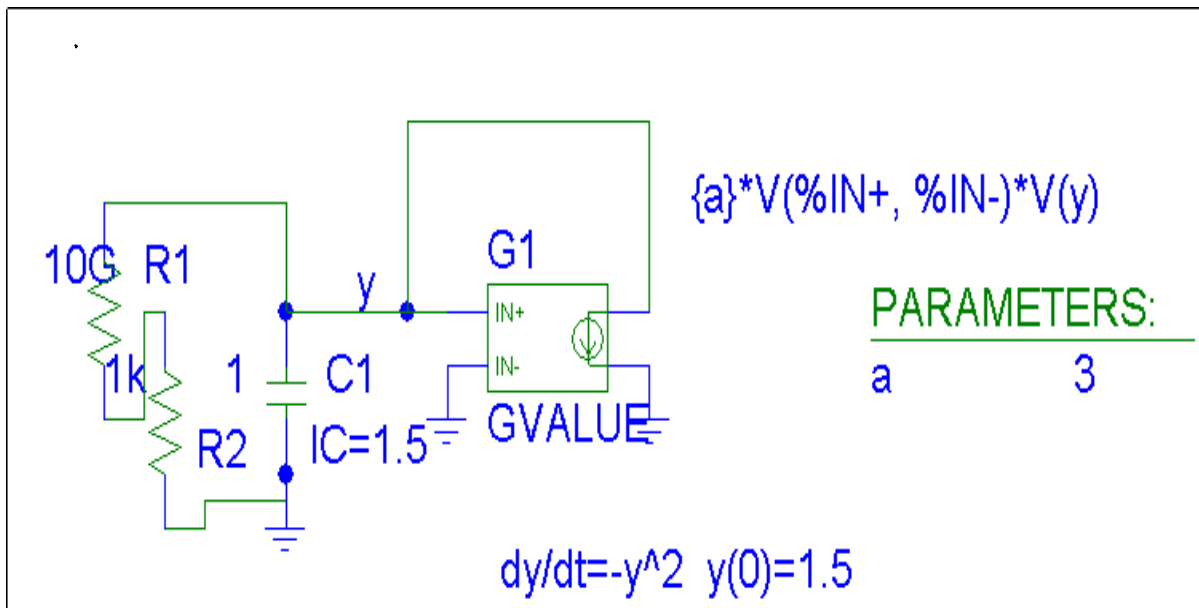
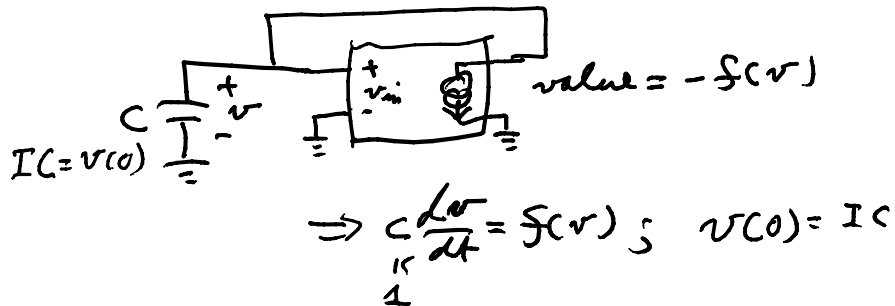
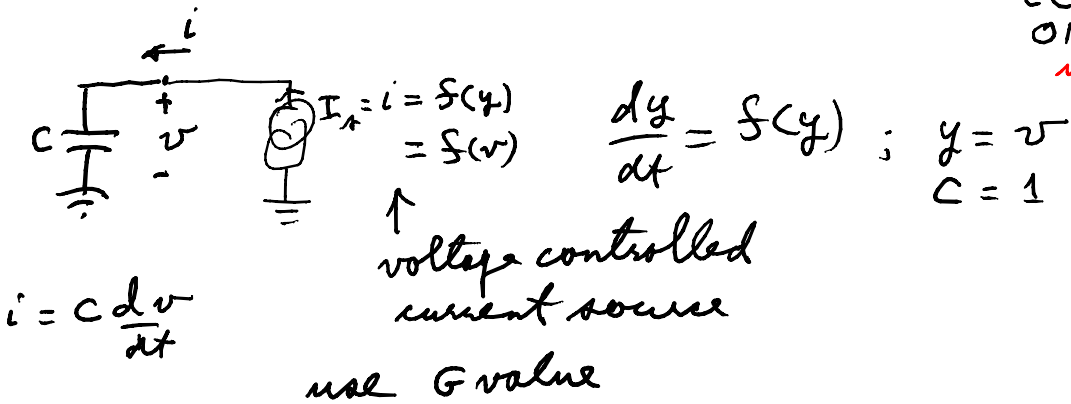
