SE Sem IV (EXTC) C-Scheme KT winter 2025.

Time:- 3 hrs. Maximum Marks:- 80

N. B.

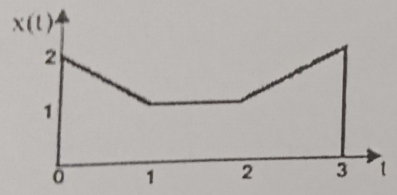
1. *Q.1 is compulsory.*
2. *Answer any **three** out of the remaining five questions.*
3. *Figures to the right indicate marks.*
4. *Answer to the questions should be grouped and written together.*

1.a. Test the given signal for stability and Linearity : 5

$$y(t) = e^{-t}x(t)$$

b. Plot the unit ramp function starting at $t = a$ and obtain it Laplace transform. 5

c. For the given signal x(t), plot $x(-t+3)$ and $-x(2t)$ 5



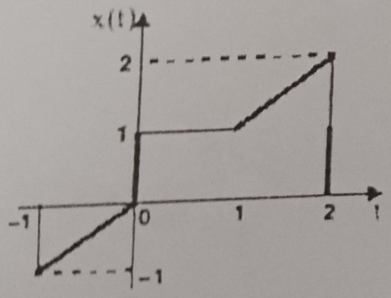
d. State properties of ROC of Z -transform. 5

2.a Determine the response of discrete time LTI system governed by the difference equation 10

$$y(n) = -\ 0.5\, y(n-1) + x(n),$$

when the input is unit step and initial condition, $y(-1) = \frac{1}{3}$

b. For the given signal x(t) 10



Sketch 1. $x(1-t)[u(t-2)]$

2. $\boldsymbol{x(t-1)[u(t+1)]}$

3a. Obtain Inverse Laplace transform of the function for the following ROC's 10

$$X(s) = \frac{3s+7}{s^2-3s-10}$$

Also comment on Stability and causality of the system for each of the ROC conditions. Support your answer with appropriate sketches of ROC's

i. Re(s) > 5

ii. Re(s) < -2

iii. -2 < Re(s) < 5

b. Perform convolution of 10

i. $2u(t) with\ u(t)$

ii. $e^{-2t}u(t) with\ e^{-5t}u(t)$

4a Classify the following sytems as Linear/nonlinear, time variant / invariant Causal/Noncausal and static/dynamic. 10

i. $y[n] = x[n^2]$

ii. $y(t) = x(t) + x(t+2)$

b. A causal discrete-time LTI system is described by 10

$y[n] - \frac{3}{4}y[n-1] + \frac{1}{8}y[n-2] = x[n]$ where x[n] and y[n] are the input and output of the system, respectively.

i. Determine the frequency response H (Ω) of the system.

ii. Find the impulse response h[n] of the system using Inverse Fourier Transform ONLY

5a. A causal and stable discrete time system is described by the following difference equation: 10

$$y(n) = 0.7y(n-1) - 0.12\,y(n-2) + x(n)$$

Determine its impulse response.

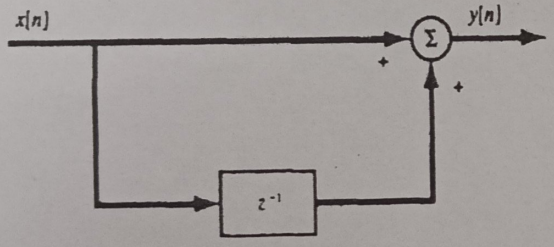
b. Using the various Laplace transform properties ONLY , Compute the Laplace transforms of the following signals from the Laplace transform of u(t): 10

i. $x_1(t) = e^{-at}cos\omega_0(t)u(t)$

ii. $x_2(t) = t\,e^{-at}\,u(t)$

6 a 10

Consider the discrete-time LTI system shown in Figure:



(a) Obtain the difference equation for the given system.

(b) Find the frequency response $H(\Omega)$ of the system.

(c) Sketch the magnitude response $|H(\Omega)|$and the phase response$\angle H(\Omega)$. *Hint (express complex exponentials in form of cosine functions)*

b. Distinguish between FIR and IIR filters. Realize the following IIR filter using minimum number of delay units 10

$$H(z) = \frac{1 + z^{-1}}{\left(1 - z^{-1} + \frac{1}{4}z^{-2}\right)\left(1 - z^{-1} + \frac{1}{2}z^{-2}\right)}$$

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