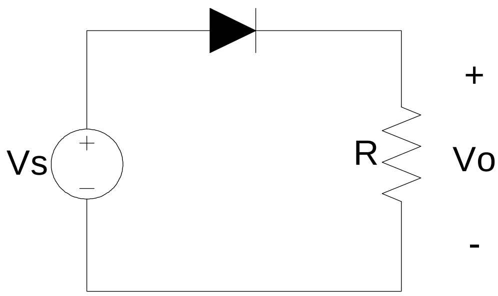
EE 40

Homework #6

Due Tuesday, November 5

Problem 1: 20 Points Possible



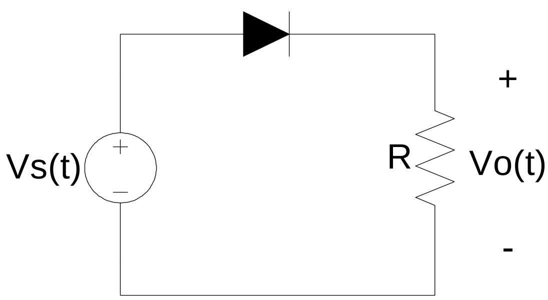
Let Vs = 1 V, R = 1 kΩ.
Use the load-line method to find Vo at left.

For the nonlinear element (the diode), use the most realistic I-V relationship

$$I_D = I_0\left(e^{\frac{qV}{kT}} - 1\right)$$

with $I_0 = 10^{-15}$ and kT/q = 0.026 V.

Problem 2: 20 Points Possible

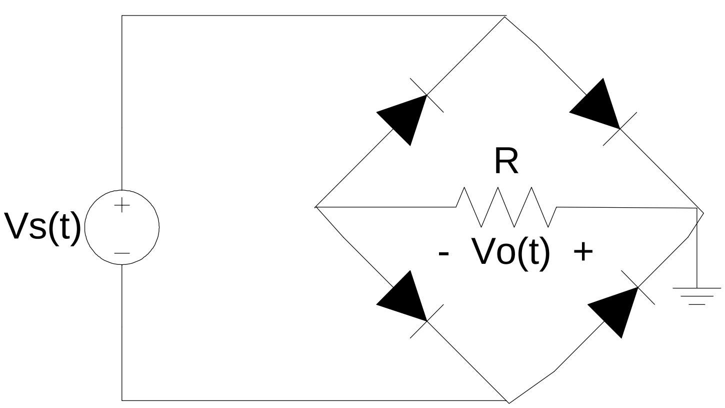


Let Vs(t) = sin(t).

a) Sketch the output Vo(t) assuming the ideal diode model.

b) Sketch the output Vo(t) assuming the large signal diode model.

Problem 3: 20 Points Possible

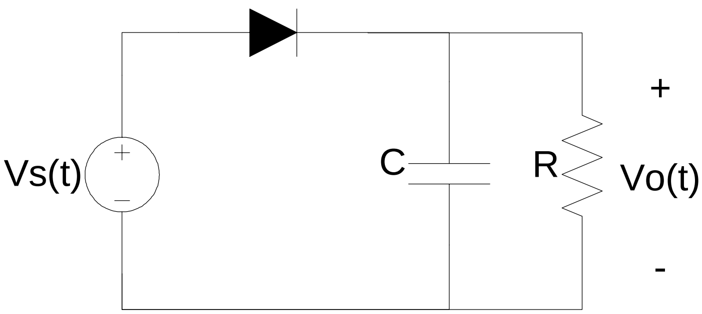


Let Vs(t) = sin(t).

c) Sketch the output Vo(t) assuming the ideal diode model.

d) Sketch the output Vo(t) assuming the large signal diode model.

