401 Answers: EEEB DEDC BACB

Serial Number: **401** Name:

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

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 four 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 a Bode plot of $|H(j\omega)|$ is a straight line of slope 40 dB/decade between $\omega = 300$ and $\omega = 1200$ such that $|H(j600)| = 0$ dB. What is $|H(j1200)|$? Choose the closest answer.
A: 18 dB.
B: 30 dB.
C: 24 dB.
D: 6 dB.
E: 12 dB.

Question 2: Consider a linear time-invariant system with impulse response $h(t) = (e^{-t} - e^{-3t})u(t)$. Determine the magnitude response.
A: $\frac{1}{\sqrt{1+\omega^2}} - \frac{1}{\sqrt{9+\omega^2}}$.
B: $\frac{1}{\sqrt{1+\omega^2}} + \frac{1}{\sqrt{9+\omega^2}}$.
C: $\frac{2\sqrt{4+\omega^2}}{\sqrt{1+\omega^2}\sqrt{9+\omega^2}}$.
D: $\frac{1}{\sqrt{1+\omega^2}\sqrt{9+\omega^2}}$.
E: $\frac{2}{\sqrt{1+\omega^2}\sqrt{9+\omega^2}}$.

Question 3: Consider a linear time-invariant system with $H(j\omega) = \frac{(2+j\omega)^3}{(1+j\omega)^2(3+j\omega)}$. Determine the phase response $\angle H(j\omega)$. The answer has the form $A\tan^{-1}(\frac{\omega}{B}) + C\tan^{-1}(\frac{\omega}{D}) + E\tan^{-1}(\frac{\omega}{F})$, where $B > 0$, $D > 0$, and $F > 0$. What is $A + B + C + D + E + F$? Choose the closest answer.
A: 7.
B: 8.
C: 9.
D: 10.
E: 6.

Question 4: Consider a linear time-invariant system with impulse response $h[n] = (\frac{2}{3})^n u[n]$ and output $y[n] = (\frac{1}{3})^n u[n]$. Use Fourier techniques to determine the input $x[n]$. The answer has the form $A\delta[n] + B(\frac{1}{C})^n u[n]$. What is $A + B + C$? Choose the closest answer.
A: 5.
B: 4.
C: 1.
D: 2.
E: 3.

Question 5: Suppose $H(j\omega) = \dfrac{(10+j\omega)^3(100+j\omega)(50+j\omega)}{(j\omega)^2(200+j\omega)^2(250+j\omega)^2}$. Determine the slope of the Bode plot in the region from $\omega = 100$ to $\omega = 200$.
A: 0 dB/decade.
B: 40 dB/decade.
C: 20 dB/decade.
D: 60 dB/decade.
E: 80 dB/decade.

Question 6: Suppose $H(j\omega) = \dfrac{j\omega(80+j\omega)^3}{(20+j\omega)(40+j\omega)^2(160+j\omega)}$. Determine the value of the Bode approximation to $|H(j\omega)|$ at $\omega = 40$. Choose the closest answer.
A: 15 dB.
B: 9 dB.
C: 3 dB.
D: 12 dB.
E: 6 dB.

Question 7: Consider a linear time-invariant system with impulse response $h(t) = \frac{2}{\sqrt{t}}e^{-3t}u(t)$ and input $x(t) = e^{-3t}u(t)$. Determine the output $y(t)$. You may use without proof the facts that, if $a > 0$, $\sqrt{t}e^{-at}u(t)$ has Fourier transform $\frac{\sqrt{\pi}}{2}\frac{1}{(a+j\omega)^{3/2}}$ and $\frac{1}{\sqrt{t}}e^{-at}u(t)$ has Fourier transform $\frac{\sqrt{\pi}}{(a+j\omega)^{1/2}}$. Determine the output $y(t)$. The answer has the form $(A+B\sqrt{t}+Ct)e^{-Dt}u(t)$. What is $A + B + C + D$? Choose the closest answer.
A: 6.
B: 10.
C: 9.
D: 7.
E: 8.

Question 8: Consider the filter with magnitude response $|H(j\omega)| = \frac{(1+j\omega)(100+j\omega)}{(10+j\omega)^2}$. Let $A = 0$ if this filer is passive and $A = 1$ if it is active. Let $B = 1$ if this filter is lowpass, $B = 2$ if highpass, $B = 3$ if bandpass, and $B = 4$ if bandstop. What is $A + B$? *Hint:* Look at the Bode plot.
A: 5.
B: 1.
C: 4.
D: 2.
E: 3.

Question 9: Consider a linear time-invariant system with $H(e^{j\omega}) = \frac{1-\frac{1}{2}e^{-j\omega}}{(1-\frac{3}{4}e^{-j\omega})^2}$. Determine group delay $D(\omega)$. What is $D(0)$? Choose the closest answer.
A: 4.
B: 5.
C: 1.
D: 3.
E: 2.

Question 10: Consider a linear time-invariant system with input $x(t) = 5\delta(t) - 4e^{-2t}u(t)$ and output $y(t) = e^{-t}u(t) + 4e^{-2t}u(t)$. Use Fourier techniques to determine the impulse response $h(t)$. The answer has the form $h(t) = A\delta(t)+Be^{-Ct}u(t)$. What is $A + B + C$? Choose the closest answer.
A: 2.
B: 1.
C: 5.
D: 3.
E: 4.

Question 11: Consider the low-pass system with frequency response $H(j\omega) = \begin{cases} 10 & \text{if } |\omega| \leq 25 \\ 10e^{-(|\omega|-25)/10} & \text{if } |\omega| > 25 \end{cases}$. Determine the roll-off ratio. Assume the passband attenuation level is 90% of peak and the the stopband attenuation level is 10% of peak. Choose the closest answer.
A: 1.6.
B: 2.0.
C: 1.8.
D: 1.2.
E: 1.4.

Question 12: Consider a linear time-invariant system such that $H(e^{j\omega}) = \frac{4}{5-4\cos^2(\omega)}$. If the input $\tilde{x}[n]$ is periodic with period $N_0 = 6$ and Fourier series coefficients $x_k = \frac{4}{4-|k|}$ for $-3 \leq k \leq 2$ (and x_ks are periodic with period 6) then determine the output Fourier series coefficients y_0 and y_2. What is $y_0 + y_2$? Choose the closest answer.
A: 10.
B: 6.
C: 8.
D: 2.
E: 4.