**Digital Signals Processing   
Final Problem Set**

December 2023

**2 Questions**

**2.1 Complex Algebra 1**

Identify the set of complex numbers that satisfies the condition

**2.2 Complex Algebra 2**

Simplify the function

**2.3 Periodic Signals**

Compute for the minimum period in samples of the signal for:

(a) M=1; N=1

(b) M=1; N=3

(c) M=56; N=9

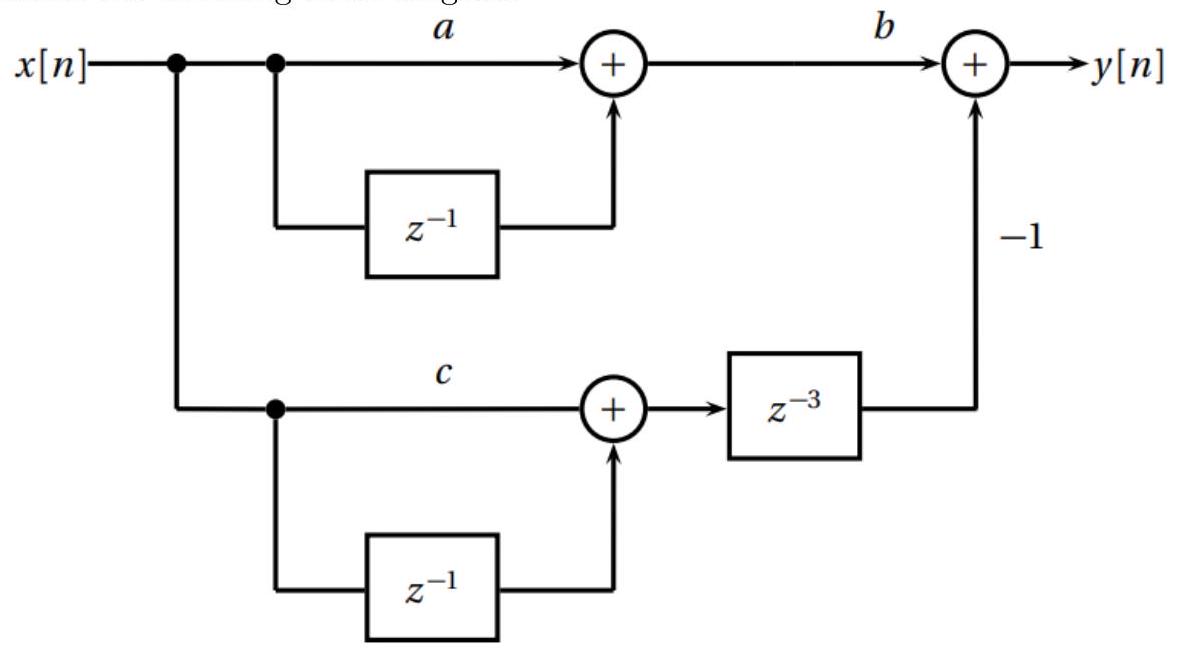
**2.4 Signal Operations 1**

Compute the moving average of the signal from an input signal

. Whereas is defined as

**2.5 Signal Operations 2**

Consider the following block diagram



What is the equation representing the output response ?

**2.6 Signal Operations 3**

If we represent finite-length signals as vectors in Euclidean space, many operations on signals can be encoded as a matrix-vector multiplication. Consider for example a circular shift in : a delay by one (i.e. a right shift) transforms the signal into and it can be described by the matrix

so that

Determine the matrix that implements the one-step-different operator in i.e. the operator that transforms a signal into

**2.7 Frequency Analysis**

Given the three signals:

(a)

(b)

(c)

Prove that . Identify the fundamental frequencies of signals 2.7.a, 2.7.b, and 2.7.c. Relate the frequencies you have determined to the equality you have just solved. You may use verbal or computational reasoning.