MAT 320 Quiz 4 Answer Sheet

Fall 2021

Quiz ID: QDC Name: ____________________

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Test ID: QDC   Name: ____________________

MAT 320 Quiz 4 Spring 2021

1. Consider the digital filter F_1: $y_t = x_t - \frac{1}{4}x_{t-1}$. What is the transfer function $\mathcal{H}(z)$ for this filter?

   a) $\frac{z-\frac{1}{4}}{z}$ b) $\frac{z}{z+\frac{1}{4}}$ c) $1-\frac{1}{4}z$ d) $1-4z$ e) $1-\frac{1}{4z}$

2. Same filter F_1 as in the previous question. What is the frequency response $H(\omega)$ of this filter?

   a) $1-4e^{-i\omega}$ b) $1-\frac{1}{4}e^{-i\omega}$ c) $\frac{e^{i\omega}}{e^{i\omega}-\frac{1}{4}}$ d) $\frac{e^{i\omega}-4}{e^{i\omega}}$ e) $\frac{1}{4}e^{i\omega}$

3. Same filter F_1 as in the previous question. What is the magnitude response $|H(\omega)|$ of this filter?

   a) $|1+4e^{-i\omega}|$ b) $|e^{i\omega}-\frac{1}{4}|$ c) $\frac{1}{|e^{i\omega}+\frac{1}{4}|}$ d) $|\frac{e^{i\omega}-4}{e^{i\omega}}|$ e) $|1-\frac{1}{4}e^{i\omega}|$

4. Same filter F_1 as in the previous question. Which frequency ω has the largest frequency response?

   a) $\pi/2$ b) $\pi/3$ c) $5\pi/6$ d) $2\pi/3$ e) $3\pi/4$

5. Same filter F_1 as in the previous question. If the input $\mathbf{x}$ is the unit impulse signal: $(1, 0, 0, 0, \ldots)$ then what is the output value y_1? (Assume values with index less than zero are equal to 0.)

   a) 1 b) 0 c) $\frac{1}{4}$ d) $\frac{1}{8}$ e) $-\frac{1}{4}$

6. Consider the digital filter F_2: $y_t = \frac{1}{2}x_t + x_{t-1} + \frac{1}{2}x_{t-2}$. What is the transfer function $\mathcal{H}(z)$ for this filter?

   a) $\frac{z+2}{z+\frac{1}{2}}$ b) $\frac{\frac{1}{2}z+1}{z+2}$ c) $1-\frac{1}{2}z$ d) $\frac{z^2+2z+1}{2z^2}$ e) $1-\frac{1}{2z}$

7. Same filter F_2 as in the previous question. If $H(\omega)$ is the frequency response of this filter, what is $e^{i\omega}H(\omega)$? (Hint: First factor out an exponential from $H(\omega)$.)

   a) $\dfrac{e^{-i\frac{\omega}{2}}+\frac{1}{2}}{e^{i\frac{\omega}{2}}-\frac{1}{2}}$ b) $1-\frac{1}{2}e^{-i\omega}$ c) $\frac{1}{2}e^{i\omega}+1+\frac{1}{2}e^{-i\omega}$ d) $\dfrac{e^{i\frac{\omega}{2}}-\frac{1}{2}}{e^{-i\frac{\omega}{2}}+\frac{1}{2}}$ e) $e^{i\omega}+\frac{1}{2}+e^{-i\omega}$

8. Same filter F_2 as in the previous question. Use the previous question to find a simple form for $H(\omega)$, the frequency response of this filter.

   a) $(\sin\omega-1)e^{i\omega}$ b) $(\cos\omega-1)e^{i\omega}$ c) $(\cos\omega+1)e^{-i\omega}$ d) $(\sin\omega+1)e^{-i\omega}$ e) $(\cos\omega-\frac{1}{2})e^{i\omega}$

9. Same filter F_2 as in the previous question. What is the magnitude response $|H(\omega)|$ of this filter?

   a) $\cos\omega-\frac{1}{2}$ b) $1-\frac{1}{2}\cos\omega$ c) $1-\frac{1}{2}\sin\omega$ d) $\cos\omega+1$ e) $1-\cos\omega$

10. Same filter F_2 as in the previous question. If the phasor $e^{i\omega t}$ is the input to F_2, the output signal will be the same phasor delayed by how many samples?

    a) 2 b) $\frac{3}{2}$ c) 1 d) 3 e) $\frac{1}{2}$