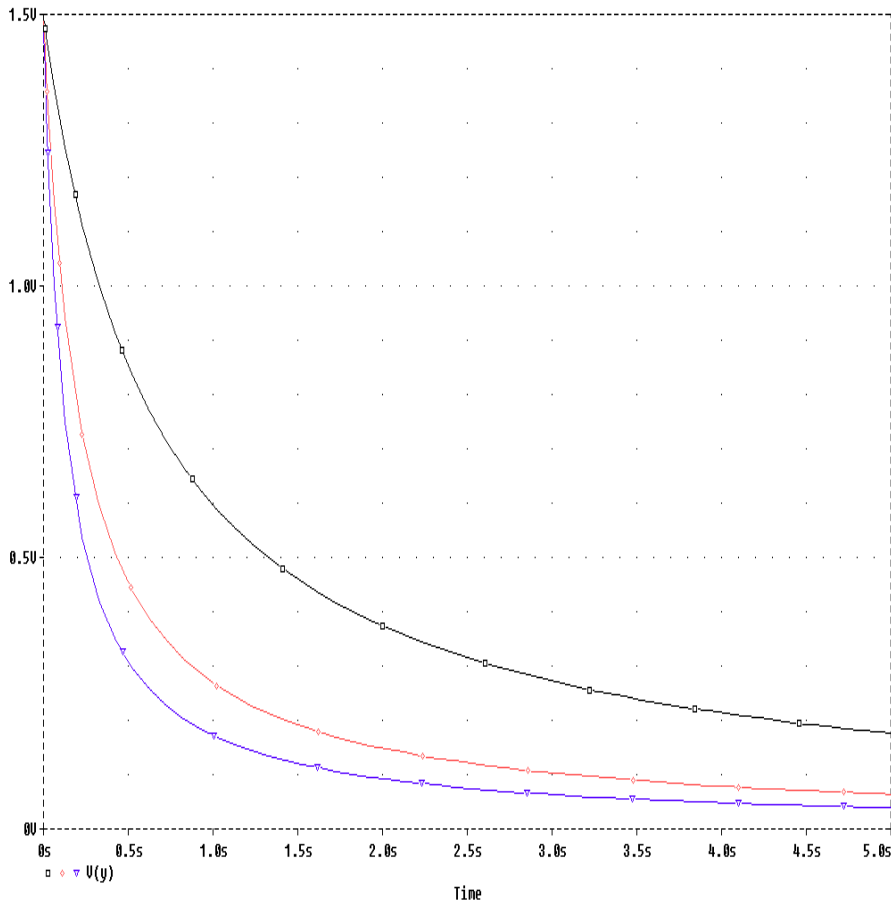
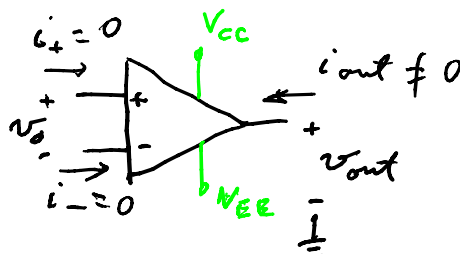


