MAT 320 Quiz 4 Answer Sheet

Fall 2021

Quiz ID: MVX Name: ____________________

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Test ID: MVX 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) $1 - \frac{1}{4z}$ b) $1 - \frac{1}{4}z$ c) $1 - 4z$ d) $\frac{z}{z+\frac{1}{4}}$ e) $\frac{z-\frac{1}{4}}{z}$

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

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

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

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

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

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

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

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

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

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

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

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

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