[This question paper contains 4 printed pages.]

Sr. No. of Question Paper : 6313 **F-5** **Your Roll No.....**

Unique Paper Code : 2511508

Name of the Paper : Signals and Systems

Name of the Course : **B.Tech Instrumentation**

Semester : **V**

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Use of scientific calculator is allowed
3. Question no. **1** is compulsory.
4. Attempt any **five** questions in all.

1. (a) Give the mathematical and graphical representation of continuous time and discrete time impulse function. (3)

   (b) State the conditions for a System to be LTI System. Give an example of LTI system. (3)

   (c) Find whether a square-law system described by the input-output relation $y(t) = x^2(t)$ is invertible or not. (3)

   (d) Find Laplace transform of the signal (3)

   $x(t) = e^{2t}u(t)$

   (e) Represent the following difference equation using block diagram (3)

   $y[n] + 3y[n-1] = 5x[n]$

2. (a) A continuous time signal is shown in figure I. sketch and label each of the following signals

(i) x(t) u(l-t)

(ii) x(t) δ(t-3/2)

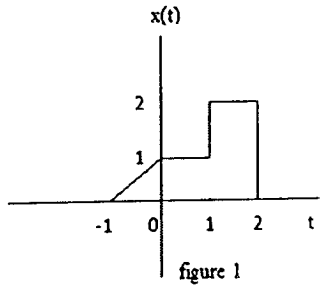

figure 1

(6)

(b) Determine whether the signal $x[n] = \cos(4\pi n)$ is periodic or not. If it is periodic, find fundamental period of the signal. (5)

(c) Determine whether this signal given below is an energy signal or power signal or neither. $x[n]= (0.05)^n u[n]$ (4)

3. (a) If input is x[n] =u[n] and $h[n] = \alpha^n u[n]$ is the impulse response of the system then, compute and sketch y[n]. (6)

(b) A discrete time signal is given by

$$x[n] = \begin{cases} 4 & 0 \le n \le 9 \\ 0 & otherwise \end{cases}$$

Describe $x[n]$ as the superposition of two step functions (5)

(c) The impulse response of a system is given as

$h(t) = u(t) - 2u(t - 1)$

Determine whether the corresponding system is memoryless, causal and stable. (4)

4. (a) Consider the system shown in figure 2, determine whether the system is

(i) causal

(ii) stable

(iii) memory less; justify your answers.

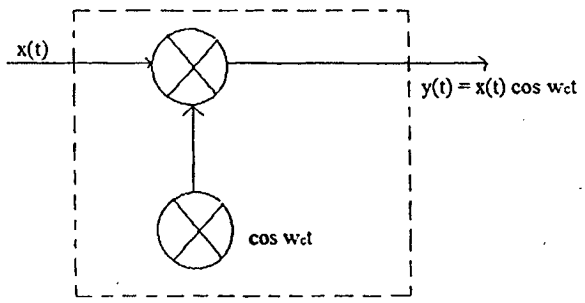

figure 2

(6)

(b) Consider a discrete time LTI system that has unit impulse response h[n] and input x[n], sketch and evaluate the output of the system if

$$h[n] = \left(\frac{1}{2}\right)^n u[n] \text{ and } x[n] = u[n] \quad (5)$$

(c) Show that

(i) $x[n]^* \delta[n - n_0] = x[n - n_0]$

(ii) $x[n]^* u[n] = \Sigma_{-\infty}^{n-n_0} x[k]$ (4)

5. (a) Find the output response of the system described by differential equationy $(\ddot{t}) + 6y(t) + 8y(t) = x(t) + 2x(t)$, When the input signal is $x(t) = e^{-t} u(t)$ (6)

(b) The system shown in figure 4 is a cascaded system, with impulse response $h_1(t)$ and $h_2(t)$ as shown below.

$h_1(t) = e^{-2t} u(t)$ and $h_2(t) = 2e^{-t} u(t)$, find the overall response and check for stability.

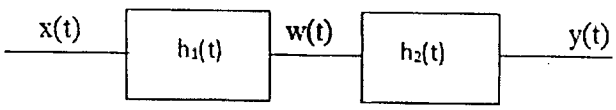

figure 4

(5)

(c) Consider a continuous LTI system whose step response is $s(t) = e^{-t}\,u(t)$. Determine and sketch y(t) for x(t) given in figure 3.

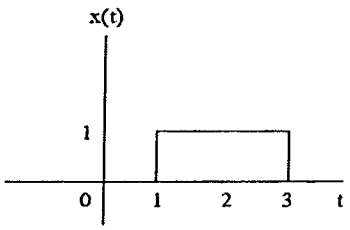

figure 3 (4)

6. (a) Find the output response of the system described by difference equation,

$$\frac{5}{6}y(n-1) - \frac{1}{6}y(n-2) + x(n) - x(n-1)$$,when the input signal,

$x(n) = 2^n\,u(n)$ .The initial conditions are y (-1) = 2 and y(-2) = 1 (6)

(b) Determine initial and final values of a signal *x(t)* whose unilateral Laplace transform is

$$X(s) = \frac{7s+10}{s(s+5)}$$ (5)

(c) Find the Laplace Transform of the signal $x(t) = e^{-}(t) + t^{-bt}u(t)$ (4)

7. (a) Find out the inverse Laplace Transform of $X(s) = \frac{s-2}{s(s+1)^3}$ (5)

(b) Let $x(t) = e^{-at}\,u(t)$. Find the Laplace transform of $\frac{dx(t)}{dt}$ by direct calculation and by using differentiation property of Laplce transforms. (5)

(c) Find the transfer function H(jw) for the first order low pass filter and plot its magnitude and phase. (5)

(100)