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CTSS

P4–RT–Exam.–Feb.–13–3–128

Con. 6990–13. **GS–9090**

(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) 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 ?

(b) Find whether following signals are Energy or Powers. Find corresponding Energy / Power if –

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

(ii) $x(t) = \text{rect}\left[\frac{t}{T_0}\right]$

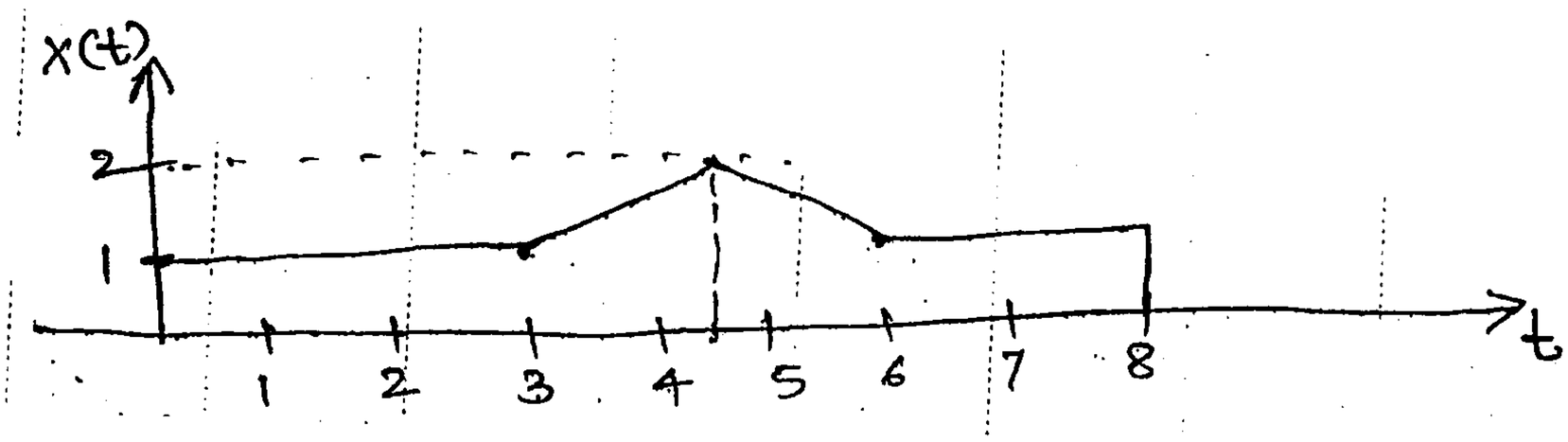
(c) For a system having input output relationship

$$y(t) = \int_{-\infty}^{\infty} x(t)$$

Check – Linearity, time variance, causality and invariability.

(d) State Initial and final value theorem in Laplace Transform. Also find initial and final value if $X(s) = \frac{s+10}{s^2+3s+2}$

(e) Express signal x(t) as shown in figure in terms of steps and/or ramp.



2. (a) Find zero i/p response, zero state response and total response of the system if – **10**

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

Subjected to the initial condition –

$$X(0^-) = 4 \quad \text{and} \quad \left.\frac{dx(t)}{dt}\right|_{t=0^-} = -8$$

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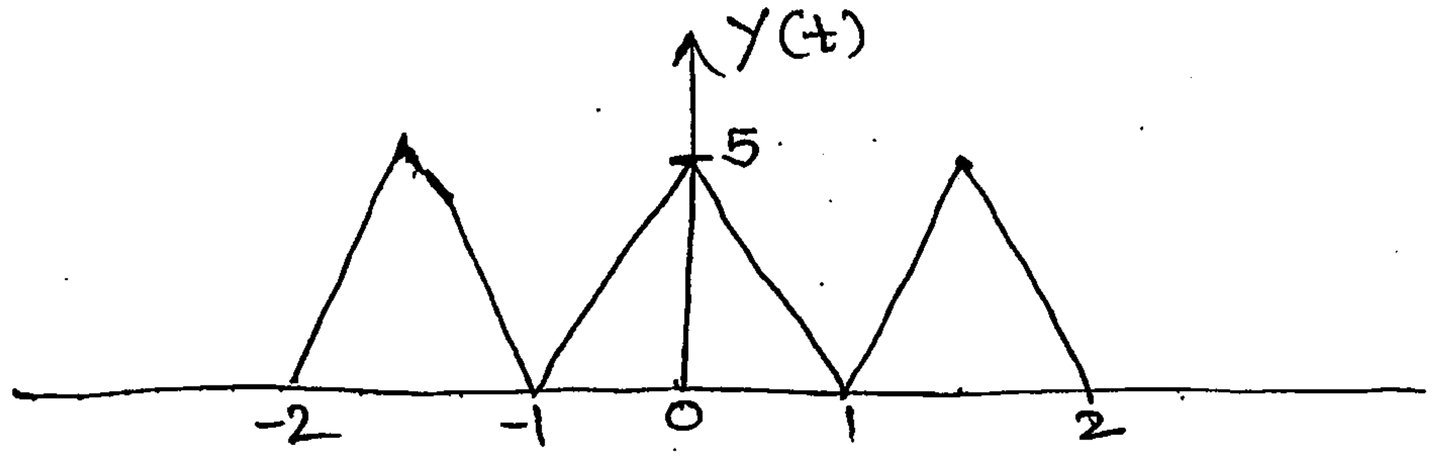
(b) Find exponential Fourier series expansion for the signal shown below. Also find corresponding coefficients of trigonometric Fourier series by using the relationship between Trigonometric and Exponential F.S. **10**



3. (a) Explain convolution theorem and perform convolution in time domain if – **10**

