B.E. / B.Tech. (Electronics & Communication / Telecommunication Engineering)
Model Curriculum Semester-III

SE104 / 004 - Signals and Systems

P. Pages : 3 **GUG/W/24/13909**

Time : Three Hours * 5 5 2 1 * Max. Marks : 80

Notes : 1. All questions carry marks as indicated.
2. Assume suitable data wherever necessary.
3. Illustrate your answers wherever necessary with the help of neat sketches.

1. A) Draw the signal $x(n) = a^n$ for **8**

i) $a > 1$ ii) $0 < a < 1$

iii) $-1 < a < 0$ iv) $a < -1$

B) Check whether the following systems are linear or not. **8**

i) $y(t) = tx(t)$ ii) $y(t) = x^2(t)$

OR

2. A) Determine the fundamental period of the following signals: **6**

i) $x(t) = 2\cos(10t+1) - \sin(4t-1)$

ii) $x(n) = 1 + e^{j4\pi n/7} - e^{j2\pi n/5}$

B) A continuous time signal x(t) is shown in fig. sketch the following signals: **10**

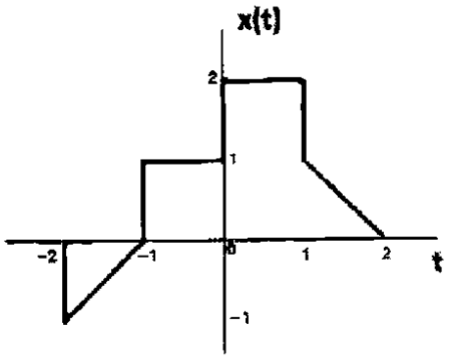
i) $x(t-1)$

ii) $x(2-t)$

iii) $x(2t+1)$

iv) $x(4-\frac{t}{2})$

v) $[x(t)+x(-t)]u(t)$



3. A) Derive the equation for Discrete time convolution sum. **6**

B) Perform the convolution of the following signals. **10**

i) $x(n) = a^n u(n)$ $h(n) = u(n)$

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

OR

4. A) Given $x(n) = \delta(n) + 2\delta(n-1) - \delta(n-3)$ and $h(n) = 2\delta(n+1) + 2\delta(n-1)$ Compute and plot each of the following convolutions: **8**

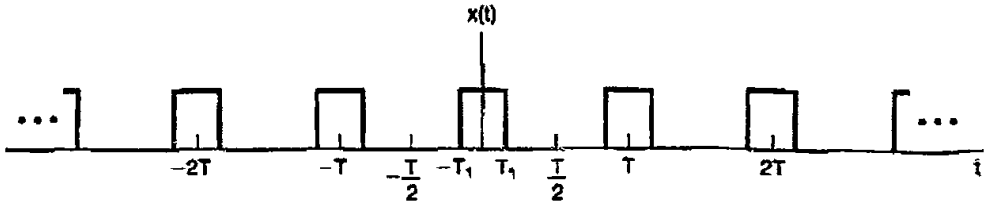
i) $y_1(n) = x(n) * h(n)$

ii) $y_2(n) = x(n+2) * h(n)$

iii) $y_3(n) = x(n) * h(n+2)$

B) Explain any four the properties of LTI system along with block diagram. Determine whether the impulse response $h(n) = \left(\frac{1}{5}\right)^n u(n)$ is causal and/or stable. **8**

5. A) Find the Fourier series of the periodic square wave shown in figure. **8**



B) Find the Fourier transform of the following signals: **8**

i) $e^{-a|t|}$

ii) $e^{-3t}[u(t+2) - u(t-3)]$

iii) $e^{at}\, u(-t)$

OR

6. A) Find the Trigonometric Fourier series coefficients for the continuous time periodic signal. **8**

$$x(t) = \begin{cases} 1.5 \text{ for } 0 < t < 1 \\ -1.5 \text{ for } 1 < t < 2 \end{cases}$$

With fundamental frequency $\Omega_0 = \pi$.

B) State and Prove Parseval's theorem of Fourier transform. **8**

7. A) Find the Laplace transform X(s) and sketch the pole-zero plot with RoC for the following signals. **8**

i) $x_1(t) = e^{-3t}u(t) + e^{-4t}u(t)$

ii) $x_2(t) = e^{-4t}u(t) + e^{3t}u(-t)$

iii) $x_3(t) = e^{-3t}u(t) + e^{-4t}u(-t)$

B) Find the z-transform of the signal $x(n) = \sin(\omega_0 n)\, u(n)$ and find its RoC. **8**

OR

8. A) Find the signal x(t) whose bilateral Laplace transform are as given below: **8**

i) $X_1(s) = \frac{2}{(s^2+1)(s+1)}$ RoC : $-1 < \sigma < 0$

ii) $X_2(s) = \frac{2s}{(s+3)(s+1)}$ if RoC is

a) $-1 < \sigma < -3$

b) $\sigma < -3$

c) $\sigma > -1$

B) Determine the z-transform of the following signals along with RoC: **8**

i) $x_1(n) = \left(\frac{2}{3}\right)^n u(n) + \left(-\frac{1}{2}\right)^n u(n)$

ii) $x_2(n) = a^{|n|}; |a| < 1$

9. A) Explain signal reconstruction using zero order hold. Also find its transfer function. **8**

B) Consider the analog signal. **8**

$x_a(t) = 3\cos(2000\pi t) + 5\sin(6000\pi t) + 10\cos(12000\pi t)$

i) What is the Nyquist rate for this signal

ii) Assume now that we sample this signal using a sampling rate Fs = 5000 samples/s. What is the discrete-time signal obtained after sampling?

OR

10. A) Explain impulse train sampling with neat diagrams and mathematical expressions. **8**

B) Consider the analog signal **8**

$x_a(t) = 3\cos(100\pi t)$

i) Determine the minimum sampling rate required to avoid aliasing.

ii) Suppose that the signal is sampled at the rate Fs = 200 Hz. What is the discrete-time signal obtained after sampling?

iii) Suppose that the signal is sampled at the rate Fs = 75 Hz. What is the discrete time signal obtained after sampling?

****