PROBLEM 1. Consider the two signals \( x[n] \) and \( y[n] \) defined as follows:

\[
x[n] = \begin{cases} 
\sin\left(\frac{n\pi}{5}\right) & 0 \leq n \leq 9 \\
0 & \text{otherwise}
\end{cases}
\]

\[
y[n] = \begin{cases} 
n & 0 \leq n \leq 9 \\
0 & \text{otherwise}
\end{cases}
\]

Use MATLAB to:

1. Plot \( z[n] = x[n] + y[n] \).
2. Compute and plot \( z[n] = x[n] \star y[n] \).
3. Compute the energy of \( x[n] \).
4. Using the MATLAB function \texttt{fft}, verify Parseval’s identity between \( x[n] \) and its DFT.

PROBLEM 2. Write a Matlab function that takes as input a sequence \( x[n] \) of length \( N \), returns the DFT of \( x[n] \), and plots both \( x[n] \) and its DFT (magnitude and phase).

1. Try your function for the input signal \( x[n] = \delta[n-3] \).
2. Use Matlab’s \texttt{fft} function to verify your answer to part (1).

PROBLEM 3.

1. Write a Matlab function that takes as input \( N \) and plots the following signal for \( N = 5, 8 \).

\[
x_N[n] = \begin{cases} 
1 & 0 \leq n \leq N - 1 \\
0 & \text{otherwise}
\end{cases}
\]

2. Derive analytically the \( 2N \) point DFT of the above defined step function for an arbitrary \( N \) and plot it for \( N = 5, 8 \).

3. Modify the DFT function you wrote for problem 2 to compute and plot (both the phases and the magnitudes of) the \( 2N \) point DFT of \( x_N(n) \) for \( N = 5, 8 \).

4. Use the Matlab function \texttt{subplot} to display your answer to parts (2) and (3) in one window.