$x(t) = t\ u(t),\quad h(t) = e^{-t}$ for $t \geq 0$

$= 0$ otherwise

(b) For all possible ROC conditions, obtain inverse Laplace Transform of – **10**

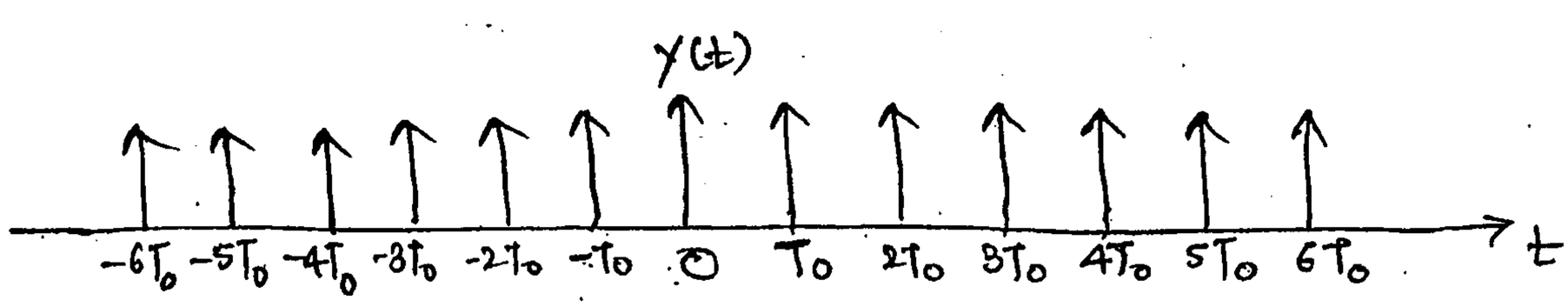
$$X(s) = \frac{5s^2 - 15s - 11}{(s+1)(s-2)^2}$$

4. (a) Compute the following integrals – **10**

(i) $\int_0^{\infty} t^2\ \delta(t-3)dt$ (ii) $\int_0^{5} \text{Sin } 2t\ \delta(t-3)dt$

(iii) $\int_{-\infty}^{\infty} (4-t^2)\ \delta(t+3)dt$ (iv) $\int_{-3}^{8} (6-t^2)\left[\delta(t+4) + 2\delta(2t+4)\right]dt$

(b) Find out exponential Fourier series for impulse train shown below – **10**



Plot its magnitude and phase spectrum.

5. (a) Define random variable and random process. Also draw and explain – **10**
   (i) Pdf of Gaussian Distribution
   (ii) Exponential distribution.

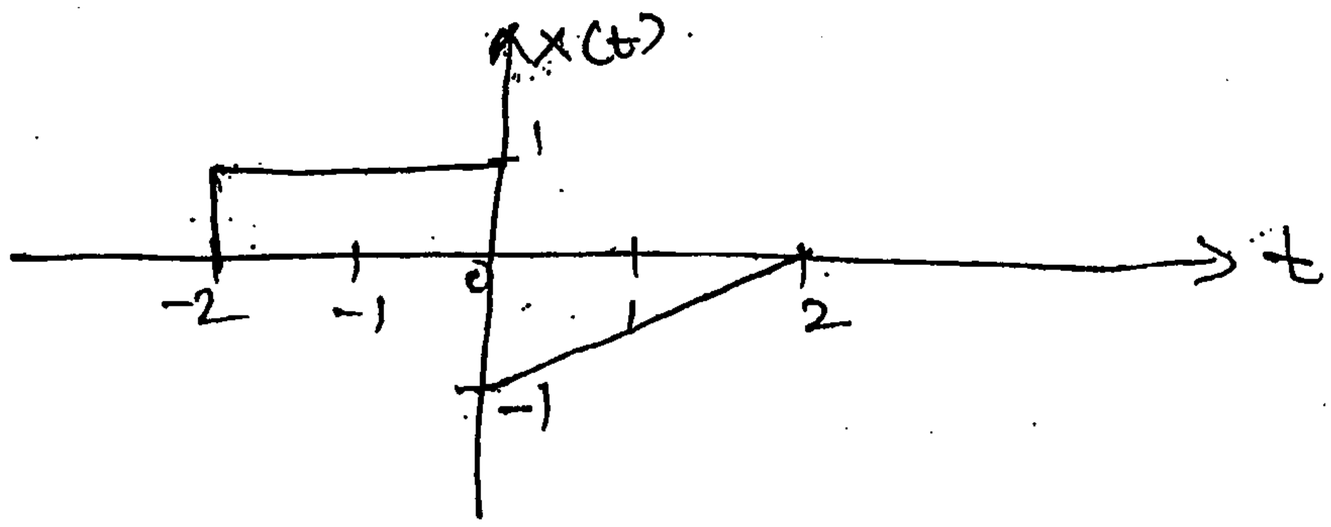
   (b) State and prove frequency shift property of Fourier transform. Explain power spectral density and state all its properties. **10**

6. (a) The T.F. of the system is given as – **10**

$$H(s) = \frac{s^2+s+5}{s^3+6s^2+8s+4}$$

Obtain state variable model using phase valuables.

(b) Signal x(t) is shown in figure below. Sketch and label following signal – **5**
(i) x(2t – 2) (ii) x(t + 5)



(c) Plot x(t) if – **5**

$$x(t) = \left[u(t) + r(t-1) - 2u(t-3)u(-t+5)\right]$$

7. Write short notes on the following :–
   (a) Relation between Fourier transform and Laplace Transform **5**
   (b) Gibb's phenomenon **5**
   (c) Parseval's theorem **5**
   (d) Draw double sided spectrum of – **5**
   $y(t) = 9 + 5\sin(120\pi t) - 10\cos(40\pi t - 60°)$