Test ID: TESTID Name: ____________________

MAT 321 **Quiz 1** Spring 2020

1. Let **x** and **y** be discrete signals (infinite time extent with values $t \in \mathbb{Z}$) defined by $x_t = 1$ for $t \geq 0$, $x_t = 0$ otherwise, and $y_t = e^{i\frac{\pi}{2}t}$, for $-2 \leq t \leq 2$, $y_t = 0$ otherwise. Find the inner product $< \mathbf{x}, \mathbf{y} >$:

   a) $-i$ b) i c) 1 d) 0 e) -1

   Correct Answer: $-i$

2. Same signals **x** and **y** as in the previous question. Let **w** be the convolution $\mathbf{x} * \mathbf{y}$. Find $\mathbf{w}(0)$ or w_0.

   a) $-i$ b) i c) 1 d) 0 e) -1

   Correct Answer: $-i$

3. Let **x** be the same discrete signal as in the previous problem, and now let **y** be this signal shifted to the right by 2 samples, so that $y_t = x_{t-2}$. What is the Z-transform of the signal **y**?

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

   Correct Answer: $\frac{1}{z(z-1)}$

4. Let $b(t)$ be the buzz function defined as: $\sum_{k=-\infty}^{+\infty} \delta(t-k)$ where $\delta(t)$ is the 'delta function' which is zero except for $t = 0$ where it has a concentrated area of value one. What is the value of the integral:

$$\int_{1/2}^{3/2} \sin(\frac{\pi}{4}t)b(t)\ dt$$

   a) 2 b) $\frac{2}{\pi}$ c) $\sqrt{2}/2$ d) 1 e) 0

   Correct Answer: $\sqrt{2}/2$

5. Solve for a_2 in the following equation:

$$\frac{1}{1-2z^{-1}+3z^{-3}} = a_0 + a_1 z^{-1} + a_2 z^{-2} + \cdots.$$

   a) 2 b) 3 c) 1 d) 4 e) 0

   Correct Answer: 4

6. Let $\mathbf{x}$ be a signal with frequency values $F(\omega)$, where ω is continuous but finite in extent, and let $\mathcal{F}(z) = \sum_{k=-\infty}^{\infty} x_k z^{-k}$ be the Z-transform of $\mathbf{x}$. The inverse Fourier Transform of F should be computed as:

   a) $\frac{1}{2\pi}\int_{-\pi}^{\pi} F(\omega)e^{i\omega t}\, d\omega$ b) $\frac{1}{N}\sum_{k=0}^{N-1} X_k e^{i\frac{2\pi}{N}kt}$ c) $\frac{1}{F(\omega)}$ d) $\int_{-\infty}^{\infty} F(\omega)e^{-i\omega t}\, d\omega$ e) $\frac{1}{\mathcal{F}(z)}$

   Correct Answer: $\frac{1}{2\pi}\int_{-\pi}^{\pi} F(\omega)e^{i\omega t}\, d\omega$

7. Same signal $\mathbf{x}$ as in the previous question. The inverse Z-transform is the process of computing:

   a) $\frac{1}{2\pi}\int_{-\pi}^{\pi} F(\omega)e^{i\omega t}\, d\omega$ b) x_t from $\mathcal{F}(z)$ c) $\frac{1}{F(\omega)}$ d) $\int_{-\infty}^{\infty} F(\omega)e^{-i\omega t}\, d\omega$ e) $\frac{1}{\mathcal{F}(z)}$

   Correct Answer: x_t from $\mathcal{F}(z)$

8. Let $\mathbf{x}$ be a signal which is periodic with continuous time t (finite in extent on an interval of one period). The (forward) Fourier Transform of $\mathbf{x}$ can be thought of as:

   a) a value of its Z-transform b) an impulse response c) a delta function d) a coefficient for a phasor e) an inverse Z-transform

   Correct Answer: a coefficient for a phasor

9. Let $\mathbf{x}$ be a signal whose frequency values are discrete of infinite extent. Then $\mathbf{x}$ can be represented as:

   a) a constant b) a step function c) a delta function d) a Fourier series e) an inverse Z-transform

   Correct Answer: a Fourier series

10. Which of the following statements are correct in the context of discrete time signals?

    i) The Z-transform of a filter is equal to the transfer function of the filter's impulse response.

    ii) The Z-transform of a filter's impulse response is equal to the transfer function of the filter.

    iii) The transfer function of a filter is equal to the Z-transform of the filter's magnitude response.

    a) i) only b) i) and ii) only c) ii) only d) iii) only e) ii) and iii) only

    Correct Answer: ii) only