet and a damping magnet. The winding of the electromagnet is provided with seven taps (generally0, which are brought on thefront panel, and the required tap is selected by a push-in -type plug. The pick-up current setting can thus be varied by the use of such plug multiplier setting. The pick-up current values of earth fault relays are normally quite low.

**Equipment Required:**

1) Timer
2) IDMT relay (Model APR-11 P)
3) Auxiliary D.C. supplies = 110V
4) 1 phase Dimmer stat = 230V, 10A
6) Ammeter AC (0-15A)
7) Rheostat (38 ohm, 8.5 Amp)
8) Experiment Kit
9) Connecting wires

**Circuit Diagram:**




**Procedure:**

1. Make the connection as shown in fig.
2. Set current and time setting of relays as per requirement
3. Set phase trip to 50% and set phase time at X1 with phase TMS at maximum position.
4. Switch on variac and check power ON indication provided on relay front panel.
5. Very dimmer state with fault current of 1A, relay will trip after certain time delay.

6. Switch OFF dimmer state without disrobing its position and change the position of DPT switch. Also reset time.
7. Switch ON dimmer state changes the position of switch and measure the relay time from timer.
8. Reap eat same procedure for varying a different fault current.
9. Repeat this procedure consider different set phase time (TMS)

**Operation:**

With supply on load are continuously monitored Electronic comparator checks this value with set value (N) of phase & earth fault trip, which can be adjusted on front plate. Pick up response is (1.1 N) IDMT timing is applicable to over current above 2N as per chosen curve. Time setting multiplier for actual tripping time delay. TMS is adjusted by 11-position switch & with variable preset pot. These pots adjusted time for intermediate values indicated on TMS switch. Tripping cause is indicated by LED lamp (OC/EF). When over current trips the circuit relay ' NO' contact changes to 'NC' when relay trips indicating LED to 'NC' when relay trip indicating LED to 'NC' when relay trips indicating LED to 'NC' when relay trip indicating LED flag will remain ON till manually reset.

**Observations:**

Current setting =……, Phase TMS

| Sr. No. | Fault Current (A) | PSM | Timer time for TSM= | Timer time for TSM= | Timer time for TSM= |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**Result:**For lower values of current the "time current "characteristics are inverse and for higher value of current, time observed is constant.

**Viva Question**

1 Application of IDMT relay.
2 Drawback of IDMT relay
3 Importance of DC supply
4 Detail of other Inverse type of relays
5 Importance of static relays
6 Why IDMT relay suitable for protection of long length of LV/MV TL.

