(a) Compute the circular convolution of the sequences
\[ x_1(n) = [2, 3, 4, 2] \text{ and } x_2(n) = [1, 2, 1, 0]. \]
(In all sequences throughout this test, the first location corresponds to \( n = 0 \) or \( k = 0 \).)

(b) Suppose that \( x_1 \) and \( x_2 \) have both been entered into Matlab. Please provide Matlab code that calculates the circular convolution using the DFT and IDFT.)
Question 2

(a) Compute the four-point ($N = 4$) DFT $X(k)$ of the sequence $x(n) = [2, 3, 4, 2]$. 
(b) Compute the inverse DFT $x(n)$ of $X(k) = [7, i, -3, -i]$. 
Question 3

(a) Compute the Four-point DFT of the sequence $x(n) = [1, 1, 2, 2]$ using a radix-2 FFT algorithm.
(b) Suppose that $N_1$ is some prime number and that $N = (N_1)^2$. Approximately how many arithmetic operations are needed to compute the DFT using a divide and conquer approach?
Question 4

Consider an analog filter with system function

\[ H_a(s) = \frac{s + 1}{(s + 1)^2 + 16}. \]

(a) Convert the analog filter into a digital IIR filter using a bilinear transformation, where the digital filter is supposed to have a resonant frequency of \( \omega_r = \pi/3 \).
In order to simplify the calculation, in the rest of question 4 please use a digital IIR filter with transfer function

\[ H(z) = \frac{10z^2 + 2z - 10}{100z^2 - 200z + 100} \]

instead of the answer you got in part (a).

(b) Where are the zero(s) and pole(s) of \( H(z) \)?

(c) Sketch the pole-zero plot.
(d) Suppose that this system is stable. What is the region of convergence (ROC) of this filter? Is $H(z)$ a causal system?