UNIVERSITY OF THE WEST INDIES
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ELET3230 - Digital Signal Processing

Test 2 **November 24, 2020**

1. A signal $s(t) = sin(2\pi f_o t)$ with $f_o = 0.75$Hz is sampled with a frequency $f_s = 25$Hz and passed through a filter with difference equation

$$y[n] = 3x[n] - 2x[n-1] + 4x[n-2]$$

(a) Write down an expression for the corresponding digital signal $x[n]$ in terms of its digital frequency Ω_o . What is the value of Ω_o ? [4]

(b) Determine the frequency response of this filter. [4]

(c) Verify your answer to part (b) using the DTFT of the filter's impulse response [4]

(d) Find $|H(\Omega_o)|$ and $\Phi(\Omega_o)$ for this filter [6]

(e) Find $H(\Omega)$ for $\Omega = 0$ [4]

(f) Find an expression for y[n] when $\Omega = 0$ [4]

2. (a) The transfer function for a digital filter is

$$H(z) = \frac{1}{0.8+0.23z^{-1}+0.15z^{-2}}$$

Plot the poles and zeros of this filter on the z-plane [6]
Prove that the filter is stable [2]
Find the difference equation and the impulse response [2]

(b) Find the poles and zeroes of the digital filter

$$y[n] = -0.6y[n-1] - 0.13y[n-2] + x[n-1]$$ [7]

Prove that the filter is stable [2]
Find the steady state output value for the step response [3]