

## Assignment 1

1. Pick the correct option based on statements below

(1) The system  $y(t) = x(t) + x(t+2)$  is linear, time-invariant and non-causal

(2) The system  $y(t) = (t-2)x(t+2)$  is time-variant, non-causal and stable

(3) The system  $y[n] = e^{x[n]}x[n]$  is non-linear, time-invariant and memoryless

(A) Only (1) & (3) are true

(B) Only (1) is true

(C) Only (2) is true

(D) None of the above

2. Consider the signal

$x(t) = \sin(2\pi t) + \sin(at)$ . It's given that  $x(t)$  is periodic, then which of the following is possible value of  $a$ .

(A)  $\sqrt{3}$

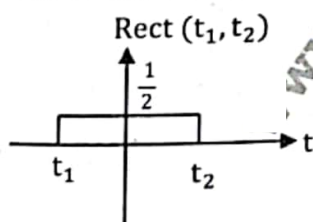
(C)  $\frac{3}{2}$

(B) 2

(D) None of these

3. Given the signal

$x(t) = u(t) - u(t-T)$ . Write its conjugate symmetric and anti-symmetric parts in terms of  $\text{rect}(t_1, t_2)$  which is defined as below.



(A)  $\text{rect}(-T, T), \text{rect}(0, T) - \text{rect}(-T, 0)$

(B)  $\text{rect}(0, T), \text{rect}(-T, 0) - \text{rect}(0, T)$

(C)  $\text{rect}(-T, 0), \text{rect}(0, T)$

(D)  $\text{rect}(-T, T), \text{rect}(-T, 0) - \text{rect}(0, T)$

4. Based on statements below, pick the correct option.

(1) Signal  $x[n] = \left(\frac{1}{2}\right)^n u[n]$  is energy signal

(2) Signal  $x[n] = \sin \omega_0 n$  is both energy & power signal

(3)  $x[n] = n u[n]$  is only power signal

(A) Only (3) is true (C) Only (2) is true

(B) Only (1) is true (D) None of these

5. Pick the correct option for the system given  $y[n] = x[n]x[n-1] + 2$ .

(A) System is linear, but time-variant

(B) System is causal, but unstable

(C) System is memoryless, but non-linear

(D) System is time invariant and stable

6. Let  $x(t)$  be the input and  $y(t)$  be the output of continuous time system, match the systems  $(S_1, S_2, S_3, S_4)$  with their characterizations  $(C_1, C_2, C_3, C_4)$

System Characterization

$S_1: y(t) = t^3 x(t)$   $C_1: \text{Causal, stable, linear}$

$S_2: y(t) = 2x(t) + 3$   $C_2: \text{memoryless, nonlinear, stable}$

$S_3: y(t) = x(t-3)$   $C_3: \text{non-linear, memoryless}$

$S_4: y(t) = |x(t)|$   $C_4: \text{Time variant, linear}$

(A)  $(S_4, C_3), (S_2, C_4), (S_3, C_2), (S_1, C_1)$

(B)  $(S_4, C_1), (S_2, C_2), (S_3, C_3), (S_4, C_4)$

(C)  $(S_4, C_4), (S_2, C_1), (S_3, C_2), (S_1, C_3)$

(D)  $(S_4, C_2), (S_2, C_3), (S_3, C_1), (S_1, C_4)$

7. Given the signal,  $x[n] = \{3 + j, 1, 3 - j\}$

↑

Based on the statements given below, pick the correct option.

