Discrete Assignment
EE1205 Signals and Systems

Nimal Sreekumar
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:

Variable	values	Description
$x(0)$	150	first term
d	-4	common difference
$x(n)$	$(150-4n)\mathrm{u}(n)$	General term
$y(n)$	$\left(148n-2n^2+150\right)\mathrm{u}(n)$	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.

$$\implies \text{total work done} = 150p \tag{1}$$

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

$$x(n) = (150-4n)\,u(n) \tag{2}$$

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

$$y(n) = x(n) * u(n) \tag{4}$$

$$Y(z) = X(z)\,U(z) \tag{5}$$

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

Using the z transforms given below:

$$(n+1)\,u(n) \overset{z}{\longleftrightarrow} \frac{1}{(1-z^{-1})^2} \qquad ,|z|>1 \tag{7}$$

$$n\left((n+1)\,u(n)\right) \overset{z}{\longleftrightarrow} \frac{2z^{-1}}{(1-z^{-1})^3} \qquad ,|z|>1 \tag{8}$$

$$\implies y(n) = 150\,(n+1)\,u(n) - 2n\left((n+1)\,u(n)\right) \tag{9}$$

$$y(n) = \left(148n-2n^2+150\right)u(n) \tag{10}$$

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.

$$\text{total work done} = y(p+7) \tag{11}$$

Equating eq(1) and eq(11)

$$120p - 2p^2 + 1088 = 150p \tag{12}$$

$$(p-17)(p+32) = 0 \tag{13}$$

$$p = 17, -32 \tag{14}$$

$$\text{No. of days cannot be negative} \implies p = 17 \tag{15}$$

$$\text{Total no. of days to complete work} = p+8 = 25 \tag{16}$$

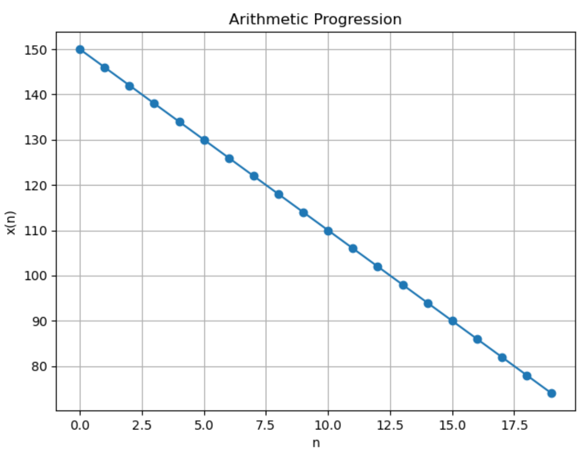

Fig. 0. Plot of x(n) vs n