ECE 3050 Analog Electronics Quiz 9

July 21, 2010

Professor Leach Name_____

Instructions. No calculators allowed on this quiz. Print your name in the space above. **Honor Code:** *I have neither given nor received help on this quiz.* Initials _____

1. (a) What were the names of the two oscillator circuits covered in class?

(b) An oscillator has a loop-gain transfer function given by

$$K\frac{(s/100)^2-3(s/100)+1}{(s/100)^4+2(s/100)^3+2(s/100)^2+3(s/100)+1}$$

Determine the value of K for steady-state oscillations at the frequency $\omega = 100\,\mathrm{rad/s}$.

$$\begin{aligned} s &= j100 \\ K\frac{(s/100)^2-3(s/100)+1}{(s/100)^4+2(s/100)^3+2(s/100)^2+3(s/100)+1} &= K\frac{-1-j3+1}{1-j2-2+j3+1} = -3K \\ K &= -\frac{1}{3} \end{aligned}$$

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2. The figure shows a non-inverting amplifier.

(a) What is the low-frequency gain?

$$1 + \frac{R_F}{R_1 + R_2}$$

(b) What is the high-frequency gain?

$$1 + \frac{R_F}{R_1 + R_2 \| R_3}$$

(c) Sketch the Bode magnitude plot and label the zero-slope gains.

High-pass shelving Bode plot

(d) Solve for the transfer function for V_o/V_i.

$$\frac{V_f}{V_i} = \frac{R_1 + R_2}{R_1 + R_2 + R_F} \frac{1 + (R_1 \| R_2 + R_3)\, Cs}{1 + [(R_1 + R_F) \| R_2 + R_3]\, Cs}$$

$$\frac{V_o}{V_i} = \left(\frac{V_f}{V_i}\right)^{-1} = \left(1 + \frac{R_F}{R_1 + R_2}\right) \frac{1 + [(R_1 + R_F) \| R_2 + R_3]\, Cs}{1 + (R_1 \| R_2 + R_3)\, Cs}$$

(e) Use the transfer function to identify the pole and zero frequencies for the Bode plot. Label them on the plot.

$$\begin{aligned} \omega_z &= \frac{1}{[(R_1 + R_F) \| R_2 + R_3]\, C} \\ \omega_p &= \frac{1}{1 + (R_1 \| R_2 + R_3)\, C} \end{aligned}$$