ECGR 4124 – Breadth Exam

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Quiz Instructions

1. Question 1 – 3 pts

An LTI system has impulse response defined by {4, -2, 7}. Determine the output of the system y[n] when the input x[n] = {1, -1, 2}. Provide a single number as your answer which is the total of the values of the output, i.e., sum(y[n]).

2. Question 2 – 3 pts

What components are typically needed to construct a DSP system that can take analog signals as input and produce analog output? (Choose all that apply)
Capacitor
Resistor
CPU
op amp
ADC
DAC
Inductor

3. Question 3 – 3 pts

If an input $\sin(5\pi t)$ is sampled with a frequency of 8 samples/sec, what is the discrete-time frequency in rad/sample? Provide answer with two decimal digits.

4. Question 4 – 3 pts

Let x[n] denote samples from a continuous signal $x(t)=\cos(2\pi \cdot 1.5t)$. For a sampling interval of T=0.3 sec/sample, find ω_0 (radians/sample).

5. Question 5 – 3 pts

How many of the following are periodic?
(1) $\cos(0.3\pi n)$
(2) $\sin(\pi n/5)$
(3) 4
(4) $e^{\wedge}(j2\pi n/9)$

6. Question 6 – 3 pts

If X = 3 + 4j and Y = 2 - j, simplify (X/Y*) and provide the result in a + jb form.

7. Question 7 – 3 pts

(True/False) The signal $x[n] = \cos(\pi\sqrt{2}\, n)$ is periodic.

8. Question 8 – 3 pts

Which of the following are equivalent to $\cos(\omega n + \varphi)$?
(a) $\cos(\omega n - \varphi)$
(b) $\sin(\omega n + \varphi)$
(c) $\cos(-\omega n - \varphi)$
(d) None of the above

9. Question 9 – 3 pts

What is the phase angle (in radians) of the complex number $-2 + 2j$?

10. Question 10 – 3 pts

Given $x[n] = \{1,2,3\}$, $h[n] = \{1,0,-1\}$, list all values of $y[n] = x[n]*h[n]$.

11. Question 11 – 3 pts

If $x[n] = \delta[n-2] + 3\delta[n-4]$, what is $x[4]$?

12. Question 12 – 3 pts

Two discrete-time sequences x[n] and h[n] have lengths 6 and 5, respectively. What is the maximum possible length of their linear convolution y[n]?
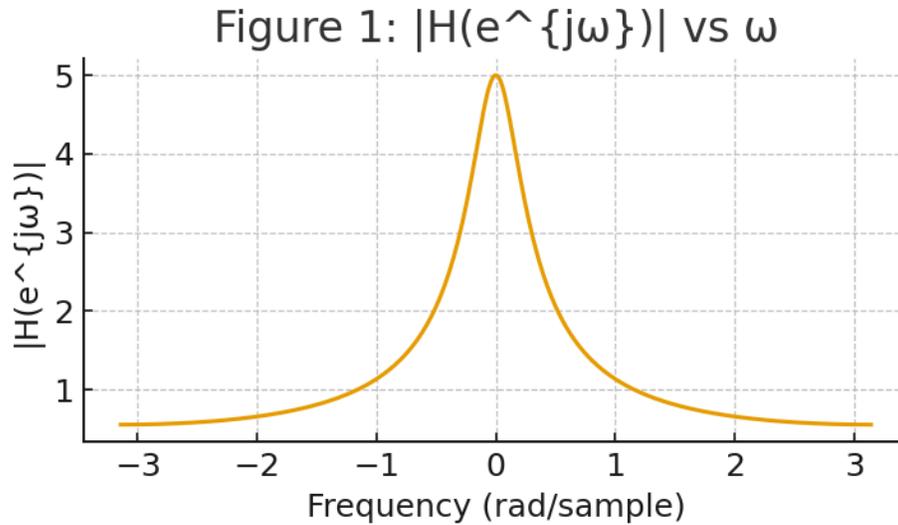
13. Question 13 – 3 pts

Let $x[n] = e^{\wedge}(j3\pi n/8)$. Find the fundamental period of x[n].

14. Question 14 – 3 pts

Given $x[n] = u[n-5]$, determine the index n_0 where x[n] first becomes 1.

15. Question 15 – 3 pts

A system has DTFT magnitude response shown below. Given B=3, indicate if the system is causal (1 = Yes, 0 = No). [Figure 1: magnitude plot included]

Figure 1: |H(e^{jω})| vs ω

16. Question 16 – 3 pts

A system satisfies y[n] = 2x[n−1] + 4x[n−3]. Is it LTI? (1 = Yes, 0 = No)

17. Question 17 – 3 pts

For the system y[n] = 0.8y[n−1] + x[n], determine if it is stable (1 = Yes, 0 = No).

18. Question 18 – 3 pts

If X[k] is the DFT of x[n], what is the phase of X[4] if X[4] = 3e^(jπ/6)?

19. Question 19 – 3 pts

If x[n] = δ[n] + δ[n−2], find its DTFT X(e^{jω}).

20. Question 20 – 3 pts

A signal x[n] = cos(0.4πn) is sampled with N=64 for DFT. What index k corresponds to its main frequency component?

21. Question 21 – 3 pts

If x(t) = cos(200πt) is sampled with Ts=2ms, write x[n].

22. Question 22 – 3 pts

A system that aliases frequencies is LTI? (True/False)

23. Question 23 – 3 pts

Given x(t) with maximum frequency 250 Hz, what is the lowest sampling rate that avoids aliasing?

24. Question 24 – 3 pts

For y[n] = 0.9y[n−1] + x[n], determine stability (1=Stable, 0=Unstable).

25. Question 25 – 5 pts

Compute y[n] = x[n]*h[n] for x[n]={1,2,1}, h[n]={1,1,1}. Find y[2].

26. Question 26 – 3 pts

The DFT of x[n] is defined for k=0,…,N−1. If N=128, what is the frequency spacing $\Delta\omega$ in radians/sample?

27. Question 27 – 3 pts

If x[n] = e^(j0.25πn) + e^(j0.5πn), what is its fundamental period?

28. Question 28 – 3 pts

Given X[k] = DFT{x[n]}, which operation on x[n] causes a linear phase shift in X[k]?

29. Question 29 – 3 pts

If x(t) = sin(400πt) and is sampled at 300 Hz, will aliasing occur? (1=Yes, 0=No)

30. Question 30 – 3 pts

What sampling period Ts corresponds to 2× Nyquist rate for a signal of 400 Hz bandwidth?

31. Question 31 – 3 pts

A signal x(t)=cos(600πt) + cos(1000πt). Find the minimum sampling rate to avoid aliasing.

32. Question 32 – 3 pts

Indicate if the system y[n] = 0.5y[n−2] + 3x[n−1] is stable (1=Yes, 0=No).

33. Question 33 – 8 pts

Compute the convolution of x[n]={1,0.5,−0.5} and h[n]={0.5,1,0.5}. Find y[1]. [Figure 2: Discrete-time waveform shown]

Figure 2: Example Discrete-Time Signal x|