Con. 5767-07.

(REVISED COURSE)

(3 Hours) [Total Marks : 100

N.B. (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions from remaining questions.
(3) Assume **suitable** data if **necessary** with proper **justifications**.

1. (a) Show that the product of two even signals or two odd signals is an even signal and that product of an even and odd signal is odd signal. **5**

(b) $x_1(t)$ and $x_2(t)$ are periodic signals with fundamental periods T_1 and T_2 respectively. Under what conditions the sum $x(t) = x_1(t) + x_2(t)$ is periodic, and what is fundamental period if x(t) is periodic ? **5**

(c) Determine whether the following signals are energy signals, power signals or neither :— **5**

(i) $x(t) = e^{-at} u(t)$, $a > 0$

(ii) $x(t) = t\, u(t)$

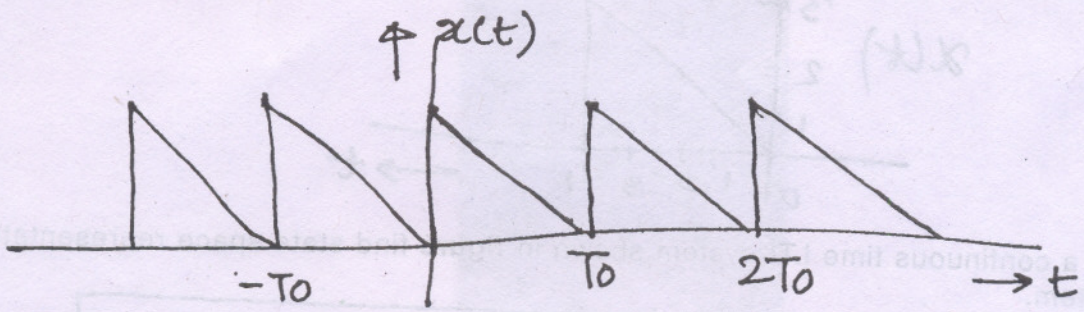
(d) Prove that $\delta(at) = \frac{1}{|q|}\delta(t)$ **5**

2. (a) Show that following signals are orthogonal over an interval [0, 1] : **6**

$f(t) = x(t)$ $\quad x(t) = \sqrt{3}(1-2t)$

(b) Explain Gibb's phenomenon. **4**

(c) For the waveform x(t) shown in **figure**, find traingular Fourier Series using differentiation technique. **10**



3. (a) A continuous time system whose input x(t) and output y(t) ar related by :—

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

where a is constant.

(i) Show that system is not linear if $y(0) = y_0 \neq 0$. **4**

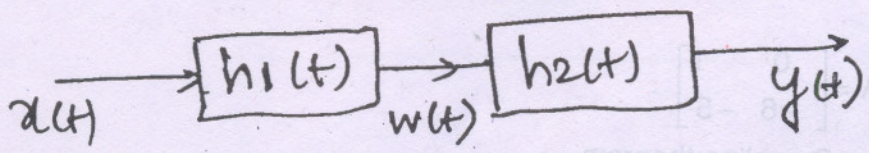
(ii) Show that system is linear if $y(0) = 0$. **4**

(b) Evaluate $\int_{-3}^{6} (6-t^2)\,[\,\delta(t+4) + 2\delta(2t+4)]\,dt$ **4**

(c) System shown below is formed by connecting two systems is cascade with **8**

$h_1(t) = e^{-2t} u(t)$ $\quad h_2(t) = 2e^{-t} u(t)$

Find impulse response h(t) of overall system



Do not use transform method.

