Problem 1 (25 Points):

Find a numerical value for $I_{\text{OUT}}$ in the circuit above. For the MOSFETs assume that $K=10 \ \mu\text{A/V}^2$, $V_T = 1.5 \ \text{V}$, and $\lambda = 0$. Assume that all MOSFETs are matched.
Problem 2: (25 Points)

Find numerical values for $R_1$ and $R_2$ in the circuit above so that the current $I_{OUT}$ is equal to 10 µA. For the MOSFET assume that $K=10 \, \mu A/V^2$, $V_T = 1.5 \, V$, and $\lambda = 0$. Assume that $\beta = 100$ and $V_{BE} = 0.7 \, V$ for the BJTs. Assume that $M_1$ and $M_2$ are matched and that $Q_1$ and $Q_2$ are matched.
Problem 3: (25 Points)
A new device has recently been discovered called a Bird Foot Device:

Note that the symbol was created by ornithologists. The equations that govern this device are:

\[ I_X = K_1 V_{XY}^3 + K_2 \]
\[ I_Z = \beta I_X (1 + K_3 V_{ZY}) \]

Where \( K_1, K_2, \) and \( K_3 \) are constants and \( \beta \) is a constant in the range of 50 to 500. Note that \( V_{XY} \) is the controlling voltage of this device. The small signal model of this device is shown below:

Generate equations for the small signal quantities \( r_{xy}, r_{zy}, \) and \( g_m \) for this device.
Problem 4 (25 Points)

Find an equation for the gain $\frac{v_o}{v_{in}}$ in the circuit above.