ECE 2026 Exam 1
Fall 2022

Name ______________________________

General Instructions instructions:

- Exam is closed book / closed notes other than the one-page of handwritten notes.
- Choose the best possible answer available in all cases.
- Blank scratch paper is allowed

_______ Part I: Objective Questions

_______ Part II: Open Response Question

_______ Final Score

Part I: Objective Questions

These questions have straight-forward answers. Make sure to put your answer in the line required as that is the part that will be graded for the answer given. Only the final answers, as indicated by the question, will be considered correct for each question. Each question is worth 4 points (total of 80 points)

Matching:

_________ 1. T_0

_________ 2. $f(nT_s)$

_________ 3. $u(t)$

_________ 4. $\delta[n]$

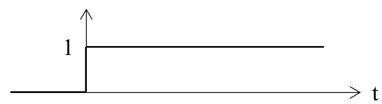
_________ 5. $H(\hat{\omega}) = \sum_{k=0}^{M} h_k e^{-j\hat{\omega}k}$

a. Convolution

b. FIR Frequency Response

c. Sampling Period

d. Waveform Period

e. 

f. Sampled function

g. Discrete Impulse Function

h. Discrete Step Function

Matching: $\omega_1 = 2\pi f$, f = 1kHz

_________ 6. $4\cos(\omega_1 t) + 3\sin(\omega_1 t)$

_________ 7. $5\cos(\omega_1 t + \pi/3) + 5\cos(\omega_1 t - \pi/3)$

_________ 8. $2\cos(\omega_1 t + \pi/6) - 2\cos(\omega_1 t - \pi/6)$

a. 5 cos(ω_1t + π/2)
b. 5 cos(ω_1t + 0.644)
c. -5 cos(ω_1t)
d. 5 cos(ω_1t)
e. 5 cos(ω_1t – 0.644)
f. 5 cos(ω_1t - π/2)
g. -2.83 cos(ω_1t)
h. 2.83cos(ω_1t - π/2)
i. 2.83 cos(ω_1t)
j. 2.83 cos(ω_1t + π/2)
k. -2 cos(ω_1t)
l. 2 cos(ω_1t - π/2)
m. 2 cos(ω_1t)
n. 2 cos(ω_1t + π/2)

Match the sampled signals to the real signal, $x(t) = 4\cos(2\pi f t)$, f = 1kHz. Assume an ideal Continuous to Discrete (C-to-D) transformation.

__________ 9. f_s = 4kHz

__________ 10. f_s = 2kHz

__________ 11. f_s = 1.33kHz

__________ 12. f_s = 1kHz

a. $4\cos(-\frac{\pi}{2}n)$

b. $4\cos(-\frac{\pi}{4}n)$

c. 4

d. $4\cos(\frac{\pi}{4}n)$

e. $4\cos(\frac{\pi}{2}n)$

f. $4\cos(\pi n)$

Match the sampled signals to the real signal, $x(t) = 3\cos(2\pi f t) + \cos(6\pi f t)$. Assume an ideal Continuous to Discrete (C-to-D) transformation.

__________ 13. f_s = 18kHz

__________ 14. f_s = 6kHz

__________ 15. f_s = 3kHz

a. $3\cos(\frac{2\pi}{3}n) + \cos(\pi n)$

b. $3\cos(\frac{2\pi}{3}n) + 1$

c. $3\cos(\frac{\pi}{9}n) + \cos(\frac{\pi}{3}n)$

d. $3\cos(\frac{\pi}{3}n) + \cos(\frac{\pi}{2}n)$

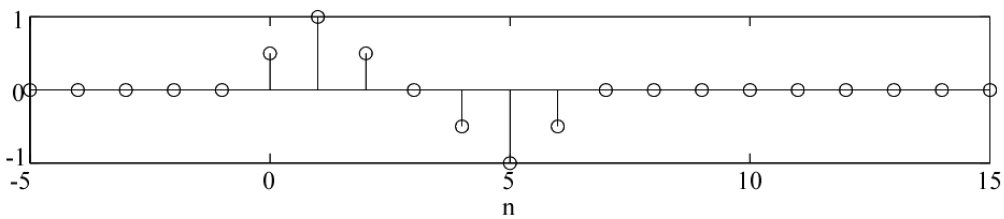
e. $3\cos(\frac{\pi}{9}n) + \cos(-\frac{\pi}{2}n)$

f. $3\cos(\frac{\pi}{3}n) + \cos(\pi n)$

g. $3\cos(\frac{\pi}{9}n) + \cos(\frac{\pi}{2}n)$

h. $3\cos(\frac{\pi}{3}n) - \cos(\pi n)$

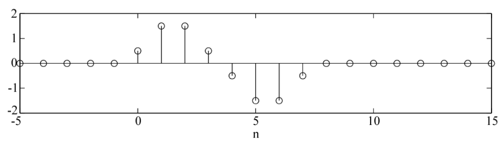
For a given input (x[n])



