

# **BENG 186B Winter 2012**

## **Quiz 1**

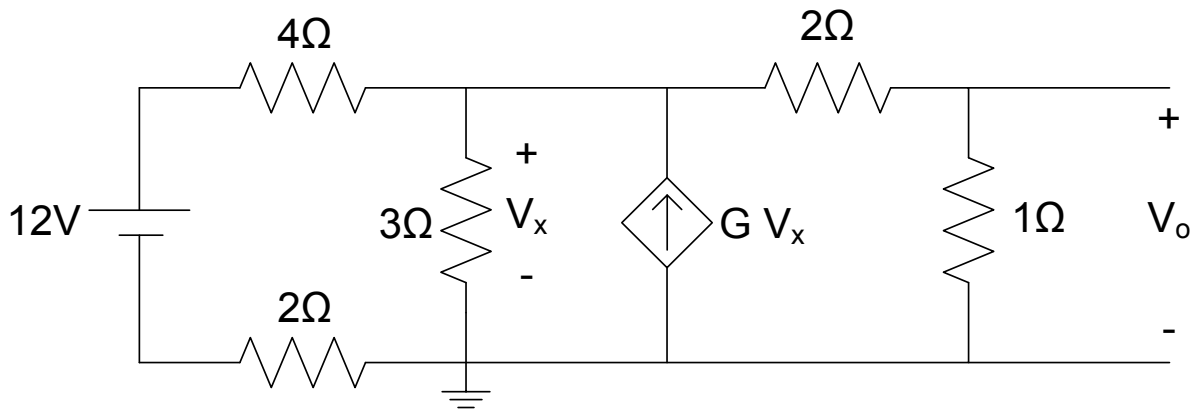
January 25, 2012

**NAME (Last, First)** \_\_\_\_\_

- This quiz is closed book, closed notes, you may use a calculator for algebra.
- Circle your final answers in the space provided; show your work only on the pages provided.
- Do not attach separate sheets. If you need more space, use the back of the pages.
- Points for each problem are given in [brackets], 100 points total. The quiz is 50 minutes long.

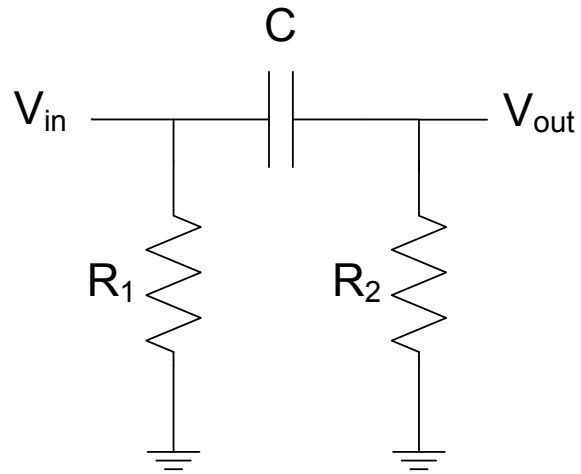
1	/25
2	/35
3	/20
4	/20
Total	/100

1. [25 pts] Find the Thévenin equivalent at  $V_o$  for the following circuit, where  $G = \frac{1}{3} \frac{1}{\Omega}$



(1. continued)

2. [35 pts] For the following circuit:



a. Find the input impedance ( $Z_{in}$ ).

(2. continued)

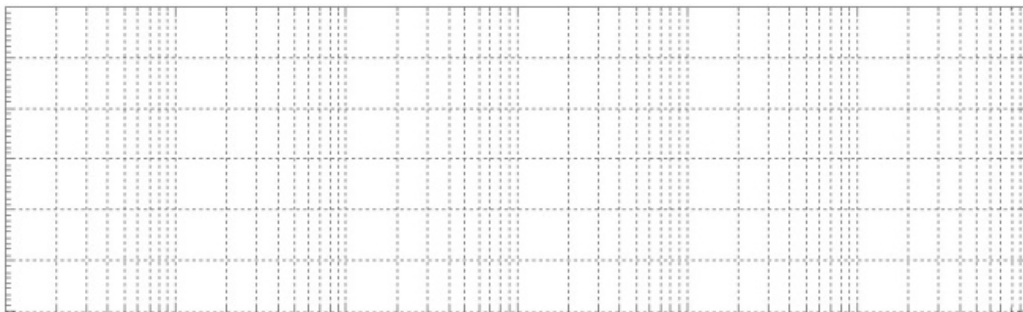
b. Find the output impedance ( $Z_{out}$ ).

