Gleichstrom:

$$P = U \cdot I = I^2 \cdot R = \frac{U^2}{R}$$

$$P_{max} = \frac{Q_q^2}{4 \cdot R_i}$$

$$R = R_{20} \left(1 + \alpha_{20} \cdot \Delta\vartheta\right)$$

$$R = R_{20} \left(1 + \alpha_{20} \cdot \Delta\vartheta + \beta_{20}\Delta\vartheta^2\right)$$

$$I_2 = I_0 \frac{G_2}{\Sigma G} = I_0 \frac{G_2}{G_1 + G_2} = I_0 \frac{R_1}{R_1 + R_2}$$

$$U_2 = U_0 \frac{R_2}{\Sigma R} = U_0 \frac{R_2}{R_1 + R_2}$$

$$\frac{U_2}{U_0} = \frac{1}{\frac{R_1}{R_2} + 1}$$

$$\frac{I_2}{I_L} = \frac{R_L}{R_2} = \frac{U_2}{U_0} \cdot \frac{U_0 - U_{20}}{U_{20} - U_0}$$

$$U_2 = U_0 \frac{1}{R_1 \left(\frac{1}{R_2} + \frac{1}{R_L}\right) + 1}$$

$$R_{12\curlywedge} = \frac{R_{1\triangle} \cdot R_{2\triangle}}{\Sigma R}$$

$$G_{12\triangle} = \frac{G_{1\curlywedge} \cdot G_{2\curlywedge}}{\Sigma G}$$

Strömungsfeld

$$S = \frac{I}{A}$$

$$\vec{S} = \kappa \vec{E} = \frac{\vec{E}}{\rho}$$

$$I = \vec{S} \cdot \vec{A}$$

Elektrostatisches Feld:

$$E = \frac{U}{d}$$

$$E = \frac{Q}{\varepsilon \cdot A}$$

$$R = \frac{1}{G} = \frac{U}{I} = \frac{\rho \cdot l}{A} = \frac{l}{\kappa \cdot A}$$

$$D = \frac{Q}{A}$$

$$\vec{D} = \varepsilon_0 \varepsilon_r \vec{E}$$

$$F = Q \cdot E$$

$$\varepsilon_0 = 8,86 \cdot 10^{-12}$$

$$C = \frac{Q}{U}$$

$$C = \frac{\varepsilon_0 \varepsilon_r \cdot A}{d} = \frac{D \cdot A}{E \cdot d}$$

$$\frac{1}{C_{Reihe}} = \frac{1}{C_1} + \frac{1}{C_2}$$

$$C_{Parallel} = C_1 + C_2$$

$$W = \frac{1}{2} \cdot U \cdot Q = \frac{1}{2} \cdot C \cdot U^2 = \frac{1}{2} \frac{Q^2}{C}$$

$$\vec{F} = Q \cdot \vec{E}$$

Koaxial-Kabel

$$R_{iso} = \frac{\ln\left(r_a / r_i\right)}{\kappa \cdot 2 \cdot \pi \cdot l}$$

$$C = \frac{\varepsilon_0 \varepsilon_r 2\pi l}{\ln\left(r_a / r_i\right)}$$

$$E = \frac{U/r}{\ln\left(r_a / r_i\right)}$$

$$U_{12} = U \frac{\ln\left(r_2 / r_1\right)}{\ln\left(r_a / r_i\right)}$$

$$C = \frac{\varepsilon_0 2\pi l}{\frac{\ln(r_a/r_i)}{\varepsilon_{r1}} + \frac{\ln(r_2/r_1)}{\varepsilon_{r2}}}$$

$$E_{rn} = \frac{U}{\varepsilon_{rn} r_n \left(\frac{\ln(r_1/r_i)}{\varepsilon_{r1}} + \frac{\ln(r_2/r_1)}{\varepsilon_{r2}}\right)}$$

konzentrische Kugeln

$$R_{iso} = \frac{1/r_i - 1/r_a}{\kappa 4\pi}$$

$$C = \frac{\varepsilon_0 \varepsilon_r 4\pi}{1/r_i - 1/r_a}$$

$$E = \frac{U/r^2}{1/r_i - 1/r_a}$$

$$U_{12} = U \frac{1/r_1 - 1/r_2}{1/r_i - 1/r_a}$$

$$C = \frac{\varepsilon_0 4\pi}{\frac{1/r_i - 1/r_1}{\varepsilon_{r1}} + \frac{1/r_1 - 1/r_2}{\varepsilon_{r2}}}$$

$$E_n = \frac{U}{\varepsilon_{rn} r_n \left(\frac{1/r_i - 1/r_1}{\varepsilon_{r1}} + \frac{1/r_1 - 1/r_2}{\varepsilon_{r2}}\right)}$$