4. (a) Find Fourier transform of a gate function. 6
   (b) Using results in (a) and not otherwise find Fourier transform of : 8
   (i) $x_1(t) = \delta(t)$ (ii) $x_2(t) = A$
   (c) State and prove Parseval's theorem. 6

5. (a) Find inverse Laplace transform of : 8

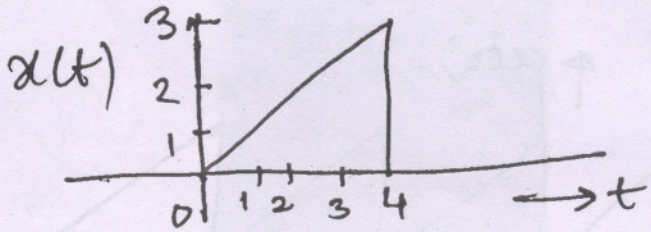
$$X(s) = \frac{2+2se^{-2s}+4e^{-4s}}{s^2+4s+3} \quad Re(s) > -1.$$

   (b) The output y(t) of a continuous LTI system is found to be $2e^{-3t}u(t)$ when input x(t) is u(t).
   (i) Find impulse response h(t) of system. 6
   (ii) Find output y(t) when input x(t) is $e^{-t}u(t)$. 6

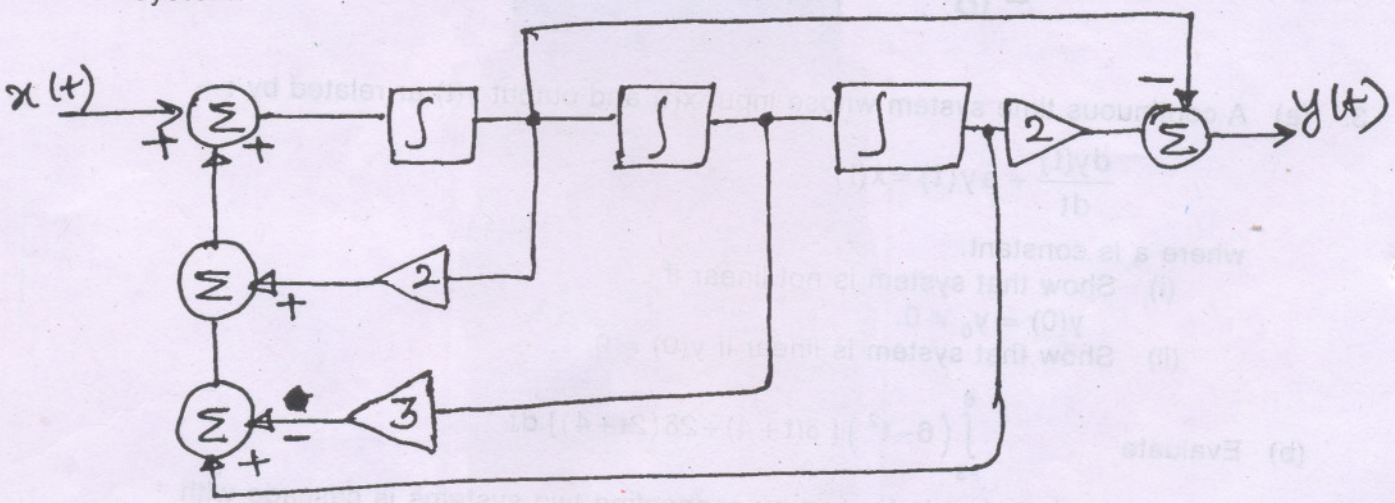
6. (a) Find the response of system 12

$$\frac{d^2y(t)}{dt^2} + \frac{5dy}{dt} + 6y(t) = x(t)$$

   subject to initial conditions $y(0) = 2$, $y'(0) = 1$ and input $x(t) = e^{-t}u(t)$.
   (b) For signal x(t) shown sketch and label 8
   (i) x(t – 2) (ii) x(2t) (iii) x(t/2) (iv) x(– t)



7. (a) For a continuous time LTI system shown in **figure** find state space representation of system. 10



   (b) FInd e^{At} for $A = \begin{bmatrix} 0 & 1 \\ -6 & -5 \end{bmatrix}$. 5
   (c) State and prove Sampling theorem. 5