QUESTION BANK

Baba Banda Singh Bahadur Engineering College, Fatehgarh Sahib Department of Electronics and Communication Engineering OUESTION BANK (DESCRIPTIVE)

Subject: SIGNALS AND SYSTEMS

Course & Branch: B.Tech - ECE

<u>UNIT –I</u>

INTRODUCTION TO SIGNALS AND SYSTEMS SHORT ANSWER OUESTIONS (2 MARKS)

1. Define a Signal. What is the relation between impulse, step, ramp and parabolic signals?

2. How are the signals are classified?

3. Define Unit impulse and Unit step Signals.

4. Distinguish between periodic and non-periodic signals

5. Distinguish causal and anti-causal signals.

6. Define Linear and Non-Linear System

7. Define time-variant and time-invariant systems.

8. How are systems classified?

9.Define stable and unstable systems.

10.Define causal and non-causal systems.

LONG ANSWER OUESTIONS (10 MARKS)

1. Define various elementary signals in continuous time and discrete time and indicate them Graphically?

2. What are the basic operations on signals? Illustrate with an example.

3.Explain the classification of signals in both continuous time and discrete time with suitable examples.

4.(a) Find which of the signals are causal or non-causal.

(i) $x(t) = e^{2t} u(t-1)$ (ii) $x(t) = 3 \operatorname{sinc} 2t$ (iii) x(n) = u(n+4) - u(n-2) (iv) x(t) = u(-n)

(b) Sketch the following signals

(i) 2 u(t+2)- 2 u(t-3) (ii) u(t+4) u(-t+4) (iii) r(t)-r(t-1)-r(t-3)-r(t-4) (iv) $\pi(t-2)$

5. Find whether the following signals are periodic or not? If periodic determine the fundamental Period

(a) $\sin 12\pi t$ (b) $3\sin 200\pi t + 4\cos 100t$ (c) $\sin 10\pi t + \cos 20\pi t$

(d)sin (10t+1)- 2cos (5t-2) (e) $e^{j4\pi t}$

6.(a) Find the even and odd components of the following signals

(i) $x(t) = e^{j2t}$ (ii) $x(t) = (1+t^2+t^3) \cos^2 10t$ (iii) $x(n) = \{-3, 1, 2, -4, 2\}$ (iv) $x(n) = \{5, 4, 3, 2, 1\}$

(b)Determine whether the following signals are energy signals or power signals. Calculate their energy or power?

(i)
$$x(t) = \frac{8\cos 4t \cos 6t}{100}$$
 (ii) $\sin^2 \omega_0 t$ (iii) $x(t) = e^{j[3t+(\pi/2)]}$ (iv) $x(n) = (1/2)^n u(n)$

7.Define a system. How are systems classified? Define each one of them.

8. Check whether the following system is

- (a) static or dynamic
- (b) linear or non-linear (c) causal or non- causal (d) Time invariant or time variant

(i) $d^{3}y(t)/dt^{3}+2d^{2}y(t)/dt^{2}+4 dy(t)/dt+3y^{2}(t)=x(t+1)$ (ii) $d^2y(t)/dt^2+2y(t) dy(t)/dt+3ty(t)=x(t)$

9.(a) Check whether the following systems are causal or not?

(i) $y(t)=x^{2}(t)+x(t-4)$ (ii) y(t)=x(t/2) (iii)y(n)=x(2n)

(b) Find whether the following systems are stable or not

(i) y(t) = (t+5) u(t) (ii) $y(t) = (2+e^{-3t}) u(t)$ (iii) $h(n) = a^n$ for 0 < n < 11

Topic: FOURIER SERIES AND FOURIER TRANSFORM

SHORT ANSWER OUESTIONS

1. What is Fourier Series.

2. What are the three important classes of Fourier series methods available.

3. What are the Dirichlet's conditions? State them.

4. What is the Relationship between exponential Fourier series and trigonometric Fourier series coefficients?

5. How do you obtain Cosine Fourier series from exponential Fourier series?

6. Differentiate the Fourier series and Fourier transform.

7.what is Fourier transform?

8. Define Linearity Property of Fourier transform

9. What are the Merits of Fourier Transform?

LONG ANSWER OUESTIONS

1. Find the Fourier series expansion of the half wave rectified sine wave shown in figure.



- 2. State and Prove any Five Properties of the Fourier Series.
- 3. Derive the expressions for the trigonometric Fourier series coefficients.

4. Explain about exponential Fourier series and derive the Fourier series coefficient

5.(a) Obtain the trigonometric series for the waveform shown in figure



(b) Derive the expression for Fourier transform from Fourier series.

