# ENGR-4300 Fall 2008 Test 1

Name \_\_\_\_\_

Section: 1(MR 8:00) 2(TF 2:00) (circle one)

Question I (20 points)

Question II (20 points)

Question III (20 points)

Question IV (20 points)

Question V (20 points)

Total (100 points)

On all questions: SHOW ALL WORK. BEGIN WITH FORMULAS, THEN SUBSTITUTE VALUES <u>AND UNITS</u>. No credit will be given for numbers that appear without justification.

## Question I – Circuit Analysis (20 points)



1) Find the *equation* for total resistance. (6 pts)

2) Find the total resistance *and* total current. (4 pts)

3) Find voltage at points A and B using the voltage divider equation. (5 pts)

4) Find the current through R4 *and* R6. (5 pts)

## Test 1

#### **Question II – Filters (20 points)**

You are given the following circuit. The input at V1 is a 10V AC signal. Leave all answers for 1) - 5) in terms of R1, R2, R3, C1, L1, L2 and the value of V1. V2 and V3 are measured with respect to ground.



1) Redraw the circuit for  $\omega \rightarrow 0$  with appropriate simplifications for the impedances and find V2 and V3. (5 pts)

2) Redraw the circuit for  $\omega \rightarrow \infty$  (high frequencies) with appropriate simplifications for the impedances and find V2 and V3. (5 pts)

3) At what value of  $\omega$  (greater than 0 and less than  $\infty$ ) would you expect to find V3 minimized? (3 pts)

4) What special name is given to the  $\omega$  value in 3)? (2 pts)

5) If Vac is set to 0V and Vdc is set to 5V on V1, what are the values of V2 and V3? (3 pts)

6) What type of filter is the circuit at V3, Low Pass, High Pass, Band Pass, or Band Reject? (2 pts)





1) What is the transfer function  $H(j\omega)$  for the circuit above in terms of R, L, and C? You must reduce it to a simple ratio of polynomials in  $\omega$ . (6 pts)

2) Substitute the values R = 2, C = 4, and L = 1 into  $H(j\omega)$  in 1) and simplify. (4 pts)

3) Find the simplified transfer function for low frequencies and high frequencies (4 pts)

4) For  $\omega = 1$  radian/s, determine the magnitude of H(j $\omega$ ). (2 pts)

5) For  $\omega = 1$  radian/s, determine the phase of H(j $\omega$ ). (2 pts)

## Test 1

6) Which plot correctly displays the relationship between Vin (solid trace) and Vout (dashed trace) at  $\omega = 1$  radian/s? (2 pts)



e. None of these.

## **Question IV: Transformers and Inductors (20 points)**



1) In the circuit above, the transformer is ideal. If  $R1=6K\Omega$ , find the equivalent impedance,  $Z_{AB}$ , seen from points A and B. (5 pts)

## **ENGR-4300**

## Test 1

We have connected the above circuit to an AC source with a resistor R2.



2) If the input voltage has an amplitude of 10V, and the voltage at point A is 526mV, what is the value of R2? (8 pts)

3) What is the value of the voltage across R1? (7 pts)

## **Question V: PSpice (20 points)**

The following circuit is setup in PSpice



1) Setup a transient analysis in the simulation settings window below that will show 4 cycles of the signal, (the "start saving data after:" box can be neglected) (3 pts)

Simulation Settings - temp		
General Analysis Include Fil	es Libraries Stimulus Options Data Collection Probe Window	
Analysis type: Time Domain (Transient) ▼	<u>B</u> un to time: seconds (TSTOP)	
Options:	Start saving data after: seconds	
General Settings Monte Carlo/Worst Case	Transient options	
□Parametric Sweep □Temperature (Sweep)	Skip the initial transient bias point calculation (SKIPBP)	
□Save Bias Point □Load Bias Point	Output <u>File</u> Options	

2) What steps should be included (to avoid errors) in creating an AC Sweep simulation over a range to 1 Megahertz for the circuit above? (circle all that apply) (6 pts)

- a. Place ground in the circuit
- c. Set parameter for VSIN called AC (double click AC source)
- d. Set start frequency to 0 Hz
- f. Set end frequency to 1MHz
- h. Set Points/Decade to 0

- b. Choose AC Sweep/Noise from the drop down box
- e. Set start frequency to 1 Hz
- g. Set end frequency to 1Meg
- i. Set Points/Decade to 100

Simulation Settings - bias				
General Analysis Configuratio Analysis type: AC Sweep/Noise	n Files Options Data C AC Sweep Type C Linear	ollection   Probe Window   Start Frequency:		
Options: General Settings Monte Carlo/Worst Case Parametric Sweep Temperature (Sweep) Save Bias Point Load Bias Point	Logarithmic Decade  Noise Analysis Enabled	End Frequency: Points/Decade: utput Voltage:		
Interval:     Output File Options     Include detailed bias point information for nonlinear controlled sources and semiconductors (.OP)     OK   Cancel   Apply   Help				

3) On the simulation output, label on the plot vprobe1 (Vin), vprobe2 (Vout), and the transfer function *(Vout/Vin)*. (3 pts)



4) What kind of filter is this? (3 pts)

5) How do you determine the corner frequency from the simulation output? How do you calculate the corner frequency from the circuit component values? *Compare the two results.* (5 pts)