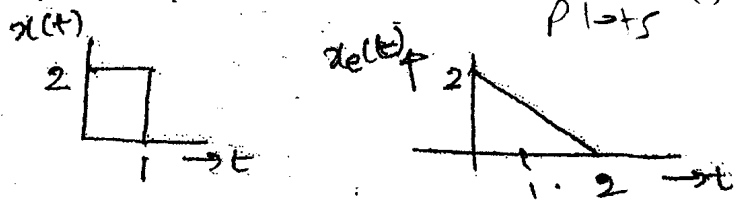KR–5339

(3 Hours)

[Total Marks : 100

N. B. : (1) Question No. 1 is **compulsory**.
      (2) Solve any **four** questions from the remaining.
   (3) Assume **suitable** data if **required**.

1. (a) Derive relation between unit impulse, unit step and unit ramp signals.   20
   (b) **Figure** below shows some part of signal x(t) and its even part for $t \geq 0$. The even part for $t < 0$ is not shown. Complete plots of x(t) and $x_e(t)$
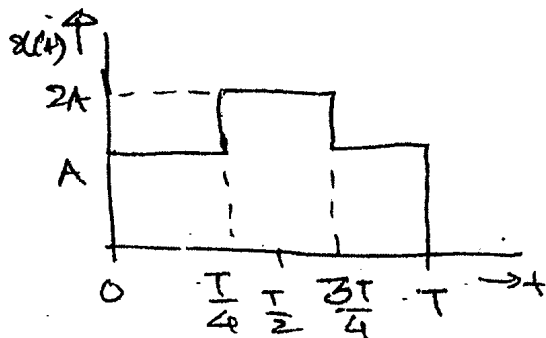

   (c) Give equations and sketch PDF of exponential and Gaussian distribution.

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

2. (a) Convolve the following signals in time domains. Do not use transform. Sketch   10
        the convolved result.
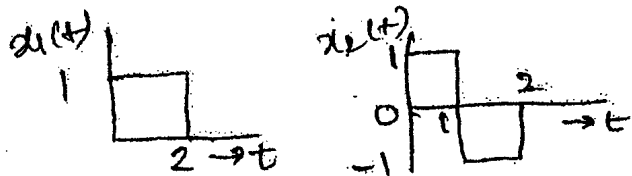
   (b) Using properties of Fourier transform find Fourier transform of signal shown.   10

3. (a) Obtain transfer function for a system having state equation.   10

$$\begin{bmatrix} \dot{x}_1 & (t) \\ \dot{x}_2 & (t) \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \longrightarrow ?$$

   (b) The input $x(t) = e^{-2t}\, u(t)$ is given to system. The output response of system to   10
       input is $y(t) = e^{-t}\, u(t)$. Find impulse response and frequency response of sytsem.

[**TURN OVER**

4. (a) If $u(t) \leftrightarrow X(s)$, determine time domain signal that corresponds to following transform   **10**
domain signals. Use properties only and clearly state them :—
   (i) $SX(s) - 1$ (ii) $X(2s)$ (iii) $X(s+1)$ (iv) $s^{-1} X(s)$

   (b) Find Fourier transform of impulse train shown :   **10**
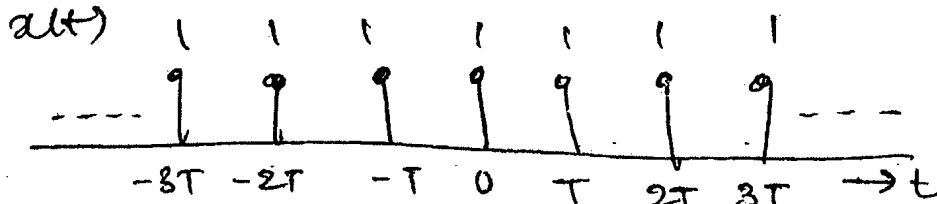
5. (a) State conditions which are required to be satisfied by $x(t)$ for Fourier series to exist.   **5**
   (b) Define ESD and PSD. What is relation of ESD and PSD with autocorrelation ?   **5**
   (c) Sketch $x(t) = 2u(t) + u(t-2) - u(t-4) + r(t-6) - r(t-8)$ **5**
   Hence obtain $x(2t + 2)$ **5**
   (d) Obtain Canonical form of system $\dot{x} = Ax(t) + Bu(t)$ **5**

$$A = \begin{bmatrix} 0 & 1 & 1 \\ 1 & 2 & 3 \\ 0 & 1 & 0 \end{bmatrix} \quad B = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$$

6. (a) State and prove convolution property of Fourier transform.   **5**
   (b) Derive relation between Laplace transform and Fourier transform. Determine   **10**
   Inverse Laplace transform for all possible ROC's of $X(s)$

$$X(s) = \frac{s^2 + 2s + 5}{(s+3)(s+5)^2}$$

   (c) Impulse response of a system is $G(t) = -3 e^{+2t} u(t)$.
   Find whether system is Causal/Non causal and Stable/Unstable   **5**

7. (a) Show single and double sided representation of signal $x(t) = \sin\left[20\pi t - \frac{\pi}{4}\right]$.   **5**
   (b) Find CDF of random variable given below :—   **5**
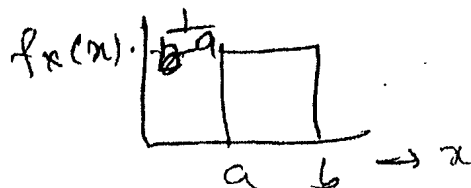
     Plot it

   (c) Explain Rayleigh's energy theorem.   **5**
   (d) Write short note on Random process.   **5**

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Q. 3 a) Obtain transfer function for a system
having state equation

$$\begin{bmatrix} \dot{x}_1(t) \\ \dot{x}_2(t) \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$$

and

$$y(t) = \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix}$$