Assignment 7

The due date for submitting this assignment has passed. Due on 2016-09-14, 23:30 IST.

Submitted assignment

1) Consider a first order IIR filter \( H(z) = \frac{z^{-1} - a^*}{1 - az^{-1}}, \quad |a| < 1 \). For this filter,

(a) \( |H(e^{j\omega})| \) is constant and \( \angle H(e^{j\omega}) \) is linear in \( \omega \) for all \( \omega \) in the range from \( -\pi \) to \( \pi \),

(b) \( |H(e^{j\omega})| \) is constant but \( \angle H(e^{j\omega}) \) is not linear in \( \omega \) for all \( \omega \) in the range from \( -\pi \) to \( \pi \),

(c) \( |H(e^{j\omega})| \) is variable and \( \angle H(e^{j\omega}) \) is linear in \( \omega \) for all \( \omega \) in the range from \( -\pi \) to \( \pi \),

(d) \( |H(e^{j\omega})| \) is variable but \( \angle H(e^{j\omega}) \) is not linear in \( \omega \) for all \( \omega \) in the range from \( -\pi \) to \( \pi \),

No, the answer is incorrect.

Score: 0

Accepted Answers:

(b) \( |H(e^{j\omega})| \) is constant but \( \angle H(e^{j\omega}) \) is not linear in \( \omega \) for all \( \omega \) in the range from \( -\pi \) to \( \pi \),

2) A low pass filter is described by the following difference equation:

\[
y(n) = 0.9y(n-1) + 0.18y(n-2) + 0.5x(n) + 0.1x(n-1).
\]

The filter is converted into a high pass filter by giving a \( \pi \) right shift to \( H(e^{j\omega}) \). The input-output relation of the high pass filter is given by

(a) \( y(n) = 0.9y(n-1) - 0.18y(n-2) + 0.5x(n) + 0.1x(n-1) \),

(b) \( y(n) = 0.9y(n-1) - 0.18y(n-2) + 0.5x(n) - 0.1x(n-1) \),

(c) \( y(n) = -0.9y(n-1) + 0.18y(n-2) + 0.5x(n) - 0.1x(n-1) \),

(d) \( y(n) = -0.9y(n-1) + 0.18y(n-2) - 0.5x(n) + 0.1x(n-1) \).
Discrete Time Signal Processing - Unit 8 - Week 7:

No, the answer is incorrect.
Score: 0

Accepted Answers:
(c) \( y(n) = -0.9y(n-1) + 0.18y(n-2) + 0.5x(n) - 0.1x(n-1) \),

3) An IIR filter is designed from a prototype causal and stable analog filter \( H_a(s) = \frac{1}{s^2 + 3s + 2} \) by the impulse invariance method. In other words, if \( h_a(t) \) is the impulse response of the analog filter, then \( h_a(t) \) is sampled with the sampling period \( T \), to generate the sequence \( h(n) = h_a(nT) \). The IIR filter \( H(z) \) will then have poles at

- (a) \( e^T \) and \( e^{-T} \),
- (b) \( e^{-T} \) and \( e^{2T} \),
- (c) \( e^{-T} \) and \( e^{2T} \),
- (d) \( e^T \) and \( e^{-2T} \).

No, the answer is incorrect.
Score: 0

Accepted Answers:
(b) \( e^{-T} \) and \( e^{2T} \),

4) Given that \( H(z) \) is a causal and stable IIR filter, if \( z \) in \( H(z) \) is replaced by \( \frac{1}{z} \), the resulting filter will be

- (a) neither stable nor causal,
- (b) stable but non-causal,
- (c) unstable but causal,
- (d) both stable and causal.

No, the answer is incorrect.
Score: 0

Accepted Answers:
(b) stable but non-causal,

5) Given an analog filter \( H_a(s) = \frac{s + 1}{(s + 1)^2 + 4}, \quad \text{Re}(s) > -1 \), a digital filter \( H(z) \) is designed from \( H_a(s) \) by the impulse invariance method, assuming sampling period = \( T \).

Then, \( H(z) \) is given by

- (a) \( \frac{1 - e^{-T}\sin(2T)z^{-1}}{1 - 2e^{-T}\sin(2T)z^{-1} + e^{-2T}z^{-2}}, \quad |z| < e^{-T}, \)
- (b) \( \frac{1 - e^{-T}\cos(2T)z^{-1}}{1 - 2e^{-T}\cos(2T)z^{-1} + e^{-2T}z^{-2}}, \quad |z| < e^{-T}, \)
- (c) \( \frac{1 - e^{-T}\sin(2T)z^{-1}}{1 - 2e^{-T}\sin(2T)z^{-1} + e^{-2T}z^{-2}}, \quad |z| > e^{-T}, \)
No, the answer is incorrect.
Score: 0

Accepted Answers:

(d) \[ \frac{1 - e^{-T \cos(2\theta)} z^{-1}}{1 - 2e^{-T \cos(2\theta)} z^{-1} + e^{-2T \cos(2\theta)} z^{-2}} \quad |z| > e^{-T}, \]