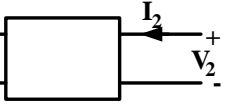


$$\begin{bmatrix} V_1 \\ I_1 \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix} \begin{bmatrix} V_2 \\ -I_2 \end{bmatrix}$$


$$AD - BC = 1, \quad G_{21} = \frac{V_2}{V_1} = \frac{1}{A + \frac{B}{R_L}}, \quad K_{21} = \frac{-I_2}{I_1} = \frac{\frac{R_L}{C + \frac{D}{R_L}}}{1}$$

$$Z_{in} = \frac{V_1}{I_1} = \frac{A + \frac{B}{R_L}}{C + \frac{D}{R_L}}, \quad P_a = \frac{|V_g|^2}{4R_g}, \quad t(s) = \frac{V_2}{V_{2max}} = \frac{2\sqrt{\frac{R_g}{R_L}}}{A + \frac{B}{R_L} + R_g(C + \frac{D}{R_L})}, \quad |t|^2 = \frac{P_2}{P_a}, \quad \rho(s) = \frac{Z_{in} - R_g}{Z_{in} + R_g}$$

$$|\rho|^2 = 1 - \frac{P_1}{P_a}, \quad |t|^2 + |\rho|^2 = 1, \quad R_{in} = \text{Re}(Z_{in}) = R_L |K_{21}|^2, \quad \frac{1}{R_g} \text{ or } R_g \geq \left[ \frac{1}{F_0} + \sqrt{\frac{1}{F_0^2} - 1} \right]^2$$

$$\begin{cases} G_{21} = \frac{F(s)}{F_0}, & Y_{in}(s) + Y_{in}(-s) = 2G_{21}(s)G_{21}(-s) \\ K_{21} = \frac{F(s)}{F_0}, & Z_{in}(s) + Z_{in}(-s) = 2K_{21}(s)K_{21}(-s) \end{cases} \quad \begin{cases} \sqrt{R_g} \frac{1+\rho}{t} = \frac{T_1}{\text{num}} + \frac{sT_2}{\text{num}} = A + B \\ \frac{1}{\sqrt{R_g}} \frac{1-\rho}{t} = \frac{T_4}{\text{num}} + \frac{sT_3}{\text{num}} = D + C \end{cases}$$

$$\frac{1}{(1+f_1x)\text{num}_1} \begin{bmatrix} T_1(x) & sT_2(x) \\ sT_3(x) & T_4(x) \end{bmatrix} = \frac{1}{(1+f_1x)} \begin{bmatrix} 1+a_1x & b_1s \\ e_1s & 1+d_1x \end{bmatrix} \frac{1}{(1+f_1x)^2\text{num}_1} \begin{bmatrix} (1+d_1x)T_1 - b_1xT_3 & (1+d_1x)T_2 - b_1T_4 \\ (1+a_1x)T_3 - e_1T_1 & (1+a_1x)T_4 - e_1xT_2 \end{bmatrix}$$

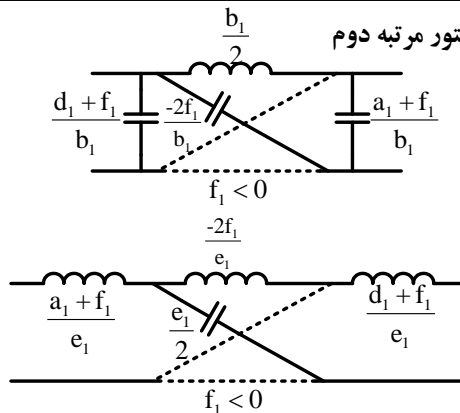
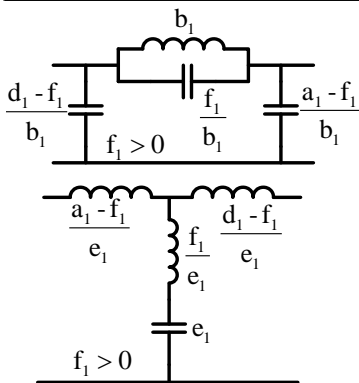
$$A = \frac{1}{1+f_1s^2} \begin{bmatrix} 1+a_1s^2 & b_1s \\ e_1s & 1+d_1s^2 \end{bmatrix}$$

فاکتور مرتبه دوم

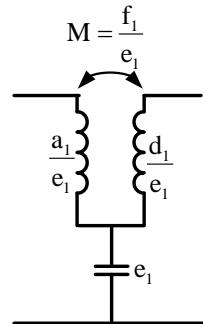
$$s^2 = x$$

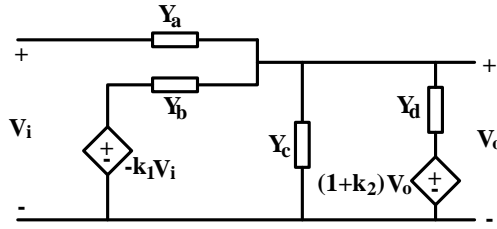
نحوه استخراج فاکتور مرتبه دوم

$$\begin{cases} d_1 = f_1 + f_1^2 \frac{T_1T_3}{T_1T_3 - T_3T_1} \\ b_1 = f_1^2 \frac{T_1^2}{T_1T_3 - T_3T_1} \\ a_1 = \frac{f_1^2}{d_1} \\ e_1 = a_1 \frac{T_3^2}{T_1T_3 - T_3T_1} \end{cases} \quad x = -\frac{1}{f_1} \quad \begin{cases} a_1 = f_1 + f_1^2 \frac{T_4T_2}{T_4T_2 - T_2T_4} \\ e_1 = f_1^2 \frac{T_4^2}{T_4T_2 - T_2T_4} \\ d_1 = \frac{f_1^2}{a_1} \\ b_1 = d_1 \frac{T_3^2}{T_4T_2 - T_2T_4} \end{cases} \quad x = -\frac{1}{f_1}$$



