T. E. (Electronics) (Sem V) (Rev) 8/12/06
Continous Time Signals & Systems

Nov. 1 Pr. 127
Con. 4677-06.

(REVISED COURSE)

YM-6694

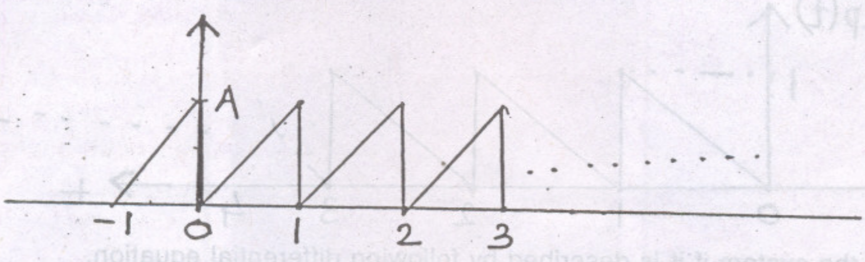
(3 Hours) [Total Marks : 100

N.B. (1) Question No. **1 is compulsory** and answer any **four** questions out of remaining.
(2) Assume suitable data, if **necessary** with proper justifications.

1. Attempt any **four** of the following :– **20**
   (a) Find whether signal is Periodic or Aperiodic. Given $x(t) = x_1(t) + x_2(t)$,where $x_1(t)$ and $x_2(t)$ are two Sinusoid with frequencies f_1 and f_2 given below–
      (i) $f_1 = \frac{\sqrt{3}}{2}$ Hz , $f_2 = \frac{1}{\sqrt{12}}$ Hz
      (ii) $f_2 = \sqrt{5}$ KHz, $f_1 = 3$ Khz
   (b) Find whether following signal is Energy or power. Find corresponding Energy or power.
   $$x(t) = u(t) + u(t-1) + 2u(t-3) - u(t-5) - 3u(t-7).$$
   (c) Find even and odd components of the signal–
      (i) $x(t) = \sin t + \cos t + \sin t \cdot \cos t$
      (ii) $x(t) = 1 + t + 2t^2$.
   (d) Evaluate following–
   $$\int_{-3}^{6}\left(6-t^2\right)\left[\delta(t+4)+2\delta(2t+4)\right]dt.$$
   (e) Find Initial and Final Value for X(s)
   $$X(s) = \frac{(2s+3)}{s^2+5s+1}.$$

2. (a) Classify system as Linear/Nonlinear, causal/Non causal, Time variant/Time invariant, memory/Memoryless **4**
      (i) $y(t) = \sin t \cdot x(t)$
      (ii) $y(t) = \sin[x(t)]$.
   (b) Convolve following signals in time domain **8**
   (do not use Transform)
   $x_1(t) = u[t+0.5] - u[t-0.5] = x_2(t)$.
   (c) If $x(t) \overset{FT}{\longleftrightarrow} x(w)$ then prove that– **8**
   $$F_1[x_1(t) \cdot x_2(t)] = \frac{1}{2\pi}[x_1(w) * x_2(w)]$$

3. (a) Obtain Trignometric Fourier Series Expansion for the signal shown below. Also find corresponding coefficients of exponential F.S. **12**



   (b) S.T. set of functions $e^{jkw_0 t}$ are orthogonal over the interval [O, T] where $T = 2\pi/w_0$, hence find corresponding orthonormal set. **8**

4. (a) Sketch. 8

$x(t) = 2u(t) + 2r(t-2) - 4r(t-3) + 2\,r(t-4) - 2u\,(t-6)$ hence perform–

(i) $x(2t)$ (ii) $x(-t+2)$

(b) Find Fourier Transform of unit step function using signum function. Using this result and property of Fourier Transform, Find Fourier Transform of– 8

$x(t) = \sin(w_o t) \cdot u(t)$. State property used.

