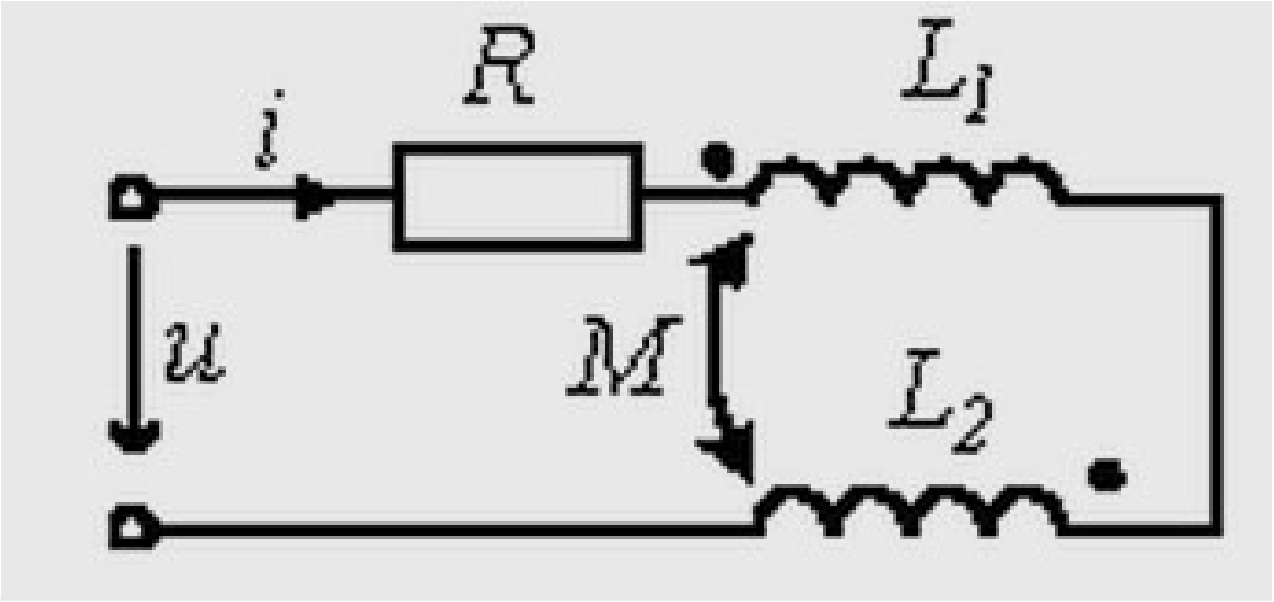
Электротехника и электроника

Цепи с взаимной индуктивностью

Коэффициент связи

$$\kappa = \frac{M}{\sqrt{L_1 L_2}}$$

$$i = I_m \sin \omega t$$



$$e_1 = -L_1 \frac{di}{dt} - M \frac{di}{dt} = -(\omega L_1 + \omega M) I_m \cos \omega t$$

$$e_2 = -L_2 \frac{di}{dt} - M \frac{di}{dt} = -(\omega L_2 + \omega M) I_m \cos \omega t$$

$$\dot{E}_1 = -j\omega L_1 \dot{I} - j\omega M \dot{I} = -jX_{L1}\dot{I} - jX_M \dot{I} = \dot{E}_{1L} + \dot{E}_{1M}$$

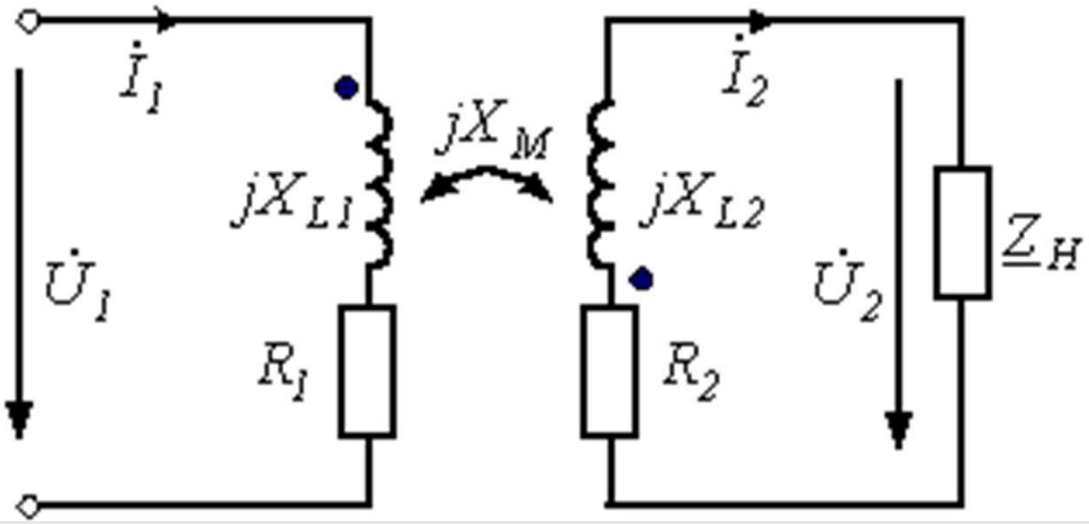
$$\dot{E}_2 = -j\omega L_2 \dot{I} - j\omega M \dot{I} = -jX_{L2}\dot{I} - jX_M \dot{I} = \dot{E}_{2L} + \dot{E}_{2M}$$

$$\dot{U} + \dot{E}_1 + \dot{E}_2 = \dot{U} + \dot{E}_{1L} + \dot{E}_{1M} + \dot{E}_{2L} + \dot{E}_{2M} =$$

$$= \dot{U} - j\omega(L_1 + L_2 + 2M)\dot{I} = R\dot{I}$$

$$\dot{I} = \frac{\dot{U}}{R + j\omega(L_1 + L_2 + 2M)}$$

Воздушный трансформатор



$$\dot{U}_1 = R_1\dot{I}_1 - \dot{E}_1 = R_1\dot{I}_1 - \left(-jX_{L1}\dot{I}_1 - jX_M\dot{I}_2\right) =$$

$$= \left(R_1 + jX_{L1}\right)\dot{I}_1 + jX_M\dot{I}_2$$

$$\dot{E}_2 = -jX_{L2}\dot{I}_2 - jX_M\dot{I}_1 = \dot{I}_2R_2 + \dot{I}_2\underline{Z}_H$$

Воздушный трансформатор

$$\dot{U}_1 = (R_1 + jX_{L1})\dot{I}_1 + jX_M\dot{I}_2$$

$$0 = jX_M\dot{I}_1 + (R_2 + jX_{L2})\dot{I}_2 + \dot{U}_2$$

$$\dot{U}_2 = \dot{I}_2 \underline{Z}_H$$

$$\dot{U}_2 = \dot{I}_2 (R_H + jX_H)$$

$$R_{22} = R_2 + R_H \; ; \; X_{22} = X_{L2} + X_H$$

$$\dot{I}_1 = \frac{\dot{U}_1}{(R_1 + R_{BH}) + j(X_{L1} - X_{BH})}$$

$$R_{BH} = X_M^2 R_{22} / \left(R_{22}^2 + X_{22}^2\right)$$

$$X_{BH} = X_M^2 X_{22} / \left(R_{22}^2 + X_{22}^2\right)$$