



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

PAPER ID : 131404

Roll No.

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B. Tech.
(SEM. IV) THEORY EXAMINATION, 2014-15
SIGNALS AND SYSTEMS

Time : 3 Hours]

[Total Marks : 100

- Note : (1) Attempt all questions.
(2) All questions carry equal marks.

1 Attempt any four parts of the following : 5×4=20

(a) Find the fundamental period of the signal :

$$x(t) = \sin (5t) + \cos (7\pi t)$$

(b) For the D.T. signal $x(n]$ shown in figure 1, plot the following transformed signals :

(i) $x [-2n+3]$ (ii) $-3x [n+4]$

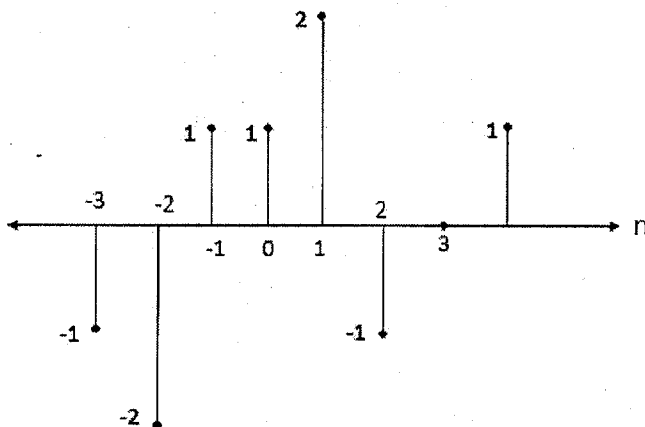


Fig.1

- (c) Determine and sketch the even and odd components of the continuous time signal :

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

- (d) (i) What is a Sinc pulse ?
 (ii) Explain Signum function.

- (e) Consider $x(t) = \cos(2\pi ft + \Phi)$. Is it a power signal or an energy signal ?

- (f) Plot the following signal :

$$x(t) = u(t) + 2u(t-1) + 3u(t-2) - 4u(t-3) - 2u(t-5)$$

2 Attempt any four parts of the following : 5×4=20

- (a) Calculate the Laplace Transforms of the following Signal :

$$x(t) = e^t \frac{d}{dt} \left(e^{(-2t)} u(-t) \right)$$

- (b) State and prove the Initial Value Theorem for a function, $f(t)$.
 (c) Solve the following differential equation and calculate the impulse response of this LTI system when :

$$\frac{d^2 y(t)}{dt^2} + 3 \frac{dy(t)}{dt} + 2y(t) = \frac{d^2 x(t)}{dt^2} + 4 \frac{dx(t)}{dt} + x(t)$$

- (i) the System is Causal
 (ii) the system is stable.
 (d) Calculate the Initial and Final values of the signal $x(t)$, whose Laplace Transform is given as :

$$X(s) = \frac{s^2 + s - 5}{s^3 + 3s^2 + 5s + 3}$$

- (e) Determine the system function and impulse response for the causal LTI system described by the difference equation :
 $y(n) - y(n-1) + 1/4y(n-2) = x(n)$
 (f) Find the Z transform of : $x(n) = [a^n \cos(\omega_0 n)] u(n)$

3 Attempt any four parts of the following : 5×4=20

- (a) Calculate the Fourier Transform of the signal $x(t)$ shown in Fig 2. (using differentiation and integration properties of Fourier Transform)

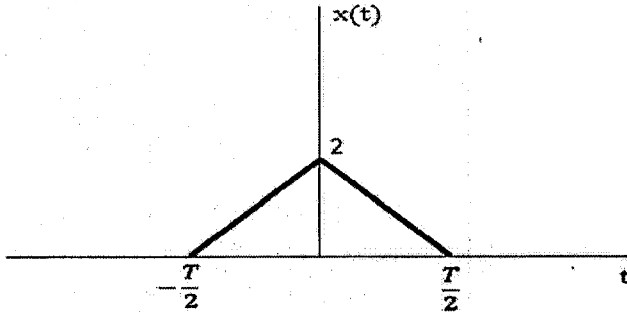


Fig. 2

- (b) State and prove the Convolution theorem for two discrete-time signals.
- (c) Find the Fourier Transform of the signal :
 $x(t) = \text{sinc}(t)$
- (d) Compute the DTFT of the signal : $x[n] = a^{|n|}$ where $0 < a < 1$.
- (e) Determine and sketch the spectrum of the signal :
 $f(t) = m(t) \cos(2\pi f_0 t)$, where the spectrum of the signal $m(t)$ is represented as $M(f)$.
- (f) Prove Parseval's theorem, for DTFT.

4 Attempt any two parts of the following : 10×2=20

- (a) If $x[n]$ denotes input and $y[n]$ denotes the output of the system, then determine that whether or not the system is:
- (i) Static
 - (ii) Causal
 - (iii) Linear
 - (iv) Time-Invariant
 - (v) Stable
 - (vi) Invertible

The input-output relationship is given as :

$$y[n] = \cos(x[n])$$

- (b) (i) Calculate the convolution of the following sequences :
 $x_1[n] = \{1,2,3,4\}$ $x_2[n] = \{1,1,2,3\}$
- (ii) Check the following discrete time system for Linearity, Causality and Time Invariance :
 $y[n] = n x[n^2]$
- (c) Compute the convolution integral $y(t) = x(t) * h(t)$, where :
 $x(t) = u(t) - u(t-2)$ $h(t) = e^{-t} u(t)$

5 Attempt any two parts of the following : 10×2=20

- (a) Design an RC high pass filter and determine the following characteristics of the filter :
- (i) Impulse response and step response.
- (ii) Derive an expression showing that the Rise Time is inversely proportional to the 3-dB Bandwidth of the filter.
- (iii) Also comment upon the Stability and Causality of this system.
- (b) Obtain Canonical Direct form, Cascade and Parallel realizations of the transfer function given as :

$$H(z) = \frac{1 - \frac{7}{4} Z^{-1} - \frac{1}{2} Z^{-2}}{1 - \frac{1}{4} Z^{-1} - \frac{1}{8} Z^{-2}}$$

- (c) Given the frequency response :

$$H(j\omega) = \frac{a - j\omega}{a + j\omega}$$

Find :

- (i) Impulse response, $h(t)$
- (ii) Differential equation describing the system
- (iii) Group delay of the system
- (iv) Magnitude Response of the system.