Assignment – Time Series Analysis

1. Answer the following:

(a) Determine and sketch the magnitude and phase spectra of the following periodic signals:
(i) $x[n] = 4\sin(\frac{\pi(n-2)}{3}n)$, (ii) $x[n] = \cos(\frac{2\pi}{3}n) + \sin(\frac{2\pi}{5}n)$ and (iii) $x[n] = \cos(\frac{2\pi}{3}n)\sin(\frac{2\pi}{5}n)$

(b) Determine the periodic signal $x[n]$ with period $N = 8$ if its Fourier coefficients are given by $c_k = \cos(\dfrac{\pi k}{4}) + \sin(\dfrac{3\pi k}{4})$.

2. Answer the following:

(a) A signal $x[n]$ has the following Fourier Transform: $X(\omega) = \dfrac{1}{1 - ae^{-j\omega}}$.
Determine the Fourier Transform of the following signals:
(i) $x[2n+1]$ (ii) $e^{\pi n/2}x[n+2]$ (iii) $x[n]\cos[0.3\pi n]$ and (iv) $x[n] \star x[n-1]$

(b) Consider the periodic signal $x[n] = 1, 0, 1, 2, 3, 2$ starting from $n = 0$. Verify Parseval's theorem for this case.

3. Answer the following:

An FIR filter is described by the difference equation: $y[n] = x[n] + x[n-4]$.

(a) Compute and sketch its magnitude and phase response.

(b) Compute its response to the input $x[n] = \cos(\dfrac{\pi}{2}n) + \cos(\dfrac{\pi}{4}n)$

(c) Explain the results obtained in part (b) using those from part (a)

4. Answer the following:

If $w_1[k] = (1 + c_1q^{-1})e_1[k]$ and $w_2[k] = (1 + c_2q^{-1})e_2[k]$, show that $w_3[k] = w_1[k] + w_2[k]$ may be written as $w_3[k] = (1 + c_3q^{-1})e_3[k]$, and derive an expression for c_3 and $\sigma^2_{e_3}$ in terms of the other two processes.