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.

CBCS SCHEME

USN | | | | | | | | | | |

15EC44

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

Time: 3 hrs. Max. Marks: 80

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

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Module-1

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

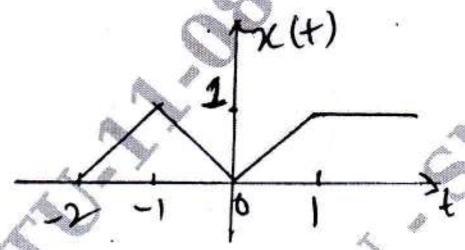

Fig.Q1(a)(i)

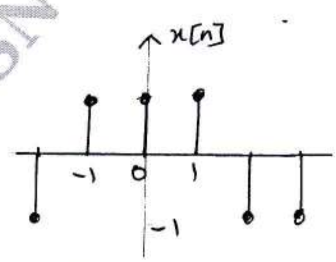

Fig.Q1(a)(ii) **(08 Marks)**

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 $x(2t)\,y(2t+1)$.

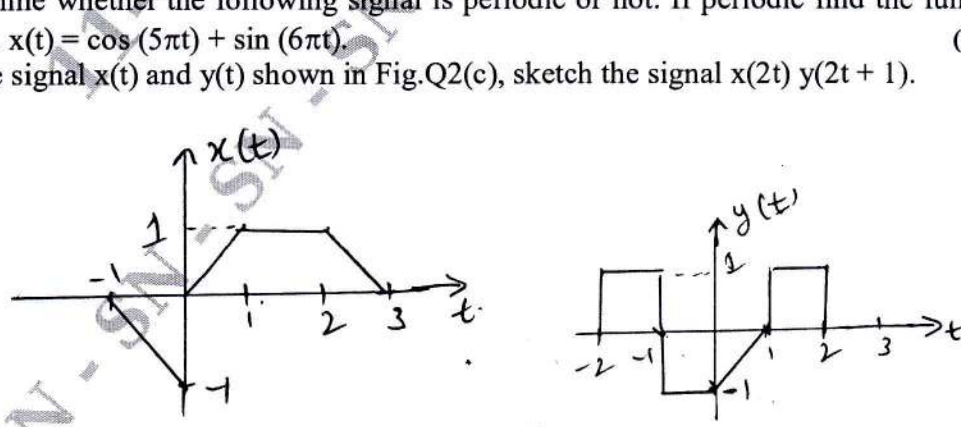

Fig.Q2(c) **(08 Marks)**

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.

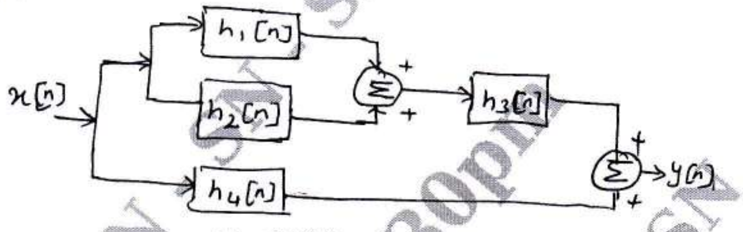

Fig.Q5(a) **(04 Marks)**

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).

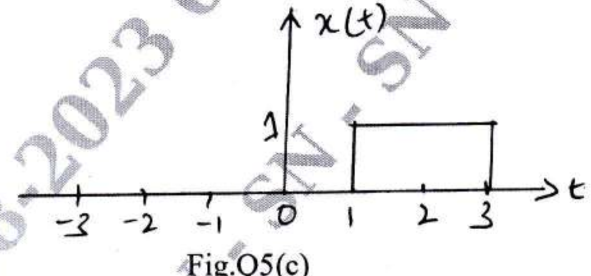

Fig.Q5(c) **(06 Marks)**

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

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

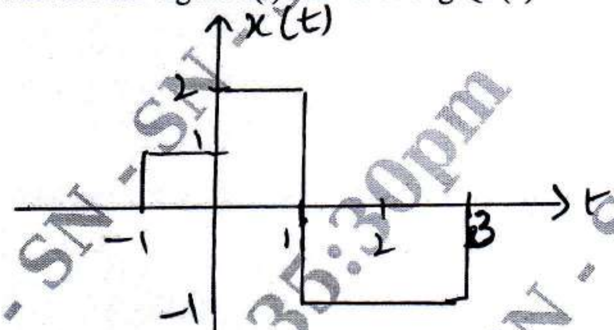

Fig.Q7(c) **(04 Marks)**

OR

8 a. Find the DTFT of the following signals :

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

ii) $x[n] = \sin\left(\dfrac{\pi}{4} n\right)\left(\dfrac{1}{4}\right)^n u(n-1)$ **(08 Marks)**

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

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

ii) $X(j\omega) = \dfrac{2j\omega + 1}{(j\omega + 2)^2}$ **(08 Marks)**

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

ii) $X(z) = \dfrac{8z^2 + 4z}{4z^2 - 4z + 1} \qquad |z| > \dfrac{1}{2}$. **(08 Marks)**

OR

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

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

ii) $x(n) = n^2\left(\dfrac{1}{2}\right)^n u(n-3)$. **(10 Marks)**

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

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

$y(n) = \delta(n) - \dfrac{3}{4}\delta(n-1)$. **(06 Marks)**

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