NCERT Discrete 10.5.2 -15

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Question: For what value of n, are the *nth* terms of two A.Ps: 63, 65, 67,... and 3, 10, 17,... equal?

Solution:

Parameter	Sub-question	Description	Value
$x_i(0)$	$x_1(0)$	1^{st} term of 1^{st} A.P.	63
	$x_2(0)$	1^{st} term of 2^{nd} A.P.	3
d_i	d_1	Common difference of 1^{st} A.P.	2
	d_2	Common difference of 2^{nd} A.P.	7

TABLE I
INPUT VALUES

$$x_i(n) = x(0)\,u(n) + dnu(n) \tag{1}$$

$$X(z) = \frac{x(0)}{1-z^1} + \frac{dz^{-1}}{(1-z^{-1})^2} \quad |z| > 1 \tag{2}$$

1)

$$x_1(n) = 63u(n) + 2nu(n) \tag{3}$$

$$X_1(z) = \frac{63}{1-z^1} + \frac{2z^{-1}}{(1-z^{-1})^2} \quad |z| > 1 \tag{4}$$

2)

$$x_2(n) = 3u(n) + 7nu(n) \tag{5}$$

$$X_2(z) = \frac{3}{1-z^1} + \frac{7z^{-1}}{(1-z^{-1})^2} \quad |z| > 1 \tag{6}$$

3) given,

$$X_1(z) = X_2(z) \tag{7}$$

$$\frac{63}{1-z^1} + \frac{2z^{-1}}{(1-z^{-1})^2} = \frac{3}{1-z^1} + \frac{7z^{-1}}{(1-z^{-1})^2} \tag{8}$$

$$\implies \frac{60}{1-z^1} = \frac{5z^{-1}}{(1-z^{-1})^2} \tag{9}$$

on taking inverse z-transform,

$$60u(n) = 5nu(n) \tag{10}$$

$$\implies n = 12 \tag{11}$$

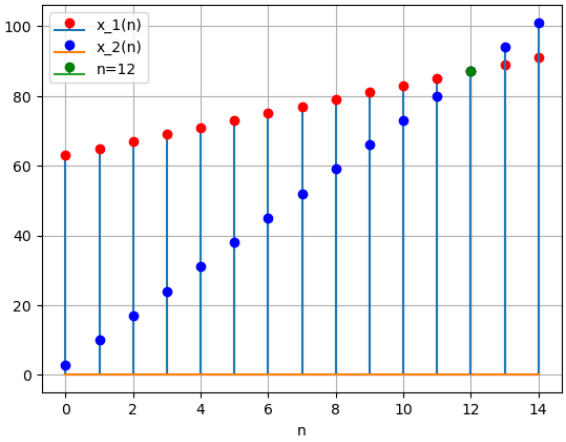

Fig. 1. Graphs of $x_1(n)$ and $x_2(n)$ and both are equal at $n = 12$