

4) optimum admittance

$$R_n = \frac{\overline{V_{nq}}^2}{4kT\Delta f} = \frac{\left(\frac{1}{g_{m1}}\right)^2 4kTRg_{m1}\Delta f + 4kTRg_{m1}\Delta f}{4kT\Delta f}$$

$$= \frac{r}{g_{m1}} + R_g$$

$$G_u = \frac{\overline{i_{nu}}^2}{4kT\Delta f} = \frac{4kTRg_{m2}\Delta f + g_{m2}^2 \cdot 4kTRg_2\Delta f}{4kT\Delta f}$$

$$= r g_{m2} + g_{m2}^2 R_{g2}$$

$$= g_{m2} (r + g_{m2} R_{g2})$$

$$\therefore G_{s,opt} = \sqrt{\frac{G_u}{R_n}} = \sqrt{\frac{g_{m2} (r + g_{m2} R_{g2})}{\frac{r}{g_{m1}} + R_{g1}}}$$

$$= \sqrt{\frac{g_{m1} g_{m2} (1 + \frac{1}{r} g_{m2} R_{g2})}{1 + \frac{1}{r} g_{m1} R_{g1}}}$$

$$B_{s,opt} = 0$$

$$\Rightarrow V_{s,opt} = G_{s,opt}$$

$$5) F_{min} = 1 + 2 R_n \sqrt{\frac{G_u}{R_n}}$$

$$= 1 + 2 \left( \frac{r}{g_{m1}} + R_g \right) \sqrt{\frac{g_{m1} g_{m2} (1 + \frac{1}{r} g_{m2} R_{g2})}{1 + \frac{1}{r} g_{m1} R_{g1}}}$$

if,  $g_{m1} = g_{m2}$  and  $R_{g2} \approx R_{g1}$ , then  $F_{min} \approx \text{~~1 + 2(R_g + r/g_{m1})~~}$

$$\approx 1 + 2(r + g_m R_g)$$

$$\approx 1 + 2r$$