Extra Questions from Lab 2

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Contents

1 Balanced Load, Lagging Power Factor

1.1 Question 5

Compare your results in Table 2.1 and Table 2.5 and give your comments.

Quantity	Table 2.1	Measured in Lagging	Difference (%)
$\|V_{AN}\|$	150.0 V	149.9 V	0.067
$\|V_{AB}\|$	259.8 V	262.8 V	1.142
$\|V_{BC}\|$	259.8 V	264.6 V	1.814
$\|I_A\|$	1.778 A	1.790 A	0.671
$\|I_B\|$	1.778 A	1.802 A	1.332
$\|I_C\|$	1.778 A	1.810 A	1.768
P_A	225 W	450 W	50.00
P_C	225 W	235 W	4.255
P	450 W	685 W	34.31
Q	0 var	372.39 var	∞
pf_A	1 (?)	0.998	0.200
pf_C	1 (?)	0.508	96.85

The voltages and currents were similar to those predicted before the lab. But parameters related to power were either poorly measured or poorly predicted (poorly predicted is more likely).

Because the team assumed a positive phase sequence in experimentation, wattmeter measurements were made over the wrong phase. It is listed as C phase, but because of the negative phase sequence of the bench, it is actually B phase. Because of this, our two-wattmeter-method is very likely wrong and the power measurements would ideally be redone.

2 Balanced Load, Unity Power Factor

2.1 Question 6

Compare your results in Table 2.2 and Table 2.6 and give your comments.

Quantity	Table 2.2	Measured in Unity	Difference (%)
$\|I_A\|$	1.5 A	1.581 A	5.122
$\|I_B\|$	1.5 A	1.586 A	5.422
$\|I_C\|$	1.5 A	1.599 A	6.191
P_A	337.5 W	341 W	1.026
P_C	337.5 W	363 W	7.025
P	675.0 W	704 W	4.119
Q	0 var	-38.11 var	∞

The currents I_B and I_C were not in the original Table 2.2 but assumedly they would also be of magnitude 1.5 Amperes in a balanced load with unity power factor.

Measurements were very close to predicted, however measuring the percentage difference to a quantity that should be zero gives an inifinite difference, though only -38 var is a small enough amount to be due to imperfect elements used in the experiment (as opposed to the ideal ones used in the calculations).

3 Balanced Load, Leading Power Factor

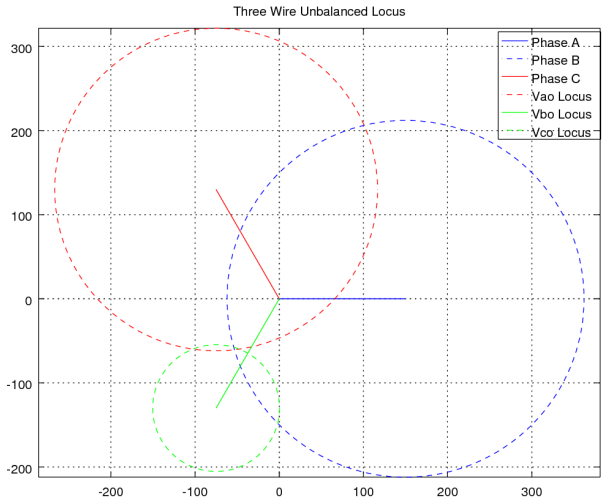
3.1 Nil

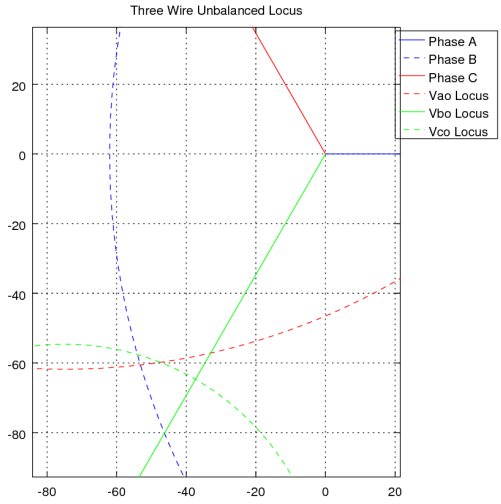
All questions were answered in the provided lab document.

4 Unbalanced Three-Wire Circuit

4.1 Question 6

Use a graphical method for determining V_{AO}, V_{BO} and V_{CO} from $|V_{AO}|$, $|V_{BO}|$ and $|V_{CO}|$ and compare results with those of Table 2.4





Looking at the loci closely, it can be seen that V_{ON} can be approximated graphically by:

$$\|V_{ON}\| = \sqrt{(-50)^2 + (-60)^2)} = 78.102V$$
$$\theta_{von} = 180 + \tan^{-1}\left(\frac{-60}{-50}\right) = 230.194^oV$$

Graphical calculations:

$$V_{AO} = V_{AN} - V_{ON} = 150\angle 0^o - 78.102\angle 230.194^o = 208.806\angle 16.699^o$$

$$V_{BO} = V_{BN} - V_{ON} = 150\angle 120^o - 78.102\angle 230.194^o = 191.541\angle 97.499^oV$$

$$V_{CO} = V_{CN} - V_{ON} = 150\angle 240^o - 78.102\angle 230.194^o = 74.2404\angle -109.67^oV$$

Value	Table 2.4	Measured	Graphical
V_{on}	214.337 ∠127.134	-	78.102 ∠230.194
V_{ao}	327.502 ∠-31.4	$\|212.7\|$	$208.806\angle 16.699^o$
V_{bo}	68 ∠-36.98	$\|75.4\|$	191.541 $\angle 97.499^o$
V_{co}	225 ∠76.04	$\|192.7\|$	74.2404 $\angle$-109.67^o

4.2 Question 8

Give your comments and conclusions.

It would seem that the calculations were all done assuming positive phase sequence, but the bench itself instead had negative phase sequence. This can be deduced from the above table in the interchanged magnitudes of the B and C line.

Besides this experimental mishap, it can be seen that an unbalanced three phase circuit can give widely varying circuit parameters. Even just slight change in parameters at the load can cause large variations between phases.

5 Unbalanced Four-Wire Circuit

5.1 Question 6

Use a phasor diagram to determine the expected value of $|I_{ON}|$ and compare this to the measured value.

Value	Measured (Absolute Value)	Graphical
I_O	1.688	Not Performed
I_{AO}	0.904	Not Performed
I_{BO}	1.516	Not Performed
I_{CO}	1.528	Not Performed

5.2 Question 8

Give your comments and conclusions.