SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35

DEPARTMENT OF ECE

23ECT202 – SIGNALS AND SYSTEMS

2 MARK QUESTIONS AND ANSWERS

1. Define Signal.

Signal is a physical quantity that varies with respect to time, space or any other independent variable Or It is a mathematical representation of the system
Eg. y (t) = t. and x(t)= sin t.

2. Define system.

A set of components that are connected together to perform the particular task.

3. What are the major classifications of the signal?

(i) Discrete time signal
(ii) Continuous time signal

4. Define discrete time signals and classify them.

Discrete time signals are defined only at discrete times, and for these signals, the independent variable takes on only a discrete set of values.
Classification of discrete time signal:
1.Periodic and Aperiodic signal
2.Even and Odd signal

5. Define continuous time signals and classify them.

Continuous time signals are defined for a continuous of values of the independent variable. In the case of continuous time signals the independent variable is continuous.
For example:
(i) A speech signal as a function of time
(ii) Atmospheric pressure as a function of altitude
Classification of continuous time signal:
(i) Periodic and Aperiodic signal
(ii) Even and Odd signal

6. Define discrete time unit step &unit impulse.

Discrete time Unit impulse is defined as

$\delta[n] = \{0, n \neq 0$

$\{1, n=0$

Unit impulse is also known as unit sample.

Discrete time unit step signal is defined by

$U[n] = \{0, n<0$

$\{1, n>= 0$

7. Define continuous time unit step and unit impulse.

Continuous time unit impulse is defined as

$\delta(t) = \{1, t=0$

$\{0, t \neq 0$

Continuous time Unit step signal is defined as

$U(t) = \{0, t<0$

$\{1, t >=0$

8. Define unit ramp signal.

Continuous time unit ramp function is defined by

$r(t) = \{0, t<0$

$\{t, t >=0$

A ramp signal starts at t=0 and increases linearly with time't'.

9. Define periodic signal. And no periodic signal.

A signal is said to be periodic, if it exhibits periodicity. i.e.,$X(t+T)=x(t)$, for all values of t.

Periodic signal has the property that it is unchanged by a time shift of T.

A signal that does not satisfy the above periodicity property is called an aperiodic signal.

10. Define even and odd signal?

A discrete time signal is said to be even when $x[-n] =x[n]$.

The continuous time signal is said to be even when $x(-t) = x(t)$

For example, Cos (n) is an even signal.

The discrete time signal is said to be odd when $x[-n] = -x[n]$

The continuous time signal is said to be odd when $x(-t)= -x(t)$

Odd signals are also known as nonsymmetrical signal.

Sine wave signal is an odd signal.

11. Define Energy and power signal.

A signal is said to be energy signal if it have finite energy and zero power.
A signal is said to be power signal if it have infinite energy and finite power.
If the above two conditions are not satisfied then the signal is said to be neither energy nor power signal

12. Define unit pulse function.

Unit pulse function (t) is obtained from unit step signals
u(t)=u(t+1/2)- u(t-1/2)
The signals u(t+1/2) and u(t-1/2) are the unit step signals shifted by 1/2units in the time axis towards the left and right ,respectively.

13. Define continuous time complex exponential signal.

The continuous time complex exponential signal is of the form x (t) =C e^{at}, where c and a are complex numbers.

14. What is continuous time real exponential signal?

Continuous time real exponential signal is defined by x (t) =C e^{at}, where c and a are complex numbers. If c and a are real, then it is called as real exponential.

15. What is continuous time growing exponential signal?

Continuous time growing exponential signal is defined as x (t) =Ce^{at} where c and a are complex numbers. If a is positive, as t increases, then x (t) is a growing exponential.

16. What is continuous time decaying exponential?

Continuous time growing exponential signal is defined as x (t) =Ce^{at}, where c and a are complex numbers. If a is negative, as t increases, then x(t) is a decaying exponential.

17. What are the types of Fourier series?

1. Exponential Fourier series
2. Trigonometric Fourier series

18. Write down the exponential form of the Fourier series representation of a periodic signal?

$X(t) = a_k e^{j(kot),}$Here the summation is taken from - ∞to∞ .
a_k=1/T x(t) e^{-jko} t, Here the integration is taken from 0 to T.
The set of coefficients { a_k} are often called the Fourier series coefficients or spectral coefficients.
The coefficient a_o is the dc or constant component of x (t).