c. Find the transfer function  $\frac{V_{out}(j\omega)}{V_{in}(j\omega)}$ .

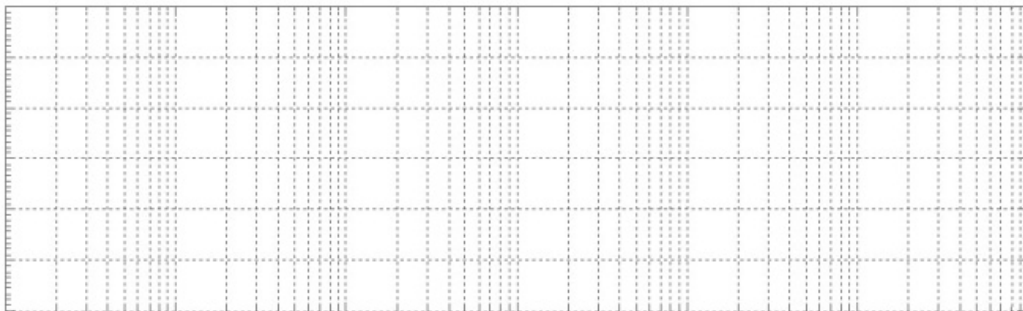
(2. continued)

- d. Sketch the Bode plots for parts (a), (b), and (c) for both magnitude and phase when  $R_1 = 1k\Omega$ ,  $R_2 = 10k\Omega$ , and  $C = 10\mu F$ . Be sure to label all axes with units.

$Z_{in}$  Magnitude

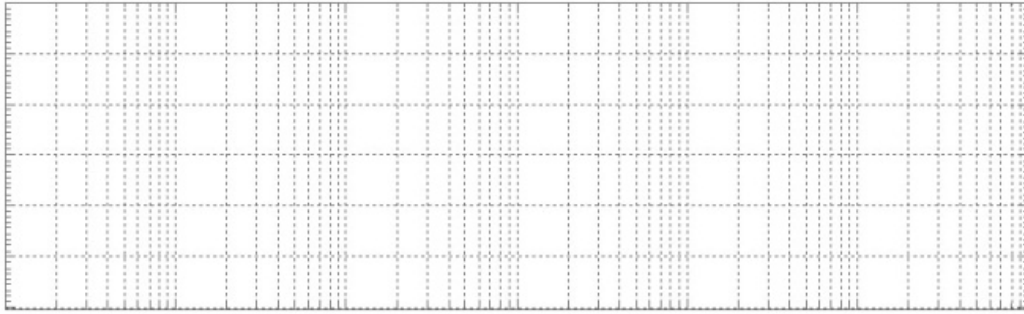


$Z_{in}$  Phase

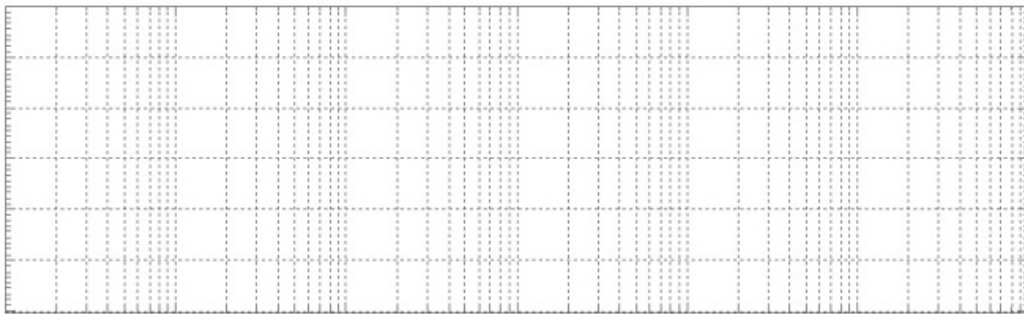


(2. continued)

