Experiment No

Aim :- To study the spark over voltage versus gap length, characteristics for Sphere Gap with one sphere earthed and to verify the empirical relationship with the result given in standard table.

Learning Objective:

- To study the measurement of power frequency high voltage with the help of sphere gaps.

Apparatus:

Zaran make 25 cm sphere gap set (vertical type) with remote control unit, and 0-250 kV test transformer along with control unit.

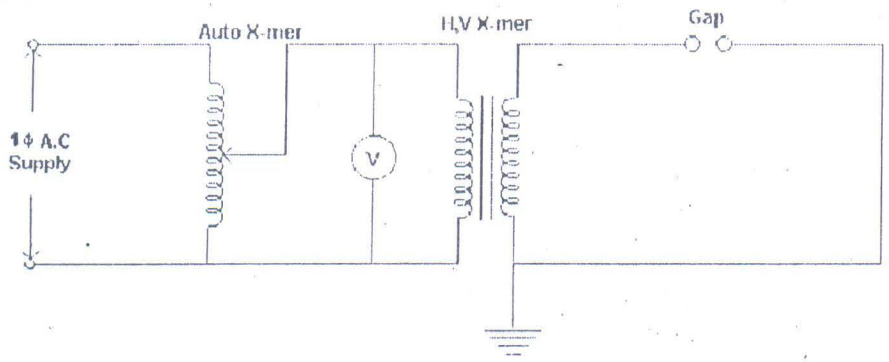
Theory:

The method makes use of the fact that a spark gap in a homogeneous field will always spark over at a particular peak voltage within known tolerance under uniform atmospheric conditions. The most uniform and best electrode configuration for uniform field is parallel plate system with suitable electrode profile. However sphere gap happens to be a commonly acknowledged means in the international practice for the measurement of d.c, a.c (power frequency) and impulse voltages.

Choice of sphere gap as a measuring spark gap is governed by the following main properties of gap: -

1. A volt-time characteristic of a sphere gap over a large interval of a time is a horizontal. Consequently the B.D voltage of the gap does not depend upon duration of application time.
2. Impulse ratio of break down for sphere gap is practically unity.
3. Out of all the gaps having weakly non-uniform field the sphere gap can be prepared most easily and it has least dimensions.

Circuit Diagram:



Procedure:

Adjust the gap length for 1 cm and determine the break down value on the panel voltmeter. Also note the value from the standard chart and get the corrected under laboratory conditions. Actually the value given in standard table is valid for:

i) An ambient temperature of 20^0 C and an atmospheric pressure of 760 mm of Hg.

When the tests are carried out at conditions other than these conditions, the ambient temperature and the atmospheric pressure shall be recorded for the purpose of applying correction factor (k). This factor is a function of the relative air density "δ", defined by

$$= \left[\left(\frac{b}{760}\right) \times \left\{\frac{(273+20)}{(273+t)}\right\}\right] = 386 \times \frac{b}{(273+t)}$$

Where b is atmospheric pressure in mm of Hg and t is the temperature in degree centigrade. The relation between air density factor (δ) and correction factor (k) can be obtained from the table.

Air density correction factors

Relative air density (δ)	0.70	0.75	0.80	0.85	0.90	0.95	1.0	1.05	1.10	1.15
Correction factor (k)	0.72	0.77	0.82	0.86	0.91	0.95	1.00	1.05	1.09	1.13

The procedure is repeated for gap lengths of 1.5,2,3,4 cm.

Observation Table:

D = Dia of sphere = 25cm, t = room temp^{0}C = _____

b = Atmospheric pressure -mm. Air density factor $\delta = \frac{0386b}{(273+t)}$

S. No	Gap Spacing	V_0, kV for 25cm dia sphere with one sphere earthed.	Corrected value of (from St. Chart) $V_0' = V_0 * k$ (Peak)	Panel voltmeter Reading (kV) (rms)	Corrected value of voltage (rms) $V_1 = V_0'/1.44$	% error $\frac{(V-V')*100}{V}$

Result:

1. Plot the graph between: -
2. % error and voltmeter reading (v).
3. Voltmeter reading vs gap spacing.

Discussion:

1. What are the factors affecting spark over voltage of sphere-sphere gap?
2. Explain the application of sphere gap in high voltage measurement?

Aim :- Study of 100kV power frequency, high voltage transformer & its accessories.

Learning Objective:

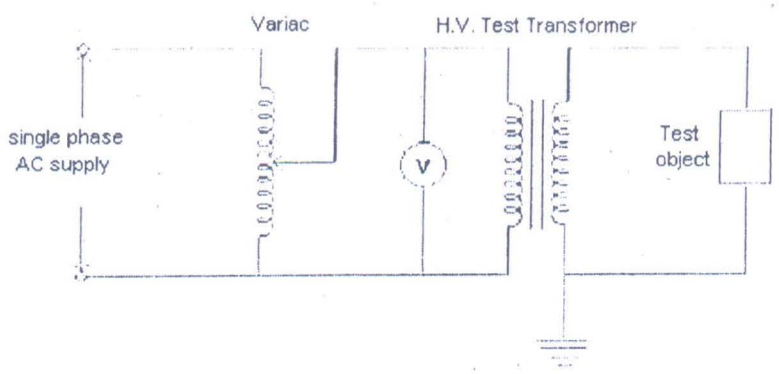
1 .To have the knowledge about generation of High Voltage AC through HV Transformer and to understand the difference between Power transformer and HV Test Transformer.

