[4457] - 182

S.E. (E&TC/ELX) (Semester - I)
SIGNALS & SYSTEMS
(2012 Course)

Time : 2 Hours] *[Max. Marks : 50*

Instructions to the candidates :

1) Attempt four questions Q. 1 or Q. 2 Q. 3 or Q. 4, Q. 5 or Q. 6 and Q. 7 or Q. 8.
2) Figures to the right indicate full marks.
3) Assume suitable data if necessary.
4) Neat diagrams must be drawn wherever necessary.
5) Use of electronic non-programmable calculator is allowed.

Q1) a) Find odd and even components of following signals. **[4]**

     i) $x(t) = 3 - 2t^2 + 6t^3 + 9t^4$.

     ii) $x[n] = u[n]$.

   b) Determine whether the following signals are periodic or aperiodic. If periodic find the fundamental period. **[4]**

     i) $x(t) = 3 \sin(4\pi t) + 7 \cos(3\pi t)$.

     ii) $x[n] = \cos(2n)$.

   c) Find the response of the LTI system for i/p $x(t) = \text{rect}\left(\dfrac{t}{2}\right)$. If the system is described by impulse response. $h(t) = \delta(t+1) - 2\delta(t) + \delta(t-1)$. **[4]**

<div align="center">OR</div>

Q2) a) Sketch the following signals : **[4]**

     i) $x(t) = u(t) + u(t-2) + u(t-4) - 3u(t-6)$.

     ii) $x(t) = \displaystyle\sum_{k=-10}^{10} \delta(t-2k)$.

   b) Classify whether the following system are : **[4]**

     i) Causal/Non-causal.
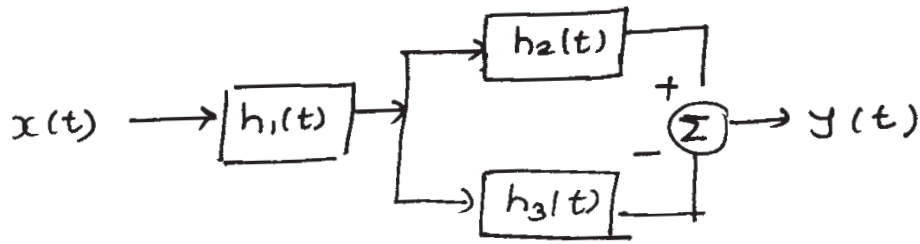
     ii) Stable/unstable.

        I) $h(t) = e^{2t} u(-t)$

        II) $h[n] = \delta[n] + \delta[n-2] - 2\delta[n-3]$.

<div align="right">*P.T.O.*</div>

c) Find the overall impulse response of the system given below : **[4]**

$h_1(t) = \delta(t)$, $\qquad h_2(t) = u(t)$.
$h_3(t) = u(t-2)$.

Q3) a) Find the Fourier Transform of following signals. **[6]**

    i) $x(t) = \text{sgn}(t)$.

    ii) $x(t) = \text{rect}(t)$.

b) Find the transfer function and impulse response of the system describe by following differential equation. **[6]**

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

OR

Q4) a) Using differentiation in frequency domain property. Find Fourier transform of : **[6]**

$y(t) = t\,x(t)$

where $x(t) = e^{-at}\,u(t)$.

b) Find initial and final value of following : **[6]**

    i) $x(s) = \dfrac{2}{s(s^2 + 3s + 5)}$.

    ii) $x(s) = \dfrac{1}{s^2}$.

Q5) a) Prove that auto-correlation and ES.D form a Fourier transform pair. Verify the same for $x(t) = e^{-at}\,u(t)$. **[7]**

b) Compute cross correlation between given two sequences : **[6]**

$x_1[n] = \{1, 1, -2, -1\}$
            ↑

$x_2[n] = \{1, 2, 3, 4\}$
    ↑

Using analytical or graphical methods only sketch the output sequence.

Q6) a) Find auto-correlation, PSD, and power of given signal.   **[7]**

   $x(t) = 2 \cos t + 3 \cos 3t + 5 \sin 4t$.

   b) State and describe the properties of energy spectral density (ESD). **[6]**

Q7) a) PDF of a random variable 'X' is given as $F_X(x) = e^{-x}$ for $x \geq 0$. **[7]**
   Find :

   i)   Mean E $[x]$.
   ii)   Mean square E $[x^2]$.
   iii) Variance.
   iv)   Std. deviation.

   b) Explain Gaussian probability model with respect to its density and distribution function .   **[6]**

<center>OR</center>

Q8) a) A random variable X is defined by the CDF.   **[7]**

$$F_x(x) = \begin{cases} 0 & x < 0 \\ \dfrac{1}{2}x & 0 \leq x \leq 1 \\ k & x \geq 1 \end{cases}$$

   i)   Find value of K.
   ii)   Find and sketch PDF.
   iii) P $(x > 2)$.

   b) State and explain properties of PDF.   **[6]**

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