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 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:

![Circuit Diagram]

a. Find the input impedance ($Z_{in}$).
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.
(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 $R_G = 10k\Omega$, gauge factor $G = 40$, and Young’s modulus $E = 10\text{MPa}$.

\[ V_o = \frac{V}{\sigma} \]

a. Find the sensitivity $\frac{V_o}{\sigma}$, where $\sigma$ is the stress in MPa.
b. If you expect a heart rate of 150 beats per minute, what should your minimum sampling frequency be?