NCERT Question 10.5.2.5

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Question 10.5.2.5 : Find the number of terms in each of the following APs. Then express each term as x(n) and find the z transform, ROC and plot the graph for x(n):

1) 7, 13, 19, ... 205
2) 18, $15\frac{1}{2}$, 13, ... -47

Solution:

Parameter	Used to denote	Values
$x_i(n)$	n^{th} term of i^{th} series $(i = (1,2))$	$(x_i(0) + nd_i)\,u(n)$
$x_i(0)$	First term of i^{th} AP	$x_1(0) = 7$ $x_2(0) = 18$
d_i	Commmon difference of i^{th} AP	$d_1 = 6$ $d_2 = -2.5$

TABLE 2
PARAMETER TABLE

The number of terms in the AP x(n) is given by:

$$\frac{x(n) - x(0)}{d} + 1 \tag{1}$$

$$X_i(z) = \frac{x_i(0)}{1 - z^{-1}} + d_i \frac{z^{-1}}{(1 - z^{-1})^2} \text{ , for i=1,2} \tag{2}$$

ROC : $|z| > 1$ as it is an AP (3)

1)

$$x_1(n) = (7 + (n)\,6)\,u(n) \tag{4}$$

Using the values in Table 2 and equation (1),

$$k_1 = \frac{205 - 7}{6} + 1 = 34 \tag{5}$$

Using the values in Table 2 and equation (2) :

$$X_1(z) = \frac{7 - z^{-1}}{(1 - z^{-1})^2} \tag{6}$$

ROC is $|z| > 1$

2)

$$x_2(n) = (18 + n\,(-2.5)\,u(n)) \tag{7}$$

Using the values in Table 2 and equation (1),

$$k_2 = \frac{-47 - 18}{-2.5} + 1 = 27 \tag{8}$$

Using the values in Table 2 and equation (2) :

$$X_2(z) = \frac{18 - (20.5)\,z^{-1}}{(1 - z^{-1})^2} \tag{9}$$

ROC is $|z| > 1$.

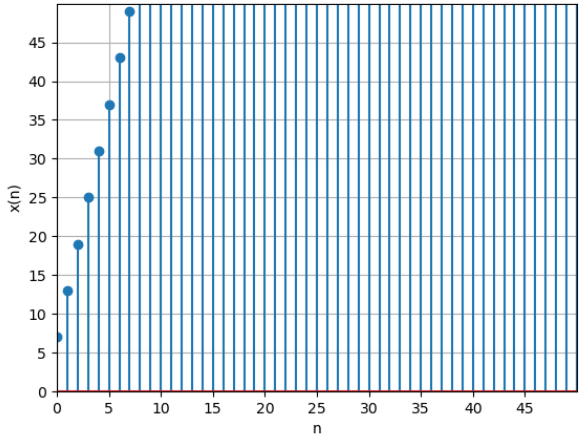

Fig. 2. Plot of $x_1(n)$

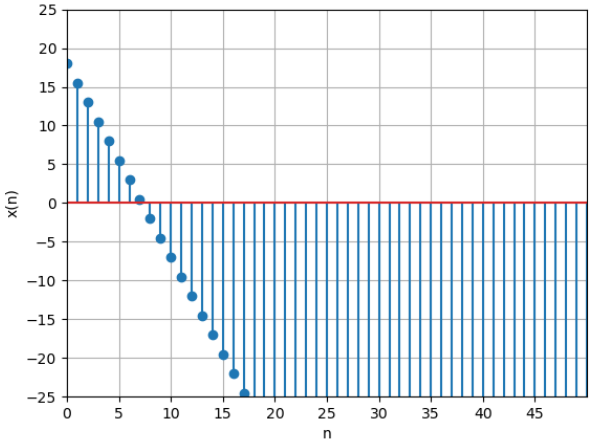

Fig. 2. Plot of $x_2(n)$