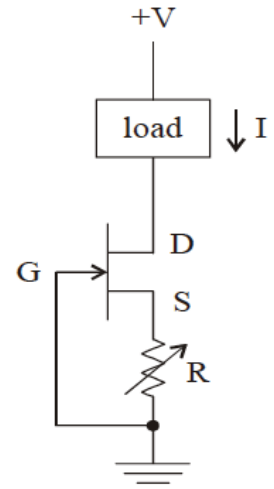
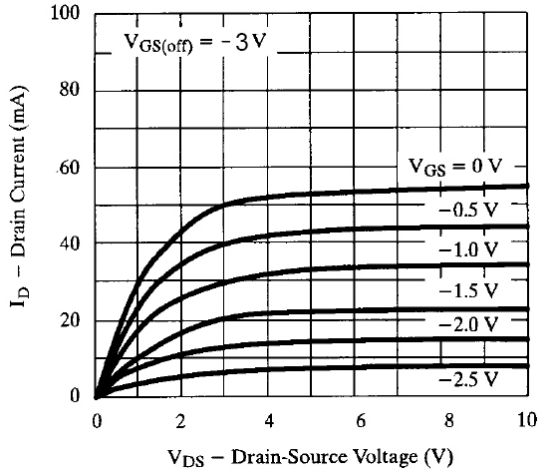


## HW 7 - 2018

### 1. A n-channel FET is specified with

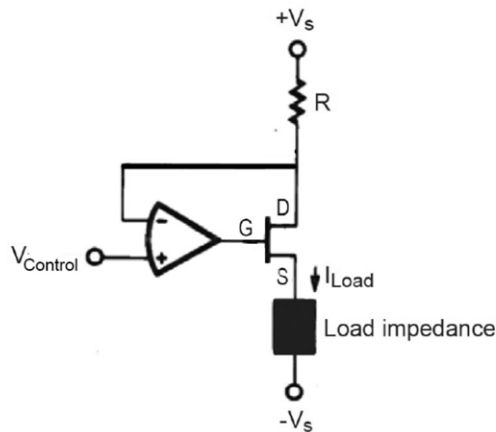
1.  $V_{GS(off)} = -3\text{ V}$
2.  $I_{DSS} = 55\text{ mA}$



Pick  $R$  to build a current source with  $I_{D,S,Q} = 2.0\text{ mA}$ .

- (a) What is the minimum load resistance?
- (b) What is the maximum load resistance?
- (c) Show these as load-line plots.

### 2. A FET is used with an op-amp to make a single-ended current source.



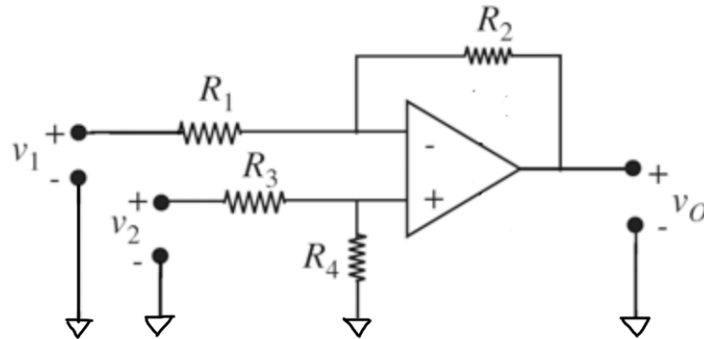
Derive an expression for  $I_{Load}$  in terms of  $V_{control}$  and  $R$ .

**3. The circuit below is called a differential amplifier.**

(a) Using the ideal Op Amp model (infinite open loop gain, infinite input resistance, zero output resistance) derive an expression for the output voltage  $v_O$  in terms of the input voltages  $v_1$  and  $v_2$  and the resistances  $R_1$ ,  $R_2$ ,  $R_3$ , and  $R_4$ .

(b) Does connecting a load resistor  $R_L$  between the output and ground change the previous expression for  $v_O$ ? Why?

(c) Let  $v_1 = v_2$ . Find  $R_4$  so that  $v_O = 0$ .



**4. A bipolar pulse is a common waveform defined by**

$$V(t) = \begin{cases} 0 & \text{for } t < -T/2 \\ -1/T & \text{for } -T/2 < t < 0 \\ +1/T & \text{for } 0 < t < +T/2 \\ 0 & \text{for } t > +T/2 \end{cases}$$

(a) Sketch the pulse as a function of time.

(b) What is the Fourier transform,  $V(\omega)$ , of the pulse?

(c) Plot the magnitude  $|V(\omega)|$  for  $0 < \omega < 12\pi/T$ .