19. Write down the trigonometric form of the Fourier series representation of aperiodic signal?

$x(t)= a_o+ [a_n \cos n\ _o t + b_n \sin n\ _o t]$

where $a_o=1/T \int x(t)\, dt$, $a_n =1/T \int x(t)\cos(n_o t)dt$, $b_n=1/T \int x(t)\cos (n_o t)dt$

20. Write short notes on dirichlet conditions for Fourier series.

a. x(t) must be absolutely integrable

b. The function x(t) should be single valued within the interval T.

c. The function x(t) should have finite number of discontinuities in any finite interval of time T.

d. The function x(t) should have finite number of maxima &minima in the interval T.

21. State Time shifting property in relation to Fourier series.

$x(t-to)$ FS $a_k\, e^{-j\,(kot)}$

Time shifting property states that; when a periodic signal is shifted in time, the magnitudes of its Fourier series coefficients, remain unaltered.

22. State parseval's theorem for continuous time periodic signals.

Parseval's relation for continuous time periodic signals is

$1/T \int x(t)^2 dt = ak^2$

Parseval's relation states that the total average power in a periodic signal equals the sum of the average power in all of its harmonic components.

23. Define continuous time system.

A continuous time system is a system in which continuous time input signals are applied and result in continuous time output signals.

24. Define Fourier transform pair.

Consider the aperiodic signal x(t) &Fourier transform of x(t) is defined as

$X(j\ ) = \int x(t)\, e^{-jt}\, dt$ ----------(1)

Inverse Fourier transform of x(t) is given by

$x(t) =1/2 \int X(j\ )\, e^{jt}\, dj$ ------(2)

Equations (1)& (2) are referred to as the Fourier transform pair.

25. Write short notes on dirichlets conditions for Fourier transform.

a. x(t) be absolutely integrable

b. x(t) have a finite number of maxima and minima within any finite interval.

c. x(t) have a finite number of discontinuities within any finite interval.

Furthermore each of these discontinuities must be finite.

26. Explain how aperiodic signals can be represented by Fourier transform.

Consider the aperiodic signal x(t) &Fourier transform of x(t) is defined as

$X(j\ ) = x(t)\ e^{-jt}\ dt$ ----------(1)

Inverse fourier transform of x(t) is given by

$x(t) = 1/2X(j\ )\ e^{jt}\ dj$ ------(2)

27. State convolution property in relation to Fourier transform.

$Y(t) = x(t)*h(t)$

$Y(j\ ) = H(j\ )X(j\ )$

Convolution property states that convolution in time domain corresponds to multiplication in the frequency domain.

28. State parseval's relation for continuous time Fourier transforms.

If x(t) and X(j) are a Fourier transform pair then

$x(t)2\ dt = 1/2\ i\ |X(j\ )|2\ dj$

29. Define a causal system.

The causal system generates the output depending upon present &past inputs only. A causal system is non anticipatory.

30. What is meant by linear system?

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

$F[ax_1(t)+bx_2(t)]\ a\ y_1(t)+by_2(t)$

$y_1(t)=F[x_1(t)]$

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

31. Define time invariant system.

A system is time invariant if the behavior and characteristics of the system are fixed over time.

A system is time invariant if a time shift in the input signal results in an identical time shift in the output signal.

For example, a time invariant system should produce y(t-t0)as the output when x(t-to) is the input.

32. Define stable system?

When the system produces bounded output for bounded input, then the system is called bounded input& bounded output stable. If the signal is bounded, then its magnitude will always be finite.

33. Define memory and memory less system.

The output of a memory system at any specified time depends on the inputs at that specified time and at other times. Such systems have memory or energy storage elements. The system is said to be static or memoryless if its output depends upon the present input only.

34 .Define invertible system.

A system is said to be invertible if the input is get from the output input. Otherwise the system is noninvertible system.

35 .What is superposition property?

