Digital Signal Processing
Homework Assignment Chapter 2

YOUR NAME

STUDENT NUMBER

1 Theoretical Problems

1. Consider the following sequences:

$$x[n] = \{2, \quad 0, \quad -1, \quad 6, \quad -3, \quad 2, \quad 0\}, -3 \leq n \leq 3$$

$$y[n] = \{8, \quad 2, \quad -7, \quad -3, \quad 0, \quad 1, \quad 1\}, -5 \leq n \leq 1$$

$$w[n] = \{3, \quad 6, \quad -1, \quad 2, \quad 6, \quad 6, \quad 1\}, -2 \leq n \leq 4$$

   The sample values of each of the above sequences outside the ranges specified are all zeros. Generate the following sequences:

   (a) $c[n] = x[n+3]$,
   (b) $d[n] = y[n-2]$,
   (c) $e[n] = x[-n]$,
   (d) $u[n] = x[n-3] + y[n+3]$,
   (e) $v[n] = y[n-3] \cdot w[n+2]$,
   (f) $s[n] = y[n+4] - w[n-3]$,
   (g) $r[n] = 3.9w[n]$.

2. Determine the following sequences obtained by a linear convolution of the sequences given in Problem 1:

$$\text{(a)} \quad u[n] = x[n] \circledast y[n], \quad \text{(b)} \quad v[n] = x[n] \circledast w[n], \quad \text{(c)} \quad g[n] = w[n] \circledast y[n].$$

3. Consider the sequence $\{g[n]\} = \{-3,\ 0,\ 4,\ 9,\ 2,\ 0,\ -2,\ 5\}, -4 \leq n \leq 3$.

   (a) Determine the sequence $\{h[n]\}$ obtained by a right circular shift of $\{g[n]\}$ by 5 sample periods.

(b) Determine the sequence $\{w[n]\}$ obtained by a left circular shift of $\{g[n]\}$ by 4 sample periods.

4. Determine the autocorrelation sequence of each of the following sequences, and show that it is an even sequence in each case. What is the location of the maximum value of the autocorrelation sequence in each case?

   (a) $x_1[n] = \alpha^n \mu[n], |\alpha| < 1$

   (b) $x_2[n] = \begin{cases} 1, 0 \leq n \leq N-1, \\ 0, \text{otherwise.} \end{cases}$

2 Program Problems

1. Determine and plot using MATLAB the autocorrelation sequence of the causal exponentially decaying sequence $x[n] = \alpha^n \mu[n]$, for the following values of α: (a) $\alpha = 0.6$, and (b) $\alpha = 0.8$.

   Please insert your matlab code in a proper format.

```
for i = 1:3
    if i ≥ 5 && a ≠ b        % literate programming replacement
        disp('cool');            % comment with some LaTeXin it:  πx^2
    end
    [:,ind] = max(vec);
    x_last = x(1,end) - 1;
    v(end);
    really really long really really long really really long ...
       really really long really really long line % blaaaaaaaa
    ylabel('Voltage (μV)');
end
```