- **Classification of signals**

→ Theoretical Summary:-

1) **Deterministic or Random**:-

Deterministic=predictable; cos(t) || Random like noise in Electrical circuits.

2) **Periodic or Aperiodic**:-

CT → periodic if **"$x(t+T_o) = x(t)$**", where the smallest T_o is called the **Fundamental period** ($T_o=2\pi/w_o$)

→ Trigonometrics ($Cos(w_ot)$, $sin(w_ot)$) are **always** periodic for **any** w_o.

→ Sum of periodic is **not always** periodic; periodic **only if** T_1/T_2 is a **rational** number(1, 1/5 ,etc…)
The new Fundamental period of the sum $T_s = LCM(T_1,T_2)$

DT → periodic if **"x(n+No) = x(n)";** the smallest N_o is called the **Fundamental period** ($N_o=2\pi/w_o$)

→ Trigonometrics ($Cos(w_ot)$, $sin(w_ot)$) are **Not always** periodic;

It's periodic only if [$N = \frac{2\pi .k}{w}$. = Integer] is true for any arbitrary integer k.

→ Sum of periodics is **always** periodic;

The new Fundamental period of the sum $N_s = (N_1*N_2)/gcd(N_1,N_2)$.

3) **Even or Odd:-**

Even if → x(t) = x(-t) or x[n] = x[-n].

Odd if → x(-t) = -x(t) or x[-n] = -x[n].

* any signal can be represented as a sum of an even an odd signal where;

$$x_{even} = \frac{x(t)+x(-t)}{2} \quad || \quad x_{odd} = \frac{x(t)-x(-t)}{2}$$

4) **Energy or power sg.** :-

CT; $E = \lim_{T\to\infty} \int_{-T}^{T} |x(t)|^2\, dt$ DT; $E = \lim_{N\to\infty} \sum_{n=-N}^{N} |x[n]|^2$

for an Energy sg. → $0 < E < \infty$ & $P_{avg} = 0$.

CT; $P_{avg} = \lim_{T\to\infty} \frac{1}{2T} \int_{-T}^{T} |x(t)|^2\, dt$ DT; $P_{avg} = \lim_{N\to\infty} \frac{1}{2N+1} \sum_{n=-N}^{N} |x[n]|^2$

for a power sg. → $0 < P_{avg} < \infty$ & $E = \infty$

* Periodic signals are power signals.

- **Complex Exponentials:-**

In CT; e^{jwot} is periodic for any value of w_o

In DT; e^{jwon} is periodic only if [$N = \frac{2\pi}{wo} K$= integer] exists for any arbitrary integer k.

Euler's formula:- $e^{jwot} = \cos(w_ot) + j \sin(w_ot)$

** magnitude of complex exp → $|e^{jwot}| = 1$

Q1) Classify if periodic and find the fundamental period:-

i) $x(t) = \cos(2.32\pi t)$

ii) $x(t) = [\cos(2t + 2\pi/3)]^2$

iii) $x(t) = \cos(2\pi t) + \sin(0.5\pi t) + \sin(\pi t)$

iv) $x[n] = \cos(2n)$

v) $x[n] = \cos(2\pi n) + \exp(j\pi n)$

Q2) Calculate the Energy and power of the following, and state whether it's power or energy signal:-

i) $x(t) = e^{-2t} u(t)$

ii) $x(t) = A\, e^{j(\omega t+\alpha)}$

iii) $x[n] = (0.5)^n u[n]$

Q3) Determine and sketch the even and odd part of the following signals:-

i) x(t)

ii) $x_2(t)$

iii) y[n] = u[n] - u[-n-1]