R von Scheibe oder Tunnel:

$$R = \frac{p \cdot 2\pi}{\kappa \cdot l \cdot \ln\left(r_a / r_i\right)} \quad p = \frac{\alpha}{2\pi}$$

Kondensator:

$$\tau = R \cdot C = \frac{\varepsilon_0 \varepsilon_r}{\kappa} = \rho \varepsilon_0 \varepsilon_r$$

$$W = \frac{1}{2}CU^2$$

$$i_c = C\frac{\mathrm{d}u}{\mathrm{d}t}$$

Aufladen:

$$u_C = U_0\left(1 - e^{-t/\tau}\right)$$

$$i_C = I_0 \cdot e^{-t/\tau}$$

Entladen:

$$u_c = U_0 \cdot e^{-t/\tau}$$

$$i_C = -I_0 e^{-t/\tau}$$

Spule:

$$\tau = \frac{L}{R}$$

$$W = \frac{1}{2}LI^2$$

$$u_L = L\frac{\mathrm{d}i}{\mathrm{d}t}$$

Aufladen:

$$u_L = U_0 e^{-t/\tau}$$

$$i_L = I_0\left(1 - e^{-t/\tau}\right)$$

Entladen:

$$u_L = -U_0 e^{-t/\tau}$$

$$i_L = I_0 e^{-t/\tau}$$

Magnetfeld:

$$B = \mu \cdot H = \mu_0 \cdot \mu_r \cdot H$$

$$\mu_0 = 1,25 \cdot 10^{-6}\,\frac{\mathrm{Vs}}{\mathrm{Am}}$$

$$\Phi = \vec{B} \cdot \vec{A} = \mu_0\mu_r H \cdot A = \mu\frac{I \cdot N}{l}A$$

$$R_m = \frac{l}{\mu_0 \cdot \mu_r \cdot A} = \frac{\Theta}{\Phi}$$

$$R_{m,Luft} = \frac{\delta}{\mu_0 \cdot H}$$

$$\Phi = \frac{R_m}{\Theta} = \frac{I \cdot N}{\Theta} = \frac{H \cdot l}{\Theta}$$

$$B = \frac{\Phi}{A}$$

$$L = \frac{\Phi \cdot N}{I} = \frac{N^2}{R_m} = \frac{N \cdot B \cdot A}{I}$$

ideale Kopplung:

$$L = \left(\sqrt{L_1} + \sqrt{L_2}\right)^2 = L_1 + L_2 + 2\sqrt{L_1 L_2}$$

Leiter:

$$H = \frac{I}{2\pi r}$$

$$\vec{F} = l\left(\vec{I} \times \vec{B}\right)$$

Ringspule:

$$H = \frac{I \cdot N}{2\pi r}$$

$$L = N^2\frac{\mu \cdot A}{l}$$

Spule mit Eisenkern:

$$H = \frac{I \cdot N}{l_{Fe}} = \frac{\Theta}{l_{Fe}}$$

Zylinderspule:

$$H = \frac{I \cdot N}{l_{Spule}}$$

Durchflutungsgesetz:

$$H_L\delta + H_{Fe}l_{Fe} = I \cdot N$$

$$\frac{B}{\mu_0}\delta + H_{Fe}l_{Fe} = I \cdot N$$

Scherungsgerade:

$$B = \frac{I \cdot N}{\delta}\mu_0 - H_{Fe}\mu_0\frac{l_{Fe}}{\delta}$$

$$B_0 = \frac{I \cdot N}{\delta}\mu_0 \quad H_0 = \frac{I \cdot N}{l_{Fe}} \quad H_L = \frac{B}{\mu_0}$$

Induktivität: gilt nur im Arbeitspunkt

$$L = \frac{\Psi}{I} = \frac{N \cdot \Phi}{I} = \frac{N \cdot B \cdot A}{I}$$

$$\Psi = N \cdot \Phi = L \cdot i$$

Energie: gilt nur im Arbeitspunkt

$$W = \frac{1}{2}L \cdot I^2 = \frac{1}{2} \cdot \Theta \cdot \Phi$$

Lorenzkraft

$$\vec{F} = Q\left(\vec{v} \times \vec{B}\right)$$

$$F_m = Q \cdot v \cdot B \cdot \sin\sphericalangle\left(\vec{v},\ \vec{B}\right)$$

