PROBLEM:

Circle the correct answer to each of these short answer questions (3 pts. each):

(a) "If $H(e^{j\hat{\omega}})$ is the frequency response of a digital filter, and the input is $x[n] = \cos(0.3\pi n)$, then the output is $y[n] = H(e^{j0.3\pi})x[n]$." This statement is

(a) Always true
(b) Sometimes true
(c) Never true

(b) "If the signal $x(t)$ is a sinusoid and its spectrum has frequency components at $f = \pm 55$ Hz, then the signal $y(t) = x^2(t)$ has frequency components at the same frequencies." This statement is:

(a) True
(b) False

(c) A causal IIR filter with system function $H(z) = \dfrac{1 - 2z^{-1}}{1 + 0.25z^{-1}}$ is:

(a) *not* stable.
(b) stable

(d) Evaluate the complex number $z = j^{-1} + j^{-2} + j^{-3}$.

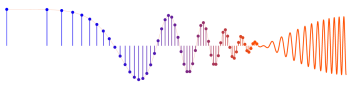
(a) $z = 0$
(b) $z = j$
(c) $z = -j$
(d) $z = 1$
(e) $z = -1$

(e) Suppose that the discrete-time signal $x[n] = \cos(0.2\pi n)$ is the input to an FIR filter whose frequency response is $H(e^{j\hat{\omega}}) = 2e^{-j2\hat{\omega}}\cos(2\hat{\omega})$. Determine the output signal, $y[n]$.

(a) $y[n] = 2\cos(0.2\pi n - 0.2\pi)$
(b) $y[n] = 2\cos(0.2\pi n - 0.4\pi)$
(c) $y[n] = 0.618\cos(0.2\pi n - 0.4\pi)$
(d) $y[n] = 0.618\cos(0.2\pi n - 0.2\pi)$
(e) $y[n] = 0$

McClellan, Schafer and Yoder, *Signal Processing First*, ISBN 0-13-065562-7.
Prentice Hall, Upper Saddle River, NJ 07458.

SOLUTION



Circle the correct answer to each of these short answer questions:

(a) "If $H(e^{j\hat{\omega}})$ is the frequency response of a digital filter, and the input is $x[n] = \cos(0.3\pi n)$, then the output is $y[n] = H(e^{j0.3\pi})x[n]$." This statement is

(a) Always true
(b) Sometimes true
(c) Never true

If $H(e^{j0.3\pi})$ is real, it is true
No phase

(b) "If the signal $x(t)$ is a sinusoid and its spectrum has frequency components at $f = \pm 55$ Hz, then the signal $y(t) = x^2(t)$ has frequency components at the same frequencies." This statement is:

(a) True
(b) False

$\left(e^{j2\pi(55)t} + e^{-j2\pi(55)t}\right)^2 \rightarrow e^{j2\pi(110)t}$ etc.

(c) An IIR filter with system function $H(z) = \dfrac{1 - 2z^{-1}}{1 + 0.25z^{-1}}$ is:

(a) *not* stable.
(b) stable

pole at $z = -0.25$ is inside unit circle.

(d) Evaluate the complex number $z = j^{-1} + j^{-2} + j^{-3}$.

(a) $z = 0$
(b) $z = j$
(c) $z = -j$
(d) $z = 1$
(e) $z = -1$

$z = -j - 1 + j = -1$

(e) Suppose that the discrete-time signal $x[n] = \cos(0.2\pi n)$ is the input to an FIR filter whose frequency response is $H(e^{j\hat{\omega}}) = 2e^{-j2\hat{\omega}}\cos(2\hat{\omega})$. Determine the output signal, $y[n]$.

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(e) $y[n] = 0$

Mag, phase

$H(e^{j0.2\pi}) = 2e^{-j0.4\pi}\cos(0.4\pi) = 0.618\,e^{-j0.4\pi}$

$y[n] = 0.618\cos(0.2\pi n - 0.4\pi)$