

Answers to Test 301: CCEA BAAD EAAC

Serial Number: **301**

Name:

ECE 3300 SPRING 2016 (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. The examination lasts 50 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: Suppose $|X(j\omega)| = \begin{cases} \sqrt{1+3\omega^2} & \text{if } 0 < |\omega| \leq 1 \\ 2 & \text{if } 1 < |\omega| < 2 \\ 0 & \text{otherwise} \end{cases}$.

Determine the percentage of energy in the frequency band $(0, 1)$. Choose the closest answer.

A: 70%.

B: 60%.

C: 30%.

D: 40%.

E: 50%.

Question 2: Suppose $\tilde{x}(t)$ has Fourier transform $\tilde{X}(j\omega) = 4\pi\delta(\omega + \pi) - 2\pi\delta(\omega + \frac{\pi}{2}) + 4\pi\delta(\omega) - 2\pi\delta(\omega - \frac{\pi}{2}) + 4\pi\delta(\omega - \pi)$. Determine the Fourier series coefficients x_1 and x_2 and the fundamental period T_0 . What is $x_1 + x_2 + T_0$? Choose the closest answer.

A: 4.

B: 3.

C: 5.

D: 7.

E: 6.

Question 3: Suppose $x[n]$ is a real, odd signal, and suppose $X(e^{j\omega}) = \frac{j \sin(\pi\omega)}{1-\omega^2}$. Determine $\angle X(j\omega)$ at $\omega = \frac{1}{2}$ (call this value A), $\omega = \frac{3}{2}$ (call this value B), and $\omega = \frac{5}{2}$ (call this value C). What is $A + 2B + 3C$? Choose the closest answer. *Hint:* A , B , and C should each be represented in the range $-\pi \leq \angle X(j\omega) < \pi$. Also, read carefully; the problem is not asking for $A + B + C$.

A: π .

B: $\pi/2$.

C: 2π .

D: $3\pi/2$.

E: 0.

Question 4: Determine the Fourier transform of $2\delta[n+2] - 2\delta[n-2]$. The answer can be written in the form $A \cos(B\omega) + Cj \sin(B\omega)$, where $B > 0$. What is $A + B + C$? Choose the closest answer.

A: 6.

B: 10.

C: 4.

D: 2.

E: 8.

Question 5: Suppose $x(t)$ has Fourier transform $\frac{2+3j\omega}{(1-2j\omega)^2}$. Determine the Fourier transform of $x(t) - 2\frac{d}{dt}x(t)$. The answer has the form $\frac{A+Bj\omega}{1+Cj\omega}$. Determine $A + B + C$. Choose the closest answer.

A: 1.

B: 3.

C: 4.

D: 2.

E: 5.

Question 6: Suppose $\tilde{x}[n]$ has fundamental cycle $x[n]$ and fundamental period $N_0 = 6$. If the Fourier transform of the fundamental cycle is $X(e^{j\omega}) = \frac{36}{1+2\cos^2(\omega)}$, determine the Fourier series coefficients x_k . What is $x_0 + x_1$? Choose the closest answer.

A: 6.

B: 7.

C: 9.

D: 10.

E: 8.

Question 7: In this problem use without proof the fact that $\sum_{n=0}^{\infty} \frac{a^n}{n!} = e^a$ for all a , even if complex-valued. Using the definition of the Fourier transform, determine $X(e^{j\omega})$ if $x[n] = \frac{(\frac{1}{2})^n}{n!} u[n]$. The answer can be written in the form $e^{(Ae^{Bj\omega})}$. Determine $A + B$. Choose the closest answer.

A: -0.5.
 B: -2.5.
 C: -1.5.
 D: -1.0.
 E: -2.0.

Question 8: Determine the Fourier transform of $((\frac{1}{2})^n + (-\frac{1}{2})^n)^2 u[n]$. The answer has the form $\frac{A}{1-Be^{-j\omega}} + \frac{C}{1-De^{-j\omega}}$. What is $A + B + C + D$? Choose the closest answer. *Hint:* Expand the square.

A: 5.
 B: 1.
 C: 2.
 D: 4.
 E: 3.

Question 9: Given that $\frac{\sqrt{2}}{2}e^{-\sqrt{2}|t|}$ has Fourier transform $\frac{2}{2+\omega^2}$, determine the Fourier transform of $\frac{\sqrt{2}}{2}te^{-\sqrt{2}|t|}$. The answer has the form $\frac{Aj\omega+B}{\omega^4+C\omega^2+D}$. Determine $A + B + C + D$. Choose the closest answer.

A: 12.
 B: 8.
 C: 6.
 D: 10.
 E: 4.

Question 10: Suppose $x(t) = 4e^{-t}u(t) - 3e^{-2t}u(t)$. Determine the magnitude of the Fourier transform. The answer has the form $|X(j\omega)| = \frac{\sqrt{A+\omega^2}}{\sqrt{B+\omega^2}\sqrt{C+\omega^2}}$. Determine $A/(B+C)$. Choose the closest answer. *Hint:* Read carefully. This is not asking for $A + B + C$.

A: 5.
 B: 2.
 C: 1.
 D: 4.
 E: 3.

Question 11: Suppose $\tilde{x}(t)$ has period $T_0 = 2$ and Fourier series coefficients $x_2 = 2 - j$, $x_{-2} = 2 + j$, $x_3 = 2j$, and $x_{-3} = -2j$; all other x_k s are zero. Determine the percentage of power in the second harmonic. Choose the closest answer.

A: 55%.

B: 75%.

C: 65%.

D: 70%.

E: 60%.

Question 12: Determine the inverse Fourier transform $x(t)$ if $X(j\omega) = e^{j\omega} \text{rect}(\frac{\omega}{2})$.

The answer has the form $\frac{1}{\pi(t-B)} \sin(A(t-B))$. What is $A + B$? Choose the closest answer.

A: -2.

B: 1.

C: 0.

D: -1.

E: 2.