EE303H
01/29/09
updated 3 pm





op-amp - ideal



ideal law

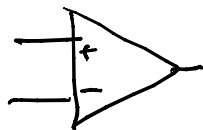
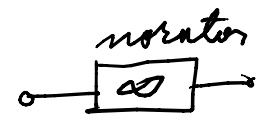
$$i_+ = i_- = 0, v_d = 0$$

open & short
simultaneously
≙ nullator ⇒

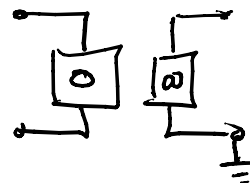


($i_{out} = \text{anything}; v_{out} = \text{anything}$)

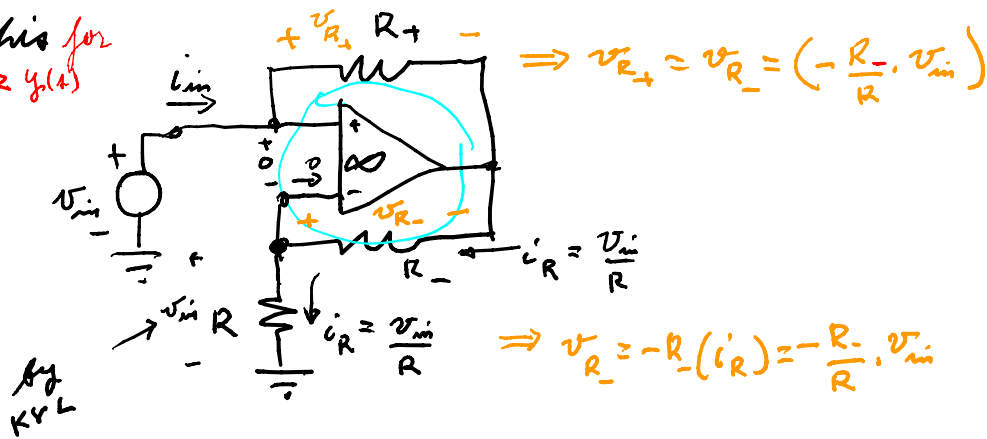
determined by
loads



≡



Use this for a negative g_{in} circuit

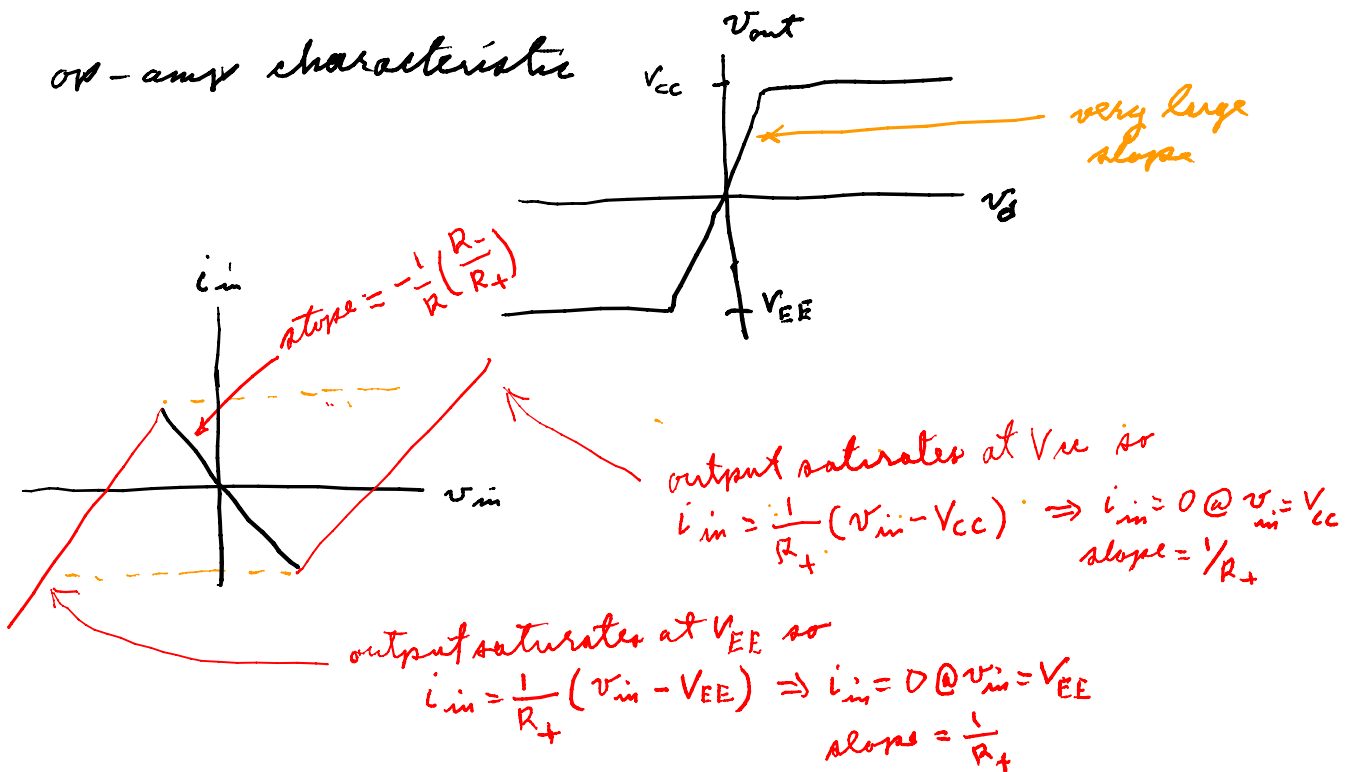


$$\Rightarrow i_{in} = \frac{v_{R_+}}{R_+} = -\frac{R_-}{R_+} \cdot \frac{v_{in}}{R_+} = -\frac{1}{R_+} \cdot \frac{R_-}{R_+} \cdot v_{in} = G_{in} \cdot v_{in}$$

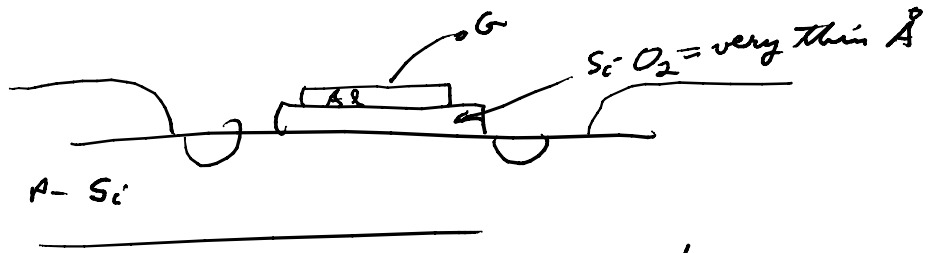
