Serial Number: **101**

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C	C	B	E	C	E	E	D	D	A	E	A
1	2	3	4	5	6	7	8	9	10	11	12

Put your name **also** on the second page.

You must show your work on every problem, showing all steps on your test. Do not use scratch paper or write your work anywhere but on the test. Write your letter answers in the bubbles next to each problem and on the first page. The examination lasts 60 minutes and you may use six sheets of notes (front and back); no old test questions can be on your notes. Calculator use is permitted. There is one correct answer per question. In problems asking to find coefficients A, B, C, etc., some of these coefficients may equal zero.

Serial Number: **101** Name:

ECE 3300 Fall 2017 (Signals, Systems, and Transforms): Exam 6

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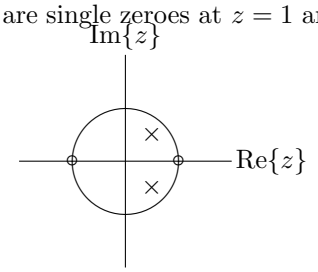
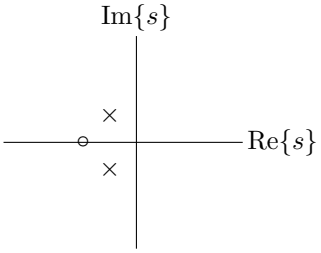
Question 1: Consider the pole-zero plot shown. The zeroes are single zeroes at $z = 1$ and $z = -1$, and the poles are single poles at $z = \frac{1+j}{2}$, and $z = \frac{1-j}{2}$. This filter is



A: Lowpass.
B: Highpass.
C: Bandpass.
D: Allpass.
E: Bandstop.

Question 2: For the system with pole-zero plot shown, there are single poles at $s = -1 + j$ and $s = -1 - j$, and there is a single zero at $s = -2$. Determine $\frac{|H(j1)|}{|H(j0)|}$. Choose the closest answer. *Hint:* This can be determined from the plot.



A: 0.75.
B: 0.5.
C: 1.0.
D: 1.5.
E: 1.25.

Question 3: Suppose an LTI system has impulse response $h(t) = \delta(t) - e^{-t}u(-t)$ and input $x(t) = e^{-3t}u(t) + e^{-2t}u(-t)$. The output has the form $y(t) = Ae^{-Bt}u(t) + Ce^{-Dt}u(-t)$. Determine $A + B + C + D$. Choose the closest answer.

A: 9.
B: 5.
C: 6.
D: 8.
E: 7.

Question 4: Consider a linear time-invariant system given by $H(z) = \frac{1}{1+2z^{-1}} + \frac{1}{(1+2z^{-1})^2} + \frac{1}{1-2z^{-1}} + \frac{1}{(1-2z^{-1})^2}$. Let T denote the total number of realizations of this system. Let C denote the number of these realizations that are causal and S the number that are stable. Determine $T + C + S$.

A: 6.
B: 5.
C: 3.
D: 7.
E: 4.

Question 5: Consider a linear time-invariant system with impulse response $h[n] = (2n + 3)(-1)^n u[n]$. Consider $h_I[n]$, the impulse response of the causal INVERSE system. The Z transform of this inverse system has ROC $|z| > A$. What is A? *Hint:* Look at the denominator of $H_I(z)$. Also note that $(2n + 3) = 2(n + 1) + 1$.

A: $\frac{1}{2}$.
B: 1.
C: $\frac{1}{3}$.
D: 3.
E: 2.

Question 6: Suppose $h[n] = 2(-1)^n u[n] - (-2)^n u[-n - 1]$. Which of the following lists all the zeroes of $H(z)$?

A: $-\frac{3}{5}$.
B: $-\frac{3}{5}$ and 0.
C: $-\frac{5}{3}$.
D: $-\frac{3}{5}$, $-\frac{5}{3}$, and 0.
E: $-\frac{5}{3}$ and 0.

Question 7: Suppose a causal system with transfer function $H(s)$ is such that there are single poles at $s = -2 + j$ and $s = -2 - j$ and a double zero at $s = -1$. Assume $H(0) = 1$. It follows that $H(s) = \frac{As^2+Bs+C}{s^2+Ds+E}$. What is $A + B + C + D + E$? Choose the closest answer.

A: 30.
B: 26.
C: 28.
D: 27.
E: 29.

Question 8: Suppose a linear time-invariant system with input $x[n]$ and output $y[n]$ is governed by the difference equation $y[n] - 3y[n-1] + 2y[n-2] = x[n] + 4x[n-1] + 3x[n-2]$. Determine $H(z)$. The causal realization of $H(z)$ is $h[n] = A\delta[n] + B(C)^n u[n] + D(E)^n u[n]$. What is $C + E$? Choose the closest answer. *Hint:* It is not necessary to complete the partial-fraction expansion to answer this question.

A: 2.
B: 4.
C: 0.
D: 3.
E: 1.

Question 9: Suppose a signal has maximum frequency 60 kHz and is 20% oversampled. Determine the sampling rate.

A: 12 ksamples/s.
B: 142 ksamples/s.
C: 74 ksamples/s.
D: 144 ksamples/s.
E: 72 ksamples/s.

Question 10: Consider two linear time-invariant systems with impulse responses $h_1(t) = \delta(t) - 2e^{-4t}u(t)$ and $h_2(t) = e^{-4t}u(t)$ and suppose that the two systems are arranged in a causal feedback combination (the system with impulse response $h_2(t)$ is the one "fed back"). The impulse response of the composite feedback system has the form $h(t) = A\delta(t) + Be^{-Ct}u(t) + De^{-Et}u(t)$. Determine $C + E$. Choose the closest answer. *Hint:* It is not necessary to determine A, B, or D.

A: 9.
B: 7.
C: 8.
D: 6.
E: 5.

Question 11: Consider a linear time-invariant system with input $x[n] = \delta[n] - \delta[n-1]$ and output $y[n] = u[n] + \delta[n]$ Determine the causal impulse response $h[n]$. Determine $h[0]$ and $h[1]$. What is $h[0] + h[1]$? Choose the closest answer.

A: 2.
B: 3.
C: 4.
D: 1.
E: 5.

Question 12: Consider a linear time-invariant system with impulse response $h(t) = \delta(t) - 2e^{-t}u(t) + e^{t}u(-t)$. The input-ouput differential equation for this system can be shown to have the form

$$y''(t) + Ay'(t) + By(t) = Cx''(t) + Dx'(t) + Ex(t)$$

Determine $A + B + C + D + E$. Choose the closest answer.

A: -3.
B: -2.
C: -5.
D: -1.
E: -4.