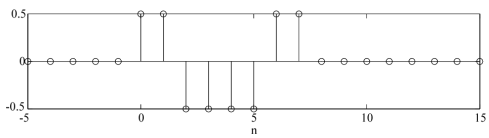
Match y[n] with h[n].

y[n] h[n]

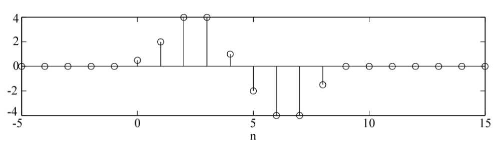
__________ 16.



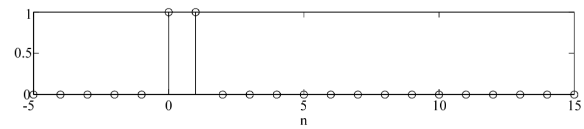
__________ 17.



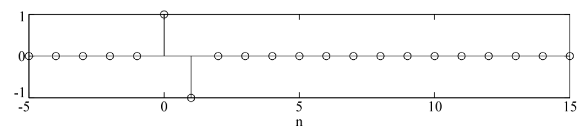
__________ 18.



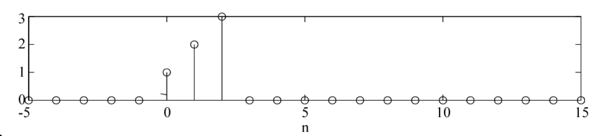
a.



b.



c.

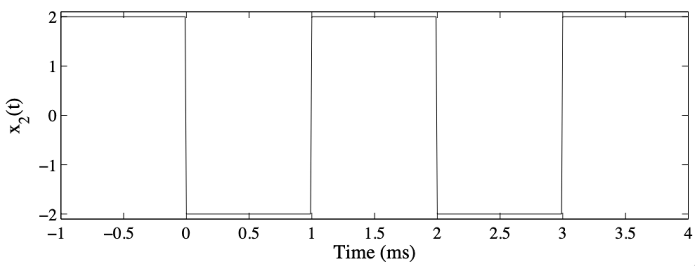


__________ 19. (True / False) A linearly increasing chirp signal would be seen in a spectrogram as a line starting from the highest frequency moving to the lowest frequency.

__________ 20. (True / False) The a_0 term in a Fourier series is the average value over a single period of a periodic signal.

Part II: Open Response Question (20 points)

Remember the function below has this Fourier series

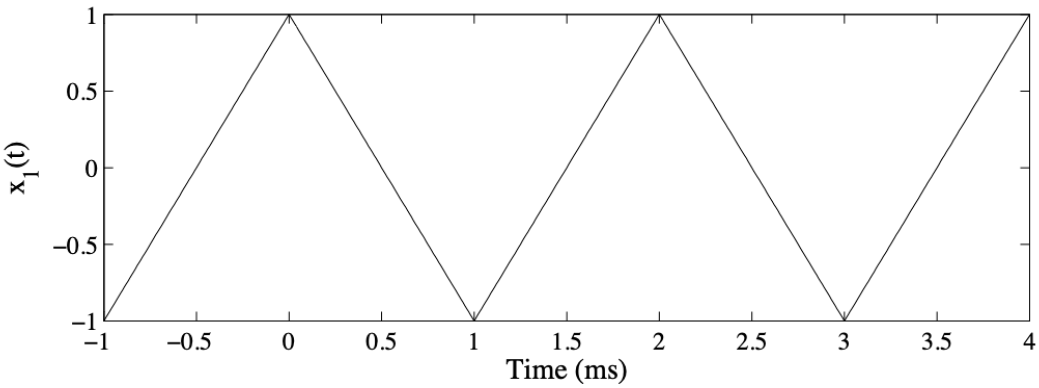


$$x_2(t) = -\sum_{k=1}^{\infty} \frac{4}{\pi k} \sin(2\pi f_0 k t)$$

(Odd k, otherwise = 0)

This question has three parts (a, b, & c)

Assume we have the following input into our ideal Continuous to Discrete (C-to-D) converter.



a. What is the Fourier Series for this signal?

b. What should be the sampling rate such that the Fourier series coefficient error is less than 4%? Explain the aliasing effects for this system. Assume an ideal Continuous to Discrete (C-to-D) transformation.

c. Using your Fourier series and the sampling rate you have determined, a digital FIR function is applied of the form

$$y[n] = x[n] - x[n-1]$$

What are the resulting complex amplitudes of the Fourier series coefficients after applying this digital FIR filter function?