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

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

B.Tech.

(SEM IV) EVEN SEMESTER THEORY EXAMINATION, 2009-2010

SIGNALS AND SYSTEMS

Time : 3 Hours *Total Marks : 100*

Note : *(i) Attempt **all** questions.*

*(ii) All questions carry **equal** marks.*

1. Attempt **any four** parts of the following :

(a) Let $x_1(t)$ and $x_2(t)$ be periodic signals with fundamental periods T_1 and T_2 respectively. Under what conditions is the sum $x(t) = x_1(t) + x_2(t)$ periodic, and what is the fundamental period of $x(t)$ if it is periodic.

(b) Find Even and Odd part of the signal $x(t)$ as shown in fig. 1 (b).

(c) A signal $x(t)$ is as shown in fig. 1(c) sketch and label carefully, the signal $x(4-(t/2))$.

(d) Define a Random Signal. In what terms, we analyze a Random Signal ?

(e) Prove that a signal can not be both an energy and a power signal.

(f) Show how the Impulse function can be defined as a sequence of :

(i) Triangular function ?

(ii) Sampling function, where all operations on Impulse function are viewed as operations on the sequence ?

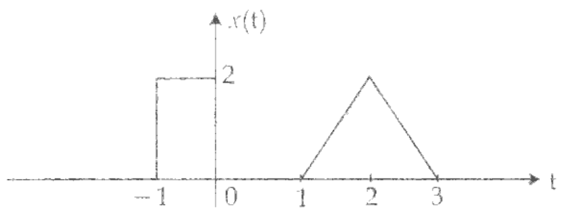

Figure - 1 (b) / Figure - 1 (c)

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

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

B.Tech.

(SEM IV) EVEN SEMESTER THEORY EXAMINATION, 2009-2010

SIGNALS AND SYSTEMS

Time : 3 Hours *Total Marks : 100*

Note : *(i) Attempt **all** questions.*

*(ii) All questions carry **equal** marks.*

1. Attempt **any four** parts of the following :

(a) Let $x_1(t)$ and $x_2(t)$ be periodic signals with fundamental periods T_1 and T_2 respectively. Under what conditions is the sum $x(t) = x_1(t) + x_2(t)$ periodic, and what is the fundamental period of $x(t)$ if it is periodic.

(b) Find Even and Odd part of the signal $x(t)$ as shown in fig. 1 (b).

(c) A signal $x(t)$ is as shown in fig. 1(c) sketch and label carefully, the signal $x(4-(t/2))$.

(d) Define a Random Signal. In what terms, we analyze a Random Signal ?

(e) Prove that a signal can not be both an energy and a power signal.

(f) Show how the Impulse function can be defined as a sequence of :

(i) Triangular function ?

(ii) Sampling function, where all operations on Impulse function are viewed as operations on the sequence ?

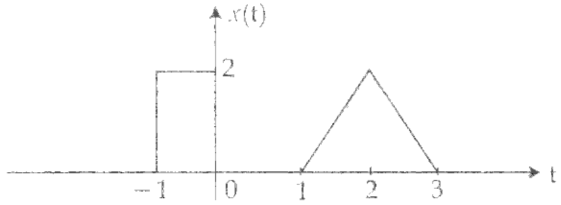

Figure - 1 (b) / Figure - 1 (c)

2. Attempt **any four** parts of the following :

(a) A signal $x(t)$ has the Laplace Transform $X(s) = (s+2)/(s^2+4s+5)$. Find the Laplace Transform of the following signal : $y(t) = x(2t-1)\ u\ (2t-1)$.

(b) Determine the Laplace Transform and the associated region of convergence and pole - zero plot for the following function of time : $x(t) = \delta(3t) + u(3t)$.

(c) Determine the system function (and specify the region of convergence) for the causal LTI system with difference equation $y[n] - \frac{1}{2}y\ [n-1] + \frac{1}{4}y[n-2] = x[n]$.

(d) Using z - transform determine y[n] for the system as described in part (c) above, if input $x[n] = (1/2)^n\ u[n]$ is applied to this system.

(e) Let h(t) be a right sided Impulse Response of a system and its Laplace Transform is given by : $H(s) = 10(-s+1)/((s+10)\ (s+1))$

Find the differential equation describing the system, and determine if the system is causal ?

