MUMT 203 Practice problems

January 14, 2008

1. For each of the following systems, state whether they are a function/not a function, linear/nonlinear, continuous-time/discrete-time, time-variant/-invariant, invertible/noninvertible, causal/non-causal, system with memory/memoryless, stable/non-stable (given T is an integer constant greater than 1, and a,b, c, d are constant rational numbers between -1 and 1) where applicable :

a) $y(t) = x(t) + x(t - 2T)$

b) $y[n] = \frac{1}{x[n+1]}$

c) $y(t) = a^{(t-T)}(x(t))$

d) $y[n] = x[n](x[n-1])$

e) $y(t) = \frac{x(t)(ax(t)-b)(cx(t)+d)}{ab(acx^2(t)-ab)}$,given $bc = ad$

f) $y(t) = (x(t))^{\frac{1}{2}}$

2. What are the even and odd parts of the following signals (write the signal as a sum of even and odd parts, noting which one is which), draw them as well:

a) $x(t) = a(sin(t) - cos(t))$

b) $x(t) = (at^2 + b)(ct + d)$

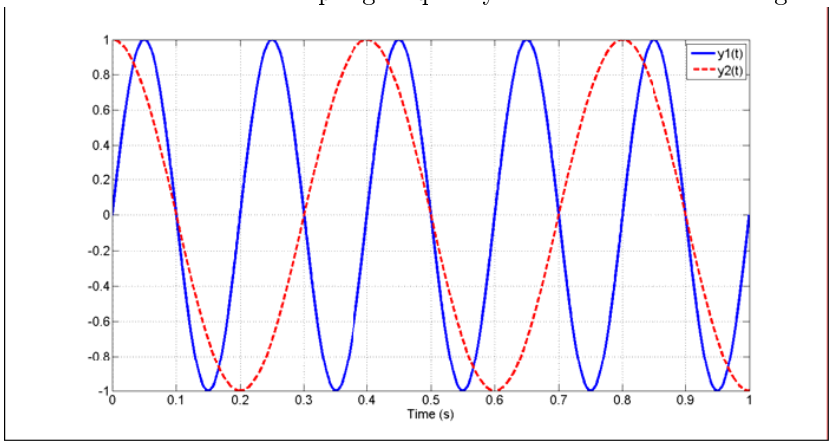
3. What are the frequency components (in Hz) of the following voltage signals and give their amplitude in decibels (to one decimal place), give their relative phases as well (in degrees):

a) $x(t) = 1.3cos(900\pi t + 2\pi) + 3.7cos(700\pi t) + 2.1sin(800\pi t)$

b) $x(t) = (cos(300\pi t)cos(305\pi t)$

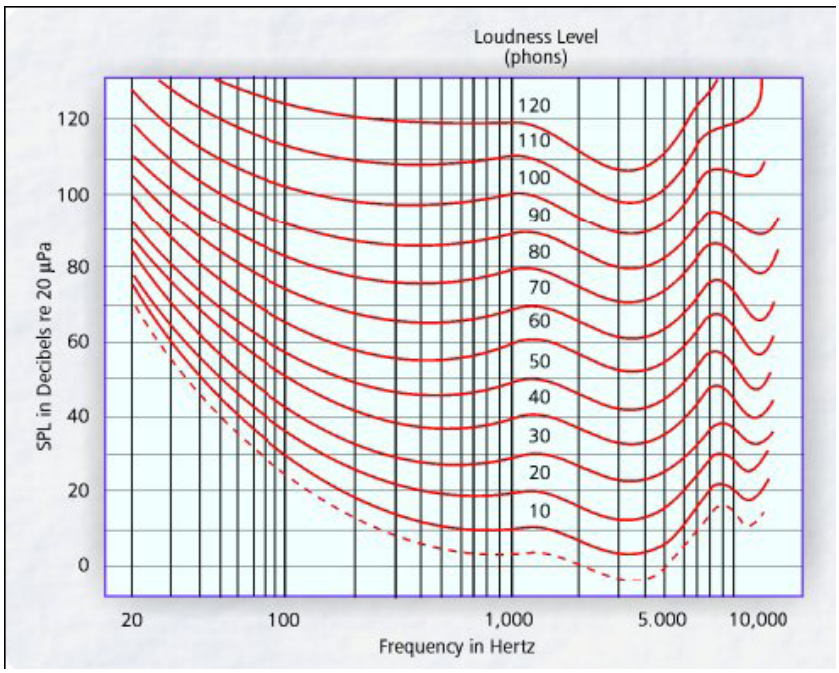
c) $x(t) = 7cos(400\pi t)(0.5 + cos(200\pi t))$

