WARSAW UNIVERSITY OF TECHNOLOGY
INSTITUTE OF ELECTRICAL MACHINES
ELECTRICAL MACHINES LABORATORY

3-PHASE TRANSFORMER TESTS (TR2)

5. LOAD CHARACTERISTIC U_2=f(I_2) for p.f.=const

The transformer is supplied from the higher voltage side (Y). The secondary is loaded by a variable 3-phase symmetrical resistor. Connection diagram as in p. 2 with a voltmeter and 3 ammeters added at secondary side. The ranges of meters should correspond to the load test.

During test the supplying voltage should be kept constant and equal to its rated value. The value of R_{load} should be varied in such a manner as the secondary current value would cover the range (0;I_{2N}).

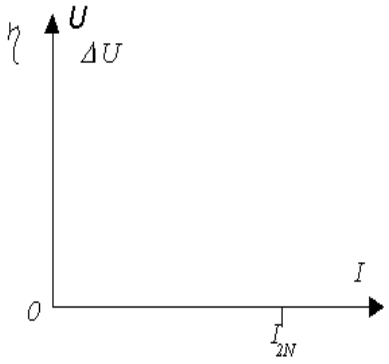
U_1=.... p.f.=1

No of read.	I_{1A}	I_{1B}	I_{1C}	I_{2A}	I_{2B}	I_{2C}	U_2	I_1	I_2	ΔU	η
	A	A	A	A	A	A	V	A	A	V	%
1											
2											
3											
...											

$$I_1 = \frac{I_{1A} + I_{1B} + I_{1C}}{3}; \quad I_2 = \frac{I_{2A} + I_{2B} + I_{2C}}{3}; \quad \Delta U = U_{20} - U_2$$

Efficiency value in per-cent can be calculated from the relation:

$$\eta = \frac{P_2}{P_1} \times 100\% = \frac{P_2}{P_2 + \Sigma\Delta P} \times 100\% = \frac{\sqrt{3}U_2 I_2}{\sqrt{3}U_2 I_2 + \left(\frac{I_1}{I_{1N}}\right)^2 P_{CuN} + P_{FeN}} \times 100\%$$



In common coordinates, draw the characteristics:

U_2, ΔU, η = f(I_2)

Basing on the results of measurements already performed, calculate per-cent values of the voltage regulation (voltage drop) for the following cases:

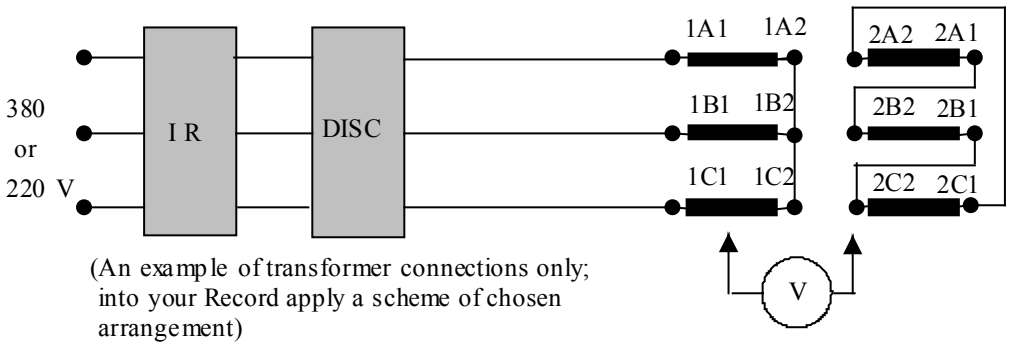
- $\Delta U_{\%}$ for cosφ$_2$ =1 (compare calculations with measurement results)
- $\Delta U_{\%}$ for cosφ$_2$ = 0.8 lag.
- $\Delta U_{\%}$ for cosφ$_2$ = 0.5 lead.

6. MEASUREMENT OF VOLTAGE RATIO AND GROUP OF CONNECTIONS TEST

6.1. Voltage ratio

Transformer should be connected into chosen 3-phase arrangement (Yy, Yd, Dy or Dd) and supplied from higher voltage side through induction regulator (IR). By means of the voltmeter do the measurement of corresponding voltages of higher and lower voltage sides for three different values of supplying voltage (U_1 not higher than U^*_N where U^*_N is rated voltage for chosen arrangement).

On the basis of determined K_{av} for chosen and tested arrangement calculate the values of voltage ratios for another possible connections as to have ratios for Yy, Yd, Dy, Dd known.



(An example of transformer connections only; into your Record apply a scheme of chosen arrangement)

No of read.	MEASUREMENTS						CALCULATIONS			
	$U_{1A1-1B1}$	$U_{1A1-1C1}$	$U_{1B1-1C1}$	$U_{2A1-2B1}$	$U_{2A1-2C1}$	$U_{2B1-2C1}$	U_{1av}	U_{2av}	K	K_{av}
	V	V	V	V	V	V	V	V	-	-
1										
2										
3										

6.2. Group of connections

Having your transformer connected as in p. 6.1. decide which terminals will be recognised as 1A, 1B, 1C and 2A, 2B, 2C and then connect two terminals 1A and 2A respectively. Supply the transformer with voltage U_1=100 V (or other) and measure the following voltages:

U_{1A-1B}=.... U_{2A-2B}=.... U_{1B-2B}=....
U_{1B-2C}=.... U_{1C-2B}=.... U_{1C-2C}=....

At the sheet of drawing paper, applying appropriate scale, draw the triangles (phasor diagrams) of the voltages of higher and lower sides (not forgetting about connection 1A-2A), in order that triangles position confirms measured values of voltages. On the basis of the diagram determine the group of connections.

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