TYBSc: EL 355: Paper V: Signals and Systems

Question Bank on

UNIT 1: Fundamentals of Electronic Signals

UNIT 2: Types of Systems

1. Define Signal.

A signal is a function of one or more independent variables which contain some information. Eg: Radio signal, TV signal, Telephone signal etc.

2. Define System.

A system is a set of elements or functional block that are connected together and produces an output in response to an input signal.

Eg: An audio amplifier, attenuator, TV set etc.

3. Define CT signals.

Continuous time signals are defined for all values of time. It is also called as an analog signal and is represented by x(t).

Eg: AC waveform, ECG etc.

4. Define DT signal.

Discrete time signals are defined at discrete instances of time. It is represented by x(n). Eg: Amount deposited in a bank per month.

5. Give few examples for CT signals.

AC waveform, ECG, Temperature recorded over an interval of time etc.

6. Give few examples of DT signals.

Amount deposited in a bank per month,

7. Define unit step, ramp and delta functions for CT.

Unit step function is defined as

$U(t) = 1$ for $t >= 0$

0 otherwise

Unit ramp function is defined as

$r(t) = t$ for $t>=0$

0 for $t<0$

Unit delta function is defined as

$\delta(t)= 1$ for $t=0$

8. State the relation between step, ramp and delta functions (CT).

The relationship between unit step and unit delta function is

$\delta(t) = u(t)$

The relationship between delta and unit ramp function is

$\delta(t).\ dt = r(t)$

9. State the classification of CT signals.

The CT signals are classified as follows

- Periodic and non-periodic signals
- Even and odd signals
- Energy and power signals
- Deterministic and random signals.

10. Define deterministic and random signals.

A deterministic signal is one which can be completely represented by mathematical equation at any time. In a deterministic signal there is no uncertainty with respect to its value at any time.

Eg: $x(t)=\cos wt$

$x(n)=2wft$

A random signal is one which cannot be represented by any mathematical equation. Eg: Noise generated in electronic components, transmission channels, cables etc.

11. Define Random signal.

There is no uncertainty about the deterministic signal. It is completely represented by mathematical expression.

12. Define power and energy signals.

The signal x(t) is said to be power signal, if and only if the normalized average power p is finite and non-zero.

ie. $0<p<4$

A signal x(t) is said to be energy signal if and only if the total normalized energy is finite and non-zero.

ie. $0<E< 4$

13. Compare power and energy signals.

POWER SIGNAL

1. The normalized average power is finite and non-zero
2. Practical periodic signals are power signals

ENERGY SIGNALS

1. Total normalized energy is finite and non- zero.
2. Non-periodic signals are energy signals

14. Define odd and even signal.

A DT signal x(n) is said to be an even signal if x(-n) =x(n) and an odd signal if x(-n) =-x(n).

A CT signal is x(t) is said to be an even signal if x(t)=x(-t) and an odd signal if x(-t) =-x(t).

15. Define periodic and aperiodic signals.

- A signal is said to be periodic signal if it repeats at equal intervals.
- Aperiodic signals do not repeat at regular intervals.
- A CT signal which satisfies the equation $x(t) = x(t+T0)$ is said to be periodic and a DT signal which satisfies the equation $x(n) = x(n+N)$ is said to be periodic.

16. State the classification or characteristics of CT and DT systems.

The DT and CT systems are according to their characteristics as follows

(i). Linear and Non-Linear systems

(ii). Time invariant and Time varying systems.

(iii). Causal and non-causal systems.

(iv). Stable and unstable systems.

(v). Static and dynamic systems.

(vi). Inverse systems.

17. Define linear and non-linear systems.

A system is said to be linear if superposition theorem applies to that system. If it does not satisfy the superposition theorem, then it is said to be a nonlinear system.

18. What are the properties linear system should satisfy?

A linear system should follow superposition principle. A linear system should satisfy,

$f [a_1 x_1(t) + a_2 x_2 (t)] = a_1 y_1(t) + a_2 y_2 (t)$

where $y_1(t) = f [x_1(t)]$

$y_2(t) = f[x_2(t)]$

19. What is the criterion for the system to possess BIBO (Bounded Input, Bounded Output) stability?

A system is said to be BIBO stable if it produces bounded output for every bounded input.

