Ayden Chow **2019W2_ELEC_221_201**
Assignment Problem_Set_6 due 03/06/2019 at 11:59pm PST

Suppose that $x(t)$ is a real signal that has a Nyquist rate $\omega_0 = 25$ Hz. Find the Nyquist rate of each of the signals in the table below.

	Signal, $y(t)$	**Nyquist Rate**
1	$x(t) - x(t-9)$ is not zero for all t	____
2	$\frac{d^9 x(t)}{dt^9}$	____
3	$2x^2(t)$	____
4	$x(t)cos(7\omega_0 t)$	____

Correct Answers:

- `25`
- `25`
- `50`
- `375`

A periodic signal has a Fourier series representation given by $x(t) = \sum_{k=-\infty}^{\infty} \sqrt{0.1^{|k|}} e^{jkt}$

a) Is this signal band-limited? [?/Yes/No]

b) Find the power, P_x, of the signal.

$P_x =$ ___

c) Now suppose that the signal is approximated by $\hat{x}(t) = \sum_{k=-N}^{N} \sqrt{0.1^{|k|}} e^{jkt}$ by using only $2N+1$ terms instead. Find the minimum N such that $\hat{x}(t)$ has 90% of the original signal's power, P_x.

$N =$ ___

d) Using the N you found in part **c**, determine the maximum sampling period that can be used to sample $\hat{x}(t)$ without aliasing.

$(T_s)_{max} =$ ___

Correct Answers:

- `No`
- `1.22222`
- `1`
- `pi/1`

Consider the causal exponential signal $x(t) = 8e^{-5t}u(t)$.

a) Determine the frequency, ω_M for which the energy of $x(t)$ corresponds to 99% of its total energy.

$\omega_M =$ ___

b) Is $x(t)$ band-limited? [?/Yes/No]

*Part **b** will only be marked correct if part **a** is correct.*

Correct Answers:

- `5*tan(0.99*pi/2)`
- `No`

Consider the signal $x(t) = 7cos(2\pi t + \pi/2)$. Determine if the signal is band-limited or not. Then for each of sampling periods $T_s = 0.3$, 0.5 and 1 sec/sample determine if the Nyquist condition is satisfied or not, then give an expression for the sampled signal, $x(nT_s)$, and determine its period.

Sampling Period, T_s	**Nyquist condition satisfied?**	**Sampled Signal**
0.3	[?/Yes/No]	________
0.5	[?/Yes/No]	________
1	[?/Yes/No]	________

Correct Answers:

- `Yes`
- `7*cos(2*pi*0.3*n+pi/2)`
- `10`
- `Yes`
- `7*cos(pi*n+pi/2)`
- `2`
- `No`
- `7*cos(pi/2)`
- `0`

A continuous-time signal, $x(t) = 3cos(15\pi t) + 5sin(38\pi t) + 6cos(44\pi t + \pi/7)$ is sampled at 38 Hertz. Determine the signal $\omega(t)$, reconstructed using an ideal interpolator with sampling rate $T = (1/38)$ s.

$\omega(t) =$ ________

Correct Answers:

- `3*cos(15*pi*t)+6*cos(32*pi*t-pi/7)`

JY Note Apr 18: Replaced question corrected.

For each of the signals given in the table below, determine whether or not it is periodic and find its period if it is. If the signal is aperiodic, enter *NA* for its period.

	Signal, $x[n]$	Periodic/Aperiodic	Period
1	$cos\left(\frac{\pi n}{5}\right)cos\left(\frac{\pi n}{10}\right)$	[?/Periodic/Aperiodic]	____
2	$7cos\left(\frac{\pi n}{14}\right) - sin\left(\frac{\pi n}{28}\right) + 10cos\left(\frac{\pi n}{7} - \frac{\pi}{5}\right)$	[?/Periodic/Aperiodic]	____
3	$9 + cos\left(\frac{\pi n^2}{8}\right)$	[?/Periodic/Aperiodic]	____
4	$9e^{j(n-3)/3}$	[?/Periodic/Aperiodic]	____
5	$19cos(8n) + 4sin(2\pi n) - cos(3n)$	[?/Periodic/Aperiodic]	____
6	$-11e^{j\pi(n-5)/5}$	[?/Periodic/Aperiodic]	____

Correct Answers:

- `Periodic`
- `20`
- `Periodic`
- `56`
- `Periodic`
- `8`
- `Aperiodic`
- `NA`
- `Aperiodic`
- `NA`
- `Periodic`
- `10`

JY Note Apr 18: Energy for signal 2 corrected.

Given the following discrete-time signals, compute their energy and power. If either is infinite, enter "INF".

	Signal, $x[n]$	Energy	Power
1	$6\left(\frac{1}{5}\right)^n u[n]$	____	____
2	$9e^{j9n}u[n]$	____	____

Correct Answers:

- `37.5`
- `0`
- `infinity`
- `40.5`