

✓ sem-V / signals & Systems / INST / 11-12-15

QP Code : 5734

(3 Hours)

[ Total Marks : 80

- N. B. : (1) Question No. 1 is compulsory.  
 (2) Attempt any three questions from remaining five questions.  
 (3) Assume suitable data if necessary.

1. Solve the following :- 20

(a) Show that

$$x(t) * \delta(t-t_0) = x(t-t_0)$$

(b) Obtain the linear convolution of given signals. Also sketch the result.

$$x(t) = 1 \quad \text{for } 0 \leq t \leq 1 \\ = 0 \quad \text{elsewhere}$$

$$h(t) = 1 \quad \text{for } 0 < t < 1 \\ = -1 \quad 1 \leq t \leq 2 \\ = 0 \quad \text{elsewhere}$$

(c) Find the z-transform of the signal

$$x(n) = \left(\frac{1}{2}\right)^n \cos(\omega_0 n) u(n) . \text{ Specify its ROC.}$$

(d) State and explain Dirichlet's conditions for the existence of continuous time Fourier series.

(e) Find the Fourier transform of the signal

$$x(t) = \frac{d}{dt} [(e^{-3t} u(t)) * (e^{-2t} u(t-2))]$$

2. (a) Find if the following sequences are periodic or not. If yes find its fundamental period. 6

(i)  $x_1(n) = e^{j(\pi/4)n}$

(ii)  $x_2(n) = 3 \sin(1/8)n$

(b) Plot the following sequences :- 10

(i)  $x_1(n) = (-2)^n u(n)$

(ii)  $x_2(n) = 2 + u(n-4) + u(-n)$

(iii)  $x_3(n) = 2^n u(-n-1)$

(c) Find bilateral z-transform of the signal 4

$$x(n) = 9 \delta(n+2) + 3 \delta(n-1) - 4 \delta(n) + 3 \delta(n-2) + 4 \delta(n-4)$$

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3. (a) Solve the difference equation 10

$$y(n) - \frac{1}{9}y(n-2) = x(n-1)$$

with  $y(-1) = 0$ ,  $y(-2) = 1$ ,  $x(-1) = 0$  and  $x(n) = 3u(n)$

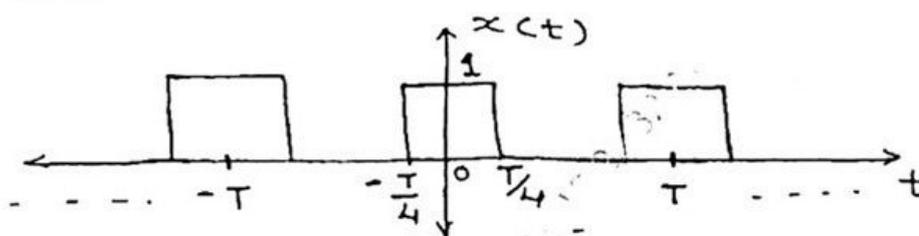
- (b) Classify the following system for memory, linearity, causality, time variance and stability. 5

$$y(n] = a x(n) - b x(n-1)$$

- (c) Find  $x(t)$  corresponding to FT 5

$$x(j\omega) = \frac{-j\omega}{(j\omega)^2 + 3j\omega + 2}$$

4. (a) Determine complex exponential fourier series for the signal  $x(t)$  shown below 10



- (b) Determine z-transform of following function 10

(i)  $x(n) = \left(\frac{2}{3}\right)^n u(n+2)$

(ii)  $x(n) = n \left(\frac{5}{8}\right)^n u(n)$

(iii)  $x(n) = (0.6)^n u(n) * (0.9)^n u(n)$

5. (a) Find laplace transform of  $x(t) = te^{-3t} u(t)$ . Prove the property used. 5

- (b) Find fourier transform of SINC function. 5

- (c) Find the inverse laplace transform of 10

$$x(s) = \frac{-3}{(s+2)(s-1)}$$

If the ROC is

- (i)  $-2 < \text{Re}(s) < 1$   
 (ii)  $\text{Re}(s) > 1$   
 (iii)  $\text{Re}(s) < -2$

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6. (a) If  $x(t) \leftrightarrow x(\omega)$  is fourier transform pair then prove that  $x(t) \leftrightarrow 2\pi x(-\omega)$  5
- (b) Find the initial and final values of the signal 5

$$x(z) = \frac{(z-3)z}{(z-1)(z-0.4)}$$

- (c) Find inverse z-Transform of 10

$$x(z) = \frac{1 - \frac{1}{2}z^{-1}}{1 + \frac{3}{4}z^{-1} + \frac{1}{8}z^{-2}} \quad |z| > \frac{1}{2}$$

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