

1. 50 points (MOS Differential Pair) (see pages 588 & 597 of the textbook)

a) Using the 4007 transistors create in PSpice an **all** MOS differential pair with differential output current. Set this up to use $I_{\text{tail}} = 1\text{mA}$ in the tail current source transistor and choose $V_{\text{DD}} = -V_{\text{SS}} = 5\text{V}$. For output measurements use an F component (with bottom input terminal to ground with a 1KOhm load on the output to ground) to obtain $I_{\text{out}} = I_{\text{D2}} - I_{\text{D1}}$.

b) Determine the value of the gate voltage on the tail current source transistor.

c) Run Spice and submit the DC curves of I_{D1} & I_{D2} as well as $I_{\text{out}} = I_{\text{D2}} - I_{\text{D1}}$.

2. 50 points (modulated Differential Pair)

For the above differential pair put a 2V sine wave at 10KHz on the left input and ground the right input.

a) Give a transient response over 20 periods of the input.

b) Then vary your tail current by adding a small sine wave of voltage, 1mV at 1KHz, in series with the gate of the tail current source transistor. Do a transient analysis over the same 20 periods to show the modulation.