(1) Conjugate symmetric part of  $x[n]$  is  $\{3, 1, 3\}$

(2) Conjugate anti-symmetric part of  $x[n]$  is  $\{-j, 0, j\}$

(A) Only (1) is true

(B) Only (2) is true

(C) Both (1) & (2) are true

(D) Both (1) & (2) are false

8. Consider the signal and its derived version,  $y[n] = x[3n-2]$ . Then  $y[n]$  is obtained from  $x[n]$  by
- Picking every 3<sup>rd</sup> sample of  $x[n]$  and then delaying by 2 samples
  - Picking every 3<sup>rd</sup> sample of  $x[n]$  and then advancing by 2 samples
  - Delaying by 2 samples and then pick every 3<sup>rd</sup> sample
  - Advancing by 2 samples and then pick every 3<sup>rd</sup> sample
9. Consider signal  $x(t) = (1 + \sin 100\pi t) \cos(200\pi t)$ . The fundamental frequency component in  $x(t)$  is \_\_\_\_\_ Hz.
- 200 Hz
  - 150 Hz
  - 50 Hz
  - 100 Hz
10. Pick the correct option out of the following.
- $x[n] = \delta[n]$  is not energy signal
  - $x[n] = u[n]$  is not power signal
  - $x[n] = e^{-n}u[n]$  is energy signal
  - None of the above
11. A discrete - time system is described by equation,  $y[n] = e^{x^2[n]}$ . Then the system is \_\_\_\_\_
- Linear and memoryless
  - Non-linear and causal
  - Non-Linear and stable
  - None of the above
12. A discrete-time system is described by the equation,  $y[n] = f[n] x[n] + g[n]$ . For a given  $f[n]$  and  $g[n]$ , the system is
- Stable if  $f[n]$  and  $g[n]$  are first order polynomials in  $n$
  - Linear if  $g[n]$  is constant
  - Time invariant if  $f[n]$  is of form  $an + b$  and  $g[n] = 0$
  - Memoryless for any  $f[n]$  &  $g[n]$
13. Which of the following is energy signal, but not power signal?
- $a^n u[n]$ ;  $a < 1$
  - $\sin \omega_0 n$
  - $u(t)$
  - $t u(t)$
14. Which of following discrete-time signals given has period of  $3/2$ ?
- $e^{j(\frac{4\pi}{3}n)}$
  - $\sin(\frac{6\pi}{5}n)$
  - $\cos(6\pi n)$
  - None of these
15. A continuous - time system is described by  $Y(t) = f(\int_{-\infty}^t x(t) dt)$ . Where,
- $$f(x) = \begin{cases} 20 & \text{for } x \geq 20 \\ -20 & \text{for } x \leq -20 \\ 0 & \text{else} \end{cases}$$
- Then system is \_\_\_\_\_
- Causal and stable
  - Non - causal and unstable
  - Linear and stable
  - Linear and non-causal
16. A discrete-time system is described by
- $$y[n] = \begin{cases} \sum_{m=1}^n f[m] x[m] & \text{if } m \geq 0 \\ 0 & \text{else} \end{cases}$$
- For which of the following  $f[n]$ , system is stable.
- $n u[n]$
  - $e^n u[n]$
  - $\sin \omega_0 n u[n]$
  - $e^{-n} u[n]$
17. Consider two signals,  $x(t) = \sin(2\pi t)$  and  $y[n] = e^{j2\pi n}$ . Consider the following characterisations as related to  $x(t)$  and  $y[n]$ .
- One is continuous -time & other is discrete-time signal
  - One is periodic & other is non-periodic
  - One is even & other is odd
- Choose the correct option below
- Only (1) is true
  - Only (1) & (2) are true
  - Only (1) & (3) are true
  - None of the above

18. Consider the system,  

$$y[n] = \begin{cases} x[n] - x[n-1] & \text{for } n \geq 1 \\ x[n] & \text{for } n = 0 \\ 0 & \text{else} \end{cases}$$

Then the system is \_\_\_\_

- (A) Linear and time -variant  
 (B) Causal and stable  
 (C) Both (A) & (B) are true  
 (D) None of the above

19. Pick the correct option out of the following  
 (A) Causality implies memory less property  
 (B) BIBO stability implies bounded output for any input (bounded /unbounded)  
 (C) Time-invariance implies same output for any delayed input  
 (D) None of the above

20. Consider a continuous-time system described by the following Input-output relation

$$y(t) = \frac{1}{T} \int_{t-T/2}^{t+T/2} x(\tau) d\tau; T \in \mathbb{R}^+$$

The system is \_\_\_\_

- (A) Non-linear (C) Causal  
 (B) Time-variant (D) Stable

21. Consider the following statements as related to signal  $x[n] = e^{(j\frac{\pi}{3}n)} u[n]$   
 (1)  $x[n]$  is energy signal  
 (2)  $x[n]$  is power signal  
 Then pick the correct option as related to correctness of above statements  
 (A) Only (1) Is True  
 (B) Only (2) Is True  
 (C) Both (1) and (2) are true  
 (D) None of the above

