

~~Web Programming~~
Signals and Systems
(3 Hours)

QP Code : 30797

[Total Marks : 80]

N.B.:

1. Question no.1 is compulsory
2. Attempt any three questions out of the remaining five.
3. Assume suitable data wherever necessary.

Q 1] Answer the following

[20]

a) Determine if the following system is memoryless, causal, linear, time invariant

$$y(t) = x^2(t-t_0) + 2$$

b) Explain in brief ROC (Region of Convergence) conditions of Laplace transform.

c) Consider two LTI systems connected in series. Their impulse responses are $h_1[n]$ and $h_2[n]$ respectively. Find the output of the systems if $x[n]$ is the input being applied to one of the systems.

$$x[n]=\{1,2\} \quad h_1[n]=\{1,0,-1\} \quad h_2[n]=\{2,1,-1\}$$

d) State and prove time reversal property of Continuous time Fourier Series.

e) Find energy of a causal exponential pulse $x(t) = e^{-at}u(t)$ $a > 0$

Q 2] a) A DT signal is given by the following expression. Find its Z transform

[10]

$$x[n] = n\left(-\frac{1}{2}\right)^n u[n] * \left(\frac{1}{4}\right)^{-n} u[-n]$$

b) A CT signal $x(t)$ is applied to the input of a CT LTI systems with unit impulse response $h(t)$. Find out $y(t)$ using Convolution integral.

[10]

$$x(t) = e^{-at}u(t) \quad a > 0$$

$$h(t) = u(t)$$

Q3] a) Consider a causal LTI system with $H(j\omega) = \frac{1}{j\omega + 2}$. For a particular input $x(t)$, this systemproduces output $y(t) = e^{-2t}u(t) - e^{-3t}u(t)$. Find out $x(t)$ using Fourier Transform.

[10]

b) Obtain Inverse Laplace Transform of the function $X(s) = \frac{3s+7}{s^2-s-12}$ for following ROCs.

Also comment on the stability and causality of the system for each of the ROC conditions. Support your answer with appropriate sketches of ROCs.

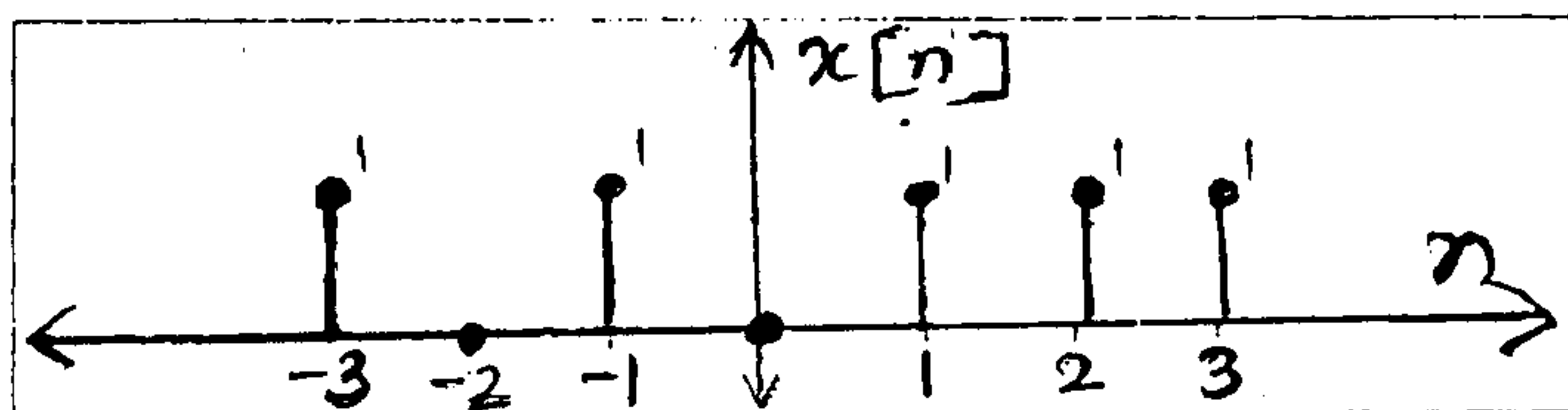
[10]

i) $\text{Re}(s) > 4$

ii) $\text{Re}(s) < -3$

iii) $-3 < \text{Re}(s) < 4$

Q. 4] a) A DT signal has been shown. Sketch the following signals. [08]



i) $x[n-4]$

ii) $x[4-n]$

iii) $x[-2n+2]$

iv) $x[n]u[3-n]$

b) Find out DTFT of the following [96]

i) $x[n] = \{1, -1, 2, 2\}$

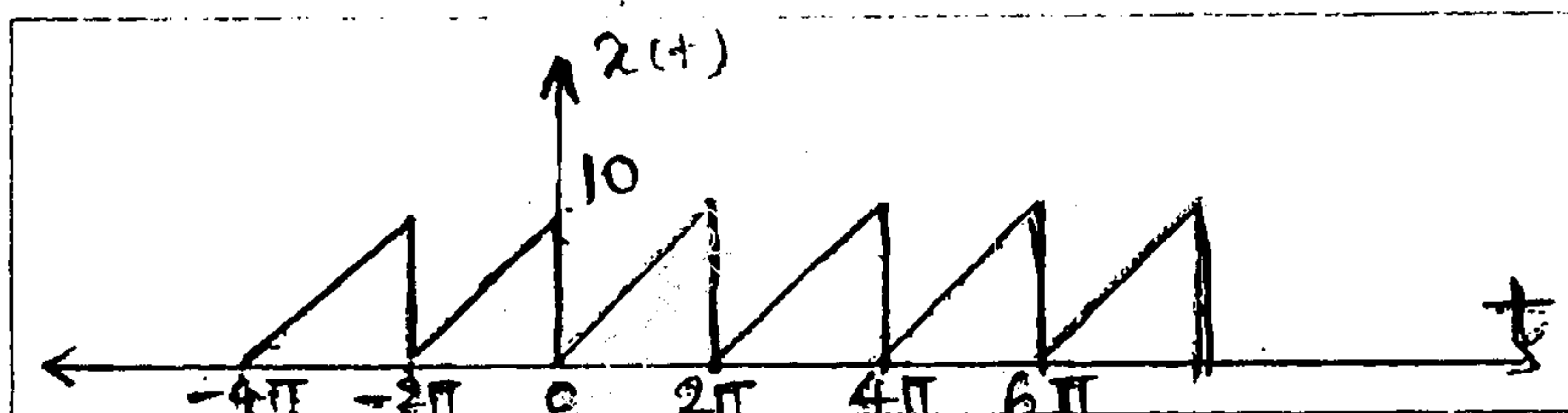
ii) $x[n] = \sin\left[\frac{\pi n}{2}\right]u[n]$

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c) Determine inverse Z Transform of [06]

$$X(Z) = \frac{3}{(1-Z^{-1})(1+Z^{-1})(1-0.5Z^{-1})(1-0.2Z^{-1})}$$

Q5) a) Find the trigonometric Fourier Series for the waveform shown in the following figure. [10]



b) Determine impulse response of $h[n]$ for the system described by the second order difference equation. [10]

$$y[n] - 4y[n-1] + 4y[n-2] = x[n] - x[n-1] \text{ when } y[-1] = y[-2] = 0$$

Q6) a) A LTI system has the following transfer function [10]

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

i) Give all possible ROC conditions

ii) Show pole-zero diagram of a system

iii) Find impulse response of system

iv) Comment on the system stability and causality for all possible ROCs