

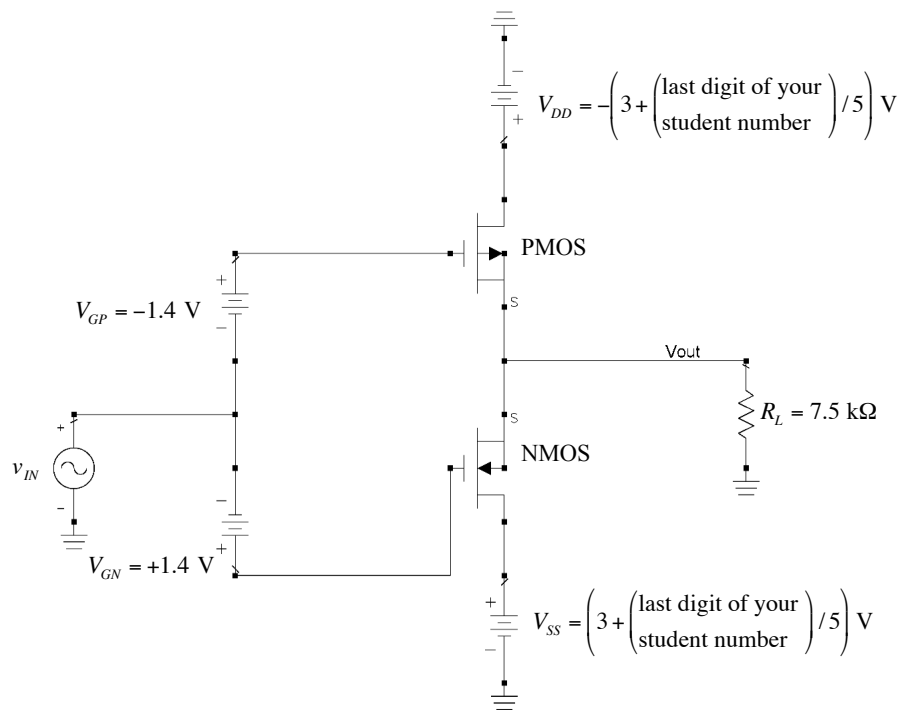
**SCHOOL OF ELECTRICAL AND COMPUTER ENGINEERING**

**EEET2097 ELECTRONIC CIRCUITS**

**ASSIGNMENT 2**

**Group size:**                      **2 members**

A push-pull common-drain MOSFET power amplifier is shown in Figure 1 below. The NMOS and PMOS transistors are matched with  $k'_n(W/L) = 0.75 \text{ mA/V}^2$  and  $V_{in-channel} = -V_{tp-channel} = 1 \text{ V}$ .



**Figure 1 Push-pull MOSFET power amplifier circuit.**

1. Determine the DC bias conditions on both transistors ( $I_D$ ,  $V_{DS}$  and  $V_{GS}$ ) for  $v_{IN} = 0 \text{ V}$ . What is the class of operation of the power amplifier? **[5 marks]**
2. Calculate the maximum possible output voltage  $V_{out,max}$  and the minimum possible output voltage  $V_{out,min}$  for the transistor, assuming that both transistors remain in the saturation region. Also calculate the values of  $v_{IN}$  ( $v_{IN,max}$  and  $v_{IN,min}$ ) required to produce  $V_{out,max}$  and  $V_{out,min}$ . **[8 marks]**
3. Assuming that you have a sinusoidal input voltage  $v_{IN} = V_p \sin(2\pi ft)$  where  $V_p = 0.5 \cdot (v_{IN,max} - v_{IN,min})$  and  $f = 1 \text{ kHz}$ , calculate the power dissipated in the load,  $P_L$ , the power supplied by the DC supplies,  $P_{IN}$ , the power dissipated in each device,  $P_D$  and the amplifier efficiency  $\eta$ . **[7 marks]**

4. Simulate your amplifier using PSpice and verify all of your results to parts 1, 2 and 3 above and generate a plot of  $V_{out}$  versus time. **[7 marks]**
5. Use PSpice to calculate the 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> harmonic distortion in the output voltage,  $V_{out}$ . **[3 marks]**

*PSpice modelling of the NMOS and PMOS devices:*

We will use the PSpice Level 3 MOSFET model. The key parameters are:

$$V_t \equiv V_{to} = 1\text{V (for NMOS) or } -1\text{V (for PMOS)}$$

$$k_n' \equiv K_p = 0.75\text{E-3}$$

$$W \equiv W = 2.0\text{E-6} = 2\mu$$

$$L \equiv L = 2.0\text{E-6} = 2\mu$$

For the NMOS device, use the MbreakN3 part. Edit the model parameters so that you have:

.model MbreakN-X NMOS (Level=3 Kp=0.75E-3 Vto=1 W=2u L=2u)

For the PMOS device, use the MbreakP3 part. Edit the model parameters so that you have:

.model MbreakP-X PMOS (Level=3 Kp=0.75E-3 Vto=-1 W=2u L=2u)

Assignments must be submitted by 5:00pm on the 7<sup>th</sup> of October 2011. Submit only one submission per group via the Blackboard course shell for EEET2097. Make certain that the names and students numbers of both group members are on the assignment front page.

Assignments **will not be** accepted after the deadline.

Assignments must be submitted as a MS Word .doc file (**not .docx**) or a .pdf file.

*A/Prof James Scott, September 16<sup>th</sup>, 2011*