Problem 4: 20 Points Possible



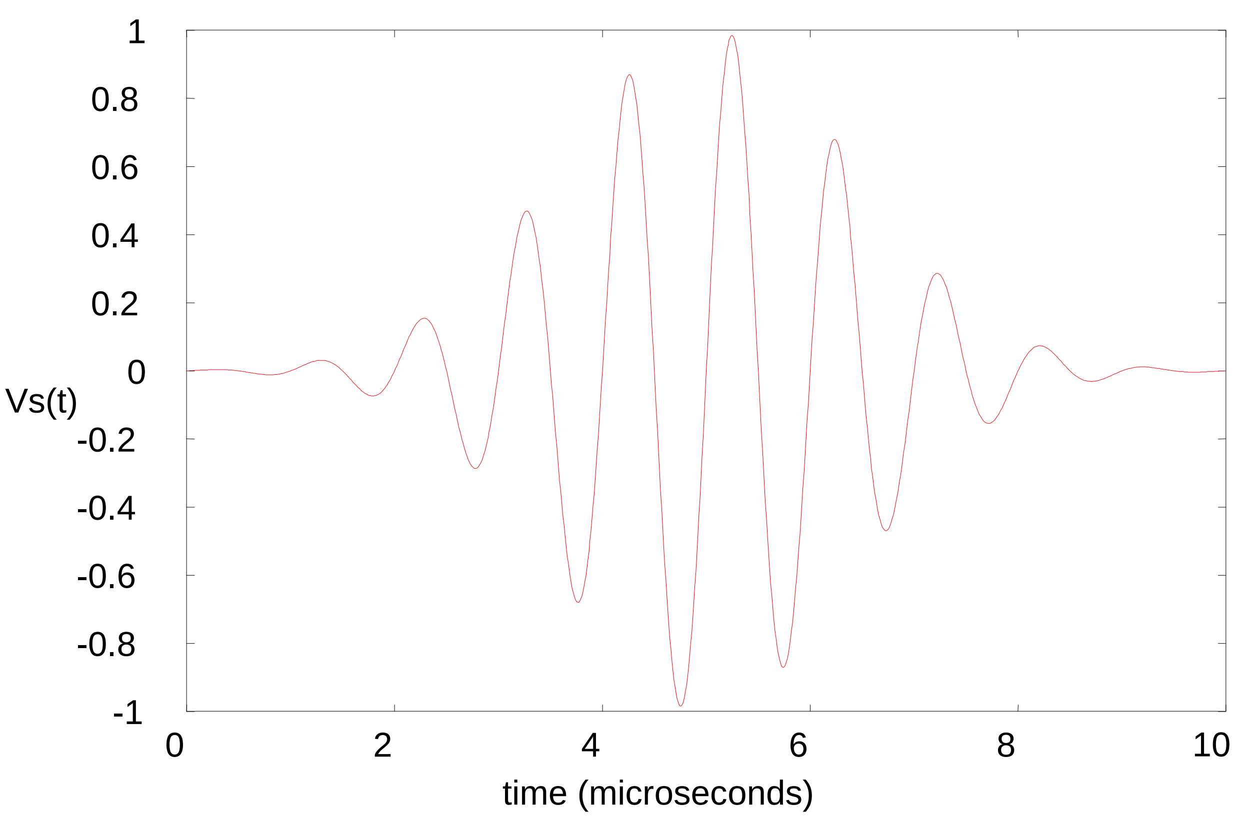
Let Vs(t) be a square wave of amplitude 1, frequency 1 Hz and duty cycle 50%. This means

$$V_s(t) = \begin{cases} 1 & \text{if } \sin(2\pi t) > 0 \\ 0 & \text{if } \sin(2\pi t) = 0 \\ -1 & \text{if } \sin(2\pi t) < 0 \end{cases}$$

With Vo(t=0)=0, R = 10 kΩ and C = 50 μF, sketch Vo(t) for t = 0 to t = 3 seconds.

Problem 5: 20 Points Possible

Suppose I want to use the circuit from Problem 4 as a **peak detector** or **envelope detector**. I want the output to trace the envelope (i. e., connect the peaks) of a typical AM signal:



a) Make a **rough** sketch of the output Vo(t) for the Problem 4 circuit with the above input signal when the time constant is approximately the period of the carrier signal (1μs).

b) What factors should be considered when designing the time constant of the circuit to perform this envelope detection task? What are the benefits and drawbacks of a small time constant? What are the benefits and drawbacks of a large time constant?