20. Define shift invariance.

If the system produces same shift in the output as that of input, then it is called shift invariance or time invariance system. i.e.,

$f[x(t - t_1)] = y(t - t_1)$

21. Define Causal and non-Causal systems.

A system is said to be a causal if its output at anytime depends upon present and past inputs only. A system is said to be non-causal system if its output depends upon future inputs also.

22. Define time invariant and time varying systems.

A system is time invariant if the time shift in the input signal results in corresponding time shift in the output. A system which does not satisfy the above condition is time variant system.

23. Define stable and unstable systems.

When the system produces bounded output for bounded input, then the system is called bounded input, bounded output stable. A system which does not satisfy the above condition is called a unstable system.

24. Define Static and Dynamic system.

A system is said to be static or memory less if its output depends upon the present input only. The system is said to be dynamic with memory if its output depends upon the present and past input values.

25. Check causality of the system given by, $y(n) = x(n-n_o)$

If $n_o \geq 0$, then output y(n) depends upon present or past input. Hence the system is causal. If $n_o < 0$, the system become noncausal.

26. Check whether the given system is causal and stable.

$y(n) = 3x(n-2) + 3x(n+2)$

Since y (n) depends upon x(n+2), this system is noncausal. As long as x (n – 2) and x (n + 2) are bounded, the output y(n) will be bounded. Hence this system is stable.

27. When the discrete signal is said to be even?

A discrete time signal is said to be even when, $x(-n) = x(n)$.

For example, cos(ωn) is an even signal.

28. Is diode a linear device? Give your reason.

Diode is nonlinear device since it operates only when forward biased. For negative bias, diode does not conduct.

29. Define power signal.

A signal is said to be power signal if its normalized power is nonzero and finite. i.e., $0 < P < \infty$

30. Define signal. What are classifications of signals?

A function of one or more independent variables which contain some information is called signal.

31. Is the system $y(t) = y(t-1) + 2t\, y(t-2)$ time invariant?

Here $y(t-t1) = y(t-1-t1) + 2t\, y(t-2-t1)$ and

$y(t\ t1) = y(t-t1-1) + 2(t-t1)\, y(t-t1-2)$.

Here $y(t-t1) \neq y(t\ t1)$. This is time variant system.

32. Check Whether the given system is causal and stable. y (n) = 3 x (n - 2) + 3 x (n + 2)

Since y (n) depends upon x(n+2), this system is noncausal. As long as x (n – 2) and x (n + 2) are bounded, the output y(n) will be bounded. Hence this system is stable.

33.What is meant by a band limited signal?

A band limited signal is a signal x(t) for which the Fourier transform of x(t) is Zero above certain frequency ω_m.

$x(t) <--> X(j\omega) = 0$ for $|\omega| > \omega_m = 2\pi f_m$

34. Define two-sided sequence (or) signal.

A signal that has finite duration on both left and right sides is known as Two-sided sequence.

$$X(z) = \sum_{n=-\infty}^{\infty} x(n) z^{-n}$$

For such a type of sequences the ROC is entire z-plane except at z=0 and z=∞.

Example: x(n) = {2,-1,3,2,1,0,2,3,-1}

35. Explain Elementary signals.

1.3 ELEMENTARY SIGNALS

There are several elementary signals which play vital role in the study of signals and systems. These elementary signals serve as basic building blocks for the construction of more complex signals. Infact, these elementary signals may be used to model a large number of physical signals which occur in nature. These elementary signals are also called standard signals.

The standard signals are:

1. Unit step function
2. Unit ramp function
3. Unit parabolic function
4. Unit impulse function
5. Sinusoidal function
6. Real exponential function

36. Explain Unit step signal.

37. Explain Unit ramp signal.

38. Explain Unit impulse signal.

39. Explain exponential and sinusoidal signals.