EE5390 Homework 5: Due Monday 30/04/2012

1. Derive an expression for I_{OUT} in the circuit shown in Figure 1.

2. For the Bandgap Reference shown in Figure 2, derive the expression for V_{out}.

3. Draw the input output characteristics of the amplifier shown in Figure 3, clearly labelling the different regions of operation of each transistor. Next, assume bias voltage V_{Bn} is such that conduction angle is θ. Derive an expression for P_{out} and efficiency as a function of θ.

4. Consider the Bandgap Reference circuit shown in Figure 4.

    (a) If M1 and M2 exhibit channel length modulation, what is the error in output voltage?

    (b) If M1 and M2 have a V_T mismatch of ΔV, what is the error in output voltage?

Extra Problem (no credit)

5. (a) Repeat 4(a) and 4(c) for M3 and M4.

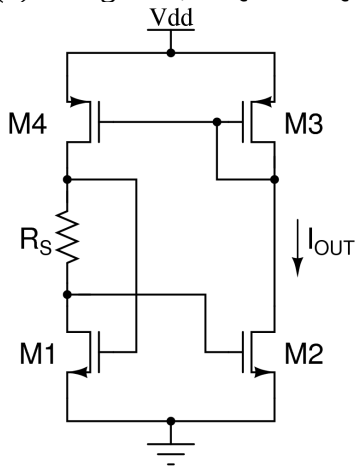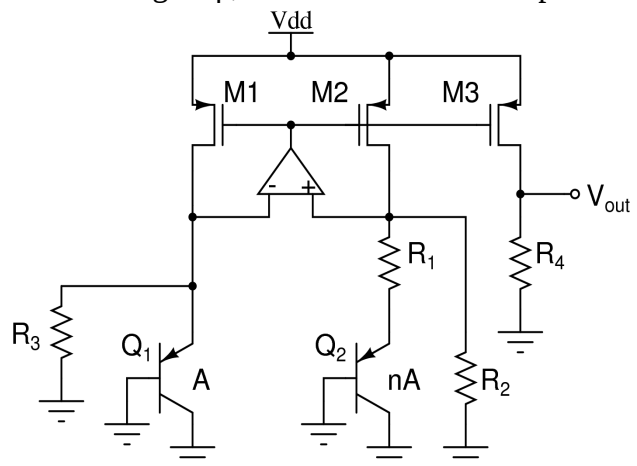   (b) In Figure 4, if Q2 and Q4 have finite current gain β, what is the error in output voltage?
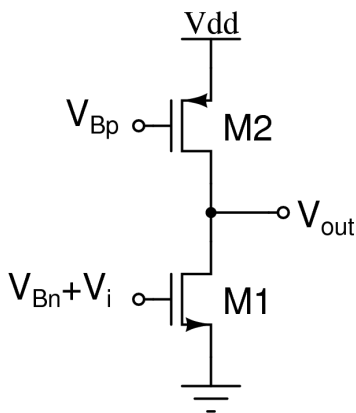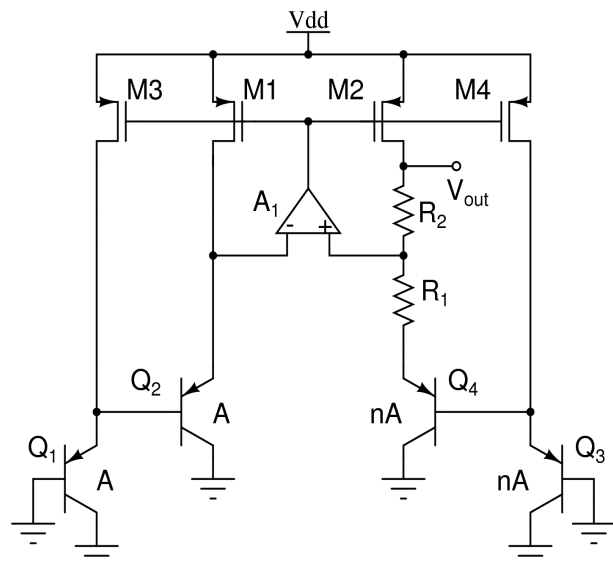

Figure 1

Figure 2

Figure 3

Figure 4