Supplementary figures and equations:

magnetic field:

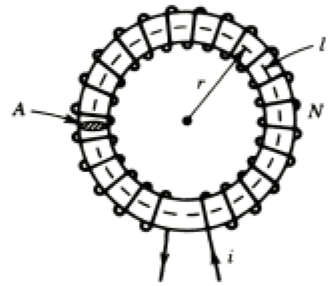


Fig .1

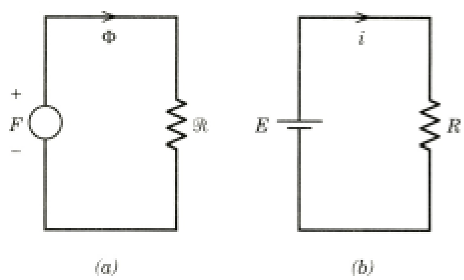


Fig 2

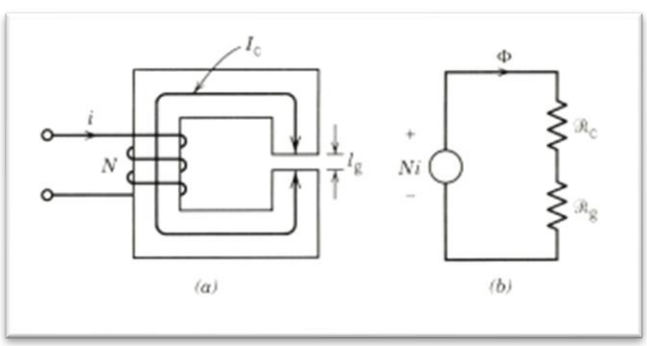


Fig 3

$$\Phi = \frac{Ni}{\mathscr{R}_c + \mathscr{R}_g} \tag{1.17}$$

$$Ni = H_c l_c + H_g l_g \tag{1.18}$$

where l_c is the mean length of the core
l_g is the length of the air gap

The flux densities are

$$B_c = \frac{\Phi_c}{A_c} \tag{1.19}$$

$$B_g = \frac{\Phi_g}{A_g} \tag{1.20}$$

Fig 4

Transformer

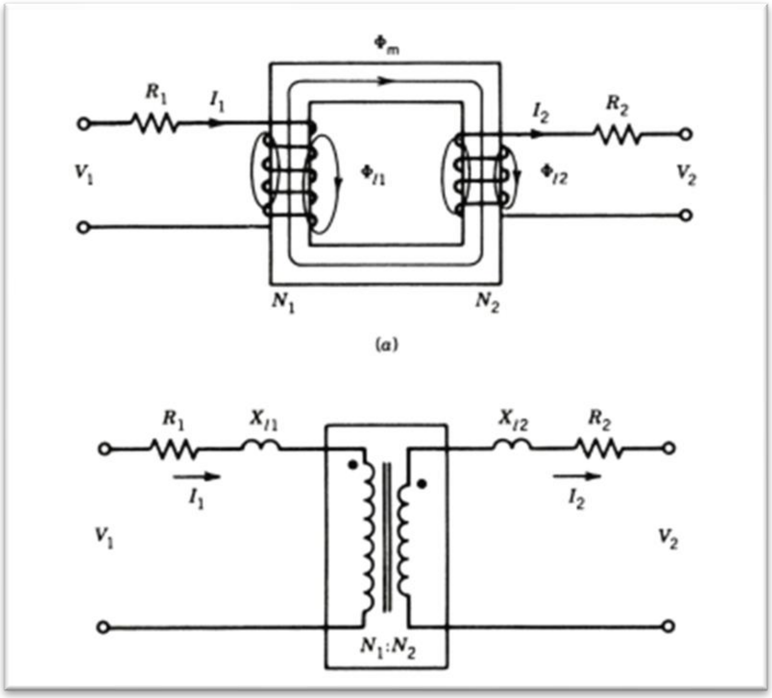


Fig 1

$$\frac{V_1}{V_2} = \frac{N_1}{N_2} = a \tag{2.8}$$

$$\frac{I_1}{I_2} = \frac{N_2}{N_1} = \frac{1}{a} \tag{2.9}$$

$$\underbrace{V_1 I_1}_{\text{input volt-amperes}} = \underbrace{V_2 I_2}_{\text{output volt-amperes}} \tag{2.10}$$

2.1.1 IMPEDANCE TRANSFER

Consider the case of a sinusoidal applied voltage and a secondary impedance Z_2, as shown in Fig. 2.7*a*.

$$Z_2 = \frac{V_2}{I_2}$$

The input impedance is

$$Z_1 = \frac{V_1}{I_1} = \frac{aV_2}{I_2/a} = a^2 \frac{V_2}{I_2}$$
$$= a^2 Z_2 \tag{2.11}$$

Fig 2

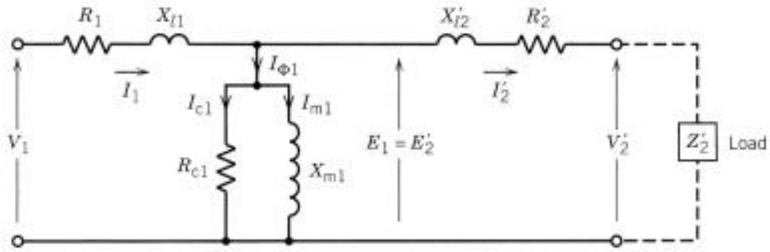
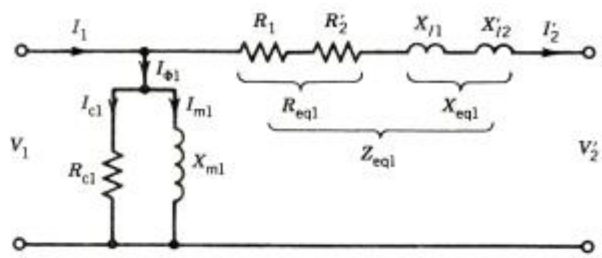
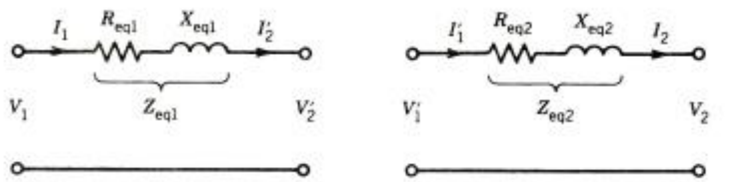


Fig 3



(*a*) $V'_2 = aV_2, \quad I'_2 = I_2/a$



(*b*) Referred to side 1, $Z_{eq1} = R_{eq1} + jX_{eq1}$ (*c*) Referred to side 2, $Z_{eq2} = R_{eq2} + jX_{eq2}$

$$R_{eq2} = \frac{R_{eq1}}{a^2} = R_2 + R'_1$$

$$X_{eq2} = \frac{X_{eq1}}{a^2} = X_{l2} + X'_{l1}$$

$$V'_1 = \frac{V_1}{a}, \quad I'_1 = I_2 = aI_1$$

Fig 4