

GATE 2023-EE Q49

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Question 49: The period of the discrete-time signal $x[n]$ described by the equation below is N = (Round off to the nearest integer).

$$x[n] = 1 + 3 \sin \left(\frac{15\pi}{8}n + \frac{3\pi}{4} \right) - 5 \sin \left(\frac{\pi}{3}n - \frac{\pi}{4} \right)$$

Solution:

Parameter	Value
f_1	15/16
f_2	1/6

TABLE I

GIVEN PARAMETERS LIST

The signal can be expressed as the sum of two sinusoids:

Sinusoid 1: Frequency

$$(f_1) = \frac{15\pi}{8\pi} = \frac{15}{16}$$

Sinusoid 2: Frequency

$$(f_2) = \frac{\pi}{6\pi} = \frac{1}{6}$$

Therefore, the frequency components of $x[n]$ are:

$$f_1 = \frac{15}{16} \quad \text{and} \quad f_2 = \frac{1}{6} \quad (1)$$

$$T_i = \frac{1}{f_i} \quad (2)$$

$$(3)$$

The time period must be an integer for a discrete time signal.

$$T_1 = \frac{1}{f_1} = \frac{16}{15} \quad (4)$$

$$T_2 = \frac{1}{f_2} = 6 \quad (5)$$

$$N = \text{LCM}(T_1, T_2) = 48 \quad (6)$$

$$(7)$$

The Time Period of the signal is

$$N = 48$$