An amplifier is shown below

The dc voltage at $V_i$ is adjusted for $V_0 = 2V$ dc.

a) Calculate bias $I_D$ and $V_{GS}$ for each device.

b) Calculate $HD_2$ and $HD_3$ (in dB) in $V_i$ and $V_0$ for a sinusoidal-signal voltage of 0.2V rms at $V_0$. Data as on P.S.5 but add $R_s = 25k\Omega / W(\mu m)$ in series with each source. Neglect charge storage and Early effect. Check using SPICE.

Hint: Start by deriving a power series for $v_i$ as a function of $v_1$. Then derive $v_1$ as a function of $v_i$. Finally, cascade $v_0$ as a function of $v_1$. Neglect body effect in $M_5$ but not in $M_3$. 
In the 50Ω transmission system shown below, a reverse-biased diode D is used to limit the amplitude of large negative voltage spikes on the line. However, the nonlinear capacitance of the diode causes distortion in \( v_0 \). The incremental diode capacitance at the bias point is represented by

\[
C = \frac{2}{\left(1 + \frac{V}{V_Q}\right)^{0.5}}
\]

where \( V_Q = 2V \) and \( v \) is the signal voltage on the diode. Capacitor C is a large coupling capacitor.

Calculate \( IM_2 \) in \( v_0 \) at \((\omega_1 - \omega_2)\) and \((\omega_1 + \omega_2)\) for two output signals in \( v_0 \) of equal amplitude 0.5V each and frequencies \( f_1 = 100 \text{ MHz} \) and \( f_2 = 101 \text{ MHz} \).