University of Nebraska-Lincoln
Digital Signal Processing: Quiz 5

October 10, 2025

Name: _____   **Total Points: 10**

Given: A discrete-time LTI system has the following impulse response:

$$h[n] = \delta[n] - \delta[n-1]$$

where $\delta[n]$ is the unit impulse function.

1. **(10 points)** Find the frequency response $H(e^{j\omega})$ of this system and determine:

   (a) The magnitude response $|H(e^{j\omega})|$

   (b) The phase response $\angle H(e^{j\omega})$

   (c) Evaluate both the magnitude and phase at $\omega = 0$ and $\omega = \pi$

   Hints:

   $$H(e^{j\omega}) = \sum_{n=-\infty}^{\infty} h[n]e^{-j\omega n}$$

   $$H(e^{j\omega}) = |H(e^{j\omega})|e^{j\angle H(e^{j\omega})}$$

   Useful Euler's identities:

   $$e^{j\theta} = \cos(\theta) + j\sin(\theta) \tag{1}$$
   $$e^{j\theta} - e^{-j\theta} = 2j\sin(\theta) \tag{2}$$
   $$e^{j\theta} + e^{-j\theta} = 2\cos(\theta) \tag{3}$$
   $$j = e^{j\pi/2} \tag{4}$$

   Note: You may express your final answer either in terms of complex exponentials or sinusoids/cosines.