Fall 2007 ECE326 Exam #1

Show all work on exam paper itself!

1.) (10 points)

a) If one purchases a 14-bit Analog-to-Digital Converter (ADC) that has a full-scale voltage range of 5 Volts, what is the size, $\Delta$, of the quantization intervals?

b) If a sampling rate of 10,000 samples/sec is chosen, then what is the highest frequency signal that may be sampled with the converter?

2.) (20 points)

An amplifier with a small signal open-circuit voltage gain of 280, an input resistance of 100 k$\Omega$, and an output resistance of 600 $\Omega$, drives a 100 $\Omega$ load. The signal source, $v_s$, driving the input to the amplifier is ideal. The output voltage, $v_o$, is taken across the load.

Draw the circuit described.
What voltage gain ($v_o/v_s$) would you expect?

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What is the current gain ($i_o/i_s$)?

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What is the power gain ($P_o/P_s$) of the circuit?

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3.) (10 points)

Design an inverting op-amp circuit for which the gain is $-5.6 \, \text{V} / \text{V}$ and the total resistance used is $6.6 \, \text{kΩ}$. Draw the schematic and show the resistor values.
4.)  **(20 points)**

Analyze the ideal op-amp circuit shown below to find an expression for $V_{out}$ in terms of $V_A$, $V_B$, and the resistor values. $V_{out}$ is taken from pin 6 of the opamp.
5.) (20 points)

For the ideal op-amp circuit shown below, derive expressions for $V_{o1}$ and $V_{o2}$ as functions of $V_s$, $R_1$, $R_2$, and $R_3$. 
6.) (10 points)

a) An op amp must faithfully reproduce a sine wave at its output? The output sinusoid has a peak-to-peak amplitude of 10 Volts. The frequency of the sine wave is 20 kHz. What is the minimum slew rate that the op amp must possess so that it may be used in this application? Express the result in Volts/μsec.

b) An op-amp with a GBW (Gain Bandwidth Product) of 120 MHz is used in a non-inverting gain configuration where the gain is 20 V / V. What is the bandwidth of this non-inverting gain stage?

7.) (10 points)

An audio amplifier (assume an output resistance of 0 Ω) operating with a load resistance of 32 Ω has a voltage gain of unity and an input resistance of 100 kΩ.

a) Determine the current gain in decibels.

b) Determine the power gain in decibels.