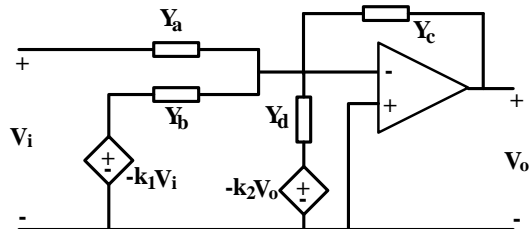
مدارهای فاکتور مرتبه دوم





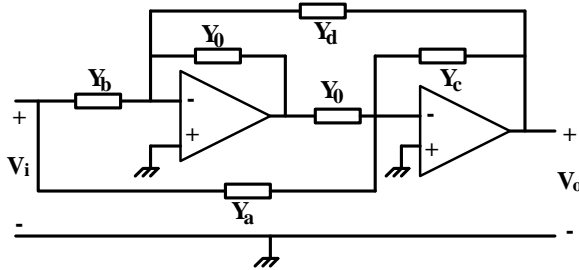
**Yanagisawa**

$$\frac{V_o}{V_i} = \frac{Y_a - k_1 Y_b}{Y_a + Y_b + Y_c - k_2 Y_d}$$



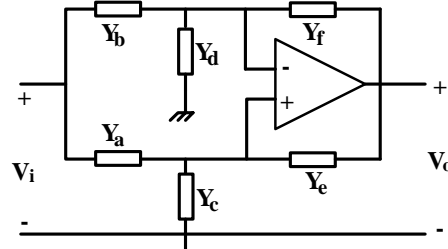
**Mathews-Seifert**

$$\frac{V_o}{V_i} = \frac{Y_a - k_1 Y_b}{k_2 Y_d - Y_c} = \frac{k_1 Y_b - Y_a}{Y_c - k_2 Y_d}$$



**Lovring**

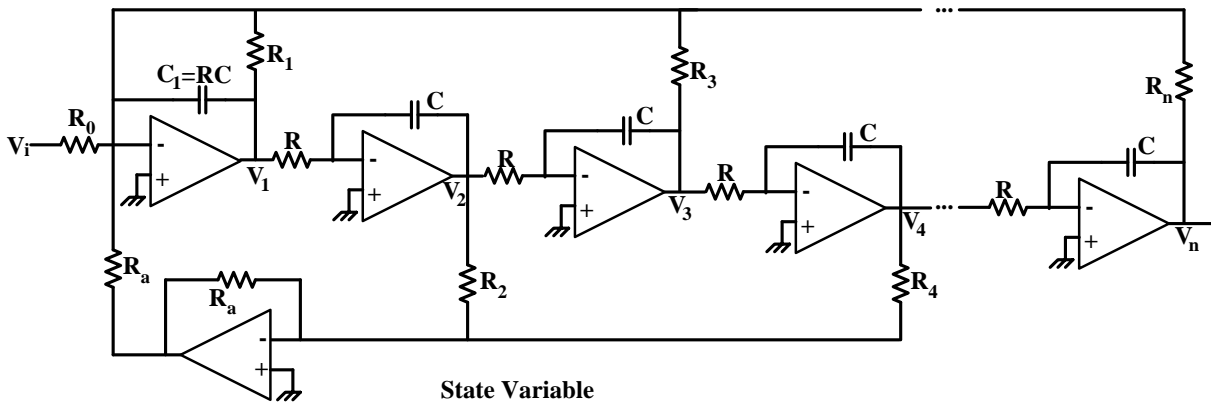
$$\frac{V_o}{V_i} = \frac{Y_a - Y_b}{Y_d - Y_c} = \frac{Y_b - Y_a}{Y_c - Y_d}$$



**Mitra**

$$\frac{V_o}{V_i} = \frac{Y_a - Y_b}{Y_f - Y_c} = \frac{Y_b - Y_a}{Y_c - Y_f}$$

$$Y_a + Y_c + Y_e = Y_b + Y_d + Y_f$$



**State Variable**

$$\frac{V_k}{V_i} = \begin{cases} \frac{(-1)^{n-k} G_0 (sRC)^{n-k}}{(sRC)^n + G_1 (sRC)^{n-1} + G_2 (sRC)^{n-2} + \dots + G_n} & : n \text{ odd} \\ \frac{(-1)^{n-k} G_0 (sRC)^{n-k}}{(sRC)^n + G_1 (sRC)^{n-1} + G_2 (sRC)^{n-2} + \dots + G_n} & : n \text{ even} \end{cases}, \quad k = 1, 2, \dots, n$$