Total No. of Questions—8] [Total No. of Printed Pages—5

Seat No.	

[5352]-531

S.E. (Elect.&TC) (First Semester) EXAMINATION, 2018

SIGNALS AND SYSTEMS

(2015 PATTERN)

Time : Two Hours **Maximum Marks : 50**

N.B. :— (*i*) Solve question No. Q. **1** *or* Q. **2**, Q. **3** *or* Q. **4**, Q. **5** *or* Q. **6**, Q. **7** *or* Q. **8**.

(*ii*) Neat diagrams must be drawn wherever necessary.

(*iii*) Figures to the right indicate full marks.

(*iv*) Assume suitable data if necessary.

1. (*a*) Perform the following operations and sketch the signals : [6]

(*i*) $y(t) = r(t+1) - r(t) + u(t-2)$

(*ii*) $y[n] = u[n+3] - 2u[n-1] + u[n-4]$

(*b*) Using impulse response properties, determine whether the following systems are : [6]

(*i*) Static/Dynamic

(*ii*) Causal/Non-causal.

P.T.O.

(*iii*) Stable/Unstable :

(1) $h(t) = e^{-2|t|}$

(2) $h(n) = 2\delta[n] - 3\delta[n-1]$.

Or

2. (*a*) Find Even and Odd components of the following signals : [6]

(*i*) $x(t) = 3t + t\cos t + t^2 \sin^2 4t$

(*ii*) $x[n] = \{1, 1, -1, -1\}$.

(*b*) Find convolution of the following, using graphical method : [6]

(*i*) $x[n] = u[n]$

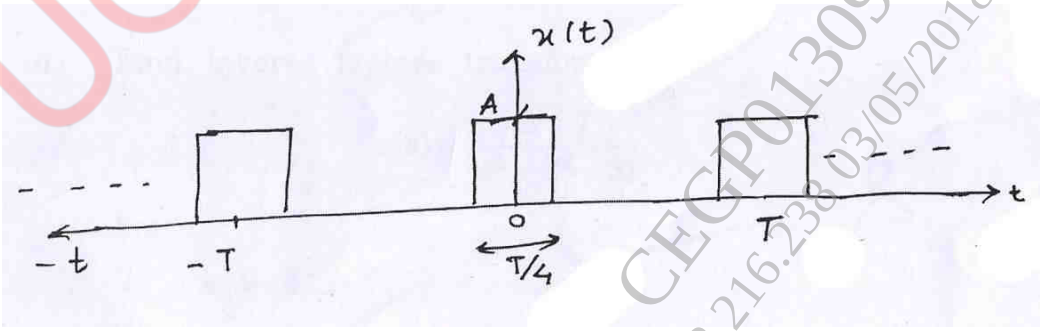
(*ii*) $h[n] = a^n u[n] \quad 0 < a < 1$.

3. (*a*) Find Fourier transform of the following signals using appropriate properties : [6]

(*i*) $x(t) = \frac{d}{dt}\{e^{-at} \cdot u(t)\}$

(*ii*) $x(t) = e^{-2t}\, u(t+2)$.

(*b*) Find and sketch exponential Fourier series of the given signal : [6]



Or

4. (*a*) Find and sketch the trigonometric Fourier series of train of impulse defined as : [6]

$$x(t) = \sum_{k=-\infty}^{\infty} \delta(t - kTs)$$

(*b*) Find Fourier transform of the following signals : [6]

(*i*) $u(t)$

(*ii*) $\text{sgn}(t)$.

5. (*a*) Find Laplace transform of the following :

(*i*) $x(t) = \dfrac{d}{dt}\, t\, e^{-t}\ u(t)$ [3]

(*ii*) $x(t) = e^{-3t} u(t) * \cos(t-2)\, u(t-2)$. [4]

(*b*) Find Initial and Final values of the signal $x(t)$ having unilateral Laplace transform : [6]

(*i*) $X(s) = \dfrac{7s+10}{s(s+2)}$

(*ii*) $X(s) = \dfrac{5s+4}{s^3+3s^2+2s}$.

Or

6. (*a*) Find inverse Laplace transform of : [7]

$$X(s) = \frac{3s+7}{(s^2-2s-3)}.$$

for :

(*i*) $s > 3$

(*ii*) $s < -1$

(*iii*) $-1 < s < 3$.

(*b*) Find transfer function and impulse response of the causal system described by the differential equation : [6]

$$\frac{d^2}{dt^2} y(t) + 5\frac{d}{dt} y(t) + 6y(t) = 2\frac{d}{dt} x(t) - 3x(t).$$

7. (*a*) Find auto-correlation function of the signal given, using graphical method : [6]

$$x(n) = \left\{ \underset{\uparrow}{2, 1, -2, 1, 3} \right\}$$

(*b*) The probability density function of a random variable X is given by : [7]

$$f_X(x) = e^{-x}\ u(x)$$

determine :

(*i*) CDF

(*ii*) $P(X \leq 1)$

(*iii*) $P(1 < X \leq 2)$

(*iv*) $P(X > 2)$.

8. (*a*) The probability density function of a random variable 'X' is given by : [7]

$$f_X(x) = \begin{cases} \frac{1}{a} & |x| \leq a \\ 0 & \text{otherwise} \end{cases}$$

determine :

(*i*) Mean E[X]

(*ii*) Mean square value $E[X^2]$

(*iii*) Standard deviation.

(*b*) State and prove the relationship between auto-correlation and energy spectral density of Energy signal. [6]