EE4445 Quiz 1

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Professor Leach First Name:_____ Last Name:_____

Instructions. *Print* your name in the spaces above and at the top of all other pages in your quiz. Draw a box around answers. Express numerical answers as a decimal number.

1 of 6. What fraction of the atmospheric pressure is the rms acoustic pressure in a sound wave having an SPL of 90 dB?

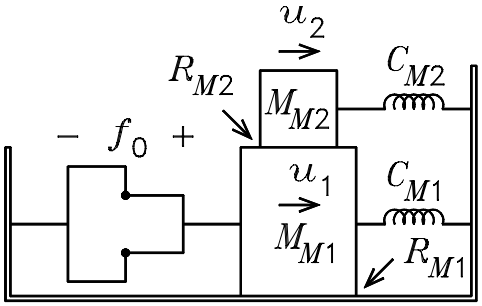
2 of 6. A one-third octave band-pass filter has a center frequency of 8 kHz. What are the upper and lower cutoff frequencies, i.e. the -3 dB frequencies, of the filter?

3 of 6. You are asked to design an octave band graphics equalizer. What ISO center frequencies would you choose for the bands if the equalizer is to cover the audio band from 20 Hz to 20 kHz?

4 of 6. What is the psychoacoustic basis for the frequency response, i.e. gain versus frequency, of the A-weighting filter in an SPL meter?

5 of 6. The diaphragm of a loudspeaker driver can be modeled as a flat circular piston of radius 8 cm. The loudspeaker radiates into an infinitely long plane wave tube of radius 8 cm to the back of the diaphragm and into a 2π steradian load to the front of the diaphragm. The power radiated to the front of the diaphragm is $P_{AR} = 20$ mW. The frequency is 200 Hz.
(a) If a simple spherical wave is radiated to the front of the diaphragm, what is the SPL at a distance $r = 2$ m from the diaphragm?
(b) What is the total power radiated into the tube to the back of the diaphragm?

6 of 6. The figure shows a mechanical system. Draw and label the mechanical diagram, the mobility analogous circuit, and the impedance analogous circuit.



Problem 1

$SPL := 90$ $p_{rms} := p_{ref} \cdot 10^{\frac{SPL}{20}}$ $p_{rms} = 0.632$ $\frac{p_{rms}}{P_0} = 6.243 \cdot 10^{-6}$

Problem 2

$f_c := 8000$ $f_1 := f_c \cdot 2^{\frac{-1}{6}}$ $f_1 = 7.127 \cdot 10^3$ $f_2 := f_c \cdot 2^{\frac{1}{6}}$ $f_2 = 8.98 \cdot 10^3$

Problem 3

$f(n) := 1000 \cdot 2^n$

$f(-5) = 31.25$ $f(-4) = 62.5$ $f(-3) = 125$ $f(-2) = 250$ $f(-1) = 500$

$f(0) = 1 \cdot 10^3$ $f(1) = 2 \cdot 10^3$ $f(2) = 4 \cdot 10^3$ $f(3) = 8 \cdot 10^3$ $f(4) = 1.6 \cdot 10^4$

Problem 4

It mimics the frequency response of the ear at the 40 phon level.

Problem 5

$a := 0.08$ $P_{AR} := 0.02$ $f := 200$ $\omega := 2 \cdot \pi \cdot f$ $r := 2$

$R_{AR} := \frac{\omega^2 \cdot \rho_0}{2 \cdot \pi \cdot c}$ $R_{AR} = 859.613$ $U_{rms} := \sqrt{\frac{P_{AR}}{R_{AR}}}$ $U_{rms} = 4.824 \cdot 10^{-3}$

$p_{rms} := \omega \cdot \rho_0 \cdot U_{rms} \cdot \frac{1}{2 \cdot \pi \cdot r}$ $p_{rms} = 0.569$ $SPL := 20 \cdot \log\left(\frac{p_{rms}}{p_{ref}}\right)$ $SPL = 89.084$

$R_A := \frac{\rho_0 \cdot c}{\pi \cdot a^2}$ $R_A = 2.025 \cdot 10^4$ $P_{AB} := U_{rms}^2 \cdot R_A$ $P_{AB} = 0.471$ $\frac{P_{AB}}{P_{AR}} = 23.554$