T.E. (Electronics) Sem V / Rev.

Continous Time Signal Systems

D438 : 1stHf07

Con. 2407-07. (REVISED COURSE) ND-9432

(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 Energy Signal or Power Signal. Find corresponding Energy/Power —
$x(t) = u(t) - u(t-10)$

(b) Evaluate the following :—

$$\int_{-2}^{4} \left(2+t^2\right)\delta(t-1) + \int_{-1}^{1} t^2\,\delta(t+4)\,dt .$$

(c) Find whether Periodic or Aperiodic Signal, if

(i) $x(t) = e^{j(\pi/4)t}$

(ii) $x(t) = \sin(12\pi t) + 2\sin(18\pi t)$.

(d) Classify system as Linear/Nonlinear, Causal/Noncausal, Time variant/Time invariant, memory/memoryless

(i) $y(t) = x(-t)$
(ii) $y(t) = 2x(t) + 3$.

(e) What is the condition for system to be stable in time domain ? If $h(t) = e^{-t}u(t)$, find L.T., Is the system stable in Laplace domain ?

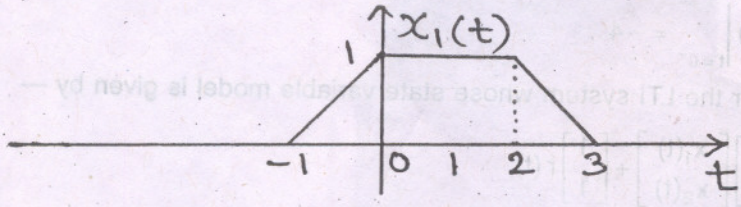
2. (a) Plot $x(t) = 4r(t) - 4r(t-2) - 8r(t-5) + 8r(t-6)$. 6

(b) Perform convolution in time domain (do not use Transform) 8
if $x(t) = t\,u(t)$, $h(t) = e^{-t}$ for $t \geq 0$
$= 0$ otherwise.

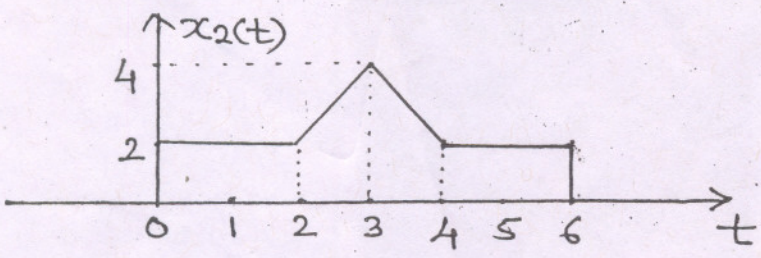
(c) State and prove modulation property in Fourier Transform. 6

3. (a) Signal $x_1(t)$ is shown in **figure** below : Sketch and label the following signals :— 12

(i) $x_1(t)\cdot u(t)$ (iii) $x_1(t+2) - x_1(t-2)$
(ii) $x_1(t)\,u(-t)$ (iv) $x_1(-t-2)$



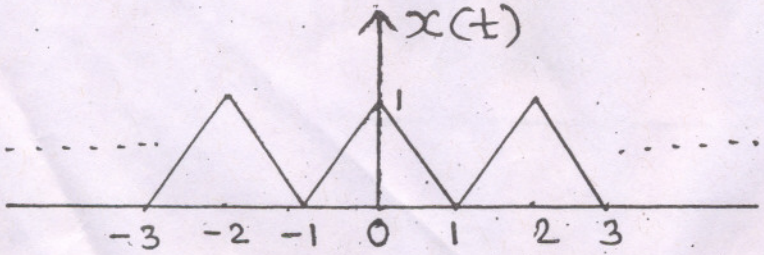
(b) Express $x_2(t)$ as shown in **figure** in terms of steps and/or ramp. 4



(c) State Initial and Final Value Theorem in Laplace Transform. Also find initial and final value if — 4

$$X(S) = \frac{S+10}{S^2+3S+2} .$$

4. (a) Find exponential Fourier Series expansion for the signal shown below. Also find corresponding coefficients of trignometric Fourier series by using the relationship between Trignometric and Exponential F.S. **10**



(b) Prove that set of signals { sin $n\omega_0 t$ } forms an orthogonal set over the interval { 0, $2\pi/\omega_0$ } 5

(c) If $x(t) \xleftrightarrow{F.T.} X(\omega)$, then prove that 5

If $\frac{d}{dt}x(t) \xleftrightarrow{F.T.} (j\omega)\, X(\omega)$.

5. (a) Find Laplace Transform of following signals :— 10

(i) $x(t) = \sin(2t + 35°)$

(ii) $x(t) = (2t - 1)\, u(t - 2)$

(iii) $\frac{d}{dt}[2\cos(3t)\, u(t)]$.

(b) The I|P signal to an LTI system having an impulse response h(t) is $x(t) = e^{st}$. Show that O|P of the system y(t) is given by signal $y(t) = e^{st} H(S)$. 4

(c) Determine Inverse Laplace Transform of — 6

$$X(S) = \frac{e^{-4s}}{S^2 - 2S - 3}$$

for causal condition ? Is System Stable ?

6. (a) Find Fourier Transform of Gate Function. 6

(b) Using Result in (a) and not otherwise find Fourier Transform of — 8

(i) $x_1(t) = \delta(t)$ (ii) $x_2(t) = A$.

(c) Find Fourier Transform of single sided exponential using above result. Find Fourier Transform of 6

$h(t) = \frac{1}{RC} e^{-t/RC} u(t)$. Also find its magnitude response by considering RC = 1.

7. (a) Find zero i/p response, zero state response and total response of the system. If — 10

$$\frac{d^2}{dt^2} y(t) + 7\frac{d}{dt} y(t) + 12\, y(t) = u(t)$$

subjected to initial condition

$$y(0^-) = 2 \quad \text{and} \quad \frac{d}{dt} y(t)\Big|_{t=0^-} = -4 .$$

(b) Calculate the state vector for the LTI system whose state variable model is given by — 10

$$\begin{bmatrix} \dot{x}_1(t) \\ \dot{x}_2(t) \end{bmatrix} = \begin{bmatrix} -1 & 0 \\ 0 & -2 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} r(t)$$

where r(t) is the unit step function occuring at t = 0 and $x^T(0) = [\, 1, 0 \,]$.