22. Find the conjugate symmetric part of the signal,  $x(t) = \left(\frac{1}{2}\right)^t u(t)$ ?

- (A)  $\frac{1}{2} (2^{-t} u(t) + 2^t u(-t))$   
 (B)  $\frac{1}{2} (2^t u(t) + 2^{-t} u(-t))$   
 (C)  $\frac{1}{2} \left( 2^t + \left(\frac{1}{2}\right)^{-t} \right) u(t)$   
 (D) None of the above

23. Pick the correct statement of the following as related to discrete - time signal,  $x[n]$ .

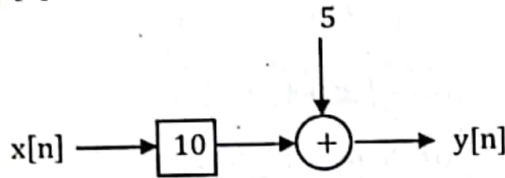
- (A) If  $x[n]$  is conjugate symmetric,  $x[0] \neq 0$   
 (B) If  $x[n]$  is conjugate skew symmetric,  $x[0] = 0$   
 (C) If  $n \notin \mathbb{Z}$ ,  $x[n] = 0$   
 (D) None of the above

### Assignment 2

1. Consider the signal;  
 $x[n] = (-0.5)^n u[n]$ . Consider the following statements as related to above signal.  
 (1)  $x[n]$  is energy signal  
 (2)  $x[n]$  is not power signal  
 Pick the correct option as related to above statements.  
 (A) Only (1) is true  
 (B) Only (2) is true  
 (C) Both (1) & (2) are true  
 (D) Both (1) & (2) are false
2. Which of the following can be a Fourier series expansion of periodic signal.  
 (A)  $x(t) = \cos(t) + \sin(t) + \sin(2t)$   
 (B)  $x(t) = \cos(t) + \sin(\sqrt{3}t) + \cos(2t)$   
 (C)  $x(t) = \cos(\pi t) + \cos(2\pi t) + \sin(\pi t) + \sin(50\pi t)$   
 (D)  $x(t) = \cos(\sqrt{3}t) + \sin(5\sqrt{3}t)$
3. Let P be linearity, Q be time invariance, R be causality and S be stability.

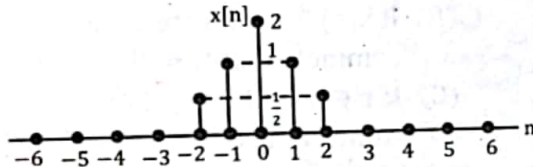


Figure shows the relationship between discrete time input  $x[n]$  and output  $y[n]$ . Choose the options which match the properties for system.  $x[n]$  as shown in figure.



- (A) P, Q, R, S      (C) P, R, S  
(B) Q, R, S      (D) P, Q, S

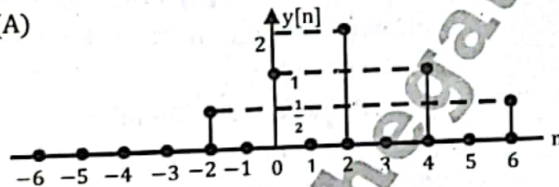
**Statement for Linked Answer Q.No. 4 & 5**  
A sequence  $x(n)$  has non-zero values as shown in the figure.



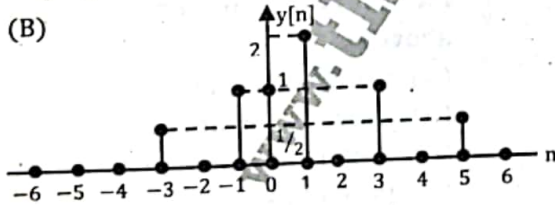
4. Find the sequence of

$$y[n] = \begin{cases} x\left(\frac{n}{2} - 1\right) & \text{for } n \text{ even} \\ 0 & \text{for } n \text{ odd} \end{cases} \text{ is}$$