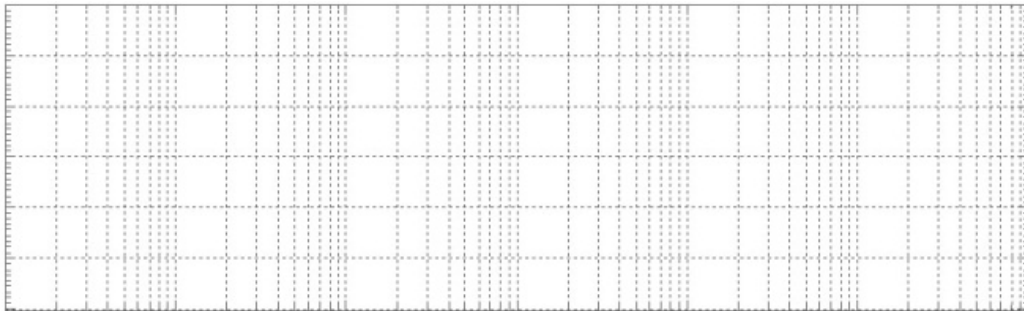
$Z_{out}$  Magnitude



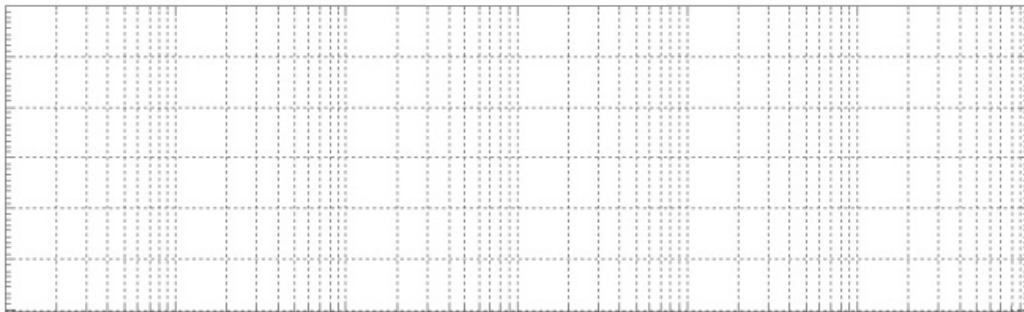
$Z_{out}$  Phase



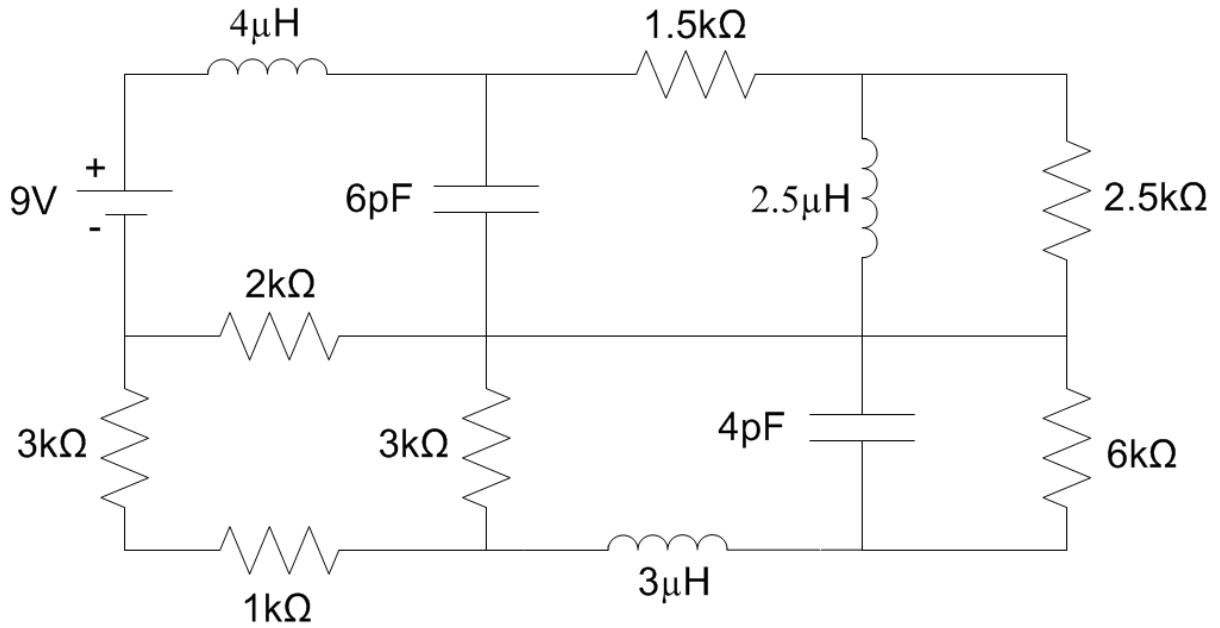
$H(j\omega)$  Magnitude



$H(j\omega)$  Phase



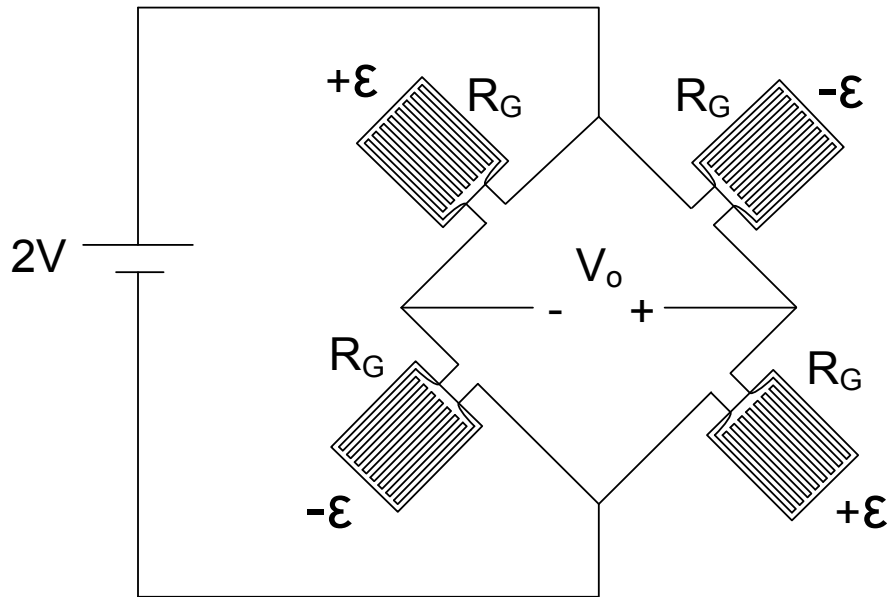
3. [20 pts] Calculate the power dissipated by the following circuit at steady state.





(3. continued)

4. [20 pts] You are designing a device to directly measure arterial blood pressure with a catheter that leads to a flexible diaphragm, which uses two sets of differential strain gauges in a Wheatstone bridge. Assume that the strain gauges have nominal resistance  $R_G = 10\text{k}\Omega$ , gauge factor  $G = 40$ , and Young's modulus  $E = 10\text{MPa}$ .



- a. Find the sensitivity  $\frac{V_o}{\sigma}$ , where  $\sigma$  is the stress in MPa.

(4. continued)

- b. If you expect a heart rate of 150 beats per minute, what should your minimum sampling frequency be?