

Discrete Assignment

EE1205 Signals and Systems

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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:

Variable	values	Description
$x(0)$	150	first term
d	-4	common difference
$x(n)$	$(150 - 4n)u(n)$	General term
$y(n)$	$(148n - 2n^2 + 150)u(n)$	sum of n+1 terms

TABLE 0
INPUT PARAMETERS

Let p be the number of days required to complete the work when all 150 workers work continuously for p days.

$$\Rightarrow \text{total work done} = 150p \quad (1)$$

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

$$x(n) = (150 - 4n)u(n) \quad (2)$$

$$X(z) = \frac{150}{1 - z^{-1}} - \frac{4z^{-1}}{(1 - z^{-1})^2} \quad (3)$$

$$y(n) = x(n) * u(n) \quad (4)$$

$$Y(z) = X(z)U(z) \quad (5)$$

$$Y(z) = \frac{150}{(1 - z^{-1})^2} - \frac{4z^{-1}}{(1 - z^{-1})^3} \quad (6)$$

$$(7)$$

Using the z transforms given below:

$$(n + 1)u(n) \xleftrightarrow{z} \frac{1}{(1 - z^{-1})^2}, |z| > 1 \quad (8)$$

$$n((n + 1)u(n)) \xleftrightarrow{z} \frac{2z^{-1}}{(1 - z^{-1})^3}, |z| > 1 \quad (9)$$

$$\Rightarrow y(n) = 150(n + 1)u(n) - 2n((n + 1)u(n)) \quad (10)$$

$$y(n) = (148n - 2n^2 + 150)u(n) \quad (11)$$

And its given in the question that it takes 8 additional ($p + 8$) days to complete the work when 4 workers start dropping out each day.

$$\Rightarrow \text{total work done} = y(p + 7) \quad (12)$$

Equating eq(1) and eq(12)

$$120p - 2p^2 + 1088 = 150p \quad (13)$$

$$(p - 17)(p + 32) = 0 \quad (14)$$

$$p = 17, -32 \quad (15)$$

No. of days cannot be negative
 $\Rightarrow p = 17$

Total no. of days it took to complete work
 $= p + 8 = 25$

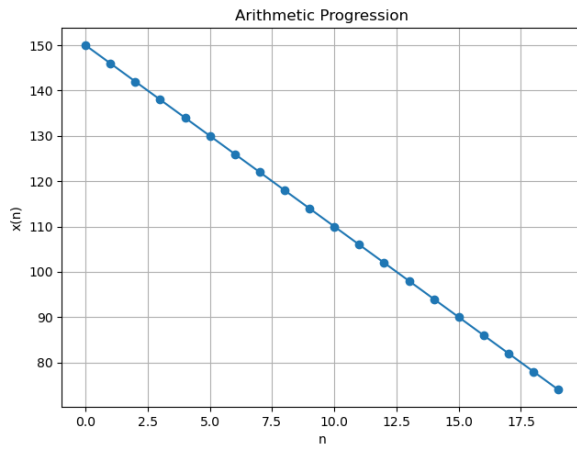


Fig. 0. Plot of $x(n)$ vs n