

ECE 320: Lecture 11

Notes

- New homework and lab assignments passed out

Transformer test data example: 20 kVA, 8000/240V transformer:

Open circuit test (on primary)

$$V_{oc} := 8000V$$

$$V_{sc} := 489V$$

$$I_{oc} := 0.214A$$

$$I_{sc} := 2.5A$$

$$P_{oc} := 400W$$

$$P_{sc} := 240W$$

$$N_2 := 240$$

$$N_1 := 8000$$

$$Z_{series} := \frac{V_{sc}}{I_{sc}} \quad Z_{series} = 195.6 \Omega$$

$$R_{series} := \frac{P_{sc}}{I_{sc}^2} \quad R_{series} = 38.4 \Omega$$

$$X_{series} := \sqrt{Z_{series}^2 - R_{series}^2} \quad X_{series} = 191.79 \Omega$$

If assume $Z_1 = Z_2'$

$$R_1 := \frac{R_{series}}{2} \quad R_2 := R_1 \cdot \left(\frac{N_2}{N_1}\right)^2 \quad R_2 = 0.0173 \Omega$$

$$X_1 := \frac{X_{series}}{2} \quad X_2 := X_1 \cdot \left(\frac{N_2}{N_1}\right)^2 \quad X_2 = 0.0863 \Omega$$

Alternate method with same results:

$$\theta_{sc} := \arccos\left(\frac{P_{sc}}{V_{sc} \cdot I_{sc}}\right) \quad R_{seriesAlt} := Z_{series} \cdot \cos(\theta_{sc}) \quad R_{seriesAlt} = 38.4 \Omega$$

$$\theta_{sc} = 78.68 \text{ deg} \quad X_{seriesAlt} := Z_{series} \cdot \sin(\theta_{sc}) \quad X_{seriesAlt} = 191.79 \Omega$$

$$R_c := \frac{V_{oc}^2}{P_{oc}} \quad R_c = 160 \text{ k}\Omega$$

$$Z_{oc} := \frac{V_{oc}}{I_{oc}} \quad Z_{oc} = 37.38 \text{ k}\Omega$$

$$Z_{oc} = \frac{R_c \cdot (j \cdot X_m)}{R_c + j \cdot X_m} \quad \text{or} \quad |Z_{oc}| = \frac{R_c \cdot X_m}{\sqrt{R_c^2 + X_m^2}}$$

You can solve for X_m :

$$X_m := 100000 \text{ ohm}$$

Given

$$Z_{oc} = \frac{R_c \cdot X_m}{\sqrt{R_c^2 + X_m^2}}$$

$$X_{m1} := \text{Find}(X_m) \quad X_{m1} = 38.45 \text{ k}\Omega$$

Alternate Approach:

$$Y_{oc} := \frac{I_{oc}}{V_{oc}} \quad Y_{oc} = 2.67 \times 10^{-5} \text{ S}$$

$$\theta_{oc} := \text{acos}\left(\frac{P_{oc}}{V_{oc} \cdot I_{oc}}\right) \quad \theta_{oc} = 76.49 \text{ deg}$$

$$R_c := \frac{1}{Y_{oc} \cdot \cos(\theta_{oc})} \quad R_c = 160 \text{ k}\Omega$$

$$X_m := \frac{1}{Y_{oc} \cdot \sin(\theta_{oc})} \quad X_m = 38.45 \text{ k}\Omega$$