Discrete Assignment
EE1205 Signals and Systems

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EE23BTECH11044

Question 11.9.5.32: 150 workers were engaged to finish a job in a certain number of days, 4 workers dropped out on second day, 4 more workers dropped out on third day and so on. It took 8 more days to finish the work. Find the number of days in which the work was completed.

Solution: Given that after first day, 4 workers starts leaving each day. This forms an A.P. with

$$x(0) = 150 \tag{1}$$

$$d = -4 \tag{2}$$

$$x(n) = 150 - 4n \tag{3}$$

$$X(z) = \frac{150}{1 - z^{-1}} - \frac{4z^{-1}}{\left(1 - z^{-1}\right)^2} \tag{4}$$

$$y(n) = x(n) * u(n) \tag{5}$$

$$Y(z) = X(z)\,U(z) \tag{6}$$

$$Y(z) = \frac{150}{\left(1 - z^{-1}\right)^2} - \frac{4z^{-1}}{\left(1 - z^{-1}\right)^3} \tag{7}$$

(8)

Using the z transforms given below:

$$(n+1)\,u(n) \overset{z}{\leftrightarrow} \frac{1}{\left(1 - z^{-1}\right)^2} \qquad , |z| > 1 \tag{9}$$

$$n\left((n+1)\,u(n)\right) \overset{z}{\leftrightarrow} \frac{2z^{-1}}{\left(1 - z^{-1}\right)^3} \qquad , |z| > 1 \tag{10}$$

$$\implies y(n) = 150\,(n+1)\,u(n) - 2n\left((n+1)\,u(n)\right) \tag{11}$$

$$y(n) = \left(148n - 2n^2 + 150\right)u(n) \tag{12}$$

Let it take x days for the work to complete when all the workers come to work

$$\implies \text{total number of workers} = 150x \tag{13}$$

And it takes 8 more days to complete when 4 workers leaves each day

$$\implies \text{total number of workers} = y(x+7) \tag{14}$$

$$120x - 2x^2 - 1238 = 150x \tag{15}$$

$$(x - 17)\,(x + 32) = 0 \tag{16}$$

$$x = 17, -32 \tag{17}$$

No. of days cannot be negative $\implies x = 17$
Total no. of days it took to complete work = x+8= 25

Variable	Description
$x(n)$	General term
$y(n)$	sum of n+1 terms
$x(0)$	first term of the A.P
d	common difference

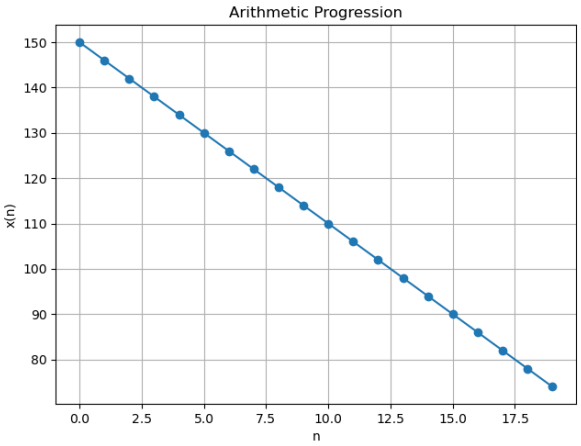

Fig. 0. Plot of x(n) vs n