About voltage regulation in lab «**The research of the single-phase two winding transformer**»

In this little note I'll give an example of one of the possible ways to perform this part of the lab successfully.

1.Preparations

1.1 Consider the follows results of short-circuit and open-circuit test

```
% Open-circuit results
V1oc = 2400;
V2oc = 246.4;
Ioc = 0.2262;
Poc = 149.8;

% Short-circuit results
Vsc=292;
Isc=10.42;
Psc=438.3;
```

1.2 Turns ratio is calculated as follows

```
% Turns ratio
a = V1oc / V2oc;
```

1.3 Power factor in short circuit test

```
% Short-circuit power factor
PFsc = Psc / (Vsc * Isc);
sin_sc = sqrt(1 - PFsc^2);
```

2. Calculation of the voltage regulation from model

2.1 Consider the follows results of load tests:

R-load:

```
% Values for R-Load:
R1 = [2.2 2.3 2.4 2.5 2.6 3 4 5 7 10]; % ohm
% Simulate the model with each value of the R-load and then add the
% following parameters to m-file for each test:
U1_R = [2400 2400 2400 2400 2400 2400 2400 2400 2400 2400];
U2_R = [239.7 240 240.4 240.7 240.9 241.8 243.1 243.9 244.7 245.2];
I1_R = [11.27 10.8 10.37 9.967 9.597 8.357 6.319 5.085 3.665 2.594];
I2_R = [108.9 104.4 100.1 96.26 92.66 80.6 60.78 48.78 34.95 24.52];
P1_R = [26760 25660 24640 23710 22840 19910 15080 12140 8752 6188];
P2_R = [26100 25050 24070 23160 22320 19490 14780 11890 8551 6013];
```

RL-load:

```matlab
% Values for R-Load:
R2 = [1.65 1.73 1.8 1.88 1.95 2.25 3 3.75 5.25 7.5]; % ohm
L = [3.86 4.03 4.21 4.39 4.56 5.26 7.02 8.77 12.28 17.54]; %mH
% Simulate the model with each value of the RL-load and then add the
% following parameters to m-file for each test:
U1_RL = [2400 2400 2400 2400 2400 2400 2400 2400 2400 2400];
U2_RL = [222.8 223.8 224.6 225.5 226.2 228.7 233 235.6 238.6 240.9];
I1_RL = [10.57 10.16 9.787 9.42 9.111 8.008 6.156 5.015 3.677 2.651];
I2_RL = [101.2 97.19 93.59 90.02 87 76.26 58.23 47.12 34.09 24.09];
P1_RL = [17490 16880 16280 15720 15230 13480 10460 8566 6296 4526];
P2_RL = [16910 16340 15760 15230 14760 13090 10170 8325 6099 4353];
```

RC-load:

```matlab
% Values for RC-Load:
R3 = [1.94 2.02 2.11 2.2 2.29 2.64 3.52 4.4 6.16 8.8]; %ohm
C = [2.54 2.43 2.33 2.23 2.29 1.86 1.39 1.12 0.8 0.56]; %mF
% Simulate the model with each value of the RC-load and then add the
% following parameters to m-file for each test:
U1_RC = [2400 2400 2400 2400 2400 2400 2400 2400 2400 2400];
U2_RC = [256 255.8 255.4 255.1 254.1 253.8 252.2 251.1 249.8 248.8];
I1_RC = [11.92 11.43 10.93 10.46 10.16 8.671 6.448 5.139 3.645 2.536];
I2_RC = [116.2 111.4 106.5 102 99.01 84.6 62.98 50.24 35.71 24.89];
P1_RC = [26920 25740 24580 23490 23020 19350 14280 11370 8058 5630];
P2_RC = [26190 25060 23940 22890 22450 18890 13960 11110 7852 5453];
```

2.2 Voltage regulation:

```matlab
voltage_regulation_mod_R = (V2oc * ones(1,10) - U2_R)./ U2_R * 100;

voltage_regulation_mod_RL = (V2oc * ones(1,10) - U2_RL)./ U2_RL * 100;

voltage_regulation_mod_RC = (V2oc * ones(1,10) - U2_RC)./ U2_RC * 100;
```

3. Calculation of the voltage regulation from theory, short-circuit and open-circuit tests

R-load:

```matlab
load_ratio_R = I2_R ./ I2;
voltage_regulation_calc_R = (V2oc - (V2oc * ones(1,10) - (load_ratio_R * Vsc / a) * (PFsc))) ./ U2_R * 100;
```
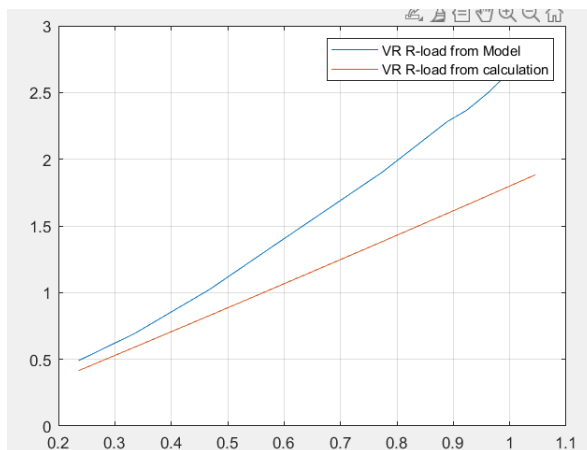
RL-load:

```
load_ratio_RL = I2_RL ./ I2;
RL_load_PF = P2_RL ./ (I2_RL .* U2_RL);
RL_load_sinPF = sqrt(1 - RL_load_PF.^2);
voltage_regulation_calc_RL = (V2oc - (V2oc * ones(1,10) - (load_ratio_RL * Vsc / a) ...
    .* (PFsc * RL_load_PF + sin_sc * RL_load_sinPF))) ./ U2_RL * 100;
```
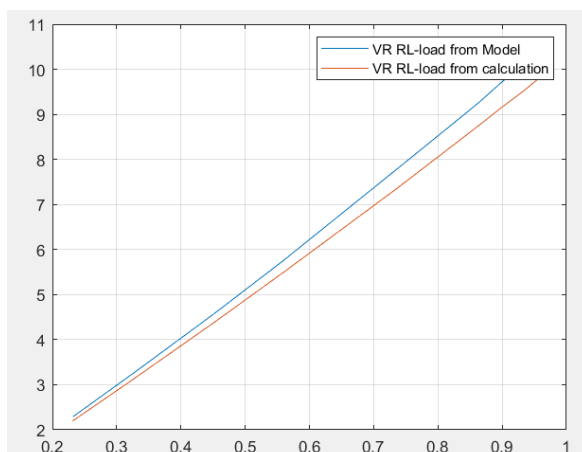
RC-load:

```
load_ratio_RC = I2_RC ./ I2;
RC_load_PF = P2_RC ./ (I2_RC .* U2_RC);
RC_load_sinPF = sqrt(1 - RC_load_PF.^2);
voltage_regulation_calc_RC = (V2oc - (V2oc * ones(1,10) - (load_ratio_RC * Vsc / a) ...
    .* (PFsc * RC_load_PF - sin_sc * RC_load_sinPF))) ./ U2_RC * 100;
```

4. Figures.

R-load:

RL-load:

RC-load: