

## Fourth Semester B.E. Degree Examination, June/July 2023 Signals and System

Max. Marks: 80

**Note:** Answer any FIVE full questions, choosing ONE full question from each module.

### Module-1

- 1 a. Sketch the even and odd part of the signals shown in Fig.Q1(a)(i) and (ii).

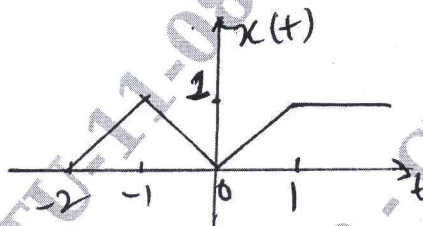


Fig.Q1(a)(i)

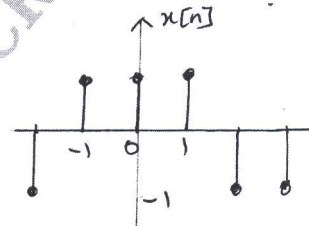


Fig.Q1(a)(ii)

(08 Marks)

- b. Determine whether the following systems are memoryless, Causal, time invariant, linear and stable.

i)  $y[n] = n x[n]$

ii)  $y(t) = \cos(x(t))$ .

(08 Marks)

OR

- 2 a. A continuous time signal  $x(t)$  and  $g(t)$  is shown in Fig.Q2(a). Express  $x(t)$  in terms of  $g(t)$ .

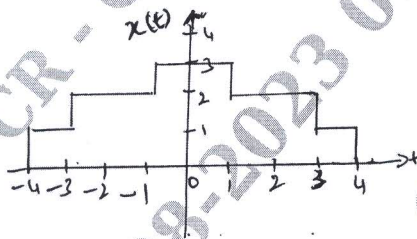
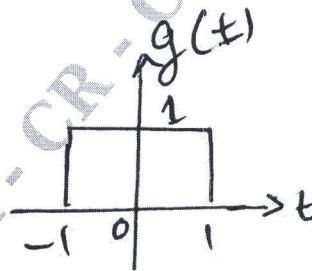


Fig.Q2(a)

(05 Marks)



- b. Determine whether the following signal is periodic or not. If periodic find the fundamental period.  $x(t) = \cos(5\pi t) + \sin(6\pi t)$ .

(03 Marks)

- c. For the signal  $x(t)$  and  $y(t)$  shown in Fig.Q2(c), sketch the signal  $x(2t) y(2t + 1)$ .

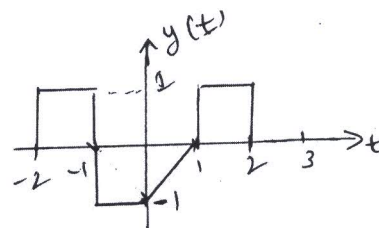
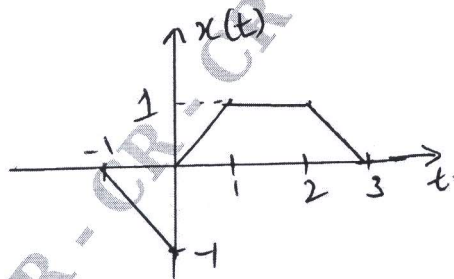


Fig.Q2(c)

(08 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.

**Module-2**

- 3 a. Derive the equation for convolution SUM. (05 Marks)  
 b. State and prove commutative properties of convolution SUM. (03 Marks)  
 c. Compute and sketch the following convolution :  
 i)  $y(t) = u(t + 1) * u(t - 2)$   
 ii)  $y[n] = \beta^n u[n] * u[n - 3]$ . (08 Marks)

**OR**

- 4 a. Compute the convolution integral of  $x_1(t)$  and  $x_2(t)$  given :  
 $x_1(t) = \cos \pi t (u(t + 1) - u(t - 3))$ ,  $x_2(t) = u(t)$ . (08 Marks)  
 b. Consider a LTI system with input  $x[n]$  and unit impulse response  $h[n]$  given below.  
 Compute and plot the output signal  $y(n)$ ,  $x[n] = 2^n u[-n]$  and  $h[n] = U[n]$ . (08 Marks)

**Module-3**

- 5 a. Consider the interconnection of LTI systems depicted in Fig.Q5(a). The impulse response of each system is given as  $h_1(n) = u[n]$  and  $h_2[n] = u[n + 2] - U[n]$ ,  $h_3[n] = \delta(n - 2)$ ,  $h_4[n] = \alpha^n u[n]$ . Find the overall impulse response of the system.

