$$g^E = \frac{(C_{12} - C_{11})\Lambda_{12} x_1 x_2}{x_1 + \Lambda_{12} x_2} + \frac{(C_{21} - C_{22})\Lambda_{21} x_1 x_2}{\Lambda_{21} x_1 + x_2}$$

$$g_{IS} = \left(\frac{G_1^\circ}{RT}\right) x_1 + \left(\frac{G_2^\circ}{RT}\right) x_2 + x_1 \ln x_1 + x_2 \ln x_2$$

$$= g_1 x_1 + g_2 x_2 + x_1 \ln x_1 + x_2 \ln x_2$$

$$g_{\text{real solution}} = g^E + g_1 x_1 + g_2 x_2 + x_1 \ln x_1 + x_2 \ln x_2$$

let $g^\# = g^E + g_1 x_1 + g_2 x_2$

$$g_{\text{real solution}} = g^\# + x_1 \ln x_1 + x_2 \ln x_2$$

let $g^\# = \left[\sum_{i=1}^{n} x_i \left(\sum_{j=1}^{n} x_j C_{ij}^s\right)^{r/s}\right]^{1/r}$

for a binary system

$$g^\# = \left[x_1 \left(C_{11}^s x_1 + C_{12}^s x_2\right)^{r/s} + x_2 \left(C_{21}^s x_1 + C_{21}^s x_2\right)^{r/s}\right]^{1/r}$$

let $r=1$ & $s=-1$

$$\Rightarrow g^\# = \left[x_1 \left(\frac{x_1}{C_{11}} + \frac{x_2}{C_{12}}\right)^{-1} + x_2 \left(\frac{x_1}{C_{21}} + \frac{x_2}{C_{21}}\right)^{-1}\right]$$

$$g^\# = \frac{x_1}{\frac{x_1}{C_{11}} + \frac{x_2}{C_{12}}} + \frac{x_2}{\frac{x_1}{C_{21}} + \frac{x_2}{C_{21}}}$$

$$g^\# = g^E + g_1 x_1 + g_2 x_2$$

$$g^E = g^{\#} - g_1 x_1 - g_2 x_2$$

$$g^E = \frac{x_1}{\frac{x_1}{c_{11}} + \frac{x_2}{c_{12}}} + \frac{x_2}{\frac{x_1}{c_{21}} + \frac{x_2}{c_{21}}} - g_1 x_1 - g_2 x_2$$