



current gain,  $\beta$

$$\beta = \frac{\hat{i}_d}{\hat{i}_g} = \frac{g_m}{s C_{gs}}$$

$$\begin{aligned} 1) \quad Z_{in} &= R_g + \frac{1}{s C_{gs}} + (1 + \beta) s L_s \\ &= R_g + \frac{1}{s C_{gs}} + \left(1 + \frac{g_m}{s C_{gs}}\right) s L_s \\ &= R_g + \frac{1}{s C_{gs}} + s L_s + \frac{g_m L_s}{C_{gs}} \end{aligned}$$

$$\begin{aligned} 2) \quad v_{gs} &= \hat{i}_g \cdot \frac{1}{s C_{gs}} \\ &= \frac{V_s}{R_s + Z_{in}} \cdot \frac{1}{s C_{gs}} = \frac{\frac{1}{s C_{gs}}}{R_s + \left(R_g + \frac{g_m L_s}{C_{gs}}\right) + s L_s + \frac{1}{s C_{gs}}} \cdot V_s \end{aligned}$$

$$\begin{aligned} i_{out} &= g_m v_{gs} = \hat{i}_g \cdot \beta \\ &= \frac{g_m / s C_{gs}}{R_s + \left(R_g + \frac{g_m L_s}{C_{gs}}\right) + s L_s + \frac{1}{s C_{gs}}} \cdot V_s \end{aligned}$$

$$3) \quad A_V = \frac{V_{out}}{V_s} = \frac{-i_{out} \cdot R_L}{V_s} = - \frac{g_m / s C_{gs} \cdot R_L}{\left(R_s + R_g + \frac{g_m L_s}{C_{gs}}\right) + s L_s + \frac{1}{s C_{gs}}}$$