Printed Pages : 4

EEC-404

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

PAPER ID : 131404

Roll No.

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]

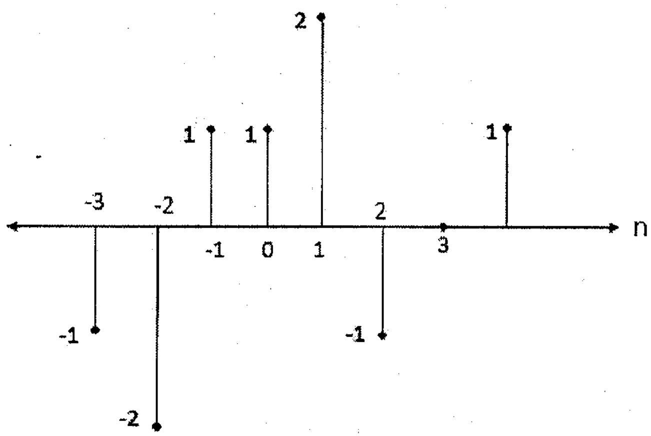

Fig.1

(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 $x(t) = \cos\left(2\pi ft+\Phi\right)$. 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 :

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

(i) the System is Causal

(ii) the system is stable.

(d) Calcualte 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 : $x(n) = [a^n \cos(w_0 n)] u(n)$

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)

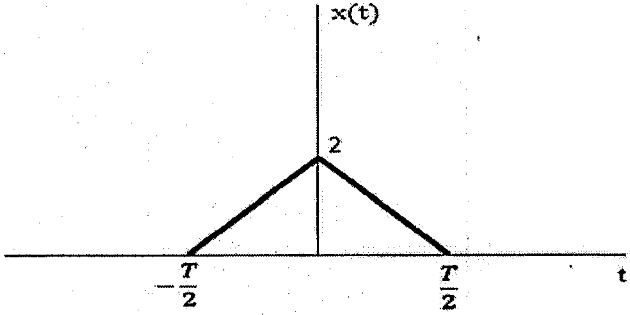

Fig. 2

(b) State and prove the Convolution theorem for two discrete-time signals.

(c) Find the Fourier Transform of the signal :
x(t) = 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 : $f(t) = m(t)\cos\left(2\pi f_0 t\right)$, 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 rerponse, h(t)

(ii) Differential equation describing the system

(iii) Group delay of the system

(iv) Magnitude Response of the system.