Test 201 Answers: ACAE DDBD DCDA

On Problem 8, E is also correct. On Problem 12, B is also correct.

Serial Number: **201** Name:

ECE 3300 SPRING 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 50 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: Consider a LTI system with impulse response $h(t)$ and periodic input $\tilde{x}(t)$ with $T_0 = 3$ such that the convolution of the impulse response with the fundamental cycle of the input is $[x * h](t) = t(u(t) - u(t-2)) + 2(u(t-2) - u(t-6)) + (8-t)(u(t-6) - u(t-8))$. If the output is $\tilde{y}(t)$, determine $\tilde{y}(1)$. Choose the closest answer.
A: 4.
B: 5.
C: 3.
D: 6.
E: 7.

Question 2: Consider the system with input $x[\cdot]$ and output $y[\cdot]$ such that $y[n] = x[2n+1] - x[2n]$. This system is
A: Nonlinear because $x[2n+1]$ is not equal to $x[0]$ at $n = 0$.
B: Nonlinear because an input of $x[n] = 1$ for all n gives an output of zero for all n.
C: Linear because, for all inputs $x_1[n]$ and $x_2[n]$ and all constants a_1 and a_2, the output due to $a_1x_1[n] + a_2x_2[n]$ is $a_1y_1[n] + a_2y_2[n]$, where $y_1[n]$ is the output due to $x_1[n]$ and $y_2[n]$ is the output due to $x_2[n]$.
D: Nonlinear because, for the input $x[n] = u[n]$, doubling the input does not double the output.
E: Linear because an input of zero for all n gives an output of zero for all n.

Question 3: Consider an LTI system with impulse response $h(t) = \frac{1}{t^2}u(-t-1)$. This system is
A: Stable but not causal and not memoryless.
B: Causal but not stable and not memoryless.
C: Causal and stable but not memoryless.
D: Not causal, not stable, and not memoryless.
E: Causal, stable, and memoryless.

Question 4: Consider a composite system in which System 1 is in parallel with the series combination of Systems 2 and 3. The systems have respective impulse responses $h_1(t) = (1+t)e^{-t}u(t)$, $h_2(t) = \delta(t) - e^{-t}u(t)$, and $h_3(t) = e^{-t}u(t)$. Determine the impulse response of the composite system. The answer has the form $h(t) = A\delta(t) + (B + Ct + Dt^2)e^{-t}u(t)$. Determine $A+B+C+D$. Choose the closest answer. *Hint:* The following facts may be used without proof: $e^{-t}u(t) * e^{-t}u(t) = te^{-t}u(t)$, $e^{-t}u(t) * te^{-t}u(t) = \frac{t^2}{2}e^{-t}u(t)$.
A: 4.
B: 1.
C: 3.
D: 5.
E: 2.

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

Question 6: Consider the system $y(t) = tx(t - \frac{1}{2}) + (t-1)x(t - \frac{3}{2})$. Let $g(t)$ be the step response of this system. Determine $g(0) + g(1) + g(2)$. Choose the closest answer.
A: 1.
B: 2.
C: 3.
D: 4.
E: 5.

Question 7: Suppose $x(t)$ and $h(t)$ have no impulses and

$$[x * h](t) = \begin{cases} (A + Bt) & \text{if } 2 < t \le 3 \\ C & \text{if } 3 < t \le 4 \\ 2e^{-(t-4)} & \text{if } t > 4 \\ 0 & \text{otherwise} \end{cases}$$

Use the "checking" properties of convolution to determine A, B, and C. What is $A + B + C$? Choose the closest answer.
A: 4.
B: 0.
C: 1.
D: 2.
E: 3.

Question 8: Consider the system $y[n] = x[n] - n$. This system is
A: Time-invariant because the output due to $x[n] = n - 1$ is a delay by 1 of the output due to $x[n] = n$.
B: Time-invariant because the output due to $x[n] = (-1)^{n-2}$ is a delay by 2 of the output due to $x[n] = (-1)^n$.
C: 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 $x[\cdot]$.
D: Time-varying because the output due to $x[n] = n - 1$ is not a delay by 1 of the output due to $x[n] = n$.
E: Time-varying because the output due to $x[n] = (-1)^{n-2}$ is not a delay by 2 of the output due to $x[n] = (-1)^n$.

Question 9: Determine the convolution of $2\delta[n] - \delta[n-1] - 2\delta[n-2] + 2\delta[n-3]$ with $\delta[n-1] - \delta[n-2] + \delta[n-3]$. The answer can be written in the form $A\delta[n-1] + B\delta[n-2] + C\delta[n-3] + D\delta[n-4] + E\delta[n-5] + F\delta[n-6]$. Determine $B + D + F$. Choose the closest answer.
A: 0.
B: 1.
C: 3.
D: 2.
E: 4.

Question 10: Consider the system with input $x[\cdot]$ and output $y[\cdot]$ such that $y[n] = (n+1)x[n-1] + (n-2)x[n]$. Is this system memoryless? Causal?
A: Memoryless and causal.
B: There is insufficient information to determine an answer.
C: Causal but not memoryless.
D: Neither memoryless nor causal.
E: Memoryless but not causal.

Question 11: Consider the system with input $x[\cdot]$ and output $y[\cdot]$ such that $y[n] = x[n]x[n-1]x[n-2]x[n-3]$. This system is
A: Unstable because the input $x[n] = \frac{1}{n}$ for all n gives an unbounded output.
B: Stable because the input $x[n] = 1$ for all n gives a bounded output.
C: Stable because the input $x[n] = 0$ for all n gives output $y[n] = 0$ for all n.
D: Stable because $|x[n]| \leq A$ for all n implies that $|y[n]| \leq B$ for all n for $B = A^4$.
E: Unstable because the input $x[n] = n$ for all n gives an unbounded output.

Question 12: Consider the system defined by $y(t) = x(t+1)u(t+1)$ where $x(\cdot)$ is the input and $y(\cdot)$ is the output. This system is
A: Not invertible because the inputs $x(t) = 1$ for all t and $x(t) = u(t+2)$ give the same output.
B: Not invertible because the inputs $x(t) = 1$ for all t and $x(t) = u(t)$ give the same output.
C: Invertible because the inverse system is $x(t) = \frac{y(t-1)}{u(t)}$.
D: Invertible because the inputs $x(t) = 1$ for all t and $x(t) = -1$ for all t give different outputs.
E: Invertible because the inverse system is $x(t) = \frac{y(t-1)}{u(t-1)}$.