Discrete Assignment

Shravya Kantayapalam
EE23BTECH11030

1) **Question 11.9.4.9**: Find the sum to n terms of the series whose nth term is given by $n^2 + 2^n$?
Solution:

TABLE 1
INPUT PARAMETERS

Parameter	Description
n	Index of the summation
k	Index variable for the summation
$x(k)$	Input sequence
$y(n)$	Output sequence
z	Complex variable in the Z-transform domain

We define the sequence $x(n)$ as:

$$x(n) = 5 - 2n, \quad n = 1, 2, 3, \ldots \tag{1}$$

Then, the sequence $y(n)$ is given by:

$$\begin{aligned} y(n) &= \sum_{k=1}^{n} x(k) \\ &= \sum_{k=1}^{n} (5 - 2k) \end{aligned}$$

The Z-transform of $y(n)$ is given by:

$$Y(z) = \sum_{n=0}^{\infty} y(n) z^{-n} \tag{2}$$

Substituting the expression for $y(n)$, we have:

$$\begin{aligned} Y(z) &= \sum_{n=0}^{\infty} \left(\sum_{k=1}^{n} (5 - 2k) \right) z^{-n} \\ &= \sum_{k=1}^{\infty} \sum_{n=k}^{\infty} (5 - 2k) z^{-n} \\ &= \sum_{k=1}^{\infty} (5 - 2k) \sum_{n=k}^{\infty} z^{-n} \\ &= \sum_{k=1}^{\infty} (5 - 2k) \frac{z^{-k}}{1 - z^{-1}} \end{aligned}$$

$x(n) = a^n$ has the Z-transform $\frac{1}{1-az^{-1}}$. However, the expression we have is not a simple geometric series, so the process to find the Z-transform of $y(n)$ might not yield a simple closed-form expression without further manipulation.