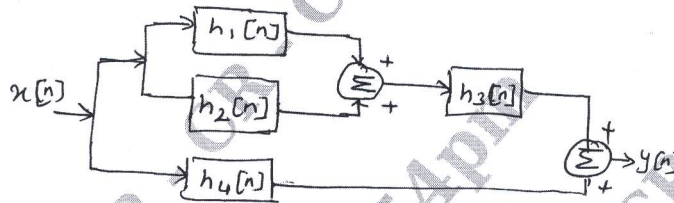


Fig.Q5(a)

- b. Determine whether the following system defined by their impulse response are memoryless, causal and stable. Justify your answers.  
 i)  $h(t) = e^t u(-1 - t)$  ii)  $h[n] = \cos(n) U[n]$ . (06 Marks)  
 c. A continuous time LTI system has step response  $s(t) = e^{-t} u(t)$ . Find the sketch the output of the system to the input  $x(t)$  shown in Fig.Q5(c).

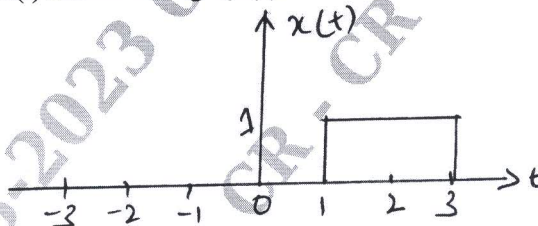


Fig.Q5(c)

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**OR**

- 6 a. Determine the DTFS coefficients of  $x[n] = \cos\left(\frac{6\pi}{13}n + \frac{\pi}{6}\right)$  and draw the magnitude and phase spectrum. (10 Marks)  
 b. State the following properties of CTFS.  
 i) Linearity  
 ii) Time shift  
 iii) Frequency shift  
 iv) Scaling  
 v) Time differentiation  
 vi) Convolution. (06 Marks)

**Module-4**

- 7 a. State and prove the following properties :

$$i) -jtx(t) \xleftrightarrow{FT} \frac{d \times (j\omega)}{d\omega}$$

$$ii) \int_{-\infty}^{\infty} |x(t)|^2 dt = \frac{1}{2\pi} \int_{-\infty}^{\infty} |X(j\omega)|^2 d\omega.$$

(08 Marks)

- b. The output  $x(t)$  of an ideal low pass filter which has cut off frequency  $\omega_c = 1000\pi$  rad/sec is impulse sampled with the following sampling periods :

$$i) T_s = 0.5 \times 10^{-3}$$

$$ii) T_s = 2 \times 10^{-3}$$

$$iii) T_s = 10^{-4}$$

Which of these sampling periods would guarantee that  $x(t)$  can be recovered from its sampled version using an appropriate low pass filter. (04 Marks)

- c. Find the Fourier transform for the signal  $x(t)$  shown in Fig.Q7(c).

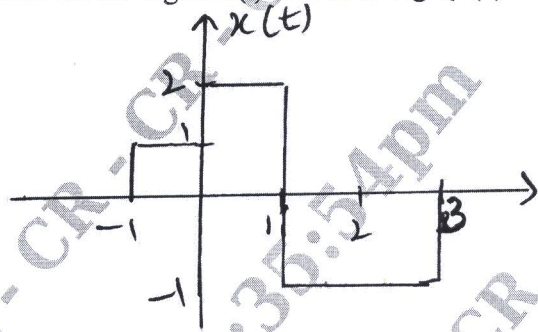


Fig.Q7(c)

(04 Marks)

OR

- 8 a. Find the DTFT of the following signals :

$$i) x[n] = 2^n u[-n]$$

$$ii) x[n] = \sin\left(\frac{\pi}{4}n\right) \left(\frac{1}{4}\right)^n u(n-1)$$

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(08 Marks)

- b. Determine the time domain signals corresponding to the following FT's :

$$i) X(j\omega) = e^{-|\omega|}$$

$$ii) X(j\omega) = \frac{2j\omega + 1}{(j\omega + 2)^2}$$

(08 Marks)

Module-5

- 9 a. State and prove time reversal and differentiation in the Z-domain property of Z-transforms. (08 Marks)
- b. Find the inverse Z-transform of:

$$i) X(z) = \frac{z^2 - 3z}{z^2 + \frac{3}{2}z - 1} \quad \frac{1}{2} < |z| < 2$$

$$ii) X(z) = \frac{8z^2 + 4z}{4z^2 - 4z + 1} \quad |z| > \frac{1}{2}. \quad (08 \text{ Marks})$$

OR

- 10 a. Use properties of Z-transform to compute X(z) of

$$i) x(n) = n \sin\left(\frac{\pi}{2}n\right) u(-n)$$

$$ii) x(n) = n^2 \left(\frac{1}{2}\right)^n u(n-3).$$

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(10 Marks)

- b. Determine the transfer function and the impulse response for the causal LTI system if:

$$x(n) = \delta(n) + \frac{1}{4}\delta(n-1) - \frac{1}{8}\delta(n-2) \text{ and}$$

$$y(n) = \delta(n) - \frac{3}{4}\delta(n-1).$$

(06 Marks)

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