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**Question 10.5.2-9:** If the 3rd and the 9th terms of an AP are 4 and -8, respectively, which term of this AP is zero?

**Solution:**

TABLE I: Input Parameters

Parameter	Value	Description
$x(n)$	$x(0) + (n)d$	$(n + 1)^{th}$ term of the AP
$x(0) + 2d$	4	Third term of the AP
$x(0) + 8d$	-8	Ninth term of the AP
$x(0)$	-	First term of the AP
$d$	-	Common difference of the AP

$$\begin{pmatrix} x(0) & -x(0) \\ 8d & -2d \\ -8 & -4 \end{pmatrix} = \begin{pmatrix} 0 \\ 6d \\ -12 \end{pmatrix} \quad (1)$$

$$6d = -12 \quad (2)$$

$$\Rightarrow d = -2 \quad (3)$$

Substitute  $d = -2$  into:

$$x(0) = 4 - 2d \quad (4)$$

$$x(0) = 4 - 2(-2) \quad (5)$$

$$x(0) = 8 \quad (6)$$

Substitute  $x(0) = 8$  and  $d = -2$  into:

$$x(n) = x(0) + (n)d = 0 \quad (7)$$

$$8 + (n)(-2) = 0 \quad (8)$$

$$n = 4 \quad (9)$$

Term number =  $n + 1 = 5$

The term where the value is zero in the given arithmetic progression is the 5th term.

1) Finding  $x(n)$

The series is an arithmetic progression.

$$x(n) = (x(0) + n(-2))(u(n)) \quad (10)$$

2) Z-transform of  $x(n)$

$$\frac{x(0)}{1 - z^{-1}} + \frac{dz^{-1}}{(1 - z^{-1})^2} \quad \forall \quad |z| > 1 \quad (11)$$

Using the values from Table I:

$$\frac{8}{1 - z^{-1}} + \frac{-2z^{-1}}{(1 - z^{-1})^2} \quad \forall \quad |z| > 1 \quad (12)$$

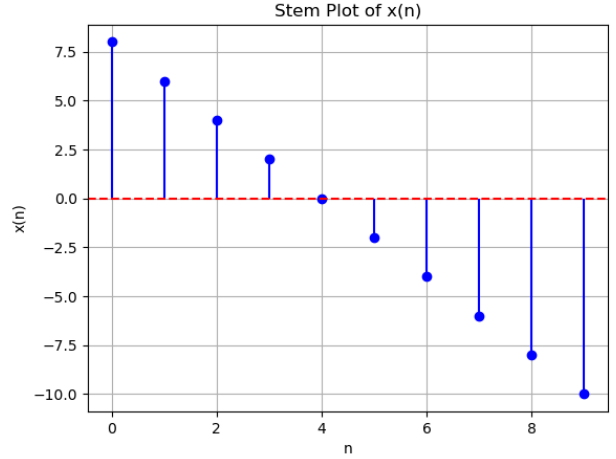


Fig. 1: Plot of  $x(n)$  vs  $n$ ; Refer to Table I for values of  $x(0)$  and  $d$