Answers: EDEE CABA DEDC

Serial Number: **601** Name:

ECE 3300 Spring 2016 (Signals, Systems, and Transforms): Exam VI

Record your name on this test; record your name, student ID, and test serial number on the scantron. Enter the test serial number in *COURSE*; you may leave *SECTION* blank. 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. Circle your answers on the test and bubble in the corresponding answers on your scantron. The examination lasts 50 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.

Question 1: Consider a linear time-invariant system with impulse response $h(t) = (2t-1)e^{-t}u(t)$. The input-ouput differential equation for this system can be shown to have the form

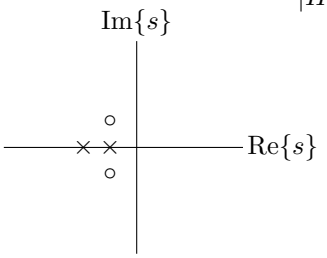
$$y''(t) + Ay'(t) + By(t) = Cx''(t) + Dx'(t) + Ex(t)$$

Determine $A + B + C + D + E$. Choose the closest answer.
A: 1.
B: 4.
C: 2.
D: 5.
E: 3.

Question 2: Suppose a pre-sampled signal has maximum frequency 425 kHz and the signal is sampled at rate 1,000,000 samples per second. Determine the percentage oversampling. Choose the closest answer.
A: 27%.
B: 24%.
C: 15%.
D: 18%.
E: 21%.

Question 3: Suppose a causal system with transfer function $H(s)$ is such that there are single poles at $s = -2$ and $s = -4$ and single zeroes at $s = -1$ and $s = -5$. Assume $H(0) = 1$. What is $H(4)$? Choose the closest answer.
A: 5.5.
B: 3.5.
C: 2.5.
D: 4.5.
E: 1.5.

Question 4: For the system with pole-zero plot shown, there are single poles at $s = -1$ and $s = -2$ and there are single zeroes at $s = -1 + j$ and $s = -1 - j$. Determine $\frac{|H(j1)|}{|H(j0)|}$. Choose the closest answer. *Hint:* This can be determined from the plot.



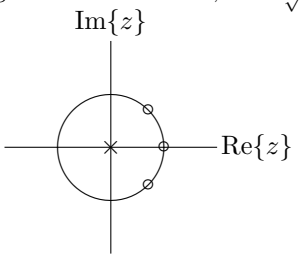
A: 0.4.
B: 1.3.
C: 1.0.
D: 1.6.
E: 0.7.

Question 5: Suppose a linear time-invariant system with input $x[n]$ and output $y[n]$ is governed by the difference equation $y[n] - 4y[n-1] + 4y[n-2] = x[n] - 2x[n-1] + x[n-2]$. Determine $H(z)$. The causal realization of $H(z)$ is $h[n] = (A + Bn)(C)^n u[n] + D\delta[n]$. What is C? Choose the closest answer. *Hint:* It is not necessary to complete the partial-fraction expansion to answer this question.
A: -2.
B: 1.
C: 2.
D: -1.
E: 0.

Question 6: Consider a linear time-invariant system with input $x[n] = \delta[n] - 2(-1)^n u[n]$ and output $y[n] = (-1)^n u[n]$. Determine all possible impulse responses $h[n]$. The answer has the form $Au[n]$, $Bu[-n-1]$, or both. If the answer has the form $Au[n]$, determine A. If the answer has the form $Bu[-n-1]$, determine B. If the answer is both, determine $A + B$. Choose the closest answer.
A: -1.
B: 2.
C: -2.
D: 0.
E: 1.

Question 7: Consider two linear time-invariant systems with impulse responses $h_1[n] = (\frac{1}{2})^n u[n]$ and $h_2[n] = \frac{1}{2}\delta[n]$ and suppose that the two systems are arranged in a causal feedback combination (the system with impulse response $h_2[n]$ is the one "fed back"). Determine $h[n]$ for the composite feedback system. The answer has the form $A(B)^n u[n]$. Determine $A + B$. Choose the closest answer. *Hint:* $\frac{c}{a - bz^{-1}} = \frac{c/a}{1 - (b/a)z^{-1}}$.
A: $\frac{5}{3}$.
B: 1.
C: $\frac{1}{3}$.
D: $\frac{2}{3}$.
E: $\frac{4}{3}$.

Question 8: Consider the pole-zero plot shown. The zeroes are single zeroes at $z = 1$, $z = \frac{1}{\sqrt{2}}(1 + j)$, and $z = \frac{1}{\sqrt{2}}(1 - j)$, and the pole is a triple pole at $z = 0$. This filter is



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

Question 9: Suppose an LTI system has impulse response $h(t) = 7e^{-3t}u(t) - \delta(t)$ and input $x(t) = (7 + 14t)e^{4t}u(-t)$. The output has the form $y(t) = Ae^{4t}u(-t) + Be^{-3t}u(t)$. Determine $A + B$. Choose the closest answer.
A: 2.
B: 5.
C: 4.
D: 3.
E: 1.

Question 10: Suppose $h[n] = -(-2)^n u[-n - 1] + u[n]$. How many zeroes does $H(z)$ have? Choose the closest answer.
A: 1.
B: 3.
C: 0.
D: 4.
E: 2.

Question 11: Consider a linear time-invariant system given by $H(s) = \frac{1}{s+2} + \frac{1}{(s+2)^2} + \frac{1}{s-2} + \frac{1}{s-4}$. 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: 3.
B: 5.
C: 7.
D: 6.
E: 4.

Question 12: Consider a linear time-invariant system with impulse response $h(t) = \delta(t) + 2e^{-t}\cos(t)u(t)$. Determine $h_I(t)$, the impulse response of the causal INVERSE system. This impulse response has the form $h_I(t) = A\delta(t) + (Bt + C)e^{-Dt}u(t)$. What is $A + B + C + D$? Choose the closest answer.
A: 1.
B: 4.
C: 3.
D: 5.
E: 2.