Digital Signal Processing
Assignment 1

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***Abstract*—This submission is part of the assignments from the Oppenhiem Textbook of the course EE-3900 DIgital Signal Processing**

Contents

1 Oppenhiem 3.3-b

1) Determine the z-transform if each of the following sequences, Included with your answer with region of convergence in the z-plane. Express all sums in closed form ; α can be complex.
   a) $x_b[n] = \begin{cases} 1, & 0 \leq n \leq N-1 \\ 0, & \text{Otherwise.} \end{cases}$

Solution: The z transform of $x_b[n]$ is given by

$$x_b[z] = \sum_{n=-\infty}^{\infty} x_b[n] z^{-n} \tag{1.1}$$

$$= \sum_{n=-\infty}^{-1} 0 + \sum_{n=0}^{N-1} 1.z^{-n} + \sum_{n=N}^{\infty} 0 \tag{1.2}$$

$$= \sum_{n=0}^{N-1} z^{-n} \tag{1.3}$$

$$= \frac{1 - z^{-N}}{1 - z^{-1}} \tag{1.4}$$

The given sequence $x_b(n)$ is a casual sequence since

$$x_b(n) = 0 \qquad , \forall n < 0 \tag{1.5}$$

Therefore,

$$x_b(n) = 1 + z^{-1} + \ldots.. + z^{-(N-1)} \tag{1.6}$$

$$= \left(1 + \frac{1}{z} + \ldots\ldots \frac{1}{z^{N-1}}\right) \qquad , z \neq 0 \tag{1.7}$$

The given sequence is a causal sequence, thus $X(z)$ converges for all values of z except at $z = 0$, i.e., **the ROC is entire z-plane except at $z = 0$.** [Since the sequence is defined at all z's except $z = 0$]