

10 DEC. 2025 SE EXTC (SEM-IV) C SCHEME SS QP CODE: 10095808

Time:- 3 hrs.

Maximum Marks:- 80

N. B.

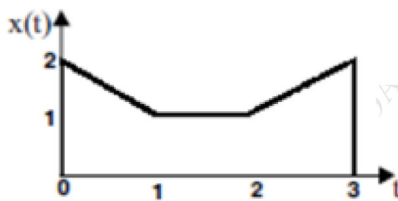
1. Q.1 is compulsory.
2. Answer any **three** out of the remaining five questions.
3. Figures to the right indicate marks.
4. Answer to the questions should be grouped and written together.

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



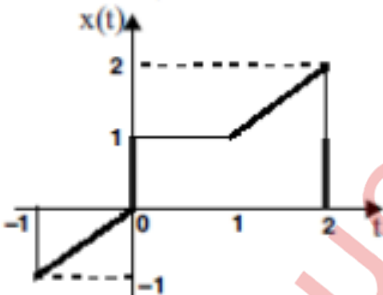
d. State properties of ROC of Z -transform. 5

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. $x(t - 1)[u(t + 1)]$

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. $\text{Re}(s) > 5$
- ii. $\text{Re}(s) < -2$
- iii. $-2 < \text{Re}(s) < 5$

- 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 systems 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

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

- i. Determine the frequency response $H(\Omega)$ 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

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

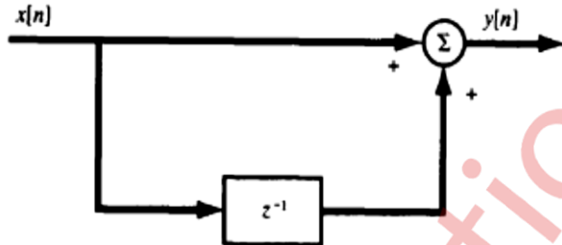
Determine its impulse response.

- 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

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