B.E. Electrical (Electronics & Power) Engineering (MODEL CURRICULUM) Sem-IV

SE205 - Signals & Systems

P. Pages : 4 **GUG/W/22/13860**

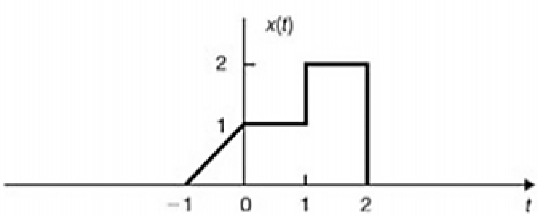
Time : Three Hours Max. Marks : 80

* 3 0 8 9 *

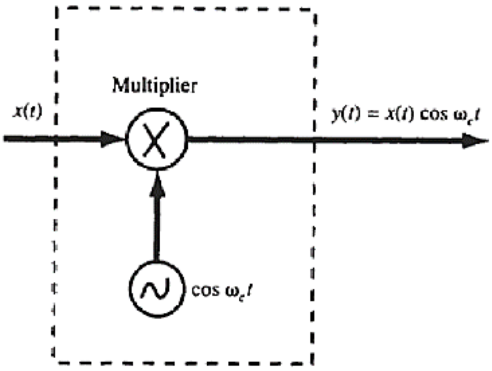
Notes :
1. All questions carry equal marks..
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Illustrate your answers wherever necessary with the help of neat sketches.
5. Use of non programmable electric calculator is permitted.
6. Answer **any five** questions as per internal given choice.

1. a) A continuous – time signal $x(t)$ is shown in fig. Sketch and label each of the following signals. **8**

$$(a)\,x(t)u(1-t);(b)\,x(t)\left[u(t)-u(t-1)\right];(c)\,x(t)\delta\left(t-\frac{3}{2}\right)$$



b) Consider the system shown in Fig. Determine whether it is (a) memoryless, (b) casual, (c) linear, (d) time – invariant, **8**



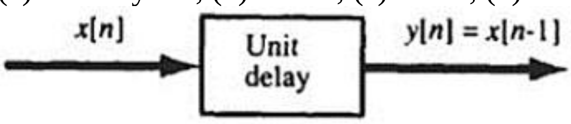
OR

2. a) Determine the even add odd components of the following signals: **8**

a) $x(t)=u(t)$ b) $x(t)=\sin\left(\omega_0 t+\frac{\pi}{4}\right)$

c) $x[n]=e^{j(\Omega_0 n+\pi/2)}$ d) $x[n]=\delta[n]$

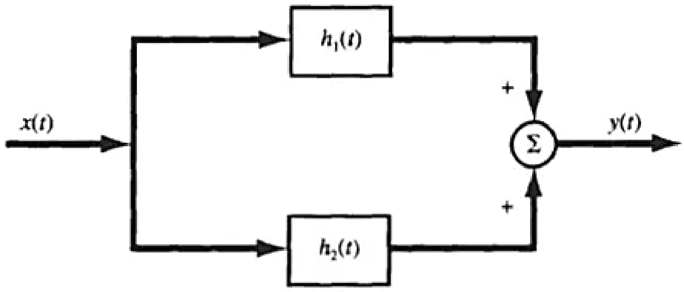
b) The discrete – time system shown in Fig. is known as the unit delay element. Determine whether the system is (a) memoryless, (b) casual, (c) linear, (d) stable. **8**



Unit delay element

3. a) The system shown in Fig. is formed by connection two systems in parallel. The impulse response of the systems are given by. **8**

$$h_1(t) = e^{-2t}u(t) \text{ and } h_2(t) = 2e^{-t}u(t)$$



a) Find the impulse response h(t) of the overall system.
b) Is the overall system stable?

