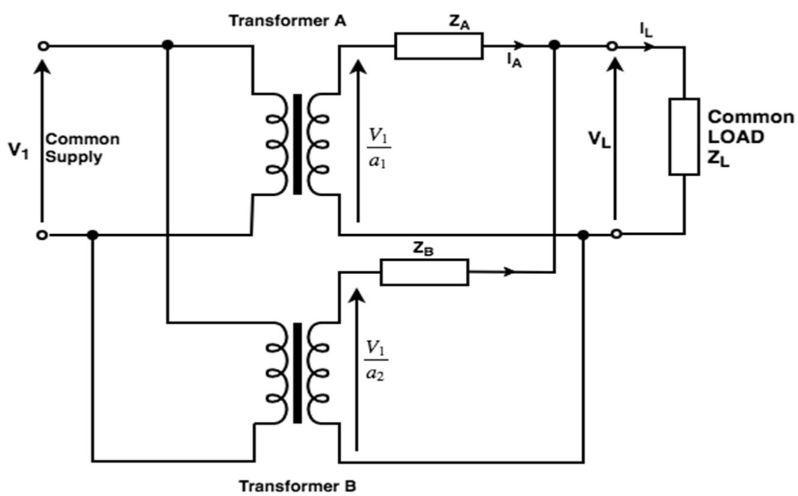
Title of the Exercise: To operate two transformers in parallel and find their load sharing

Date: 9/11/2020

Aim: To operate two transformers in parallel and find their load sharing

Tool used : MATLAB

Electrical Circuit:



Parameters used for the study

Transformer rating = 50KVA
V_1=2400V (primary voltage in Rms)
V_2=240V (Secondary voltage in Rms)
Frequency f=50 Hz

1st Transformer Parameters	2nd Transformer Parameters
R_1 = 0.7488 ohm (Primary winding resistance)	R_1= 1.3 ohm (Primary winding resistance)
X_{11} = 1.00224 ohm (Primary winding reactance)	X_{11}= 3 ohm (Primary winding reactance)
R_2= 0.007488 ohm (Secondary winding resistance)	R_2= 0.002 ohm (Secondary winding resistance)
X_{12} = 0.0100224 ohm (Secondary winding reactance)	X_{12} = 0.03 ohm (Secondary winding reactance)
X_M = 5,008 ohm (Magnetizing reactance)	X_M = 5,008 ohm (Magnetizing reactance)
R_c = 33,391 ohm (Resistance for core losses)	R_c = 33,391 ohm (Resistance for core losses)

Theoretical Analysis

Calculate the values of IAC and IBC by given formulae

$$I_{AC} = \frac{Z_B}{Z_A + Z_B} I_{load}$$

$$I_{BC} = \frac{Z_A}{Z_A + Z_B} I_{load}$$

$I_{AC} \simeq I_A$ & $I_{BC} \simeq I_B$
Z_A = Equivalent impedence of Transformer 1 referred to secondary side.
Z_B = Equivalent impedence of Transformer 2 referred to secondary side.

Calculations:

1st Transformer(K=0.1)
R1=0.788ohm
R1'= 78.88ohm(R1' = $R1/K^2$)

Similarly
X11=1.0024ohm
X1'=100.224ohm

R2=0.00748ohm
X12=0.010028

2nd Transformer(K=1/10)
R1=1.3ohm
R1'=130ohm(R1' = $R1/K^2$)

Similarly
X11=3 ohm
X1'=300 ohm

R2=0.002 ohm
X12=0.03

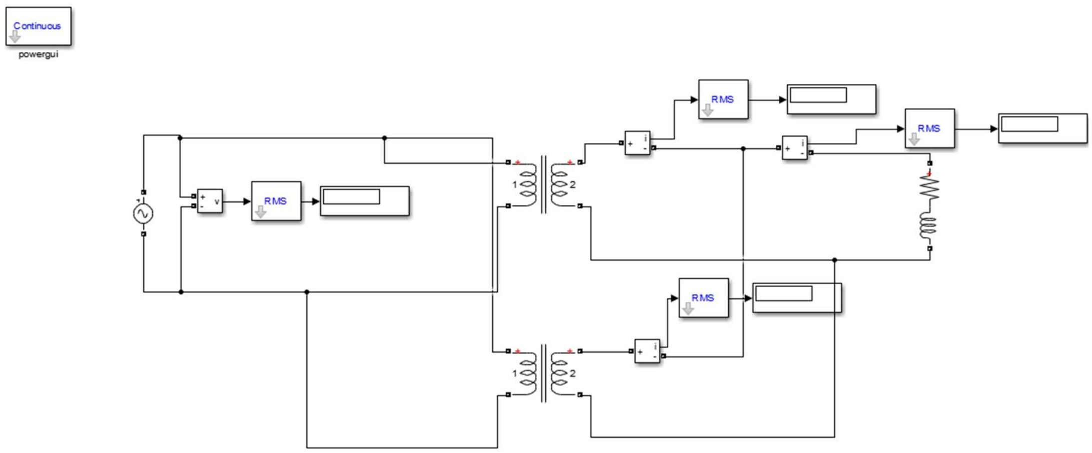
$Za= \{(0.007488+74.88)^2 +(0.010024+100.224)^2\}^{1/2} = 125.12$ohm

$Zb= \{(130+0.02)^2 +(300+0.03)^2\}^{1/2} = 326.984$ohm

Procedure for simulation study

- Write the coding for initializing the input parameters and as per requirement of plots in m file and save it.
- Open new Simulink file and make mathematical modelling as per circuit diagram and save it.
- Run the m file first, after that run Simulink file.
- View the result in Scope.
- Again, run m file and view the plots.
- Make various plots and write the results.

Simulation Diagram



Results and Discussions

S.No.	V_{load}	I_{load}	I_a	I_b	I_{ac}	I_{bc}	Z_L	
							R_L	L_L
1	127.3	121.4	88.29	33.82	87.80	33.597	1	0.001
2	209.8	41.88	30.47	11.65	30.29	11.59	5	0.001
3	233.1	7.426	5.402	2.07	5.371	2.055	20	0.1
4	239	0.7637	0.5562	0.2173	0.552	0.2113	5	1
5	240.1	0.2551	0.1872	0.0771	0.1845	0.0706	20	3

Comparisions

In case 2

$$I_{AC} = \frac{Z_B}{Z_A + Z_B} I_{load}$$

⇨ 41.88*326.984/(125.12+326.984)=30.29A

$$I_{AC} = \frac{Z_B}{Z_A + Z_B} I_{load}$$

⇨ 41.88*125.12/(125.12+326.984)=11.59A

Hence:

$I_{AC} \simeq I_A$ & $I_{BC} \simeq I_B$

Conclusion Parallel operation of transformers and their load sharing is done successfully.
Inference $I_{AC} \simeq I_A$ & $I_{BC} \simeq I_B$ Is achieved successfully.
References NIL