# IIT HYDERABAD
Arithmetic Progression Problem

Sasa Mardi, EE23BTECH11222

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
$xx(0) + 8d$	-8	Ninth term of the AP
$x(0)$	-	First term of the AP
d	-	Common difference of the AP
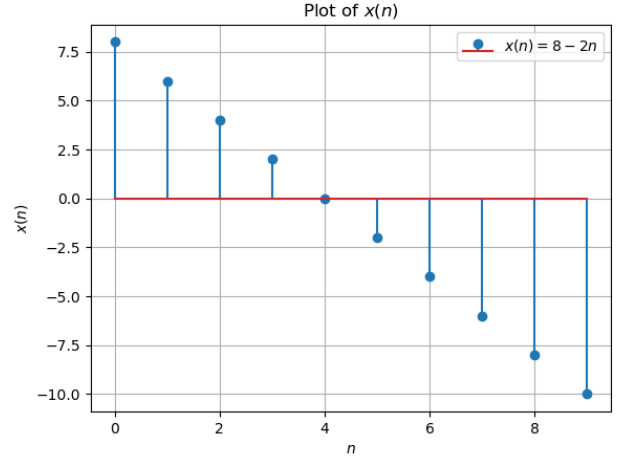
$$\begin{pmatrix} x(0) & -x(0) \\ 8d & -2d \\ -8 & -4 \end{pmatrix} = \begin{pmatrix} 0 \\ 6d \\ -12 \end{pmatrix} \qquad (1)$$

$$6d = -12 \qquad (2)$$
$$d = -2 \qquad (3)$$

Substitute d = -2 into:

$$x(0) = 4 - 2d \qquad (4)$$
$$x(0) = 4 - 2(-2) = 8 \qquad (5)$$

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

$$x(n) = x(0) + (n)d = 0 \qquad (6)$$
$$8 + (n)(-2) = 0 \qquad (7)$$
$$n = 4 \qquad (8)$$

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.

$$x(n) = (x(0) + n(-2))(u(n)) \qquad (9)$$

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

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

$$X(z) = \frac{x(0)(z)}{z - 1} + \frac{dz}{(z - 1)^2} \quad \forall \quad |z| > 1 \qquad (10)$$

Using the values from Table **??**:

$$X(z) = \frac{8z}{z - 1} + \frac{-2z}{(z - 1)^2} \quad \forall \quad |z| > 1 \qquad (11)$$