6.(a) Find the Fourier transform of the following

(i)
$$sgn(t)$$
 (ii) $sin \omega 0t$ (iii) $cos \omega 0t$ (iv) 1(Constant Amplitude)

(b). Find the Fourier transform of the following

(i) impulse function (ii) $x(t)=e^{-at}u(t)$ (iii) $x(t)=e^{j\omega}o^{t}$ (iv) x(t)=u(t)

7. State and Prove the properties of Continuous time Fourier transform?

8.(a) Find the Fourier transform of the following signals

(i)
$$x(t)=e^{-3t}u(t)$$
 (ii) $x(t)=te^{-at}u(t)$ (iii) $x(t)=e^{-t}$ sin 5t u(t) (iv) $x(t)=e^{-t}$ cos5t u(t)

(b) Find the Fourier transform of (i)sin $\omega 0t$ (ii) cos $\omega 0t$

9. Find the inverse Fourier transform of the following signals

(i)
$$X(\omega) = 4(j\omega) + 6/(j\omega)^2 + 6(j\omega) + 8$$
 (ii) $X(\omega) = 1 + 3(j\omega)/(j\omega+3)^2$ (iii) $X(\omega) = e^{-2\omega} u(w)$

10.(a) State and prove any three properties of the DTFT.

(b) Find the Fourier Transform of the Signal (i) Triangular Pulse (ii) $e^{-a |t|}$

<u>UNIT –III</u>

SHORT ANSWER OUESTIONS

1. What are the properties of LTI systems?

2. Define transfer function of a system?

3.Define impulse response of a system.?

4.what is a filter? How are filters classified?

5. What is the Relation between unit step and impulse response?

6.Define sampling and sampling period?

7. State Sampling theorem

8.what is Nyquist rate and Nyquist interval?

9. What is anti-aliasing filter?

10.State Sampling theorem?

LONG ANSWER OUESTIONS

1.(a) Explain the Filter characteristics of linear systems explain with neat diagrams

(b) Define the following (i)Impulse Response (ii)Step Response (iii) Response of the System

2.(a) Derive the transfer function and impulse response of an LTI system.

(b) Define Linear time variant, Linear time-invariant, step response of the system.

3.Discuss the properties of linear time invariant systems.

4.(a) Consider a stable LTI System characterized by the differential equation dy(t)/dt+2y(t)=x(t), Find its impulse response.

(b) Find the Nyquist Rate and Nyquist Interval of the following signals.

(i) $x(t)=1+\cos 2000 \pi t + \sin 4000 \pi t$ (ii) $x(t)=10 \sin 40\pi t \cos 300\pi t$

5.(a) Let the system function of an LTI system be $1/(j_{0}+2)$. What is the output of the system for an input $(0.8)^{t}$ u(t)?

(b) Consider a causal LTI system with frequency response $H(\omega)=1/4+j\omega$, for a input

x(t), the system is observed to produce the output $y(t)=e^{-2t}u(t)-e^{-4t}u(t)$. find the input x(t).

7. Consider a stable LTI system that is characterized by the differential equation

 $d^2y(t)/dt^2+4dy(t)/dt+3y(t)=dx(t)/dt+2x(t)$ find the response for an input $x(t)=e^{-t}u(t)$.

8. Find the Nyquist rate and Nyquist interval for the following signals

(i) $x(t)=1+\cos 2000 \pi t + \sin 4000 \pi t$ (ii) $10 \sin 40\pi t \cos 300\pi t$

(iii) $x(t)=sinc (100 \pi t) + 3 sinc^2 (60 \pi t)$ (iv) $x(t)=2 sinc (100 \pi t)$

9.State and prove the sampling theorem for the band-limited signals with the help of graphical representation.

10.(a) Discuss about Effects of the under sampling.

(b) A system produces an output of $y(t) = e^{-3t} u(t)$ for an input of $x(t) = e^{-5t} u(t)$. Determine the impulse response and frequency response of the system.

Topic: CONVOLUTION AND CORRELATION OF SIGNALS

SHORT ANSWER QUESTIONS

- 1. What is convolution? State the shift property of convolution.
- 2.State Time convolution and Frequency convolution theorem
- 3. What is correlation and types of correlation?
- 4. What are the properties of cross correlation for energy signals?
- 5. What are the properties of auto correlation for power signals?
- 6. What is the relation between convolution and correlation?
- 7. What are the Properties of ESD?
- 8. differentiate ESD and PSD?
- 9. State Parseval's energy theorem?
- 10. State Parseval's power theorem?

