Electrical Machines Lab (EE19BTECH11041)

Experiment - 2

Sumpner's (Back to Back) Test on 1 - Ø Transformer

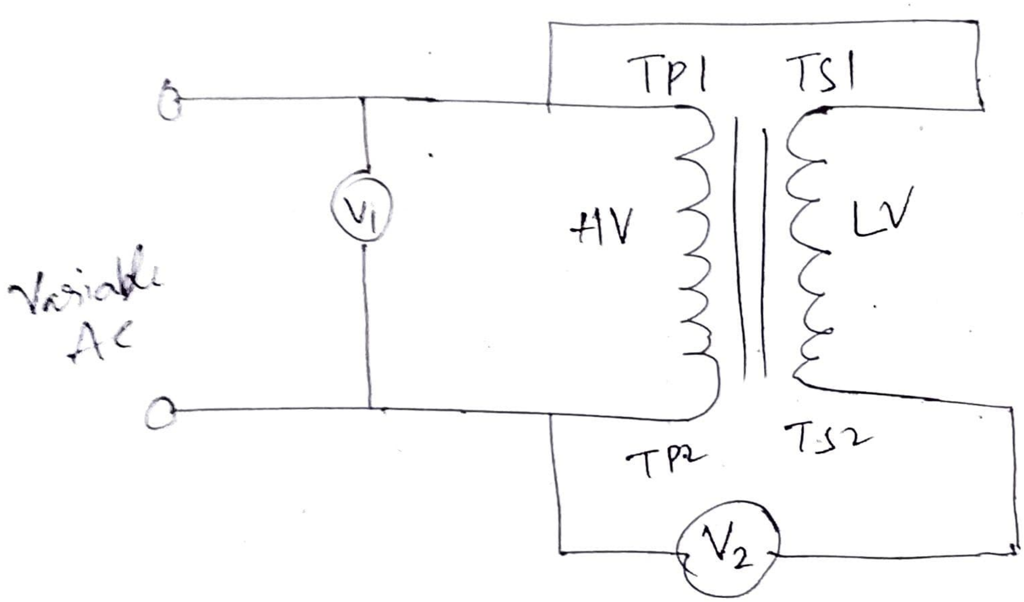
Aim:

An accurate estimation of transformer power loss is necessary to determine the maximum temperature rise in a transformer for various loading conditions. The required level of accuracy may not be achieved for the loss calculation based upon the equivalent circuit representation. On the other hand, a load test may not be feasible for a large transformer. The Sumpner's test is basically a useful way to accurately determine the power loss in a transformer.

procedure:

A polarity test should be performed before preparing the circuit arrangement for the Sumpner's test. To perform a polarity test, a voltage (not more than the rated voltage) should be applied across the HV side winding of the transformer.

