Printed Pages : 4 **EEC404**

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 0324 **Roll No.** | | | | | | | | | |

B.Tech.

(SEMESTER-IV) THEORY EXAMINATION, 2012-13

SIGNALS AND SYSTEMS

Time : 3 Hours] ***[Total Marks : 100***

Note : Attempt questions from **all** sections. Assume missing data if any.

SECTION – A

1. Attempt **all** parts : **10 × 2 = 20**

(a) The Impulse response of a system is $h(t) = \delta(t - 0.5)$. If two such systems are cascaded, the impulse response of the overall system will be ?

(b) Calculate $u[n]+u[-n]$ in term of $\delta[n]$ and some constant.

(c) Determine the Laplace Transform of $X(t) = e^{2t}u(-t+2)$

(d) Find the Fourier transform of $x(t) = \text{sgn}(t)$

(e) Find the Fourier transform of $x(t) = u(t)$

(f) $X[z] = \dfrac{z(8z-7)}{4z^2 - 7z + 3}$ the value of $x(\infty)$ will be ?

(g) Determine the power of signal $u[n]$.

(h) Determine Laplace Transform $x(t) = t^3u(t)$

(i) Explain Time variance and static properties of a system.

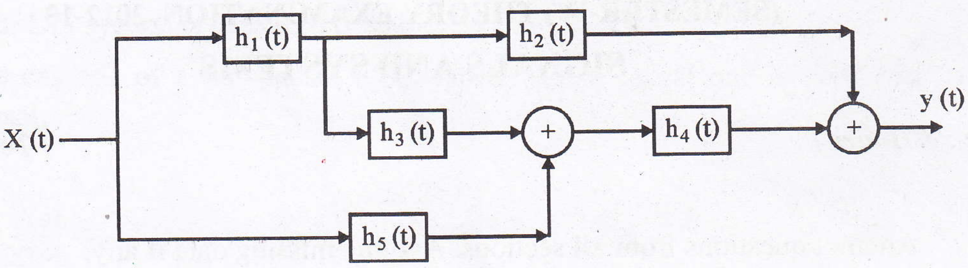
(j) Explain frequency modulation property of Fourier transform.

SECTION – B

2. Attempt any **three** parts. **3 × 10 = 30**

(a) (i) Express the system impulse response as a function of the impulse responses of the subsystems.

(ii) Let $h_1(t) = h_4(t) = u(t)$ and $h_2(t) = h_3(t) = 5\delta(t)$, $h_5(t) = e^{-2t}u(t)$



Calculate y(t).

(b) Two systems are in cascade. The impulse response of the first unit is $h_1[n] = (0.5)^n u[n]$ which that of second is $h_2[n] = \{1, -0.5\}$. Determine the output of cascaded system if the input is

$$x[n] = \cos^7\left[\frac{5n}{8}\right] - 3\sin^8\left[\frac{7n}{8}\right]$$

(c) Consider the Fourier transform pair $e^{-|t|} \leftrightarrow \frac{2}{1+w^2}$

(i) Use the appropriate Fourier transform properties to find Fourier transform of $t\,e^{-|t|}$

(ii) Use the result from part (i), along with duality prosperity to determine the Fourier transform of $\frac{4t}{(1+t^2)^2}$

(d) Given the relationships y(t) = x(t)*h(t) and g(t)=x(3t)*h(3t), and given that X(t) has Fourier transform X(jw) and h(t) has Fourier transform H(jw). Use Fourier transform properties to show that g(t) has the form g(t)=Ay(Bt). Determine the value of A & B.

(e) Consider a continuous time system with Input x(t) and output y(t) related by $y(t)=x(\sin(t))$, $y(t)=t^2x(t-1)$. Check causality and linearity with explanation.

SECTION – C

Answer the following questions : **5 × 10 = 50**

3. Determine the response of the following systems to the input signal :

$$x[n] = \begin{cases} |n| & -3 \le n \le 3 \\ 0 & \text{otherwise} \end{cases}$$

$y[n] = \frac{1}{3}\{x[n+1] + x[n] + x[n-1]\}$ and

$y[n] = \max\{x[n+1], x[n], x[n+1]\}$

OR

A system has its zeros at $\pm j$ and poles at $-\frac{1}{2} \pm \frac{j}{2}$ and H(1) = 0.8. Determine the difference equation describing the system.

4. (i) Is the following statement true or false ?
   The series interconnection of two linear time-invariant systems is itself a Linear Time-Invariant system. Justify your answer.

   (ii) Is the following statement true or false ?
   The series interconnection of two nonlinear systems is itself nonlinear. Justify your answer.

OR

Consider three systems with the following input-output relationships :

System 1 : $y[n] = \begin{cases} x[n/2] & n \text{ even} \\ 0 & n \text{ odd} \end{cases}$

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

System 3 : $y[n] = x[2n]$

Suppose that these systems are connected in series as depicted in Figure 1. Find the input-output relationship for the overall interconnected system. Is this system linear ? Is it time invariant ?

Figure 1

5. The accumulator is excited by the sequence $x[n] = nu[n]$. Accumulator can be defined by following input and output relationship

$$y[n] = \sum_{k=-\infty}^{n} x(n)$$

Determine its output under the condition

(1) It is initially relaxed

(2) Initially $y(-1) = 1$

OR

Determine whether each of the following statements concerning LTI systems is true or false. Justify your answers :

(i) If h(t) is the impulse response of an LTI system and h(t) is periodic and non zero, the system is unstable.

(ii) The inverse of a causal LTI system is always causal.

(iii) If a discrete-time LTI system has an impulse response h[n] of finite duration, the system is stable.

(iv) If an LTI system is causal, it is stable.

(v) The cascade of a non-causal LTI system with a causal one is necessarily non-causal.

6. Find the $\frac{Y(s)}{X(s)}$ for a given Figure 2.

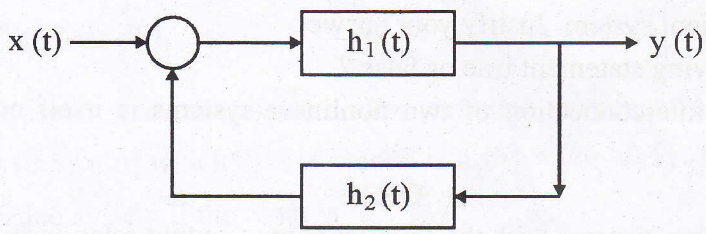


Figure 2

OR

Prove that for function $x[n] = a^{|n|}$ for a < 1, Fourier transform will be

$$x(e^{jw}) = \frac{1 - a^2}{1 - 2a\cos w + a^2}$$

7. Prove the fact that a continuous time LTI system is BIBO stable if and only if the impulse response is absolutely integrable-that is, if and only if.

$$\int_{-\infty}^{\infty} |h(\tau)|\, d\tau < \infty$$

OR

Define invertible system and prove that for invertible system.

$h[n] * h^{inv}[n] = \delta[n]$

Where h[n] is the impulse response of LTI system and inverse system with impulse response $h^{inv}[n]$.