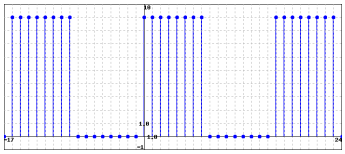
Ayden Chow **2019W2_ELEC_221_201**
Assignment Problem_Set_9 due 04/04/2019 at 11:59pm PDT

Determine the Fourier series coefficients for each of the following discrete-time periodic signals. For the signal, $x[n]$, shown in the figure below, determine the Fourier coefficients X_k (for $k \neq 0$). Simplify your answer as much as possible.



$X_k = \_\_\_ \; e \quad j\_\_\_ \quad sin(\_\_\_)sin(\_\_\_)$

Correct Answers:

- `0.5625`
- `k*(-pi/2+pi/16)`
- `k*pi/2`
- `k*pi/16`

JY Note Apr 1: The issue with part (c) should be resolved now.

A causal discrete-time LTI system is described by the difference equation $y[n] - \frac{1}{8}y[n-1] = 18x[n] + \frac{1}{9}x[n-1]$, where $x[n]$ is the input and $y[n]$ is the output signal.

a) Determine the frequency response, $H(\Omega)$, of the system. *Enter Ω as "O".*

$H(\Omega) = \_\_\_$

b) Find the impulse response, $h[n]$, of the system.

$h[n] = \_\_\_$

c) Determine the response of the system, $y[n]$ to the input $x[n] = cos(\frac{n\pi}{9})$.

$y[n] = \_\_\_$

In your answers, enter $z(n)$ for a discrete-time function $z[n]$. WebWork is unable to parse a function that uses square brackets.

Correct Answers:

- `[18+0.111111*2.71828^(-i*O)]/[1-0.125*2.71828^(-i*O)]`
- `18*0.125^n*u(n)+0.111111*0.125^(n-1)*u(n-1)`
- `20.49*cos(n*pi/9+(-0.0505039))`

Consider an LTI discrete-time system that has impulse response $h[n] = \begin{cases} \frac{sin(\pi(n-36)/6)}{\pi(n-36)} & if \; n \neq 36 \\ \frac{1}{6} & if \\ otherwise \end{cases}$

a) Determine the magnitude $|H(\Omega)|$ and the phase response $\angle H(\Omega)$ for $-\pi < \Omega < \pi$. *Enter Ω as "O" and enter the piecewise function $|H(\Omega)|$ using the heaviside function.*

$|H(\Omega)| = \_\_\_ \angle H(\Omega) = \_\_\_$

b) Determine the output of the system, $y[n]$, if the input is given by $x[n] = \delta[n-9] + cos(\frac{\pi n}{9})$. Enter your answer in terms of $h[n]$.

$y[n] = \_\_\_$

In your answers, enter $z(n)$ for a discrete-time function $z[n]$. WebWork is unable to parse a function that uses square brackets.

Correct Answers:

- `u(O+pi/6)-u(O-pi/6)`
- `-36*O`
- `h(n-9)+cos(n*pi/9)`

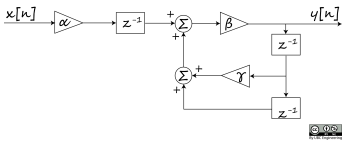
Consider a discrete-time system that has the impulse response $h[n] = \left(\frac{1}{8}\right)^n u(n)$. Find the response of the system to each of the input signals given in the table below. Perform the calculation in the time domain and simplify your answers as much as possible. On an exam, you will only be given full marks for a time-domain solution.

	Input signal, $x[n]$	**Output signal,** $y[n]$
1	$e^{j\pi n/2}$	_____
2	$cos(\frac{\pi n}{5} + \frac{pi}{3})$	_____

Correct Answers:

- `2.71828^(i*pi*n/2)/[1-0.125*2.71828^(-i*pi/2)]`
- `[cos(n*pi/5+pi/3)-0.125*cos(n*pi/5+pi/3+pi/5)]/[1.01562-0.`

JY Note: Apr 2, 2019: Issues with this question have been resolved. For part (b), write the impulse response as the product of a function with the unit step.



The block diagram below represents a discrete-time LTI system. Assume $\alpha = 6$, $\beta = -\frac{1}{14}$, $\gamma = 9$.

a) Write the difference equation that describes this system.

_____

b) Find the impulse response of the system.

$h[n] =$ _____

c) Evaluate the phase and magnitude of the frequency response of the system at each of the frequencies given in the table below.

Frequency, Ω	$\lvert H(\Omega)\rvert$	$\angle H(\Omega)$
0	_____	_____
$\frac{\pi}{4}$	_____	_____
$-\frac{2\pi}{3}$	_____	_____

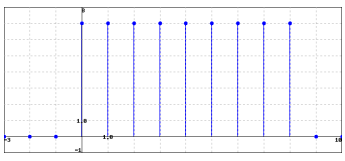
In your answers, enter $z(n)$ for a discrete-time function $z[n]$. WebWork is unable to parse a function that uses square brackets.

Correct Answers:

- `6*x(n-1)+9*y(n-1)+y(n-2) = -14*y(n)`
- `1.2*(-0.5)^n*u(n)+(-1.2)*(-0.142857)^n*u(n)`
- `0.25`
- `3.14159`
- `0.277078`
- `2.70318`
- `0.528271`
- `-1.70325`

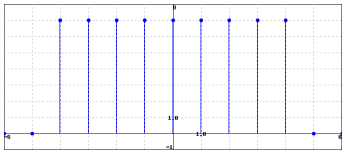
JY Note: Apr 2, 2019: Issues with this question have been resolved. For part (b), ensure that your answer is purely real-valued. If the number of nonzero values in fig (a) is even, please report this to the instructor.

a) Find the Fourier transform of the rectangular pulse sequence, $x_1[n]$, given in the figure below. *Enter Ω as "O".*



$X_1(\Omega) =$ ____

b) Use your answer from part **a** to find the Fourier transform of the rectangular pulse sequence, $x_2[n]$, given in the figure below.



$X_2(\Omega) =$ ____

- ?
- Linearity
- Time-shifting
- Duality
- Reflection
- Modulation

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

Correct Answers:

- `7*2.71828^(-i*O*4)*sin(O*4.5)/[sin(O/2)]`
- `7*sin(O*4.5)/[sin(O/2)]`
- `Time-shifting`

JY Note Mar 29: Part c & d have been updated.

The transfer function of a FIR filter is $H(z) = z^{-8}(8.5z + 1.9 + 8.5z^{-1})$.

a) Find the frequency response, $H(\Omega)$ of the system. *Enter Ω as "O".*

$H(\Omega) =$ ____

b) Is the phase response of the system linear? [?/Yes/No]

c) Find the impulse response, $h[n]$, of the system.

$h[n] =$ ____

In your answer, enter $z(n)$ for a discrete-time function $z[n]$ and enter $D(n)$ instead of $\delta[n]$. WebWork is unable to parse a function that uses square brackets.

d) Is the impulse response symmetric in the y-axis? [?/Yes/No]

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

Correct Answers:

- `2.71828^[(-8i)*O]*[1.9+17*cos(O)]`
- `Yes`
- `8.5*D(n-8+1)+1.9*D(n-8)+8.5*D(n-8-1)`
- `Yes`