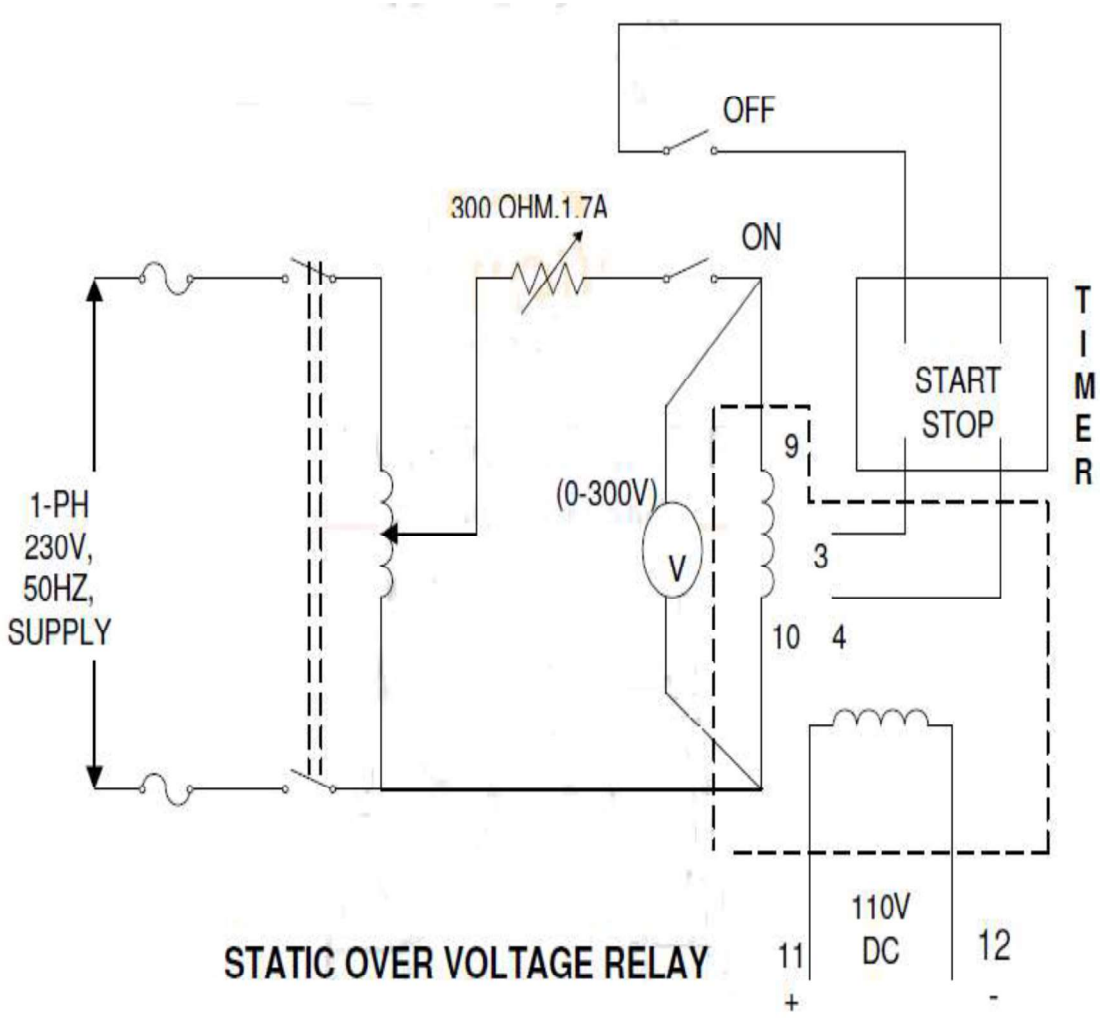
## Experiment – 3

**Aim: To study the performance of an over voltage relay.**

**Apparatus Required:-**

1) Static over voltage relay (Model No.: -ASOV)
2) Auxiliary D.C. supplies 110V
3) Time interval meter
4) Single pole variac 230V, 4A
5) Voltmeter (0-300V) AC
6) Rheostat (400 ohm, 1.7 Amp)
7) Connecting wires
8) Experiment Kit

**Circuit Diagram:**




**Procedure:**

1. Connect the ckt as shown in fig procedure is done & time is noted.
2. Set current and time setting of relays as per requirement.
3. Connect Auxiliary D.C. Supply (110) to pin 11 & 12 of relay and pin no. 3&4 to the time interval meter.

4. Switch on the D.C. supply & make sure that relay is on Glowing of LED on the front panel of the relay.
5. Switch on power supply from dimmer as well as to time interval meter.
6. Adjust the voltage setting of the relay.
7. Adjust the time setting of relay.
8. Now by making DPDT switch on, increase the value of voltage by dimmer stat up to the point at which the relay trip. Trip can be observed by glowing of trip LED on front panel of relay.
9. Switch is made off and relay is reset.
10. Now Switch is made on & time interval meter reading is noted.
11. For the same voltage setting , time setting is changed & same procedure is repeated until all the time setting are covered.
12. Again voltage setting is changed & same procedure is repeated.

