\[ V_{DD} - \frac{V_{OUT}}{R_L} = \frac{I_Q - f(V_{GS}, V_{OUT})}{R_L} \]

**DC**

**Operating Point**

\[ \frac{V_{DD} - V_{OUT}}{R_L} = I_Q \left( V_{GS}, V_{OUT} \right) \]

**Don't forget**

\[ C_{GS} = \left[ \frac{\partial Q}{\partial V_{GS}} \right]_{Q \text{ point}} \]

**1st Order**

**Linear Eqn.**

\[ 0 = g_m V_{in} + V_{OUT} \left( \frac{1}{R_L} + \frac{1}{R_D} \right) + C_L V_{OUT} \]

**Zero & First Order**

Solve both (sequentially), then combine back for total answer.

**Nonlinear!**

**Solve for**

Either triode or active eqn.

Usually not 2.5V, but close varies with temp.

**Nonlinear Diff. Eqn.**

\[ V_{DD} - \frac{V_{OUT}}{R_L} = f(V_{GS}, V_{in}, V_{OUT} + \frac{dV_{OUT}}{dt}) + C_L \frac{dV_{OUT}}{dt} \]

\[ = I_Q + V_{in} \frac{df}{dV_{GS}} + V_{OUT} \frac{df}{dV_{DS}} + C_L \frac{dV_{OUT}}{dt} \]

**Out of Nonlinear Functions, worry about region of validity!**

Add \( V_{in}(t) \) use Taylor expansion, take time varying \( V_{in}(t), V_{OUT}(t) \) out of nonlinear functions, worry about region of validity!