# Assignment-3

EE:1205 Signals and systems
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## I. Question 1.2.4

$1 \times 2 \times 3 + 2 \times 3 \times 4 + 3 \times 4 \times 5 + ...$

## II. Solution

$$X(z) = \sum_{n=-\infty}^{\infty} x(n) z^{-n} \tag{1}$$

$$= \sum_{n=-\infty}^{\infty} \left(n^3 + 3n^2 + 2n\right) u(n) z^{-n} \tag{2}$$

Using results of z-transform:

$$\therefore X(z) = \frac{6z^-1}{\left(1 - z^{-1}\right)^4}, |z| > 1 \tag{3}$$

We know:

$$y_1(n) = x_1(n) * u(n) \tag{4}$$

$$Y_1(z) = X_1(z) U(z) \tag{5}$$

$$= \frac{6z^{-1}}{\left(1 - z^{-1}\right)^5}, |z| > 1 \tag{6}$$

This can be rewritten as:

$$Y_1(z) = 6z^{-1}\left(1 - z^{-1}\right)^{-5}, |z| > 1 \tag{7}$$

Now, we can solve this question by expanding the power term using binomial theorum:

$$Y_1(z) = 6\left[z^{-1} - 5z^{-2} + \frac{(-5)(-6)}{2!}\left(z^{-3}\right).....\right] \tag{8}$$

$$= 6\sum_{n=1}^{\infty} \frac{(3+n)!}{(n-1)!4!} z^{-n} \tag{9}$$

$\therefore$ our z transform will just be:

$$y(n) = 6\frac{(3+n)!}{(n-1)!4!} \tag{10}$$

On simplifying:

$$\implies y(n) = \frac{n(n+1)(n+2)(n+3)}{4} \tag{11}$$

Hence the sum of n terms of the above series is

$y(n) = \frac{n(n+1)(n+2)(n+3)}{4}$