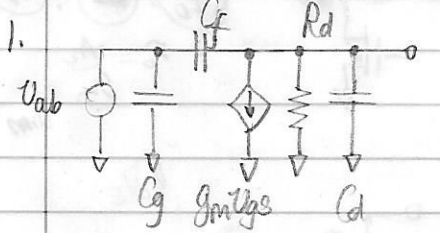
ECE264 Lect 7 Blackman's Impedance Relation

1.



① $Z_{ab}^0 = \left(\frac{R_d}{1+sC_dR_d} + \frac{1}{sC_f}\right) /\!/ \frac{1}{sC_g}$

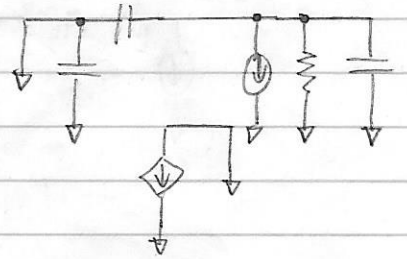
$= \frac{Z_d + \frac{1}{sC_f}}{1+sC_g\left(Z_d+\frac{1}{sC_f}\right)}$

$= \frac{1+sC_fZ_d}{sC_f+sC_g(1+sC_fZ_d)}$

$= \frac{1+sC_f\frac{R_d}{1+sC_dR_d}}{sC_f+sC_g\left(1+sC_f\frac{R_d}{1+sC_dR_d}\right)}$

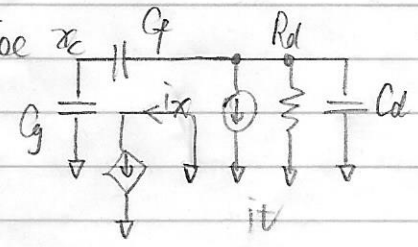
$= \frac{(1+sC_dR_d)+sC_fR_d}{sC_f(1+sC_dR_d)+sC_g(1+sC_dR_d+sC_fR_d)}$

② Tse



$T_{sc} = 0$

③ Toe



$v_t = -\left(R_d /\!/ \frac{1}{sC_d} /\!/ \left(\frac{1}{sC_d}+\frac{1}{sC_f}\right)\right) i_t$

$= -\left(Z_d /\!/ \frac{s(C_d+C_f)}{s^2C_dC_f}\right) i_t$ or $-\left(Z_d /\!/ \frac{1}{sC_m}\right) i_t = \frac{-Z_d}{1+sC_mZ_d} i_t$

$v_t = -\frac{\frac{R_d}{1+sC_dR_d}}{1+s\frac{C_fC_g}{C_f+C_g}\frac{R_d}{1+sC_dR_d}} i_t$

$= -\frac{R_d(C_f+C_g)}{(C_f+C_g)(1+sC_dR_d)+sC_fC_gR_d} i_t$

$x_c = -\frac{\frac{1}{sC_g}}{\frac{1}{sC_g}+\frac{1}{sC_f}} v_t$

$= \frac{sC_f}{sC_g+sC_f} \frac{-R_d(C_f+C_g)}{(C_f+C_g)(1+sC_dR_d)+sC_fC_gR_d} i_t$

$= \frac{-R_dC_f}{(C_f+C_g)(1+sC_dR_d)+sC_fC_gR_d} i_t$

$i_x = g_m x_c = -\frac{g_mR_dC_f}{(C_f+C_g)(1+sC_dR_d)+sC_fC_gR_d} i_t$

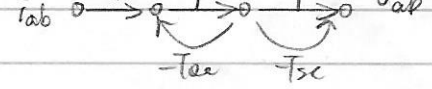
④ $Z_{ab} = \frac{1+sC_dR_d+sC_fR_d}{sC_f(1+sC_dR_d)+sC_g(1+sC_dR_d+sC_fR_d)}$

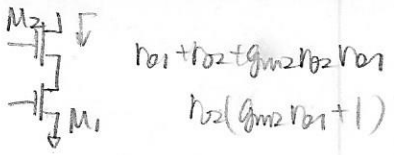
$\frac{(C_f+C_g)(1+sC_dR_d)+sC_fC_gR_d}{(C_f+C_g)(1+sC_dR_d)+sC_fC_gR_d+g_mR_dC_f}$

$= \frac{1}{s}\frac{1+s(C_f+C_d)R_d}{(C_f+C_g)(1+sC_dR_d)+sC_fC_gR_d+g_mR_dC_f}$

$Z_d = \frac{R_d}{1+sC_dR_d}$

$Z_{ab} = Z_{ab}^0 \frac{1-T_{sc}}{1-T_{oc}}$





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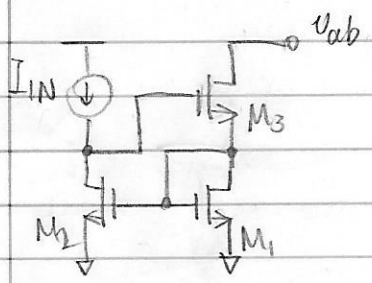
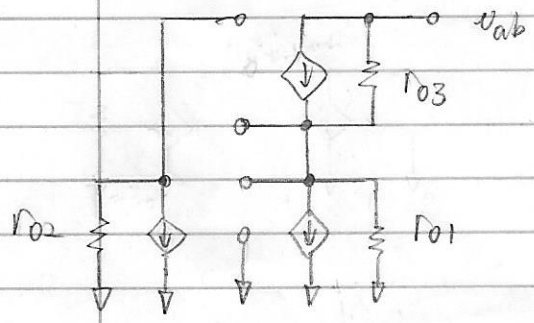
2. Wilson

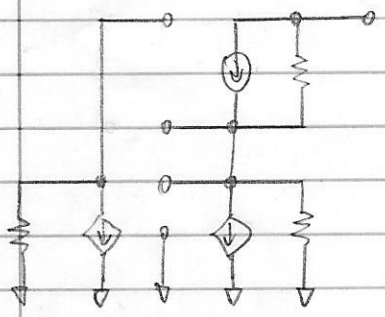




① $Z_{ab}^0 = r_{o3} + (\frac{1}{g_{m1}} /\!/ r_{o1})$

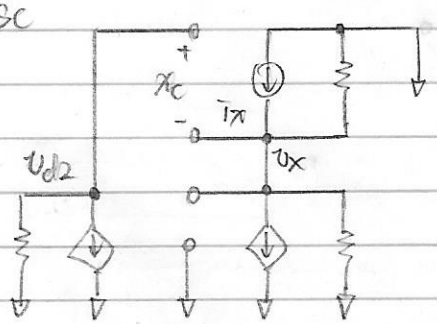
$\approx r_{o3}$

② T_{sc}



$T_{sc} = 0$

③ T_{sc}



$v_t \approx \frac{1}{g_{m1}} i_t$

$v_{d2} = -A_{o2} v_t$

$x_c = v_{d2} - v_t \approx -A_{o2} v_t \approx -\frac{g_{m2} r_{o2}}{g_{m1}} i_t$

$i_x = g_{m3} x_c = -\frac{g_{m3} g_{m2} r_{o2}}{g_{m1}} i_t$

④ $Z_{ab} = Z_{ab}^0 (1 - T_{sc})$

$\approx r_{o3} (1 + \frac{g_{m3} A_{o2}}{g_{m1}})$

$= \frac{g_{m1} r_{o3} + A_{o2} A_{o3}}{g_{m1}}$