SIGNALS AND SYSTEMS (subject code: 2141005)

TUTORIAL

1. Consider a system S with input x[n] and output y[n] related by

$y[n] = x[n]\, g[n] + g[n-1]$

(i) If g[n] = 1for all n, show that S is time invariant.

(ii) If g[n] = n, show that S is not time invariant.

(iii)If $g[n] = 1 + (-1)^n$, show that S is time invariant.

2. Define

1) Signal 2) System 3) C.T. Signal 4) D.T. Signal 5) Energy Signal

3. Explain the procedure to find whether the given signal is Even or Odd and derive the Expression to find out Even and Odd component of the signal.

4. With the help of neat sketches explain the difference between analog continuous time signal and analog discrete time signal.

5. 1) Compare Energy signal and Power signal.

2) Obtain Energy or Power of the following signal.

$X(t) = \cos^2 \omega_0 t$

6. State and prove Sampling Theorem. Also explain Quantization with neat sketch.

7. Determine whether the following system is Linear, Time Invariant.

1) $y(n) = x(n) \sum_{k=-\infty}^{\infty} \delta(n - 2k)$

2) $y(n) = x(n)\, u(n)$

8. Sketch the following signal.

1) $x(t) = -u(t+3) + 2u(t+1) - 2u(t-1) + u(t - 3)$

2) $x(t) = \sum_{k=-\infty}^{\infty} \delta(t - 3k)$

9. A 100 Hz sinusoid is sampled at rates of 140 Hz, 90 Hz and 35 Hz. In each case, has aliasing occurred, and if so, what is the aliased frequency. If the original signal has the form $x(t) = \cos(200\pi t + \theta)$.

10. Calculate the convolution using Equation method.

$X(n) = \{1 , 1, 1, 1\}$ and $h(n) = \{2 , 2\}$.

11. Write the three types of Fourier Series representation.

12. Derive the following properties of F.S.

1) Linearity   2) Convolution

13. Obtain the F.T. of following signals

1) $x(t) = e^{-at}\, u(t)$ 2) $x\ t = e^{at}\, u(-t)$

14. Determine the fundamental period of the signals if they are periodic.

1) $x(t) = \cos^2 2\pi t$ 2) $x(n) = \cos(\pi n/5)\ \sin(\pi n/3)$

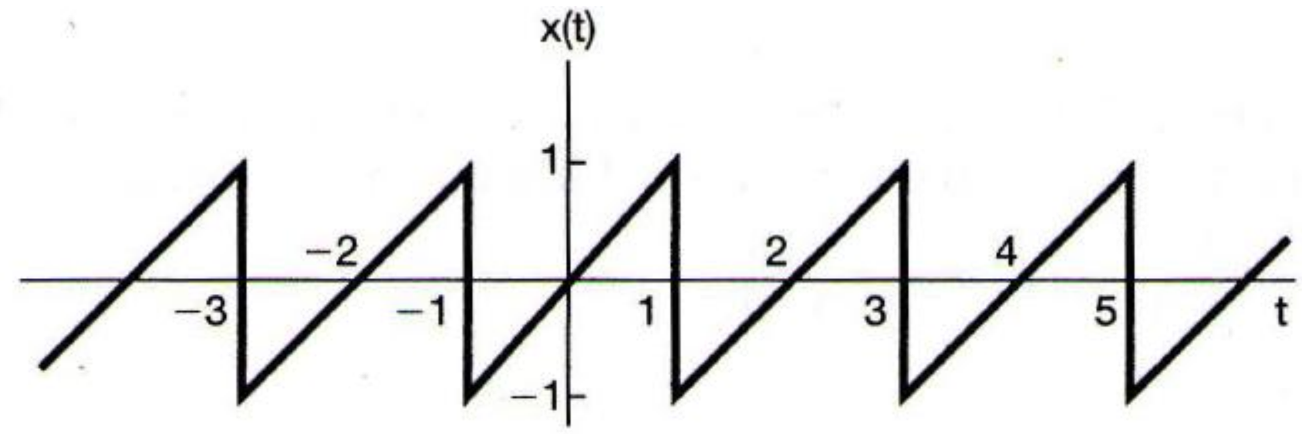
15. Find even and odd component of the following signals.

1) $x(t) = 1 + t + 3t^2 + 5t^3 + 9t^4$

2) $x(t) = \cos\ t + \sin t + \sin t \cos t$

16. State and prove a condition for a discrete time LTI system to be invertible.

17. Determine the Fourier series representations for the signal *x(t)* shown in figure below.



18. Consider a causal and stable LTI system S whose input x[n] And output y[n] are related through the second-order difference equation

$Y[n] – (1/6)\ y[n-1] – (1/6)\ y[n-2] = x[n]$

1) Determine the frequency response $H[e^{jw}]$ for the system S.

2) Determine the impulse response h[n] for the system S.

19. List the properties of the region of convergence (ROC) for the z-Transform.

20. For each of the following systems

i) y(t) = x(t-2) + x(2-t)

ii) *y(n) = n x(n)*

Determine which of properties “memory less”, “time invariant”, “linear”, “casual” holds and justify your answer.

21. Determine the poles and ROC for *X[z]*.

$$X[n] = (1/3)^n \cos[(\pi/4)n] \quad n \leq 0$$

$$= 0 \quad n > 0$$

22. Define Laplace transform. Prove linearity property for Laplace transform. State how ROC of Laplace transform is useful in defining stability of systems.