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.

Zin Magnitude



(2. continued)

Zout Magnitude



$H(j\omega)$ Magnitude

-			11	111	1				11	11			-	11	11					11	11				11	11			1 1		11	110
E .			1.1	1.1.1	1	1	1 1			11	 			1.1	1.1					1.1	1.1.1				1.1	1.1	i		1 1			1.12
F					1		1 1			11					1.1.1		: · · ·	: :		1.1	1.1.1				1.1				5 5			
														2.2	1.11			: :				: :			1.1							1.13
E I							: :			11					1.1.1					1.1					1.1			÷			1.1	1.15
	4		- 4 - h -		J		4 4		- 4 - 5	1.6.4	 		- 4 -	1.00	100		4	1			1.5.5	 A	L L	- 2-	4 - 5		· · · · · · · ·	ä	1	b -	- 6 - 6 -	
-																										1.1	1		1.1			
E I				111						11				2.2	111			: :		1.1	: : :				1.1							1.13
	i i					i	; ;			1.1				1.1	1.1.1		i			1.1					1.1	11			1 1		1.1	1.1
E .				1.1.1						1.1				1.1	1.1.1					1.1					1.1	1.1						1.10
E							1 1			11				1.1	1.1.1					1.1	1.1.1				1.1				5			1.15
		in a sign i	4.4	444			44		- 6 - 6	44.4	 		- 41	1.4.4.4	1.00					i i i i i		 			4-4	a de la compañía de l		÷	de e de		-64	
F			1.1	111	1		1 1			1.1				11	1.1.1					1.1	111				1.1	ii.	1		1 1	- i -	1.1	1.1
-			1.1	1.1.1	1		1 1			1.1					4.4.1						1.1.1				1.1	1.1			1. 1		1.1	
E .			5.5	111	1		1 1		1.1	11				1.1	1.1.1					1.1	1.1.1				1.1	11			5 5			1.11
-			2.2				: :			2.2				- 2.2				: :		: :				- 61	1.1							1.12
E			1.1				: :			11				1.1				: :		1.1					1.1			i	i i			1.11
							77				 		- 7 -	1-1	1-1-							 			177	-1-1-		*****	7			1.0
F .			1.1	111	1	1	: :			111		: :		1.1	1.1.1		:	: :		1.1	1.1.1				1.1				5 5		1.1	1.17
E .			1.1	111			: :			11	 	: :			111			: :		11		: :			1.1				: :			1.12
F				1.1.1	1		1 1	1 1 1		1.1				1.1		1	1	1 1		1 1			i i	1	1.1	11	1		1 1		1.1	0.01
C				1.1.1			1 1			1.1					1.11					1.1					1.1	1.1			1.1		1.1	1.1
F			1.1	111			1 1			11.				1.1	11					1.1	1.1.1				1.1	11			1.1		1.1	1.2
-			1.1	111			1 1			11				1.1	1.1					1.1					111	1.1			1 1	1.1	1.1	1.14
E			1.1	1.1.1		1	1 1			1.1				1.1	1.1.1					1.1					1.1	1.1	1		1 1		1.1	1.11
F																																
			1.1	111	2		: :			11		: :		1.1	1.1.1		:	: :		1.1	: : :	: :			1.1	111						1.12
F			1.1	2.2.2	2					1.2				1.1	1.11					1.1					1.1	11			2 2	- 11	1.1	10.00
	1		1.1.	111	3	- L	1	للمارية	1.1.1	11.	 	ii	- Å.,	1.1.1	1.0		1	i	È.	. i. j.	1.11	 I	ii	- 1-	1.1	11.	L	i	3	- L.	1.1.	1.1
-	1	c	1.1	· 11	J	-c	11	1.000	C 3 C 6	111		c r	- 1	110	300	· · · · · · · · ·			- r	· · · · ·	×11		r r	- 7-	1-1		e		1	- F.	- 01-	18.75
E			2.2	111			: :		11	2.2		: :		2.3	1.1.1			: :	- 1	: :	: : :	: :			1.1	11			2 2		1.1	12.25
E			1.1	111			; ;			11		: :		- 2.2	111			: :		11					1.1				: :			1.1
E	î i		1.1	111	1	1	1 1	1 1 1		1.1				1.1	1.1.1	1	i	i i	- 1	1.1	111	1 1		- 1	1.1	11	1		1 1	- i .	1.1	1.1
E .			1.1	1.1.1	1	1	1 1			1.1				1.1	1.1.1					1.1	1.1.1				1.1	1.1	1		1.1		1.1	1.1
E		C 1		1.1.1	1	1	1 1			11				1.1	1.1.1		L		- 1	1.1	I I I			1	1.1	11			1 1	11	11	11





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 Ω , gauge factor G = 40, and Young's modulus E = 10MPa.



a. Find the sensitivity $\frac{V_o}{\sigma}$, where σ 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?