Discrete Assignment

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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

Variable	Description	Value
$x(n)$	n-th term of sequence	$(n^2 + 2^n)u(n)$

$$y(n) = (x * u)(n) = \sum_{k=-\infty}^{\infty} x(k)u(n-k) \tag{1}$$

Given $(n^2 + 2^n)u(n)$, we have:

$$y(n) = \sum_{k=-\infty}^{\infty} (k^2 + 2^k)u(k)u(n-k) \tag{2}$$

Applying Z-transform of $y(n)$:

$$Y(z) = \sum_{n=0}^{\infty} y(n)z^{-n} \tag{3}$$

To find $Y(z)$, we need to use Z-transform pairs:

$$n^2 \cdot u(n) \overset{Z}{\longleftrightarrow} \frac{z^{-1}(z^{-1}+1)}{(1-z^{-1})^3} \tag{4}$$

$$2^n \cdot u(n) \overset{Z}{\longleftrightarrow} \frac{1}{1-2z^{-1}} \tag{5}$$

We need to express $y(n)$ in terms of known Z-transforms to find $Y(z)$.
Given:

$$Y(z) = \frac{z^{-1}(z^{-1}+1)}{(1-z^{-1})^3} + \frac{2}{1-2z^{-1}} \tag{6}$$

$$\frac{z^{-1}(z^{-1}+1)}{(1-z^{-1})^3} \overset{Z^{-1}}{\longleftrightarrow} n^2u(n) + nu(n) \tag{7}$$

$$\frac{2}{1-2z^{-1}} \overset{Z^{-1}}{\longleftrightarrow} 2 \cdot 2^n u(n) \tag{8}$$

Therefore, $y(n)$ is the sum of the above expressions:

$$y(n) = (n^2 + n)u(n) + 2 \cdot 2^n u(n) \tag{9}$$

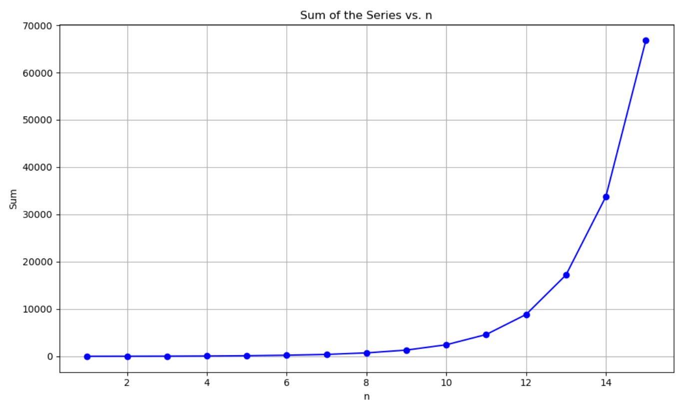

Fig. 1. Graph of $y(n)$ for $n \leq 15$ (Graph beyond $n = 29$ is not shown)