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

PAPER ID : 131404 Roll No.

B.Tech.

(SEM. IV) THEORY EXAMINATION 2013-14

SIGNALS AND SYSTEMS

Time : 3 Hours *Total Marks : 100*

Note :– Attempt **all** questions. All questions carry equal marks.

1. Attempt any **four** parts of the following : **(5×4=20)**

(a) Determine whether the following signal is periodic. If the signal of periodic find the fundamental period

$$y(t)=3\sin(t)+5\cos\left(\frac{4}{3}\right)t$$

(b) Sketch the following signals :

(i) $u(-t+1)$

(ii) $-2u(t-1)$

(iii) $3r(t-1)$

(iv) $-2r(t)$

(v) $r(-t+2)$

(c) Determine and sketch the even and odd components of the discrete time signal $x(n)=\begin{cases}1; & 0\le n\le 4\\ 0; & \text{otherwise}\end{cases}$

(d) Consider $x(t) = \cos 2\pi f_o t$. Is it a power signal ?

(e) Prove that the product of an even signal and an odd signal is odd.

(f) A discrete time signal x(n) is shown in figure 1.

Determine :

(i) x (2n –1)

(ii) x (n + 1)

(iii) x (2n)

(iv) x (2n + 1)

(v) x (–n + 1)

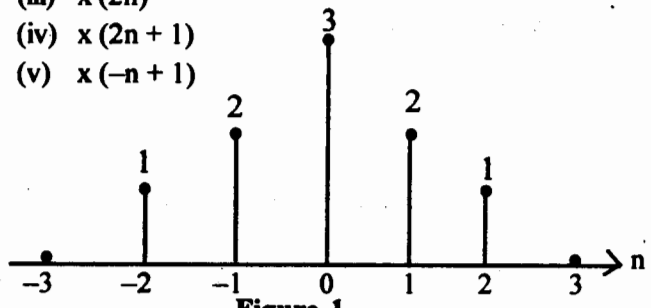


Figure 1

2. Attempt any **four** parts of the following : **(5×4=20)**

(a) Find the Laplace Transform of the signal : $x(t) = e^{-b|t|}$ and find the ROC.

(b) Consider an LTI system with system function :

$$H(S)=\frac{S-1}{(S+1)(S-2)}$$

Find the impulse response with ROC>2.

(c) Using Laplace transform, solve the following differential equations

$$\frac{d^2y(t)}{dt^2}+3\frac{d\,y(t)}{dt}+2y(t)=\frac{d}{dt}x(t).$$

It $y(0^-)=2$ and $\frac{dy}{dt}(0^-)=1$ and $x(t)=e^{-t}\,u(t)$

(d) Find the unilateral z – Transform of

$$x(n)=\left(\frac{1}{2}\right)^n u(n)+\left(\frac{1}{3}\right)^n u(n)$$ and sketch the ROC.

(e) If $x(z)=\frac{z}{3z^2-4z+1}$ find x(n), $n \geq 0$, given that ROC of x(z) is $|z| > 1$.

(f) Find the convolution of two signals x(n) = u(n) and $y(n) = a^n u(n)$, where $|a| < 1$.

3. Attempt any **two** parts of the following : **(10×2=20)**

(a) Find the Fourier transform of the following and sketch the magnitude and phase spectrum of $x(t) = e^{-2t} u(t)$.

(b) (i) Determine the time-domain signal x(t) corresponding to the Fourier transform

$$x(jw)=\frac{1}{(jw)^2+7(jw)+12}$$

Find the DTFT of $y1(n)= x(n)\cos(0.4\pi n)$.

(ii) Find the discrete time signal x(n) for the Fourier transform

$$x(jw)=\begin{cases} 2j; & 0<w\leq\pi \\ -2j; & -\pi<w\leq 0 \end{cases}$$

(c) A signal x(n) has its DTFT given by

$$x(e^{jw})=\frac{1}{1-ae^{-jw}}$$

Find the DTFT of $y_1(n) = x(n) \cos (0.4\ \pi n)$

4. Attempt any **two** parts of the following : **(10×2=20)**

(a) (i) Check whether the system

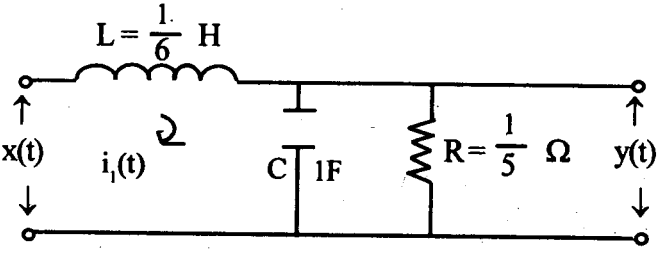
$$y(n)= x(n)+\frac{1}{x(n-1)}$$ is causal or not.

(ii) A continuous-time system is described by the following differential equation

$$2\frac{dy(t)}{dt}+5\,y(t)= x(t)$$

Is this system linear ? Justify your answer.

(b) For the circuit show in figure 2, determine the impulse response and step response. Show that it is stable in the BIBO sence.



(c) What are the properties of convolution ? Determine the convolution sum and sketch step by step of two sequences

$x(n)=\{1,4,3,2\}$; $h(n)=\{1,3,2,1\}$

5. Attempt any **two** parts of the following : **(10×2=20)**

(a) A second-order DT system is described by the following difference equation

$y(n) - y(n-1) + 0.25\, y(n-2) = x(n)$

Determine (i) its system function, h(z) (ii) its unit-sample response sequence, h(n) (iii) its step response, g(n) and its transfer function $H(e^{jw})$.

(b) Obtain canonical direct form and cascade realization for the system described by the following differential equations

$$\frac{d^2y(t)}{dt^2}+14\frac{dy(t)}{dt}+24y(t)=\frac{dx(t)}{dt}+3x(t)$$

(c) Find the voltage transfer functions H(s), of the following :

(i) The L-section RC high pass filter

(ii) The L-section LC low pass filter.