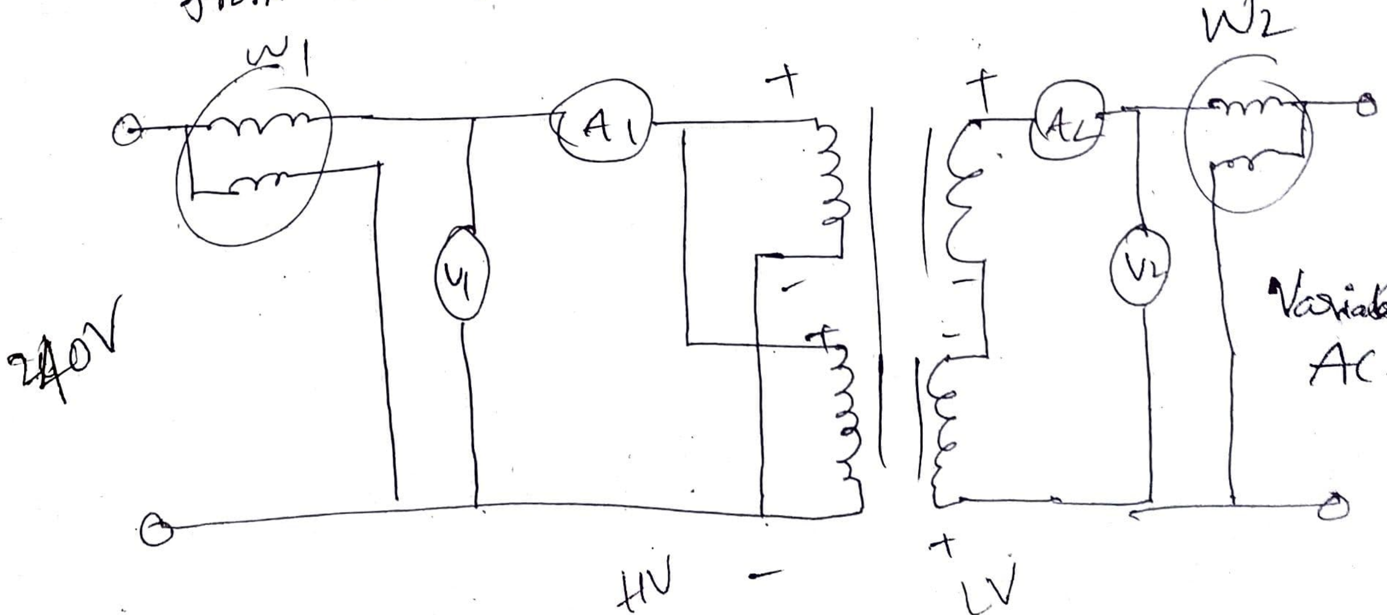
and the readings of voltmeter 1 and Voltmeter 2 are to be Observed. In the Case the reading of Voltmeter 2 is found to be lower than the reading of Voltmeter 1, terminals TP1 and TS1 (as well as TP2 and TS2) are of Same polarity. Otherwise, terminals TP1 and TS2 (as well as TP2 and TS1) Should be of Same polarity.



Circuit Arrangement for Transformer polarity test

Procedure:

For the Sumpner's test, establish x% of the rated current on the LV side by softly tuning the LV side input voltage. Note down all the meter readings. The copper loss in each of the transformers for particular load current is given by half of the power measured Wattmeter 2. Similarly, the iron loss in each of the transformers is given by half of the power measured by Wattemeter 1. Observed the transformer losses for 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% and 100% of the rated current. Compare the observed power loss with power losses calculated from the equivalent circuit.



Results and Discussions

R (reffered to LV side) = $1.251\ \Omega$

G_i (reffered to HV side) = 0.000195

$P_i = W_1/2$ = iron loss

$P_{cu} = W_2/2$ = copper loss

$P_{loss} = P_i + P_{cu} = \dfrac{W_1 + W_2}{2}$

P_i (calculated) = $I_{LV}^2 R$

P_{cu} (calculate) = $V_{HV}^2 G_i = (240)^2 (0.00019)$

$= 10.944\,W$

V_1 HV side Voltmeter	A_1 HV side Ammeter	V_2 LV side Voltmeter	A_2 LV side Ammeter	W_1 HV side Wattmeter	W_2 HV side Wattmeter	Observed loss	Calculated loss
240V	0.4A	2V	0.5	34W	0W	.17W	11.25
240V	〃	3V	1.09	34W	0W	17W	12.43
240V	〃	5V	1.5	34W	0W	17W	13.75
240V	〃	6V	1.97	34W	0W	17W	15.8
240V	〃	7V	2.5	34W	0W	17W	18.76
〃	〃	9V	3.28	34W	17W	25.5W	24.4
〃	〃	11V	3.83	34W	28W	31W	29.3
〃	〃						

Conclusion:

(1) The values calculated are less caccurate with Compared to Sumpner's test because of difference In Conditions when test; Here we observe both copper loss and iron loss in Same circuit which gives better results.