Kraft auf stromdurchflossenen Leiter:

$$\vec{F} = l\left(\vec{I} \times \vec{B}\right)$$

Kräfte auf Polflächen:

$$F = \frac{B^2 A}{2\mu_0}$$

induktive Spannung wenn L konstant:

$$u = N\frac{\mathrm{d}\Phi}{\mathrm{d}t} = L\frac{\mathrm{d}i}{\mathrm{d}t}$$

induktive Spannung wenn L nicht konstant:

$$u = \frac{\mathrm{d}\Psi}{\mathrm{d}t} = \frac{\mathrm{d}}{\mathrm{d}t}(L \cdot i) = L\frac{\mathrm{d}i}{\mathrm{d}t} + i\frac{\mathrm{d}L}{\mathrm{d}t}$$

Wechselstrom:

$$\underline{Z} = R + \mathrm{j} \cdot X = |\underline{Z}| \cdot e^{\mathrm{j}\varphi_Z} \quad \tan\varphi_Z = \frac{X}{R}$$

$$R = |\underline{Z}| \cdot \cos\varphi_Z \quad X = |\underline{Z}| \cdot \sin\varphi_Z$$

Kondensator:

$$X_C = -\frac{1}{\omega C} = -\frac{1}{2\pi f C}$$

$$\underline{Z}_C = \frac{1}{\mathrm{j}\omega C} = -\mathrm{j}\frac{1}{\omega C}$$

$$\tan\varphi_{kap} = \frac{X_C}{R}$$

$$\underline{Y}_C = \frac{1}{\underline{Z}_C} = \mathrm{j}\omega C$$

$$W = \frac{1}{2}Cu^2$$

Spule:

$$X_L = \omega L = 2\pi f L$$

$$\underline{Z}_L = \mathrm{j}\omega L$$

$$\tan\varphi_{ind} = \frac{X_L}{R}$$

$$\underline{Y}_L = \frac{1}{\underline{Z}_L} = \frac{1}{\mathrm{j}\omega L} = -\mathrm{j}\frac{1}{\omega L}$$

$$W = \frac{1}{2}Li^2$$

Scheinleistung:

$$\underline{S} = \underline{U} \cdot \underline{I}^* = |\underline{U}|^2 \cdot \underline{Y}^* = |I|^2 \underline{Z} = P + jQ$$

Kompensation:

$$P_{zu} = P_{el} = P = \frac{P_{mech}}{\eta}$$

$$Q = P \cdot \tan\varphi$$

$$P = S \cdot \cos\varphi$$

$$Q_C = \frac{\underline{\mathrm{U}}^2}{X_C} = -\underline{\mathrm{U}}^2\omega C = -\frac{1}{3}Q$$

$$C = \frac{P \cdot \tan\varphi}{3 \cdot \underline{\mathrm{U}}^2\omega} = \frac{Q}{3 \cdot \underline{\mathrm{U}}^2\omega}$$

⅄-Schaltung:

$$\underline{\mathrm{U}}_L = \sqrt{3} \cdot \underline{\mathrm{U}}_{Str}$$

$$\underline{\mathrm{I}}_L = \underline{\mathrm{I}}_{Str}$$

$$\underline{\mathrm{U}} = \underline{\mathrm{U}}_{str} = \frac{400\,\mathrm{V}}{\sqrt{3}}$$

$$C_\curlywedge = \frac{Q}{3\left(\frac{400\,\mathrm{V}}{\sqrt{3}}\right)^2 2\pi f}$$

△-Schaltung:

$$\underline{\mathrm{I}}_L = \sqrt{3} \cdot \underline{\mathrm{I}}_{Str}$$

$$\underline{\mathrm{U}} = \underline{\mathrm{U}}_L = 400\,\mathrm{V}$$

$$C_\triangle = \frac{Q}{3 \cdot (400\,\mathrm{V})^2\, 2\pi f}$$

Leistung:

$$P = 3 \cdot P_{St} = \sqrt{3}U_L I_L \cos\varphi$$

$$S = 3 \cdot S_{St} = \sqrt{3}U_L \cdot I_L$$

$$Q = 3 \cdot Q_{St} = \sqrt{3}U_L \cdot I_L \sin\varphi$$

$$P_{St} = U_{St}I_{St}\cos\varphi = \frac{1}{\sqrt{3}}U_L \cdot I_L \cdot \cos\varphi$$

$$S = U_{St}I_{St} = \frac{1}{\sqrt{3}}U_L \cdot I_L$$

$$Q_{St} = U_{St}I_{St}\sin\varphi = \frac{1}{\sqrt{3}}U_L \cdot I_L \cdot \sin\varphi$$

$$S^2 = P^2 + Q^2$$