If an input consists of the weighted sum of several signals, then the output is the superposition that is, the weighted sum of the responses of the system to each of those signals

36. Why CT signals are represented by samples?

• A CT signal cannot be processed in the digital processor or computer.
• To enable the digital transmission of CT signals.

37. What is meant by sampling?

A sampling is a process by which a CT signal is converted into a sequence of discrete samples with each sample representing the amplitude of the signal at the particular instant of time.

38. State Sampling theorem.

A band limited signal of finite energy, which has no frequency components higher than the W hertz, is completely described by specifying the values of the signal at the instant of time separated by 1/2W seconds and A band limited signal of finite energy, which has no frequency components higher than the W hertz, is completely recovered from the knowledge of its samples taken at the rate of 2W samples per second.

39. What is meant by aliasing?

When the high frequency interferes with low frequency and appears as low then the phenomenon is called aliasing.

40. What are the effects aliasing?

Since the high frequency interferes with low frequency then the distortion is generated. The data is lost and it cannot be recovered.

41. How the aliasing process is eliminated.

i). Sampling rate fs 2W.

ii). Strictly band limit the signal to 'W'.

This can be obtained by using the Low pass filer before the sampling process. It is also called as antialiasing filter.

42. .Define Nyquist rate and Nyquist interval.

When the sampling rate becomes exactly equal to '2W' samples/sec, for a given bandwidth of W hertz, then it is called Nyquist rate. Nyquist interval is the time interval between any two adjacent samples.

Nyquist rate = 2W Hz

Nyquist interval = 1/2W seconds.

43. Define sampling of band pass signals.

A bandpass signal x(t) whose maximum bandwidth is '2W' can be completely represented into and recovered from its samples, if it is sampled at the minimum rate of twice the band width.

44. Define Z transform.

The Z transform of a discrete time signal x[n] is denoted by X(z) and it is given as $X(z)= x[n]\ z^{-n}$.and the value n range from - to + . Here 'z' is the complex variable. This Z transform is also called as bilateral or two sided Z transform.

45. What are the two types of Z transform?

(i) Unilateral Z transform

(ii) Bilateral Z transform

46. Define unilateral Z transform.

The unilateral Z transform of signal x[n] is given as

$X(z)= x[n]\ z^{-n}$

The unilateral and bilateral Z transforms are same for causal signals.

47. What is region of Convergence?

The region of convergence or ROC is specified for Z transform, where it converges.

48. What are the Properties of ROC?

i. The ROC of a finite duration sequence includes the entire z- plane, except z= 0.

ii. ROC does not contain any poles.

iii. ROC is the ring in the z-plane centered about origin.

iv. ROC of causal sequence (right handed sequence) is of the form $|z| > r$.

v. ROC of left handed sequence is of the form |z| < r.
vi. ROC of two sided sequence is the concentric ring in the z plane.

49. What is the time shifting property of Z transform?
x[n] X(Z) then x[n-k] Z^{-k} X[Z].

50. What is the differentiation property in Z domain?
x[n] X(Z) then nx[n] $^{-z}$ d/dz{X[Z].}.

51. State convolution property of Z transform.
The convolution property states that if
x1[n]➔ X1(Z) and
x2[n]➔ X2(Z) then
x1[n] *x2[n] ➔X1(Z) X2(Z)
That is convolution of two sequences in time domain is equivalent to multiplication of their Z transforms.

52. State the methods to find inverse Z transform.
a. Partial fraction expansion
b. Contour integration
c. Power series expansion
d. Convolution method.

53. State multiplication property in relation to Z transform.
This property states that if ,
x1[n]➔ X1(Z) and
x2[n] ➔X2(Z) then
x1[n] x2[n] ½➔j(X1(v). X2(Z/v)v^{-1})dv
Here c is a closed contour .It encloses the origin and lies in the Roc which is common to both X1(v). X2(1/v)

54. State parseval's relation for Z transform.
If x1[n] and x2[n] are complex valued sequences, then the parseval's relation states that
$x_1[n]\ x_2^*[n]$= ½[j $X_1(v).\ X_2^*(1/v^*)v^{-1}dv$.

55. What is the relationship between Z transform and Fourier transform.
$X(z)= x[n]\ z^{-n}$.----------1.
$X(w)= x[n]e^{-jn}$. ----------2
When z- transform is evaluated on unit circle (ie.| z |= 1) then it becomes fourier transform.