**Result:** The static over-voltage relay is studied

## Experiment –4

**Aim: To measure the dielectric (Breakdown) strength of transformer oil**.

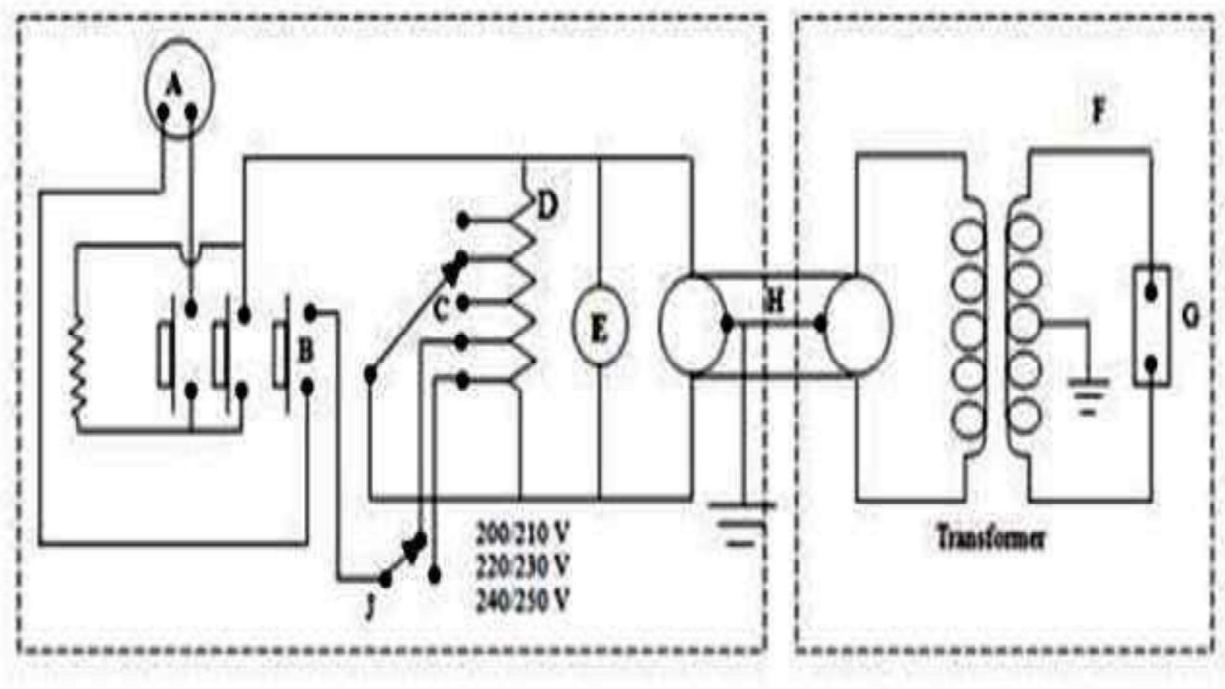
**Equipment Required:**

1. Portable oil testing set-220/250 V
2. HV transformer-50 kV/250 V
3. Gap setting gauges -0.15711 width

**Theory**

The two unit portable testing set is designed for the periodical testing of samples of insulating oils drawn from plant on site and for checking the dielectric strength of new samples of oil. The equipment is designed to operate from 200/250V, 50Hz, Single phase AC supply. Test gap voltage up to 50kV, it consists of two units, one is containing the testing transformer and other is control and metering equipments. These equipments are kept in a metal box to provide full protection to the apparatus during transport and storage. The gap is adjusted between electrodes in accordance with British Standard Specification (BSS) no. 148

**Connection Diagram:**




**Observation Table:**

| S. No. | Break down Voltage (Volts) |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |

**Procedure:**

1. Place the High Voltage transformer unit about 7 away from the control unit.
2. The control unit is connected to supply voltage taking care that the earth connections are effective.
3. The multiple point control switch is set at its lowest tapping.
4. The push button on control unit is pressed firmly for at least 5 seconds. Note that no Breakdown to occurs, in which case button should be released at once without delay. Break down is indicated by a continuous discharge across the gap, bubbling of oil in the cell and meter indicating a sudden voltage drop.

## Experiment – 5

**Aim:** ***To find ABCD, Hybrid & Image parameters of a model of transmission line***

**Apparatus Required**: - Transmission Line model is consisting of four sections of transmission Kit Voltmeter-1, Ammeter-1, Power Supply-220V, Connected Wire (As per Requirement)

**Theory: -** ABCD Parameter are widely used in analysis of power transmission engineering where they will be turned as "Generalized circuit parameter" ABCD parameters are also called as Transmission parameter. It is conventional to designate the input port as sending end and the output port as receiving end while representing ABCD parameter

$$Vs = AVr + B\,Ir$$
$$Is = CVr + Dir$$
$$[Vs/Is] = [A\ B/C\ D]\ [Vr / Ir]$$

Assuming the receiving end open Circuit i.e.

A =Vs / Vr Where Ir = 0

B = Vs / Ir Where Vr = 0

C = Is / Vr Where Ir = 0

D = Is / Ir Where Vr = 0

**Circuit Diagram:-**

In transmission line if impedance at the sending end with $Z_{12}$ [at] receiving ends be $Z_{11}$ and simulations the impedance looking back from receiving end with $Z_{11}$ at input part is $Z_{12}$ then $Z_{11}$ and $Z_{12}$ termed as the image impendence of the network

$Z_{11} = \frac{\sqrt{AB}}{CD}$ and $Z_{12} = \frac{\sqrt{BD}}{AC}$

$\alpha = \tanh^{-1} = \frac{\sqrt{BD}}{AC}$

**Calculation & Observation:-**

Open Circuit:-

| S. No | Vs | Is | Vr | A= V1 / V2 | C = I1 / V2 |
|---|---|---|---|---|---|
| | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |

Short Circuit:-

| S. No | Vs | Is | Ir | B= Vs / Ir | D = Is / Ir |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |

Procedure:-

1. To find out A and C parameters connect voltage supply of 220V to sending end and open circuit receiving end.
2. Observe the voltage of Vs, Is and Vr with the help of voltmeter and ammeters in the experimental kit.
3. To find out B and D receiving end is short circuited and supply of 220V is given to sending end.
4. Observe the voltage of Vs , Is and Ir

Result: - The Calculated A, B, C, D Parameters are

A=
B=
C=
D=