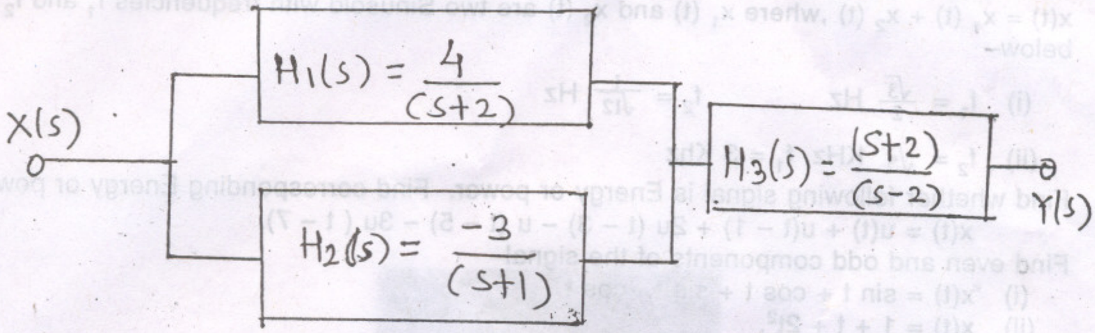
(c) If $x(t) \xleftrightarrow{FT} X(w)$ Then prove that – 4

$$F[-jt\,x(t)] = \frac{d\times(w)}{dw}.$$

5. (a) If $\cos 2t\, u(t) \longleftrightarrow X(s)$ determine time domain signal corresponds to following signals using property of Laplace Transform. Clearly state the properties used. **8**

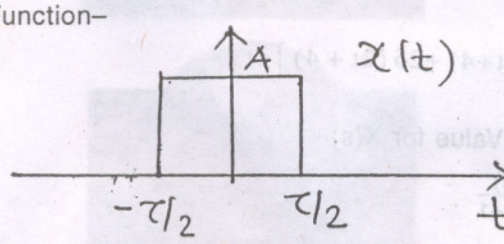
(i) $SX(s) - 1$ (ii) $X(2s)$ (iii) $X(s + 1)$ (iv) $S^{-1} X(s)$

(b) Find impulse response of the overall system. **4**

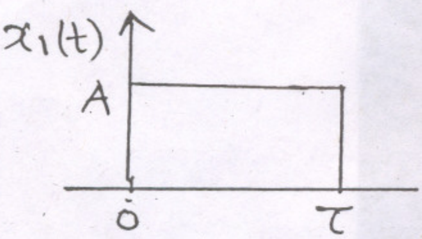


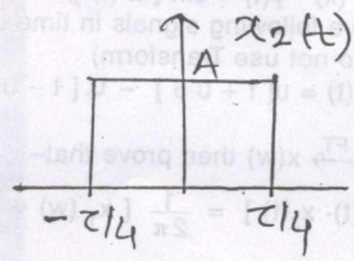
State whether system is stable.

(c) (i) Find the F.T. of Gate Function– **8**

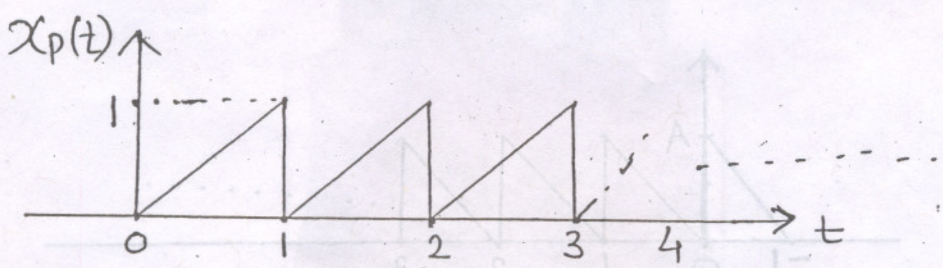


(ii) Using above result and property of Fourier Transform. Find F.T. of $x_1(t)$ and $x_2(t)$. State property used.





6. (a) Find Laplace Transform of following Periodic signal. **6**



(b) Find o/p of the system if it is described by following differential equation. **10**

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

with initial conditions $y(o^-) = 1$, $\frac{d}{dt}\, y(o^-) = -1$

with i/p $x(t)\ e^{-2t}\ u(t)$.

(c) State Sampling Theorem. **4**

if $x(t) = 3 \cos(150\,\pi\, t) + 2 \cos(250\,\pi\, t)$.

What is the Nyquist rate for this signal ?

7. (a) If $\begin{bmatrix} \dot{x}_1(t) \\ \dot{x}_2(t) \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -4 & -2 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} + \begin{bmatrix} 0 \\ 6 \end{bmatrix} u(t)$ **12**

and $y(t) = x_1(t)$,

(i) Determine Transfer Function.

(ii) Find impulse response of the system.

(b) The system is described by following differential equation. **8**

$y'''(t) + 2\,y''(t) + 3\,y'(t) + 4y(t) = u(t)$.

Construct a state variable model.