2. To know the operating procedure of test transformer.

Construction:. The Test transformer, used in High voltage laboratory, have following features.

1. The transformer is connected to a variac, which is operated through constant speed motor to obtain desired output voltage with uniform rate of rise of voltage.
2. The tank of the transformer is generally connected to centre point of the HV winding. This feature is useful to make cascade operation of test-transformer.
3. The transformer is generally sealed type with no conservator tank/ breather / diaphragm.
4. Output may be obtained across the two HT bushings or it may be obtained between any one bushing as HT Electrode and Earth being the second Terminal.
5. The input voltage to this transformer is variable (0-230 V AC)

Diagram:



Result: The study of test transformer and its accessories is carried out.

Discussion:

1. Describe the function of the H.V voltmeter fixed on the control panel. Where it is connected?
2. Enlist various safety precautions to be exercised in HV Lab.

t-experiment

Aim: Measurement of RMS voltage of H.V test transformer by ratio test.

Learning Objective:

1. To understand the procedure for Ratio test of transformer.
2. To understand the fact that panel provided in test transformer control panel is connected in low voltage side (not in HV side) but calibrated in terms of high voltage.

Theory:

For a transformer the e.m.f. equation is $E = 4.44 \phi_m f N$.

Where: ϕ_m = Useful flux in the core,

f = Frequency of supply,

N = Number of turn in winding.

If E_1 - Induced voltage in primary winding, E_2 - Corresponding voltage induced in secondary winding,

$E_1 = 4.44 \phi_m f N_1$ and $E_2 = 4.44 \phi_m f N_2$

Transformation Ratio:

It is the ratio of secondary induced voltage to primary induced voltage. Then Transformation Ratio = $\frac{E_2}{E_1} = \frac{N_2}{N_1}$, At no load $V_2 = E_2$ with I_e neglected $V_1 = E_1$

so that $\frac{V_2}{V_1} = \frac{N_2}{N_1}$ is Transformation Ratio.

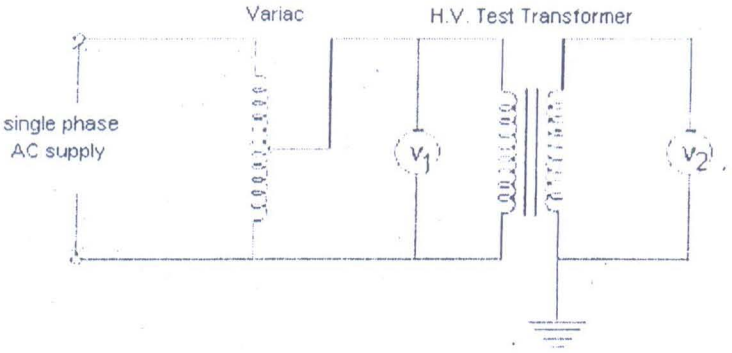
Procedure:

1. Make the connections of transformers, apparatus and supply as shown in fig-1.
2. By auto- transformer apply reduced voltage to the primary keeping secondary voltage below 400 V and take the readings of voltmeter V_1 and V_2.
3. Take different sets of readings by reducing the voltage applied through auto- transformer.

Calculations:

Take the average value of $\frac{V_2}{V_1}$. This average value is approximately equal to the transformation ratio of transformer.

Diagram:



Result: The rms voltage of given transformer is measured by ratio test.

Experiment

Aim: To determine power frequency breakdown voltage for air gap/ transformer oil with different electrodes.

Learning Objective:

- ❑ To study the effect of profile of electrode on breakdown voltage.

Apparatus:

1. Power frequency high voltage test transformer: specifications -230V/250kV, 100mA, Autotransformer 0-230 V.
2. Control panel.
3. Disc electrodes, Rod electrodes and point electrodes.

Theory:

If the electric field is uniform, a gradual increase in voltage across the gap produces breakdown of the gap in the form of spark without any preliminary discharges.

On the other hand if field is non-uniform, the increase in voltage first causes discharge in gas at points where field intensity is maximum. Then it spreads over the whole gap with corresponding increase in voltage i.e. in the case of non-uniform field; discharge converts into spark with further increase in voltage.

Procedure:

1. Set the disc electrodes for a given spacing.
2. Increase the voltage gradually till break in gap takes place. Note the corresponding voltage.
3. Change the distance (Gap spacing between electrodes) and repeat the test as above.
4. Now repeat above procedure for rod-rod and point-point electrodes also.

Observation Table:

Temperature:_____ **Pressure:**_____

S.No.	Spacing Between Electrodes	Breakdown Voltage in kV		
		Disc-Disc	Rod- Rod	Point- Point
1.	1 cm			
2.	2 cm			
3.	3 cm			
4.	4 cm			
5.	5 cm			
6.	6 cm			

Result: The experiment shows that the Breakdown phenomenon in air depends on the shape of the electrodes. The graph between B.D.V. & Spacing for different electrodes is plotted.

Discussion:

1. What do you mean by Uniform field, weakly non-uniform field & sharply non-uniform field?
2. What do you mean by corona free termination?