b) Consider a discrete – time system whose input x[n] and output y[n] are related by **8**

$$y[n] - \frac{1}{2}y[n-1] = x[n]$$

With $y[-1] = 0.$ Find the output y[n] for the following inputs:

a) $x[n] = \left(\frac{1}{3}\right)^n u[n];$

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

OR

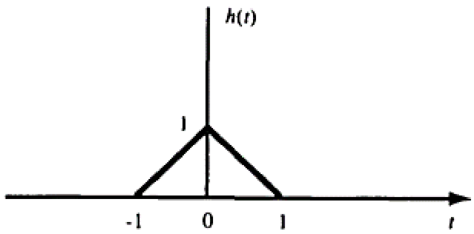
4. a) Consider an integrator whose input x(t) and output y(t) are related by **8**

$$y(t) = \int_{-\infty}^{t} x(\tau)d\tau$$

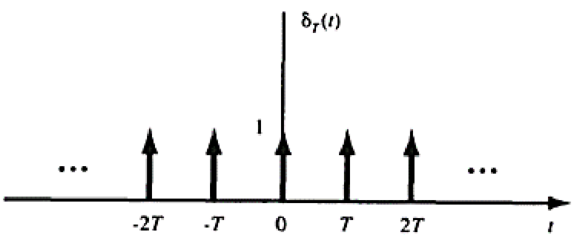
a) Find the impulse response h(t) of the integrator.
b) Is the integrator stable?

b) Let $h(t)$ be the triangular pulse shown in Fig. (a) and let x(t) be the unit impulse train Fig. (b) expressed as **8**

$$x(t) = \delta_T(t) = \sum_{n=-\infty}^{\infty} \delta(t - nT)$$



(a)

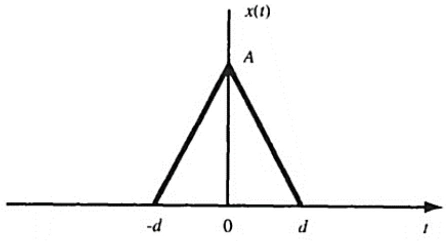


(b)

Determine and sketch $y(t) = h(t) * x(t)$ for the following values of

$T : (a) T = 3, (b) T = 2,$

5. a) Using the differentiation technique, find the Fourier transform of the triangular pulse signal shown in Fig. **8**



b) A casual discrete – time LTI system is described by **8**

$$y[n]-\frac{3}{4}y[n-1]+\frac{1}{8}y[n-2]=x[n]$$

Where $x[n]$ and $y[n]$ are the input and output of the system, respectively.

a) Determine the frequency response $H(\Omega)$ of the system.

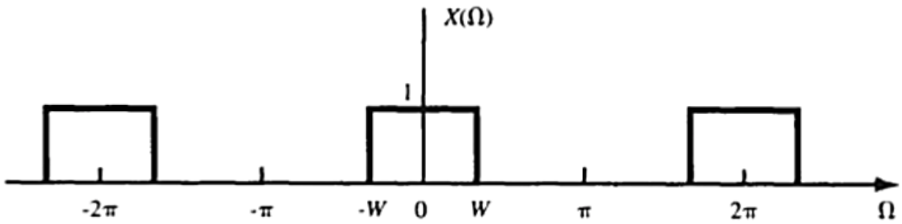
b) Find the impulse response $h[n]$ of the system.

c) Find $y[n]$ if $x[n]=\left(\frac{1}{2}\right)^n u[n]$

OR

6. a) Find the inverse Fourier transform $x[n]$ of the rectangular pulse spectrum $X(\Omega)$ defined by $[\text{Fig.}6-13(a)]$ **8**