56. What is meant by step response of the DT system.

The output of the system y(n) is obtained for the unit step input u(n) then it is said to be step response of the system.

57. Define Transfer function of the DT system.

The Transfer function of DT system is defined as the ratio of Z transform of the system output to the input. That is H (z) =Y (z)/X (z),

58. Define impulse response of a DT system.

The impulse response is the output produced by DT system when unit impulse is applied at the input. The impulse response is denoted by h(n).The impulse response h(n) is obtained by taking inverse Z transform from the transfer function H(z).

59. State the significance of difference equations.

The input and output behaviour of the DT system can be characterized with the help of linear constant coefficient difference equations.

60. Write the difference equation for discrete time system.

The general form of constant coefficient difference equation is

$Y(n) = - a_k\, y(n-k) + b_k\, x(n-k)$

Here n is the order of difference equation. x(n) is the input and y(n) is the output.

61. Define frequency response of the DT system.

The frequency response of the system is obtained from the Transfer function by replacing

$z = e^{j}$;I.e., H(z)=Y(z)/X(z), Where $z = e^{j}$

62. What is the condition for stable system.

A LTI system is stable if h(n) <0 .Here the summation is absolutely summable

63. What are the properties of convolution?

i. Commutative
ii. Associative.
iii. Distributive

64. State the Commutative properties of convolution?

Commutative property of Convolution is

x(t)*h(t)=h(t)*x(t)

65. State the Associative properties of convolution

Associative Property of convolution is [x(t)*h1(t)]*h2(t)=x(t)*[h1(t)*h2(t)]

66.State Distributive properties of convolution

The Distributive Property of convolution is {x(t)*[h1(t)+ h2(t)]}= x(t)*h1(t) + x(t)*h2(t)]

67. Define causal system.

For a LTI system to be causal if h(n)=0,for n<0.

68. What is the impulse response of the system y(t)=x(t-t0).

Answer: h(t)= (t-t0)

69. What is the condition for causality if H(z) is given.

A discrete LTI system with rational system function H(z) is causal if and only if

i. The ROC is the exterior of the circle outside the outermost pole.

ii. When H(z) is expressed as a ratio of polynomials in z , the order of the numerator cannot be greater than the order of the denominator.

70. What is the condition for stability if H(z) is given.

A discrete LTI system with rational system function H(z) is stable if and only if all of the poles H(z) lies inside the unit circle. That is they must all have magnitude smaller than 1.

71. Check whether the system is causal or not the H(z) is given by (z3 + z)/(z+1).

The system is not causal because the order of the numerator is greater than denominator.

72. Check whether the system is stable or not, the H(z) is given by (z/z-a).,|a|<1.

The system is stable because the poles at z = a lies inside the unit circle.

73. Determine the transfer function for the system described by the difference equation y(n)- y(n-1) = x(n)- x(n-2).

By taking z transform on both sides the transfer function H(z)=(z2 - 1)/(z2 - z).

74. How the discrete time system is represented.

The DT system is represented either Block diagram representation or difference equation representation.

75. What are the classifications of the system based on unit sample response?

a. FIR (Finite impulse Response) system.

b. IIR(Infinite Impulse Response) system

76. What is meant by FIR system?

If the system have finite duration impulse response then the system is said to be FIR system.

77. What is meant by IIR system?

If the system have infinite duration impulse response then the system is said to be FIR system.

78. What is recursive system?

If the present output is dependent upon the present and past value of input then the system is said to be recursive system

79. What is Non recursive system?

If the present output is dependent upon the present and past value of input and past value of output then the system is said to be non recursive system.

80. What is natural response?

This is output produced by the system only due to initial conditions .Input is zero for natural response. Hence it is also called zero input Response.

81. What is zero input Response?

This is output produced by the system only due to initial conditions .Input is zero for zero input response.

82. What is forced response?

This is the output produced by the system only due to input. Initial conditions are considered zero for forced response.It is denoted by y(f)(t).

83. What is complete response?

The complete response of the system is equal to the sum of natural response and forced response. Thus initial conditions as well as input both are considered for complete response.