(2)

$$\eta = \frac{I_{sc} V_{sc}}{I_{sc} V_{sc} + \frac{W_1 + W_2}{2}}$$

$V_{sc} = 120\ V$

$$\%\ reg = \frac{V_{20} - V_{2fl}}{V_{2fl}} \times 100\ \%$$ (Not Sure)

load current	η (efficiency)	regulation
0.5	0.779	~~0.83%~~ 0.83%
1.09	0.88	~~1.25%~~ 1.25%
1.5	0.91	~~2.08%~~ 2.08%
1.97	0.93	~~2.5%~~ 2.5%
2.5	0.94	~~2.91%~~ 2.91%
3.28	0.939	~~3.75%~~ 3.75%
3.83	0.9368	~~4.6%~~ 4.6%

(2) in first experiment

At full Load

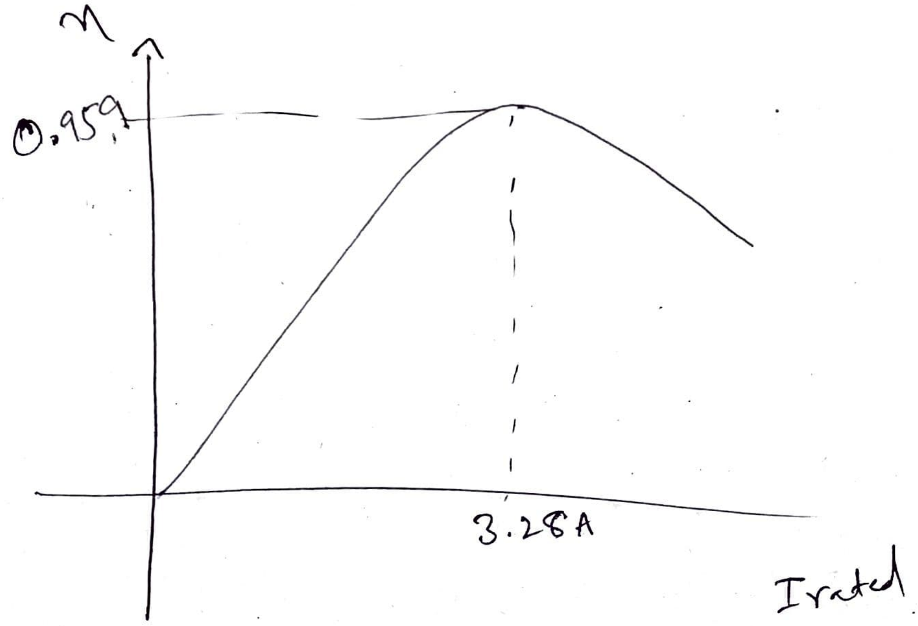
$$\eta = \frac{\cancel{\frac{400}{\sqrt{3}}} \cancel{\times 2.15} = 116 \times 4.03}{\frac{400}{\sqrt{3}} \times 2.15}$$

$$= \frac{467.48}{496.521} = 0.941$$

$\boxed{\text{Efficiency} = 0.941}$ At fL.

(3) The Sumpner's test is very practical, convenient efficent and minimum power consumption. without actual loading (heat run test).

(4) (a)



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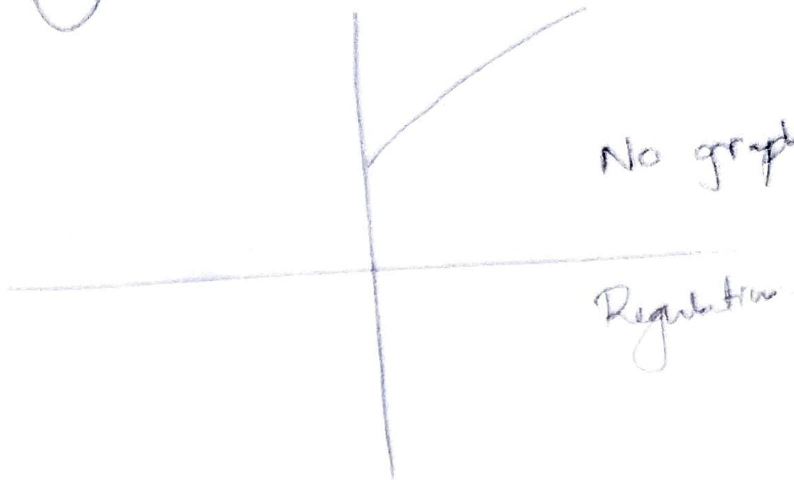
b



Not really sure regulation applies here.