1. Convolve \( h(n) \) and \( x(n) \) to get \( y(n) \). Put \( y(n) \) in closed form when possible.
   (a) \( h(n) = a^n u(n-1) \) and \( x(n) = b^n u(n-2) \).
   (b) \( h(n) = a^n u(n) \) and \( x(n) = u(n-3) \).
   (c) \( h(n) = \cos(w c n) u(n) \) and \( x(n) = u(n-4) \).
   (d) \( h(n) = u(n-1) - u(n-8) \), \( x(n) = u(n-3) - u(n-7) \). Express the result in terms of \( r(n) \), where \( u(n)*u(n) = r(n+1) \).

2. A linear time invariant (LTI) system is described by the recursive difference equation
   \[
   y(n) = 2x(n) - x(n-1) + \frac{7}{12} y(n-1) - \frac{1}{12} y(n-2)
   \]
   (a) Find \( H(e^{jw}) \) in closed form.
   (b) Find the homogeneous solution.
   (c) Find \( h(0) \) and \( h(1) \)
   (d) Find the impulse response \( h(n) \).
   (e) State whether or not the given difference equation is causal.

3. Here we derive \( F\{x(2n)\} \), the DTFT of \( x(2n) \).
   (a) First, set up this DTFT as a sum over \( n \), with no simplifications.
   (b) Next, what do we substitute for \( n \) so that the sum is over even values of the variable \( m \) ? \( n = f(m) \). what is \( f(m) \) ? Rewrite the sum.
   (c) Next, we replace \( x(m) \) by \( g(m)x(m) \) where \( g(m) = 1 \) for \( m \) even and 0 for \( m \) odd. Give \( g(m) \). Rewrite the sum so that it is over all values of \( m \).
   (d) Now, give \( F\{x(2n)\} \) in terms of \( X() \).

4. Let \( x(n) \), \( y(n) \), and \( h(n) \) denote complex sequences.
   (a) Find \( Y(e^{jw}) \) in terms of \( X(e^{jw}) \) and \( H(e^{jw}) \) if
   \[
   y(n) = \sum_{k=-\infty}^{\infty} h(k)x(-k-n)
   \]
   (b) Express the quantity \( E \) using \( H(e^{jw}) \) and \( X(e^{jw}) \) if
   \[
   E = \sum_{k=-\infty}^{\infty} h'(k)x(-k)
   \]
   (c) Find \( Y(e^{jw}) \) in terms of the DTFT of \( x(n) \) if \( y(n) = x(n/3) \) if \( n \) is a multiple of 3 and \( y(n) = 0 \) otherwise.
5. Assume that for $|w| \leq \pi$,

$$X(e^{jw}) = \cos(a \cdot w)$$

(a) Find $x(0)$.
(b) Find $\lim x(n)$ as $n$ approaches infinity.
(c) Find a real expression for $x(n)$.

6. A signal $x(n)$ has $N$ samples numbered 0 to $N-1$. The pseudo code below should calculate the magnitude and phase responses from $x(n)$ for $M$ frequencies $w(k)$, where $k$ varies from 0 to $M-1$. These frequencies are evenly spaced and include 0 and $\pi$. The only complex variables are $z$ and $H$.

\[
\Delta w = A \\
w = -\Delta w \\
\text{For } 0 \leq k \leq M-1 \\
w = w + \Delta w \\
H = B \\
z = e^{jw} \\
\text{For } 0 \leq n \leq N-1 \\
H = H + C \\
\text{End} \\
Amp(k) = |H| \\
E = \text{Real}\{H\} \\
F = \text{Im}\{H\} \\
\text{Phi}(k) = G \\
w(k) = w \\
\text{End}
\]

(a) Give the value of $A$, so that $w$ varies from 0 to $\pi$ as $k$ varies from 0 to $M-1$.
(b) Give values for $B$ and $C$, so that samples of the frequency response are temporarily stored in the variable $H$.
(c ) Give expression $G$ in terms of $E$ and $F$, so that the “correct” phase is stored as $\text{Phi}(k)$. 