DEPARTMENT OF ELECTRONICS AND COMMUNICATION
FOURTH SEMESTER B.TECH. (E&C)
IA- 4 (Take home assignment)

DIGITAL SIGNAL PROCESSING (ECE 2222)
Submission Date: On or before 16/04/2025

1) Consider a filter described by the difference equation $y[n] = 0.1\ x[n] - 0.9\ y[n-1]$. Determine the frequency (ω) at which $|H[\omega]| = 0.707$. Is this a low-pass filter or high-pass filter.

2) The specifications of the desired low-pass filter are
Passband edge: 4kHz, Stopband edge: 8 kHz
Passband ripple: 1 dB, Stopband Attenuation: 40 dB
Sampling frequency: 24 kHz
Determine the order and poles of **Butterworth filter** required to meet the above filter specification. Use bilinear transformation. Also determine the analog filter H(s) and obtain H(z) of the digital filter using bilinear transformation method.

3) Determine a 16 point DFT of a sequence input x(n)={1,2,-3,4,2,3,-2,1,1,1,-2,3,2,4,-3,2 } using an 8 point DITFFT/DIFFFT algorithm.

4) It is required to have **FIR bandpass filter** with the following specifications
Passband edge frequencies: 400HZ and 700Hz
Stopband edge frequencies: 100Hz and 1000Hz
Minimum stopband attenuation: 50dB
Sampling frequency: 3000Hz
a) Select suitable window to approximate the required response and estimate the minimum length of the filter.
b) Determine the coefficients of the filter using this windowing technique.

5) Design a digital Chebyshev type-1 filter for the following specifications

$0.8 \leq |H(e^{j\omega})| \ll 1 \quad 0 \leq \omega \leq 0.2\pi$
$|H(e^{j\omega})| \leq 0.2 \quad 0.6\pi \leq \omega \leq \pi$

Use impulse invariance method with T=1. Verify the design by checking passband and stop band specifications.

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