$$X(\Omega)=\begin{cases}1 & |\Omega|\le W\\ 0 & W<|\Omega|\le \pi\end{cases}$$



b) Find the N – Point DFT of the following sequences x[n]: **8**

a) $x[n]=\delta[n]$ b) $x[n]=u[n]-u[n-N]$

7. a) Find the z – transform of the following x[n]: **8**

a) $x[n]=\left\{\frac{1}{2},1,-\frac{1}{3}\right\}$

b) $x[n]=2\delta[n+2]-3\delta[n-2]$

c) $x[n]=3\left(-\frac{1}{2}\right)^n u[n]-2(3)^n u[-n-1]$

d) $x[n]=3\left(\frac{1}{2}\right)^n u[n]-2\left(\frac{1}{4}\right)^n u[-n-1]$

b) Find the output $y(t)$ of the continuous – time LTI system with. **8**

$$h(t)=e^{-2t}u(t)$$

For the each of the following inputs:

a) $x(t)=e^{-t}u(t)$ b) $x(t)=e^{-t}u(-t)$

OR

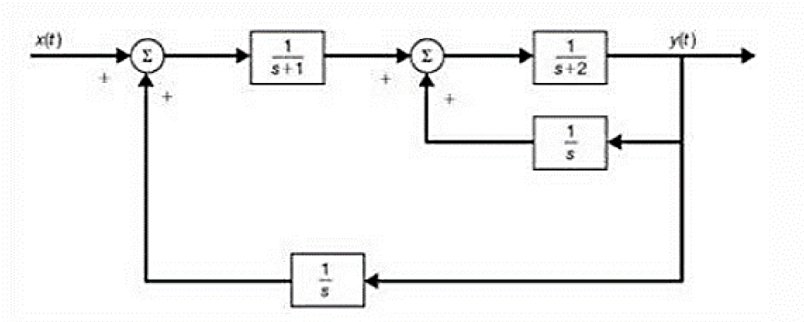
8. a) Show the following properties for the z – transform. **8**

a) If $x[n]$ is even, then $X(z^{-1})=X(z)$.

b) If $x[n]$ is odd, then $X(z^{-1})=-X(z)$

c) If $x[n]$ is odd, then there is a zero in X(z) at z = 1

b) Determine the overall system function $H(s)$ for the system shown in Fig. **8**



9. a) Determine the Nyquist sampling rate and the Nyquist sampling interval for the signals. **8**

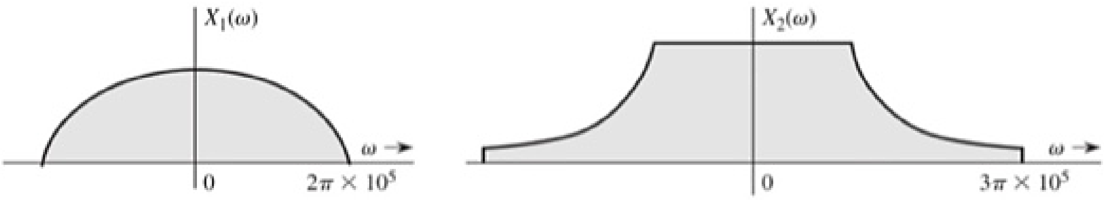
a) $\mathrm{sinc}^2(100\pi t)$ b) $0.01\mathrm{sinc}^2(100\pi t)$

c) $\mathrm{sinc}(100\pi t)+3\mathrm{sinc}^2(60\pi t)$ d) $\mathrm{sinc}(50\pi t)\mathrm{sinc}(100\pi t)$

b) A signal $x(t)=5\mathrm{sinc}^2(5\pi t)+\cos 20\pi t$ is sampled at a rate of 10Hz. Find the spectrum of the sampled signal. Can x(t) be reconstructed by lowpass filtering the sampled signal? **8**

OR

10. a) Figure shows Fourier spectra of signals $x_1(t)$ and $x_2(t)$. Determine the Nyquist sampling rates for signals $x_1(t), x_2(t), x_1^2(t), x_2^3(t)$, and $x_1(t)x_2(t)$ **8**



b) Sketch the amplitude spectrum of the sampled signal when the sampling rate is 25% above the Nyquist rate (show the spectrum over the frequency range ± 50 Hz only). How would you reconstruct x(t) from these samples? **8**

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