

SIGNALS & SYSTEMS Important Questions

1. a) Define Signals and Systems. 2
 - b) Let $x(t) = 2t \sin t \cos^3 t$ and $y(t) = 3t^4 \sin^3 t \cos^3 t$. If $z(t) = x(t)y(t)$ find whether $z(t)$ is even or odd signal? 3
 - c) Find the period of the signal $x[n] = 25 \cos \left[\frac{\pi n}{3} \right] + 300 \sin^2 \left[\frac{\pi n}{4} \right]$ 5

2. a) Give 4 differences between Continuous and Discrete Sinusoids. 4
 - b) Convolve: $x(t) = e^{-at} u(t)$ with $h(t) = e^{at} u(-t)$ 6

3. a) Derive the condition for the periodicity of discrete sinusoids and find period. 4
 - b) Plot the signal $x(t)$, find its first derivative. 4
 $x(t) = 2u(t+3) + 3u(t+1) - 8u(t) + 3u(t-1) + 2u(t-3)$
 - c) Solve: $\int_{-\infty}^{\infty} e^{(2x)} \delta(x+3) u(2x) dx$ 2

4. a) Prove the periodicity of the signal $x(t) = e^{j\omega_0 t}$ and find its period. 4
 - b) In general, if a signal $x(t)$ is even, is $x(t-1)$ also an even signal? 2
 - c) If $x(t) = u(t+1) + u(t-1) - 2u(t-3)$ then plot $x\left(\frac{t}{3} - 2\right)u(t+2)$ 4

5. a) Prove that the multiplication of two even signals or two odd signals results in an even signal. 4
 - b) Convolve $x[n] = \left\{ \underset{\uparrow}{8}, 9, \underset{\uparrow}{-9}, 7 \right\}$ and $h[n] = \left\{ -3, \underset{\uparrow}{5}, 7 \right\}$ 6

6. a) Let $X_1(t)$ and $X_2(t)$ be periodic with periods T_1 and T_2 respectively. Under what conditions the sum $X(t) = X_1(t) + X_2(t)$ periodic? 4
 - b) Find and plot the Even and Odd components of the following signal. 6
 $x[n] = \delta[n+3] + 2\delta[n+2] + 3\delta[n+1] + 4\delta[n] + 5\delta[n-4]$

7. a) Give 4 differences between Even and Odd signals. 4
- b) Investigate whether the signal $x(t) = t u(t)$, is Energy or Power signal? 6
8. a) If $x(t)$ is odd signal, find the value of $\int_{-a}^a x(t) dt$ 4
- b) Check the following properties of the system $y(t) = 10 x(t) + 5$ 4
- i. Memory
 - ii. Causality
 - iii. Linearity
 - iv. Time Invariance
- c) Find the value $\delta[n] + \delta[2n] + 3\delta[6n]$? 2
9. Realize the Direct Form 1 and Direct Form 2 realization of the following 10

$$y[n] - \frac{3}{2}y[n-1] + \frac{5}{6}y[n-3] - \frac{1}{6}y[n-5] = x[n] - 5x[n-2] + 9x[n-4] + 3x[n-6]$$
10. Investigate the properties of the following systems 10

$$h[n] = 2^n u[n-1] \quad \text{and} \quad h(t) = e^{-2|t|}$$
11. Obtain the total response of the system: 10

$$\frac{d^2 y(t)}{dt^2} + 3 \frac{dy(t)}{dt} + 2y(t) = 4e^{-2t}u(t); y(0) = 0 \text{ and } y'(0) = 4$$
12. State and prove Commutative and Associative Properties of Convolution 10
13. Find and plot the CTFS of 10

$$x(t) = 1 + \sin(\omega_0 t) + 2\cos(\omega_0 t) + \cos(2\omega_0 t + \frac{\pi}{4})$$
14. State and prove the following properties of Fourier Series representation. 10
 A) MODULATION B) PARSEVAL'S Theorem
15. Find the coefficient of CTFS of $x(t) = \begin{cases} A, & 0 < t < T/2 \\ 0, & T/2 < t < T \end{cases}$ and $x(t) = x(t+T)$ 10
16. Find and plot the DTFS of 10
- A) $x[n] = \cos\left[\frac{\pi n}{3}\right] + \sin\left[\frac{\pi n}{4}\right]$
 - B) $x[n] = \cos^2\left[\frac{\pi n}{8}\right]$

17. Find the Fourier Transform of the signal $e^{-at} u(t)$, using which find the Fourier Transform of $e^{-at} \sin(\omega_0 t) u(t)$. Also find the Fourier Transform of $e^{-2t} \sin(\pi t) u(t)$. [4+4+2]

18. State and prove Time Scaling, Frequency Differentiation and Duality properties of CTFT? [3+4+3]

19. Find the Fourier Transform of following signals

$$x(t) = \delta(t), \quad x(t) = 1, \quad x(t) = \text{sgn}(t), \quad x(t) = u(t), \quad x(t) = \frac{1}{\pi t} \quad [2+2+2+2+2]$$

20. Find the CTFT of $x(t) = e^{-3|t-2|}$ and The Inverse Fourier Transform of $\frac{j\omega+12}{(j\omega)^2+5j\omega+6}$ [5+5]

21. Find and Plot the Fourier Transform of $x(t) = \frac{\sin(at)}{\pi t}$ and $x(t) = \frac{1}{a^2+t^2}$. [5+5]

22. Give the DTFT and IDTFT equations. Find the DTFT of the following signals.

$$x[n] = \left\{ \frac{-1}{\downarrow}, \frac{1}{\downarrow}, \frac{2}{\downarrow}, \frac{-2}{\uparrow} \right\}, \quad x[n] = a^{|n|}, \quad x[n] = -a^n u[-n-1], \quad x[n] = a^n u[n] \quad [2+2+2+2+2]$$

23. Explain the Dirichlet Conditions for Convergence of Fourier Series? Give any of the 8 characteristics of ROC of Z Transform? [6+4]

24. Write the Z^{-1} transformation equation and Find the Z transforms of the following signals? [1+3+3+3]

$$x[n] = \alpha^{n+1} u[n+1], \quad x[n] = n\alpha^n u[n], \quad x[n] = 2^n u[n-2]$$

25. State and prove MODULATION and CONVOLUTION properties of CTFT.

26. Find CTFT of $x(t) = p_a(t)$ and $h(t) = e^{-a|t|}$

27. Obtain DTFT of: $h[n] = -2^n u[-n-1]$ and $h(n) = a^{|n|}$

28. State and prove CONVOLUTION and Z DIFFERENTIATION Properties of Z.

29. Find Z Transforms of

$$x[n] = \alpha^{n+1} u[n+1], \quad x[n] = n\alpha^n u[n], \quad x[n] = 2^n u[n-2]$$