Answers to Test 301: AEBA CBCB CCCD

Serial Number: **301** Name:

ECE 3300 Spring 2017 (Signals, Systems, and Transforms): Exam III

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 three 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: Determine $x[n]$ if $X(e^{j\omega}) = e^{-2j\omega}(2 - e^{-j\omega})^2$. At what time value n does $x[n] = 1$? *Hint:* First expand the square and recall that $\delta[n]$ has transform 1.
A: 4.
B: 1.
C: 5.
D: 2.
E: 3.

Question 2: Use the definition of the Fourier transform to find the Fourier transform of $x(t) = t^{-3/2}e^{-4/t}e^{-t/4}u(t)$. Use the fact that, if $\mathrm{Re}\{a\} > 0$ and $\mathrm{Re}\{b\} > 0$, $\int_0^\infty t^{-3/2}e^{-a/t}e^{-bt}dt = \sqrt{\frac{\pi}{a}}e^{-2\sqrt{ab}}$. The answer can be written in the form $\frac{\sqrt{\pi}}{A}e^{-2\sqrt{B+Cj\omega}}$. What is $A + B + C$? Choose the closest answer.
A: 8.
B: 9.
C: 6.
D: 10.
E: 7.

Question 3: Suppose $\tilde{x}[n]$ has fundamental cycle $x[n]$ and fundamental period $N_0 = 6$. If the Fourier transform of the fundamental cycle is $X(e^{j\omega}) = 12\cos(\omega) - 24\cos(2\omega)$, determine the Fourier series coefficient x_1. Choose the closest answer.
A: 4.
B: 3.
C: 1.
D: 2.
E: 5.

Question 4: Suppose $x(t)$ is a real, odd signal, and suppose $X(j\omega) = \frac{j\omega(1-\omega^2)}{1+\omega^4}$. For which of the following region(s) does $\angle X(j\omega)$ equal to $-\frac{\pi}{2}$?
A: $-1 < \omega < 0$ and $\omega > 1$.
B: $\omega > 0$.
C: $\omega < -1$ and $0 < \omega < 1$.
D: $\omega < -1$ and $\omega > 1$.
E: $-1 < \omega < 1$.

Question 5: Suppose $\tilde{x}(t)$ has period $T_0 = 4$ and Fourier series coefficients $x_0 = 1$, $x_1 = j$, $x_{-1} = -j$, $x_2 = 1+j$, $x_{-2} = 1-j$, $x_3 = 2j$, $x_{-3} = -2j$, $x_4 = 2$, and $x_{-4} = 2$, with $x_k = 0$ for all other values of k. Determine the percentage of power in the frequency band $[3, 5]$. Choose the closest answer.
A: 30%.
B: 40%.
C: 50%.
D: 70%.
E: 60%.

Question 6: Suppose $|X(e^{j\omega})| = 2$ if $|\omega| < \frac{\pi}{3}$, 1 if $\frac{\pi}{3} \leq |\omega| < \frac{2\pi}{3}$, and 3 if $\frac{2\pi}{3} \leq |\omega| < \pi$. Determine the percentage of energy in the frequency band $(\frac{\pi}{2}, \pi)$. Choose the closest answer.
A: 50%.
B: 70%.
C: 80%.
D: 90%.
E: 60%.

Question 7: Determine the Fourier transform of $e^{-2(t-2)}u(t-1)$. The answer has the form $\frac{e^{A}e^{Bj\omega}}{C+j\omega}$. What is $A+B+C$? Choose the closest answer. *Hint:* First consider $e^{-2(t-1)}u(t-1)$. Also recall that $e^{a+b}=e^{a}e^{b}$.
A: 5.
B: 2.
C: 3.
D: 1.
E: 4.

Question 8: Given that $x[n]$ has Fourier transform $\frac{1}{2-e^{-3j\omega}}$, determine the Fourier transform of $2x[n]\cos(\frac{\pi}{6}n)$. What is the value of this transform at $\omega=0$? Choose the closest answer.
A: 0.6.
B: 0.8.
C: 0.2.
D: 1.0.
E: 0.4.

Question 9: Suppose $\tilde{x}(t)$ has Fourier transform $3\pi\delta(\omega+6)+4\pi\delta(\omega+4)+5\pi\delta(\omega+2)+5\pi\delta(\omega-2)+4\pi\delta(\omega-4)+3\pi\delta(\omega-6)$. Determine T_0 and the Fourier series coefficient x_2. What is T_0+x_2? Choose the closest answer.
A: 4.
B: 7.
C: 5.
D: 6.
E: 8.

Question 10: Given that $x[n]$ has Fourier transform $\frac{1}{2-e^{-3j\omega}}$, determine the Fourier transform of $nx[n]$. The answer has the form $\frac{A+Be^{-3j\omega}}{(2-e^{-3j\omega})^{C}}$, where A, B, and C are real. What is $A+B+C$? Choose the closest answer.
A: 1.
B: 2.
C: 5.
D: 4.
E: 3.

Question 11: It can be shown that the Fourier transform of $\frac{t}{\sinh(t)}$ is $\frac{1}{2\pi}\frac{1}{\cosh(\pi\omega/2)}$. Use this fact to determine the Fourier transform of $\int_{-\infty}^{t}\frac{4\tau}{\sinh(\tau)}d\tau$. The answer has the form $\frac{A(j\omega)^B}{2\pi\cosh(\pi\omega/2)}+C\delta(\omega)$. What is $A+B+C$? Choose the closest answer. *Hint:* $\sinh(0)=0$ and $\cosh(0)=1$. You don't need to know anything else about these functions.
A: 1.
B: 2.
C: 5.
D: 3.
E: 4.

Question 12: Suppose $x(t)=2\delta(t)+3e^{-t}u(t)$. Determine the magnitude of the Fourier transform. The answer has the form $|X(j\omega)|=\frac{\sqrt{A+B\omega^2}}{\sqrt{1+C\omega^2}}$. What is $A+B+C$? Choose the closest answer.
A: 15.
B: 10.
C: 25.
D: 30.
E: 20.