Test 201 Answers: ADDB BDEA BCAA

(There was a minor error in problem 11, which has been corrected in this version. There was a more serious error in problem 3. Credit was given or not given based on work shown on the exam. The problem has been changed in this version to match what was intended.)

Serial Number: **201** Name:

ECE 3300 Fall 2016 (Signals, Systems, and Transforms): Exam II

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. The examination lasts 60 minutes and you may use two 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: Suppose $x(t)$ and $h(t)$ have no impulses and $x(t)$ is "on" from $t = 1$ to $t = 2$ and $h(t)$ is "on" from $t = 0$ to $t = 3$. Further suppose that

$$[x * h](t) = \begin{cases} A + (t-3)^2 & \text{if } B < t \leq C \\ 0 & \text{otherwise} \end{cases}$$

Use the "checking" properties of convolution to determine A, B, and C. What is $A + B + C$? Choose the closest answer.
A: 2.
B: 6.
C: 8.
D: 4.
E: 10.

Question 2: Consider the system defined by $y[n] = x[n] - x[-n]$ where $x[\cdot]$ is the input and $y[\cdot]$ is the output. This system is
A: Invertible because the inputs $x[n] = \delta[n]$ and $x[n] = \delta[n-1]$ give different outputs.
B: Not invertible because the inputs $x[n] = u[n]$ and $x[n] = u[-n]$ give the same output.
C: Invertible because the inverse system is $x[n] = y[n] + y[-n]$.
D: Not invertible because the inputs $x[n] = 1$ for all n and $x[n] = 2$ for all n give the same output.
E: Not invertible because the inputs $x[n] = \delta[n]$ and $x[n] = \delta[n-1]$ give the same output.

Question 3: Consider a composite system in which System 1 is in series with the parallel combination of Systems 2 and 3. The systems have respective impulse responses $h_1[n] = \delta[n]+\delta[n-2]$, $h_2[n] = \delta[n]+2\delta[n-1]$, and $h_3[n] = \delta[n]-\delta[n-2]$. Determine the impulse response of the composite system. The overall impulse response is denote $h[n]$. Determine $h[2]+h[3]+h[4]$. Choose the closest answer.
A: 0.
B: 3.
C: 4.
D: 2.
E: 1.

Question 4: Suppose $a(t)$, $b(t)$, and $c(t)$ are signals such that $[a*a](t) = b(t)$ and $[a*b](t) = c(t)$. Determine the convolution of $a(t-1) - b(t)$ with $2a(t-2)$. The answer has the form $Ab(t-B) + Cc(t-D)$. What is $A+B+C+D$? Choose the closest answer.
A: 7.
B: 5.
C: 6.
D: 8.
E: 9.

Question 5: Consider a LTI system with impulse response $h[n]$ and periodic input $\tilde{x}[n]$ with $N_0 = 3$ such that the convolution of the impulse response with the fundamental cycle of the input is $(x*h)[n] = 3\delta[n] - 4\delta[n-1] + 3\delta[n-2] + 2\delta[n-3] + \delta[n-4] - \delta[n-5] - \delta[n-6]$. If the output is $\tilde{y}[n]$, determine $\tilde{y}[0]$ and $\tilde{y}[1]$. What is the sum of these two values? Choose the closest answer.
A: 2.
B: 1.
C: 0.
D: -1.
E: -2.

Question 6: Consider the system with input $x(\cdot)$ and output $y(\cdot)$ such that $y(t) = (\frac{t+1}{t+2})x(t)$. This system is
A: Stable because the input $x(t) = 0$ for all t gives a bounded output.
B: Unstable because the input $x(t) = u(t+1)$ gives an unbounded output.
C: Stable because $|x(t)| \leq A$ for all t implies that $|y(t)| \leq B$ for all t for $B = A$.
D: Unstable because the input $x(t) = 1$ for all t gives an unbounded output.
E: Unstable because the input $x(t) = t+2$ for all t gives an unbounded output.

Question 7: Consider an LTI system with impulse response $h[n] = 4\delta[n] + 5u[n-10]$. This system is
A: Not causal, not stable, and not memoryless.
B: Causal and stable but not memoryless.
C: Causal, stable, and memoryless.
D: Stable but not causal and not memoryless.
E: Causal but not stable and not memoryless.

Question 8: Consider the system $y[n] = 2^n(x[n] - x[n-2])x[n-1]$. Let $g[n]$ be the step response of this system. Determine $g[0] + g[1] + g[2]$. Choose the closest answer.
A: 2.
B: 1.
C: 5.
D: 3.
E: 4.

Question 9: Consider the system $y[n] = x[n-2]\cos(x[n+3])$. This system is
A: Time-varying because the output due to $x[n] = \frac{\pi}{2}u[n-1]$ is not a delay by 1 of the output due to $x[n] = \frac{\pi}{2}u[n]$.
B: Time-invariant because, for all inputs $x[\cdot]$ and all values n_0, the output due to $x[\cdot - n_0]$ is a delay by n_0 of the output due to $x[\cdot]$.
C: Time-invariant because $x[n-2]$ is a delay by 5 of $x[n+3]$.
D: Time-varying because the output due to $x[n] = u[n-1]$ is not a delay by 1 of the output due to $x[n] = u[n]$.
E: Time-varying because the output due to $x[n] = nu[n-1]$ is a delay by 1 of the output due to $x[n] = nu[n]$.

Question 10: Consider the system with input $x(\cdot)$ and output $y(\cdot)$ such that $y(t) = x(t)e^{-t^2} - x(0)$. This system is
A: Linear because $y(t) \leq x(t)$ for all t.
B: Nonlinear because an input of $x(t) = e^{t^2}$ for all t gives an output of zero for all t.
C: Linear because, for all inputs $x_1(t)$ and $x_2(t)$ and all constants a_1 and a_2, the output due to $a_1x_1(t) + a_2x_2(t)$ is $a_1y_1(t) + a_2y_2(t)$, where $y_1(t)$ is the output due to $x_1(t)$ and $y_2(t)$ is the output due to $x_2(t)$.
D: Linear because an input of zero for all t gives an output of zero for all t.
E: Nonlinear because, for the input $x(t) = e^{t^2}$ for all t, doubling the input does not double the output.

Question 11: As part of a convolution problem, you are required to compute $\int_0^\infty (2te^{-\tau} + 2e^{-2\tau})d\tau$. Determine the answer to this integral in this case. The answer has the form $A + Bt + Ce^{-t} + De^{-2t}$. What is $A + B + C + D$? Choose the closest answer.
A: 3.
B: 4.
C: 2.
D: 1.
E: 5.

Question 12: Consider the system with input $x(\cdot)$ and output $y(\cdot)$ such that $y(t) = x(0) + e^{t+2}x(t)$. Is this system memoryless? Causal?
A: Neither memoryless nor causal.
B: There is insufficient information to determine an answer.
C: Memoryless but not causal.
D: Memoryless and causal.
E: Causal but not memoryless.
