Periodic / Aperiodic

(i) Example for Periodic

$\cos(0.01\pi n)$

Given:

$$x(n) = \cos(0.01\pi n) \dashrightarrow (1)$$

We have the standard equation,

$$x(n) = \cos(\omega n) \dashrightarrow (2)$$

Comparing Equations (1) & (2) we get,

$$\omega = 0.01\pi$$

But $\omega = 2\pi f$

$$\therefore 2\pi f = 0.01\pi$$

$$\therefore f = \frac{0.01\pi}{2\pi} = \frac{0.01}{2}$$

$$\therefore f = \frac{1}{200} \text{ cycles per sample} \rightarrow (3)$$

Since frequency 'f' is expressed as the ratio of 2 integers, the sequence is periodic. Now we have the condition of periodicity,

$$f = \frac{k}{N} \rightarrow (4)$$

Here 'N' indicates, the fundamental period.

Comparing Eq (3) & (4) Fundamental Period $= N = 200$ samples

(ii) Example for Aperiodic

$$x(n) = \cos\left(\frac{n}{8}\right)\cos\left(\frac{\pi n}{8}\right) \quad \text{......} (8)$$

The standard equation can be expressed as,

$$x(n) = \cos \omega_1 n \cos \omega_2 n \quad \text{....} (9)$$

Comparing Eq^n (8) & Eq^n (9) we get

$$\omega_1 = \frac{1}{8} \quad ; \quad \omega_2 = \frac{\pi}{8}$$

But, $\omega = 2\pi f$

$$\therefore \quad 2\pi f_1 = \frac{1}{8} \text{ and } 2\pi f_2 = \frac{\pi}{8}$$

$$\therefore \quad f_1 = \frac{1}{16\pi} \quad ; \quad f_2 = \frac{1}{16}$$

Here, f_1 is ratio of non-integer values. So it is Non periodic. While f_2 is ratio of two integer values. So it is periodic. Bu[t] the total signal is multiplication of non-perio[dic] and periodic signals. So the resultant signal $x(n)$ is non-periodic.