

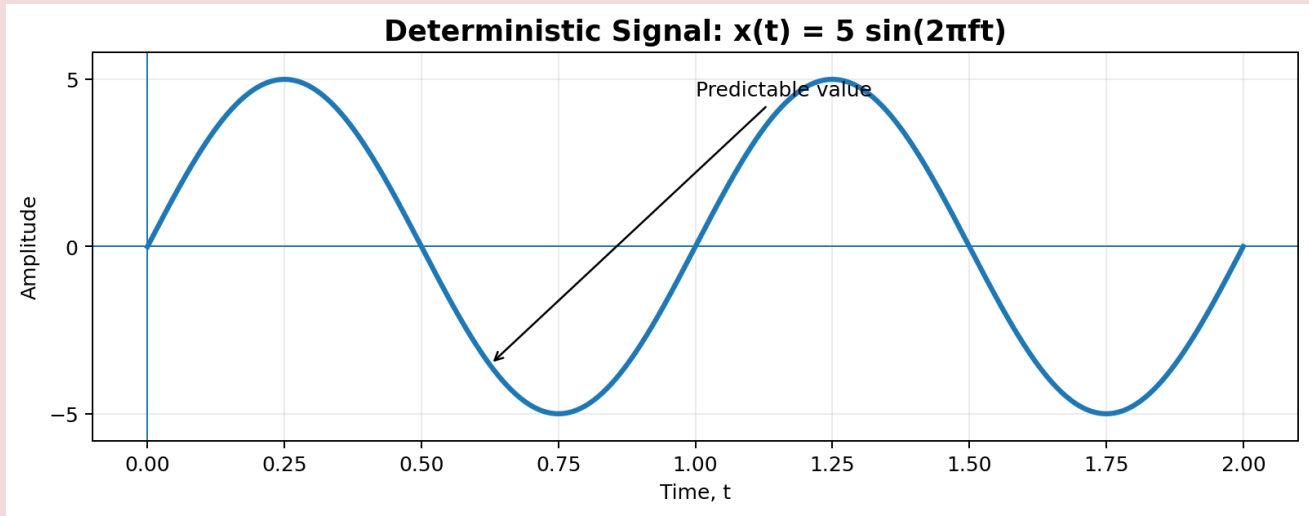
DETERMINISTIC AND RANDOM SIGNALS

Quick Notes – Signals and Systems

1. Deterministic Signal

A deterministic signal is a signal whose value can be predicted exactly at any given instant of time. It has no uncertainty about its behaviour and can usually be described by a mathematical equation.

Example: $x(t) = A \cos(\omega t)$



Important points:

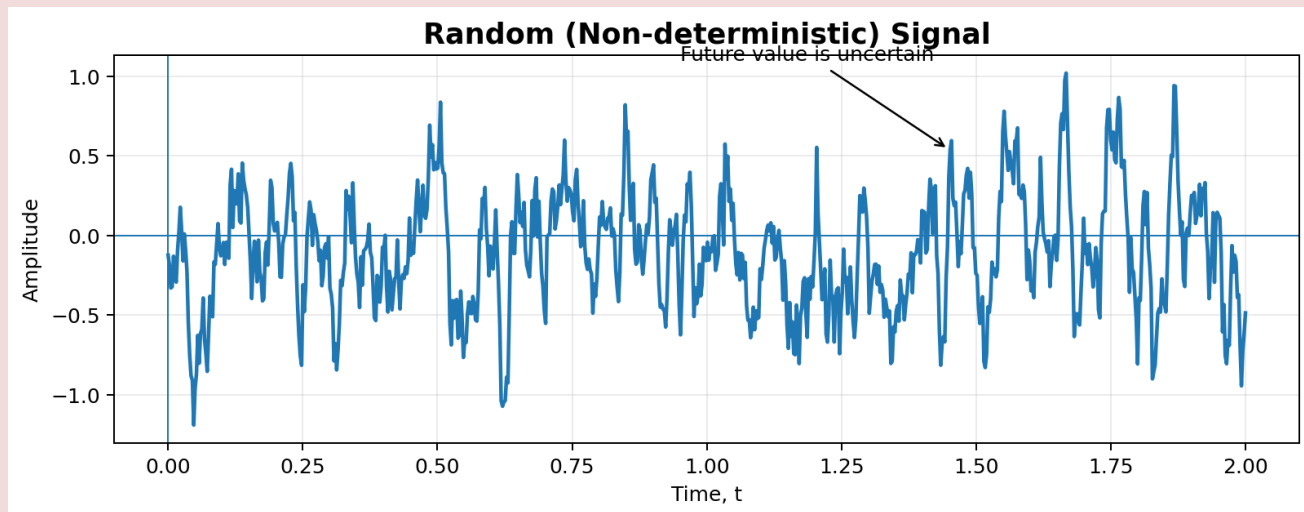
- The signal value is predictable at any time.
- Its behaviour follows a known pattern.
- It can be represented mathematically.
- For $x(t) = 5 \sin(2\pi ft)$, the amplitude is 5 and the period is $T = 1/f$.

2. Uses and Applications of Deterministic Signals

- Communication systems
- Signal generation
- Control systems
- Measurement and instrumentation
- Audio and video processing

3. Random (Non-deterministic) Signal

A random or non-deterministic signal is a signal whose future behaviour cannot be predicted with complete certainty. Its pattern is generally irregular, and there is some uncertainty about its value at a given instant.



Examples:

- Noise generated in the amplifier of a radio receiver.
- ECG (electrocardiogram) signal.
- Speech signal.

Key point: A random signal has some degree of uncertainty about its value at a particular instant.

4. Deterministic vs Random Signals

Feature	Deterministic Signal	Random Signal
Predictability	Can be predicted exactly	Cannot be predicted exactly
Uncertainty	No uncertainty	Some uncertainty
Pattern	Known / regular	Usually irregular
Description	Mathematical equation	Probability / statistical properties
Examples	$A \cos(\omega t)$, sine wave	Noise, speech, ECG
Other name	Predictable signal	Non-deterministic signal

5. Quick Revision

Deterministic = Predictable

Random = Uncertain

In simple words: if the signal value can be determined exactly from a known rule, it is deterministic. If the exact future value cannot be known in advance, it is random (non-deterministic).

