Problem Set 3
Due Friday Oct. 17, 2014

For simulations, use the transistor model card from the PTM 65nm node (http://ptm.asu.edu/latest.html). In particular, use the BSIM4 model cards released on Feb. 22, 2006 (http://ptm.asu.edu/modelcard/2006/65nm_bulk.pm).

1. Derive the third-order intercept point for a differential pair at low frequencies. Include the effect of mobility degradation due to vertical fields and velocity saturation, but otherwise use the square law model. Neglect body effect.

2. Derive the third-order intercept point for a differential pair at low frequencies. Use a single equation I-V valid from weak inversion to strong inversion to derive the results. Neglect body effect.

3. Derive reasonable model parameters for the single equation model (used above) for 65nm transistor based on a full BSIM4 model card. Examine the fit to I-V and the first 4 derivatives of \( i_d \) versus \( v_{gs} \).

4. For the differential pair, sweep the value of \( R_L \) in the simulation and find the highest value of \( R_L \) whereby the gain compression point is set by the transconductance rather than the output stage.

5. Compute the first three Volterra series coefficients for the system shown below in terms of the Volterra coefficients of \( H \), \( K_2 \) and \( G \). \( H \) and \( G \) are linear systems whereas \( K_2 \) is described by a sum of first and second order non-linearity.

6. Derive IIP3 for a MOS common gate amplifier at high frequency using the full Volterra series (follow approach in class). Compare to SpectreRF.