(f) Let H_1 (s) be the transfer function of a stable but non - causal Inverse system of H(s) as described above in part (e), i.e. H_1 (s) H(s) = 1. Find H_1 (s) and its region of convergence.

3. Attempt **any two** parts of the following :

(a) (i) Find Fourier Transform of $f_1(t)$ as shown in fig.3 (a) (i), using time - differentiation property.

(ii) Find Inverse Fourier Transform of $F_2(\omega)$, as shown in fig. 3 (a) (ii), using result of part (i) and applying Duality property.

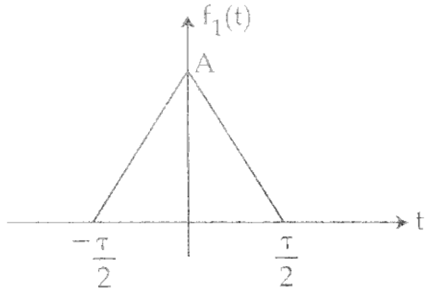

Figure - 3 (a) (i)

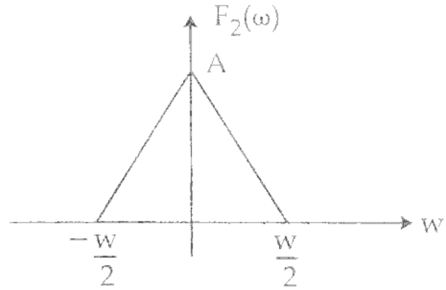

Figure - 3 (a) (ii)

(b) A causal and stable LTI System S has the property that $(4/5)^n\ u[n] \rightarrow n(4/5)^n\ u[n]$

(i) Determine the frequency response $H(e^{j\omega})$ for the system S.

(ii) Determine a difference equation relating any input x[n] and the corresponding output y[n].

(c) According to a general form of Parseval's theorem

$$\sum_{n=-\infty}^{\infty} x[n]y^*[n] = \frac{1}{2\pi}\int_{-\pi}^{\pi} X(e^{jw})Y^*(e^{jw})dw$$

Using this result determine the sum of the following infinite series :

$$\sum_{n=-\infty}^{\infty} \frac{\sin\left(\frac{\pi n}{4}\right)}{2\pi n}\ \frac{\sin\left(\frac{\pi n}{6}\right)}{5\pi n}$$

4. Attempt **any two** parts of the following :

(a) In particular, a system may or may not be Memoryless, Time Invariant, Linear, Causal and Stable. Determine which of these properties hold and which do not hold for each of the following systems.

(i) $y(t) = x(t-2) + x(2-t)$

(ii) $y[n] = n\, x[n]$

(iii) $y(t) = \int_{-\infty}^{2t} X(\tau)d\tau,$

(iv) $y[n] = Ev\,\{x[n-1]\}$

(b) (i) Consider an LTI system with input and output related through the equation

$$y(t) = \int_{-\infty}^{t} e^{-(t-\tau)} x(\tau-2)d\tau,$$

What is the impulse response h(t) for this system ?

(ii) Determine the response of the system when the input x(t) is as shown in the fig.4 (b) (ii).

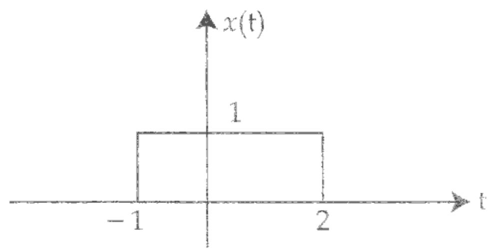

Figure - 4 (b) (ii)

(c) The power spectral density of a random process X(t) is as shown in fig. 4 (c). It consists of a delta function at f=0 and a triangular component. Determine and sketch the autocorrelation function Rx(τ) of X (t).

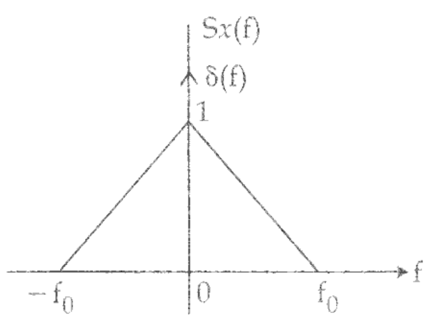

Figure - 4 (c)