$$G_{in} = \frac{1}{R_{in}} = -\frac{1}{R_+} \cdot \frac{R_-}{R_+} \Rightarrow \text{a negative resistor}$$

$P_{in} = \text{power in} = v_{in} \cdot i_{in} = v_{in} \cdot G_{in} \cdot v_{in} = G_{in} v_{in}^2 = -\frac{1}{R_+} \left(\frac{R_-}{R_+} \right) \cdot v_{in}^2$
 (into the circuit out of the v_{in}) \Rightarrow negative power into the op-amp circuit \Rightarrow power into v_{in}

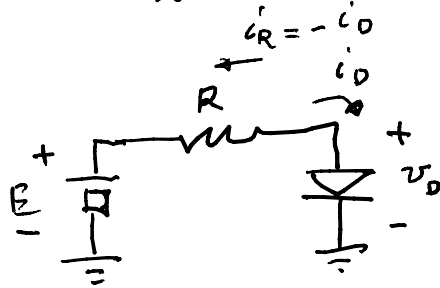
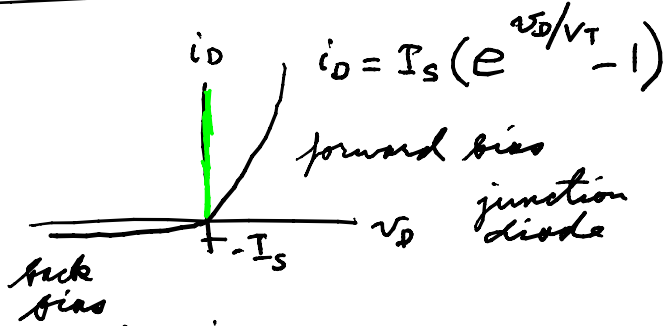
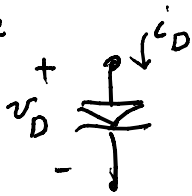
op-amp characteristic



MOS



Diode



to get the operating point

$$v_D = R i_R + E$$

$$-i_R = \frac{E - v_D}{R}$$

