

Quiz 1 (20 minutes)

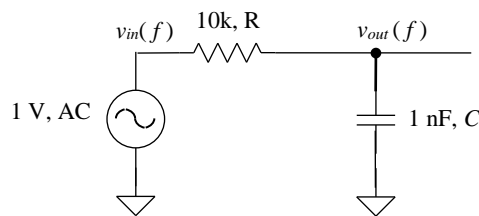
ECE 510/410 Integrated Physical Design

Fall 2015

Name: Key

1. For the circuit shown below:

a) Derive its transfer function. What is the 3-dB bandwidth ( $f_{3dB}$ ) of the circuit?



$$\frac{V_{out}}{V_{in}} = \frac{\frac{1}{sC}}{R + \frac{1}{sC}} = \frac{1}{1 + sRC}$$

$$s \leftarrow j2\pi f$$

$$f_{3dB} = \frac{1}{2\pi RC}$$

$$\Rightarrow \frac{V_{out}}{V_{in}}(f) = \frac{1}{1 + j \frac{f}{f_{3dB}}}$$

$$f_{3dB} = \frac{1}{2\pi RC} = \underline{15.915 \text{ kHz}}$$

b) Using the equations in part (a), sketch properly labeled Bode magnitude and phase plots.

c) A sinusoidal input of 1V amplitude and a frequency of 100 KHz is applied to the circuit. Sketch the properly labeled time-domain input and output waveforms ( $v_{in}$  and  $v_{out}$ ) in the circuit.

d) Now, a unit step input is applied to the circuit as shown below. What is the delay ( $t_d$ , i.e. the time taken to reach 50% of the final output) of the circuit? Sketch input and output time-domain waveforms and show  $t_d$  on the plot.

