Digital Signal Processing

1. Define the following:

   a. DSP

   b. Signals

   c. Systems

   d. Processing

2. Give four different types of signals , its analysis tool and one example for each.

3. Outline the advantages and limitations of DSP.

4. Draw the schematic diagram of basic elements of DSP with their functions.

5. Define discrete time signal.

A discrete time signal x (n) is a function of an independent variable that is an integer. A
discrete time signal is not defined at instant between two successive samples.

6. Define discrete time system.

A discrete or an algorithm that performs some prescribed operation on a discrete time signal
is called discrete time system.

7. What are the elementary discrete time signals?

- Unit sample sequence (unit impulse)
  $\delta(n) = 1$ when $n=0$
  $= 0$ otherwise
- Unit step signal
  $U(n) = 1$ when $n>=0$
  $= 0$ otherwise
- Unit ramp signal
  $Ur(n) = n$ when $n>=0$
  $= 0$ otherwise
- Exponential signal
  $x(n)=a^n$ where a is real
  x(n)-Real signal

8. State the classification of discrete time signals.

The types of discrete time signals are

- Energy and power signals
- Periodic and Aperiodic signals

• Symmetric(even) and Antisymmetric (odd) signals

9. Define energy and power signal.

$$E = \sum_{n=-\infty}^{\infty} |x(n)|^2$$

If E is finite i.e. $0<E<\infty$, then x (n) is called energy signal.

If P is finite in the expression $P = \lim_{N\to\infty} (1/2N+1)\, EN$, the signal is called a power signal.

10. Define periodic and aperiodic signal.

A signal x (n) is periodic in period N, if x (n+N) =x (n) for all n. If a signal does not satisfy this equation, the signal is called aperiodic signal.

7. Define symmetric and antisymmetric signal.

A real value signal x (n) is called symmetric (even) if x (-n) = x (n). On the other hand the signal is called antisymmetric (odd) if x (-n) = - x (n)

11. State the classification of systems.

- Static and dynamic system.
- Time invariant and time variant system.
- Causal and anticausal system.
- Linear and Non-linear system.
- Stable and Unstable system.

12. Define dynamic and static system.

A discrete time system is called static or memory less if its output at any instant n depends

almost on the input sample at the same time but not on past and future samples of the input.

e.g. $y(n) = a\, x(n)$

In any other case the system is said to be dynamic and to have memory.

e.g. $(n) = x(n)+3\, x(n-1)$

13. Define time variant and time invariant system.

A system is called time invariant if its output, input characteristics does not change with time.

e.g. $y(n) = x(n)+x(n-1)$

A system is called time variant if its input, output characteristics changes with time.

e.g. $y(n) = x(-n)$.

14. Define linear and non-linear system.

Linear system is one which satisfies superposition principle.

Superposition principle:

The response of a system to a weighted sum of signals be equal to the corresponding

weighted sum of responses of system to each of individual input signal.

i.e., $T [a_1x_1(n)+a_2x_2(n)]=a_1T[x_1(n)]+a_2\, T[x_2(n)]$

e.g. $y(n) = nx(n)$

A system which does not satisfy superposition principle is known as non-linear system.

e.g. $y(n) = x_2(n)$

15. Define causal and anticausal system.

The system is said to be causal if the output of the system at any time 'n' depends only on

present and past inputs but does not depend on the future inputs.

e.g. $y (n) = x(n) - x(n-1)$

A system is said to be non-causal if a system does not satisfy the above definition.

16. Define stable and unable system.

A system is said to be stable if we get bounded output for bounded input.

17. What are the steps involved in calculating convolution sum?

The steps involved in calculating sum are

- Folding
- Shifting
- Multiplication
- Summation

18. Define causal LTI system.

The LTI system is said to be causal if

$h(n) = 0$ for $n < 0$.

19. Define stable LTI system.

The LTI system is said to be stable if its impulse response is absolutely summable.

i.e. $\left|y(n)\right| = \sum_{k=-\infty}^{\infty} \left|h(k)\right| < \infty$

20.what are the properties of convolution sum

The properties of convolution sum are

- Commutative property.
- Associative law.
- Distributive law.

21.State associative law

The associative law can be expressed as

$[x(n)*h_1(n)]*h_2(n)=x(n)[h_1(n)*h_2(n)]$

Where x(n) is input

$h_1(n)$ & $h_2(n)$ are impulse responses.

22.State commutative law

The commutative law can be expressed as

$x(n)*h(n)=h(n)*x(n)$

23. State distributive law

The distributive law can be expressed as

$x(n)*[h_1(n)+h_2(n)]=x(n)*h_1(n)+x(n)*h_2(n)$