Answers: CDDA EDDD BBDD

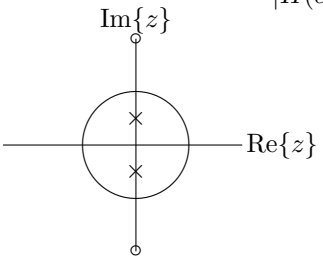
Serial Number: **601** Name:

ECE 3300 Fall 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 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.

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

Question 2: For the system with pole-zero plot shown, there are single poles at $z = \frac{j}{2}$ and $z = -\frac{j}{2}$ and there are single zeroes at $z = 2j$ and $z = -2j$. Determine $\frac{|H(e^{j\pi/2})|}{|H(e^{j0})|}$. Choose the closest answer. *Hint:* This can be determined from the plot.
A: 0.6.
B: 0.8.
C: 0.4.
D: 1.0.
E: 0.2.



Question 3: Suppose a causal system with transfer function $H(z)$ is such that there is a double pole at $z = -1$ and single zeroes at $z = 0$ and $z = -\frac{1}{2}$. Assume $H(1) = \frac{1}{2}$. What is $H(-2)$? Choose the closest answer.
A: 3.
B: 1.
C: 5.
D: 4.
E: 2.

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

Question 5: Consider a linear time-invariant system with impulse response $h[n] = \delta[n] + (-1)^n(n+2)u[n]$. The input-ouput difference equation for this system can be shown to have the form

$$y[n] + Ay[n-1] + By[n-2] = Cx[n] + Dx[n-1] + Ex[n-2]$$

Determine $(C+D) - (A+B+E)$. Choose the closest answer. *Hint:* Careful - this is NOT asking for $A+B+C+D+E$.
A: 0.
B: -2.
C: 1.
D: -1.
E: 2.

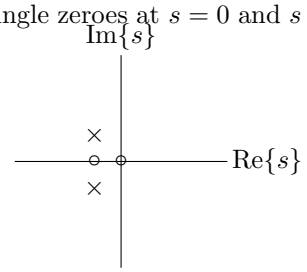
Question 6: Consider two linear time-invariant systems with impulse responses $h_1(t) = \delta(t) + 6e^t u(t)$ and $h_2(t) = \delta(t)$ and suppose that the two systems are arranged in a causal feedback combination (the system with impulse response $h_2(t)$ is the one "fed back"). Determine $h(t)$ for the composite feedback system. The answer has the form $A\delta(t) + Be^{-Ct}u(t)$. Determine $A+B+C$. Choose the closest answer.
A: 1.
B: 5.
C: 3.
D: 4.
E: 2.

Question 7: Suppose a signal is sampled at 20% oversampling and a sampling rate of 585 ksamples/sec. Determine the maximum frequency of the pre-sampled signal. Choose the closest answer.
A: 500 kHz.
B: 750 kHz.
C: 1250 kHz.
D: 250 kHz.
E: 1000 kHz.

Question 8: Consider a linear time-invariant system given by $H(z) = \frac{1}{1-z^{-1}} + \frac{1}{1+z^{-1}} + \frac{1}{1-\frac{1}{2}z^{-1}} + \frac{1}{1+\frac{1}{2}z^{-1}}$. 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: 7.
C: 3.
D: 4.
E: 5.

Question 9: Consider a linear time-invariant system with input $x(t)$ and output $y(t)$ such that $X(s) = \frac{s(s+2)}{(s+1)^2}$, $Y(s) = \frac{s}{(s+1)^2}$, and both have ROC $\mathrm{Re}\{s\} < -1$. Determine all possible impulse responses $h(t)$. The answer has the form $Ae^{-Bt}u(t)$ (in which case determine $A+B$), $Ce^{-Dt}u(-t)$ (in which case determine $C+D$), or both (in which case determine $A+B+C+D$). Choose the closest answer.
A: 6.
B: 4.
C: 3.
D: 5.
E: 2.

Question 10: Consider the pole-zero plot shown. The zeroes are single zeroes at $s = 0$ and $s = -1$, and the poles are single poles at $s = -1 + j$ and $s = -1 - j$. This filter is



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

Question 11: Suppose $h(t) = e^{-t}\cos(2t)u(t)$. Determine the poles and zeroes. What is the sum of the values of all the poles and zeroes? Choose the closest answer.
A: -5.
B: -2.
C: -1.
D: -3.
E: -4.

Question 12: Suppose a linear time-invariant system with input $x(t)$ and output $y(t)$ is governed by the differential equation $\frac{d^2}{dt^2}y(t) + \frac{d}{dt}y(t) - 2y(t) = \frac{d}{dt}x(t) + x(t)$. Determine $H(s)$. The stable realization of $H(s)$ is $h(t) = Ae^{Bt}u(t) + Ce^{Dt}u(-t)$. What is $B + D$? Choose the closest answer. *Hint:* It is not necessary to complete the partial-fraction expansion to answer this question.
A: -2.
B: 0.
C: 2.
D: -1.
E: 1.