LONG ANSWER OUESTIONS

- 1.(a) Write the properties of convolution.
- (b) Find the convolution of the following signal $x_1(t) = e^{-2t} u(t)$, $x_2(t) = e^{-4t} u(t)$
- 2.(a) State and prove the time convolution theorem with Fourier transforms.
 - (b) State and prove the frequency convolution theorem with Fourier transforms.
- 3.(a) Derive the relation between convolution and correlation.
 - (b). Write the properties of cross correlation for energy signals
- 4.(a) State and prove the Parseval's theorem for energy signals.
 - (b) State and prove the Parseval's theorem for power signals.
- 5.(a) Derive and Define the properties of Energy Spectral Density.
- (b) Derive and Define the properties of Power Spectral Density
- 6.(a) Show that R(r) and ESD form Fourier transform pair.
 - (b) Show that R(r) and PSD form Fourier transform pair.
- 7.(a) Verify Parseval's theorem for the energy signal $x(t)=e^{-4t} u(t)$.
- (b) Determine the autocorrelation function and energy spectral density of $x(t)=e^{-at} u(t)$.
- 8.(a) Find the autocorrelation of the signal $x(t) = a \sin(\omega_0 t + \theta)$.
- (b) Distinguish the ESD and PSD.
- 9.(a) Explain the detection of periodic signals in the presence of noise by auto correlation.
 - (b) Explain the detection of periodic signals in the presence of noise by cross correlation. Explain the extraction of noise by Filtering.

10.Explain the extraction of a signal from noise by filtering.

Topic: LAPLACE TRANSFORMS AND Z TRANSFORMS

SHORT ANSWER OUESTIONS

1.What is the region of convergence (ROC)?
2.What is the relation between Laplace transform and Fourier transform?
3.State initial value theorem and final value theorem of Laplace transform.
4.What are the properties of ROC?
5. What is the Laplace Transform of Parabolic Function.?
6.What is the relation between Discrete-time Fourier transform and Z-transform?
7.What is the Z-transform of unit step signal?
8.Find Z-transform and ROC of x(n)=(1/2)ⁿ u(n-2)
9.State the Convolution Property of Z-transform
10. Discuss the comparison of Laplace and Z-Transform.

LONG ANSWER OUESTIONS

1.State and prove the any five Properties Laplace Transform

2.(a) Find the Laplace transform of the signal $x(t) = e^{-at} u(t) - e^{-bt} u(-t)$ and also find its ROC

(b) Find the Laplace transform and region for the following signals

(i)x(t)=e-5t u(t-1) (ii)x(t)=e^{2t} \sin 2t \text{ for } t \le 0 (iii) x(t)=t $e^{-2} |t|$

3. Find the inverse Laplace transform of the following

(a)
$$X(s) = 1/s(s+1)(s+2)(s+3)$$
 (b) $X(s) = (3s^2+22s+27)/(s^2+3s+2)(s^2+2s+5)$

(c)
$$X(s)=s/(s+3)(s^2+4s+5)$$

4.(a) Find the convolution of the sequences:

Discuss about the Properties of the ROC of Laplace transform

5. Find the inverse z-transform of:

(a) If ROC;
$$|z|>2$$
 (b) If ROC; $|z|<1$ (c) If ROC; $1<|z|<2$

6.(a) Find the inverse Z-transform of X(z) given X(z) = $1/(1-az^{-1})$, ROC; z|>|a|

(b) Find the convolution of the sequences:

 $x_1(n)=(1/2)^n u(n) \text{ and } (1/3)^{n-2}u(n)$

7.(a) State and prove initial and final value theorems of Z-transform?

(b) Using the Properties of Z-transform. Find the Z-transform of following signals

(i) x(n)=u(-n) (ii) $x(n)=2^n u(n-2)$ (iii) $2(3)^n u(-n)$

(b)

8.(a) Prove that the final value of x(n) for $X(z) = z^2/(z-1)(z-0.2)$ is 1.25.

(b). Find the inverse Z-transform of $X(z) = z^{-1}/(3-4z^{-1}+z^{-2})$, ROC: |z| > 1

9. Find the energy of the signal $x[n] = (1/2)^n u[n]$

10. Find the odd and even components of the signal: cost + sin t + cost sin t.

11. Find odd and even components of *x*[*n*] = {1, 2, 2, 3, 4}.

12. Find the energy of the signal e-2t u(t).

13. Test whether the signal y(t) = ax(t) + b is linear or nonlinear.

14. Find power and rms value of the signal: $x(t) = 20cos2\pi t$

15.Explain the following signals

i. Periodic and aperiodic ii. Even and odd

Short Answer type Questions:

- 1. State Sampling theorem.
- 2. What is meant by aliasing?
- 3. Define Nyquist rate.and Nyquist interval.
- 4. Define sampling of band pass signals.
- 5. Define Z transform.
- 6. Define unilateral Z transform.
- 7. What is region of Convergence.
- 8. What are the Properties of ROC.
- 9. What is the relationship between Z transform and fourier transform.
- 10. What is meant by step response of the DT system.
- 11. Define Transfer function of the DT system.
- 12. Define frequency response of the DT system.
- 13. What is the condition for stable system.
- 14. State the Commutative properties of convolution.
- 15. State the Associative properties of convolution.
- 16. State Distributive properties of convolution.
- 17. Check whether the system is causal or not, the H(z) is given by $(z^3 + z)/(z+1)$.
- 18. Check whether the system is stable or not, the H(z) is given by (z/z-a)., lal < 1.
- 19. Determine the z-transform of following sequences?
 - i. Unit Impulse Response
 - ii. Unit step response