4. What is the critical sampling frequency for each of the above signals to ensure no loss of information?



5. For the figure above, what are the periods and frequencies for $y_1(t)$ and $y_2(t)$?

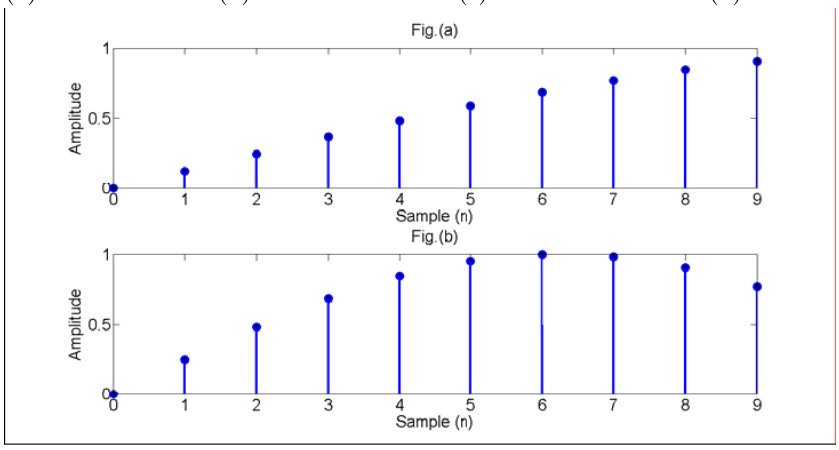
6. Write out the equations that describes the simple harmonic motion (in terms of a cosine function) for the two signals from above.



7. According to the above curves of equal loudness, what is the approximate SPL in Decibels at 100Hz for a tone to be of equal loudness as 10 dB SPL at 1000Hz? (dB = Decibel)

8. According to Curves of Equal Loudness, In what frequency range, ear is most sensitive?

(a) 20Hz – 100Hz (b) 100Hz – 2000Hz (c) 2000Hz – 5000Hz (d) 5000Hz – 10,000Hz



9. $sin(2\pi t)$ is sampled by two different sampling frequencies as above. Each figure shows first 10 samples from index 0. which one is sampled by a higher sampling frequency? (Assume that both sampling frequences are above twice the nyquist frequency)

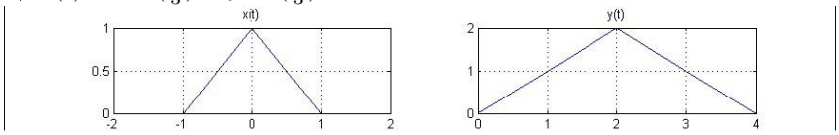
10. Convolve the first and second signals, (approximate the amplitudes shown, and assume a zero amplitude for samples with index outside the range shown).

11. If we sample a pure sinusoidal signal of frequency 10kHz with a sampling frequency 15kHz, what will be the frequency of the primary aliased component?

12. What is the Euler formulation of the following:

a) $x(t) = Acos(\omega t + \phi)$

b) $x(t) = cos(\frac{\pi}{3}) - jsin(\frac{\pi}{3})$



13. Express y(t) in terms of x(t), for the above figure.