SIGNALS & SYSTEMS (ECE 181305)

Supplementary assignment cum practice questions

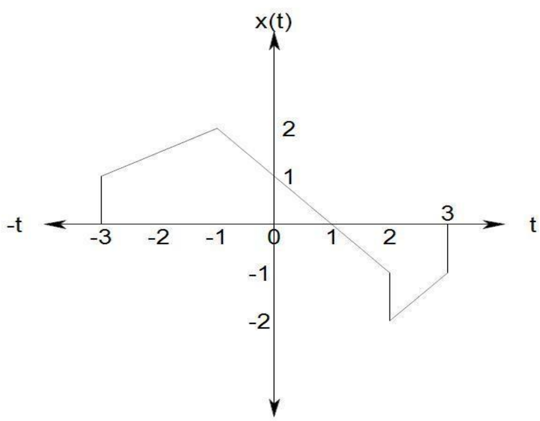
(For both regular & backlog students)

INSTRUCTION

- *Students are to write individual Roll number and name in the booklet. Upload the scan copy of answer book in the Google class room. Answer book may utilized for preparatory purpose. However, repeater student may submit the scan copy through email.*
- *Last date of submission within* ***30.01.2022***

1. Discuss different fundamental signals. Relate them mathematically.

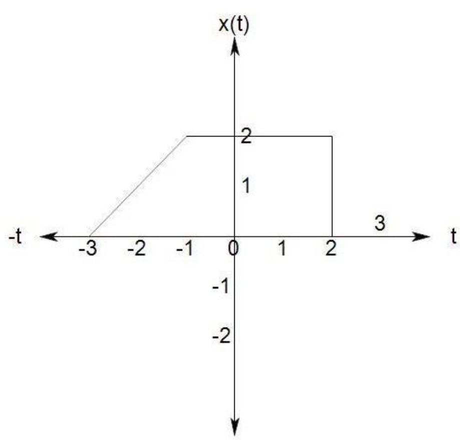
2.



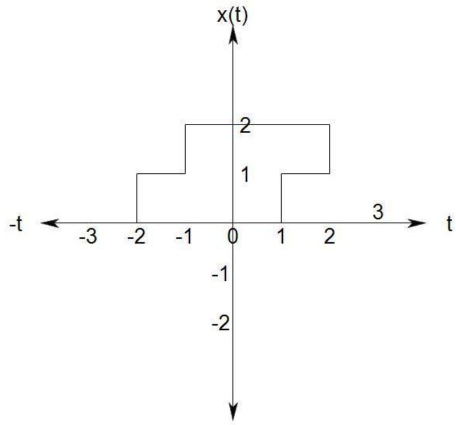
Find

- $x(-3t+1)$
- $x(2t-1)$
- $2+x(t/2)$

3. Write the equation of the signal as depicted below using the basic signals.



4. Draw the even & odd part of the signal as depicted below.



5. Find if the signal given by equation $x[n] = 6\ e^{j3/2n}$ is a power or an energy signal?
6. If $\boldsymbol{x(t) = \sin(2\pi 100 t)}$or $0 \le t \le 1/2$, find if $\boldsymbol{x(t)}$is an energy signal?
7. What is a causal system? Determine if $\boldsymbol{x(t) = u(t) - u(t-1)}$ is causal or not with explanation?
8. Check if the system determined by the equation $\boldsymbol{y(t) = x(t) + 2}$ is linear or non-linear?
9. Check if the system determined by the equation $\boldsymbol{y(t) = \frac{1}{2}\,x(t) - 4}$ is invertible or not with explanation.
10. Check if the system determined by the equation given below is stable or not. Explain?

$$y[n] = \sum_{k=-\infty}^{n} x[k+1]$$

11. Determine from observation if the system determined by equation $\boldsymbol{y(t) = tx(t)}$ is time invariant or time variant? Explain.
12. Perform convolution of the two sequences $x(n) = \{2,1,2,1\}$ & $h(n) = \{1,2,3,4\}$

    Using Circular, linear, and tabular method.
13. Sketch the following signals
    (i) $y(t) = u(t) - u(t-1)$
    (ii) $y(t) = u(t+1) - 2u(t) + u(t-1)$
    (iii)$y(t) = r(t+2) - r(t+1) - r(t-1) + r(t-2)$
14. Determine the convolution of the two signals.
    (i) $x(t) = e^{-3t}\ u(t)$ & $h(t) = u(t)$
    (ii) $x(t) = e^{-2t}\ u(t)$ & $h(t) = u(t+2)$
15. Determine the convolution sum of the given sequences
    a) $x(n) = \{1,2,3,1\}$ & $\{1, 2,1, -1\}$ Sketch the output also.
16. Find the Fourier series representation for the signals $x(t) = sin(2\pi t) + cos\ (2\pi t)$. Sketch the magnitude and phase spectra.
17. State and proof the differentiation and integration property of Laplace transform.
18. Derive the equation to determine the output of a time invariant system having impulse response $h(n)$ & input $x(n)$.
19. Determine the output $y(t)$ of a relaxed time invariant system with impulse $h(n) = a^n u(n), |a| < 1$ when the input is a unit step sequence $x(n) = u(n)$ [Proakis book]

20. Determine the response of the system characterized by the impulse response

$$h(n) = \left(\frac{1}{2}\right)^n u(n) \text{ to the input signals such as}$$

(i) $x(n) = 2^n u(n)$

(ii) $x(n) = u(-n)$

21. Determine the z-transform & ROC of the following signals.

i) $x(n) = \left(\frac{1}{2}\right)^n u(n)$

ii) $x(n) = -\alpha^n u(-n-1)$

iii) $x(n) = \alpha^n u(n) + \beta^n(-n-1)$

iv) $x(n) = [3(2^n) - 4(3^n)]u(n)$

v) $x(n) = n\, a^n u(n)$

22. Determine the system function and unit sample response of the system described by the difference equation $y(n) = \frac{1}{2} y(n-1) + 2x(n)$

23. Determine the impulse response $h(n)$ for the system described by the second order difference equation $y(n) - 4y(n-1) + 4y(n-2) = x(n-1)$

24. Determine the inverse z-transform of the following function.

$$X(z) = \frac{1}{1 - 0.5z^{-1} + 0.5z^{-2}}$$

$when\ i)\ ROC: |z| > 1$ & $ii)\ ROC: |z| < 0.5$

25. Compute the DFT of the sequence $x(n) = \{0, 1, 2, 3\}$

26. Define energy and power signal. Differentiate between them.

27. Define Nyquist sampling rate. Discuss about aliasing effect in context to signal processing.

28. Write down the Dirichlet's condition for the existence of Fourier transform.

29. Derive the relationship between Laplace and Fourier transform.

30. Prove that the convolution of a function $x(t)$ with a unit impulse function **δ**(t) results the function itself.

31. What is an LTI system? Explain various conditions for LTI stability.

32. What is the difference between linear and circular convolution.