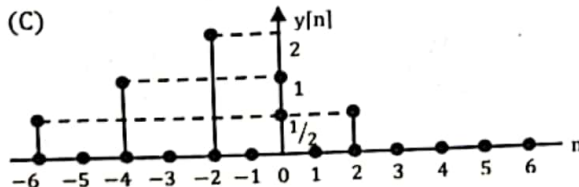
(A)



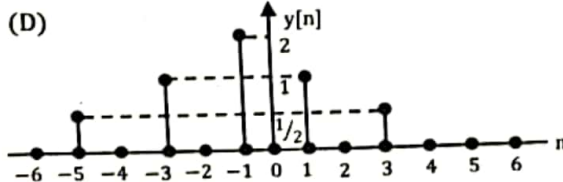
(B)



(C)



(D)



5. The Fourier transform of  $y[2n]$  will be  
(A)  $e^{-2j\omega} [\cos 4\omega + 2\cos 2\omega + 2]$   
(B)  $[\cos 2\omega + 2\cos \omega + 2]$   
(C)  $e^{-j\omega} [\cos 2\omega + 2\cos \omega + 2]$   
(D)  $e^{-2j\omega} [\cos 2\omega + 2\cos \omega + 2]$

6. The continuous-time system,  $y(t) = x(t - 1) \cos(10\pi t)$  is \_\_\_\_\_  
(A) Linear and non-causal  
(B) Causal & unstable  
(C) Non-invertible & time-variant  
(D) Memoryless and linear

7. Which of the systems given in the options below is linear, time-variant and has memory.

- (A)  $y[n] = x^2[n - 2]$   
(B)  $y(t) = x(2t)$   
(C)  $y[n] = e^{x[n-1]}$   
(D)  $y(t) = x(t) x(t - 1)$

8. Which of the following discrete-time system is invertible.

- (A)  $y[n] = \sin(2x[n])$   
(B)  $y[n] = x^2[n] + x[n]$   
(C)  $y[n] = 2x[n] + 5$   
(D)  $y[n] = x^3[n] + x^4[n]$

9. consider the signals given below;

$$x_1(t) = \sin(t) + \sin(2\pi t)$$

$$x_2(t) = \sin(t) + \sin(3t)$$

$$x_3(t) = \sin(\sqrt{3}t) + \sin(5\sqrt{3}t)$$

$$x_4(t) = \sin(t) + \sin(\sqrt{3}t)$$

Which of the above signals are periodic.

- (A) Only  $x_2(t)$  and  $x_3(t)$  are periodic  
(B) Only  $x_1(t)$  and  $x_4(t)$  are periodic  
(C) Only  $x_2(t)$  is periodic  
(D) Only  $x_3(t)$  and  $x_1(t)$  are periodic

10. Match the systems in List I with characterization in List II

List I	List II
A. $y(t) = (t+4)x(t-1)$	(1) non-linear, time-invariant & stable
B. $y(t) =  x(t) $	(2) linear, time-variant, causal & unstable
C. $y(t) = x^4(t+1)$	(3) non-linear, stable, has memory

- (A) A - 2; B - 3; C - 1  
 (B) A - 1; B - 2; C - 3  
 (C) A - 2; B - 1; C - 3  
 (D) A - 1; B - 3; C - 2

11. Consider the signals

$$x(t) = \sin(\pi t) + \cos(2t) \text{ and}$$

$$y[n] = e^{j\frac{\pi}{3}n} + \cos\left(\frac{\pi}{4n}\right)u[n].$$

Pick the correct option as related to above Signals.

- (A) Only  $x(t)$  is periodic  
 (B) Only  $y[n]$  is periodic  
 (C) Both  $x(t)$  and  $y[n]$  are periodic  
 (D) None of the above

12. Consider the following statements as related to signal,  $x[n]$

- (1) If  $x[n]$  is conjugate skew-symmetric,  $x[0]$  must be 0  
 (2) If  $x[n]$  is conjugate symmetric,  $x[0]$  must be real

Pick the correct option as related to above statements.

- (A) Only (1) is true  
 (B) Only (2) is true  
 (C) Both (1) & (2) are true  
 (D) Both (1) & (2) are false

13. The value of the integral

$$\int_{-5}^{+6} e^{-2t} \delta(t-1) dt \text{ is equal to } \underline{\hspace{2cm}}$$