Roll No:													

BTECH
(SEM. IV) THEORY EXAMINATION 2025-26
SIGNAL SYSTEM

TIME: 3 HRS **M.MARKS: 70**

Note: Attempt all Sections. In case of any missing data; choose suitably.

SECTION A

1. Attempt *all* questions in brief. **02 x 7 = 14**

Q no.	Question	CO	Level
a.	Distinguish between deterministic and random signals with a suitable example for each.	1	K2
b.	Determine if the signal $x(t) = e^{-2t}u(t)$ is an energy or power signal.	1	K3
c.	Define a stable LTI system using the BIBO criterion.	2	K2
d.	State the Dirichlet conditions for the existence of the Fourier series.	3	K1
e.	Write the time shifting property of the Laplace transform.	3	K1
f.	Define the region of convergence (ROC) and its significance in Z-transforms.	4	K2
g.	Briefly explain the concept of aliasing in sampling.	5	K2

SECTION B

2. Attempt any *three* of the following: **07 x 3 = 21**

Q no.	Question	CO	Level
a.	Define even and odd signals. Determine the even and odd components of the signal $x(n) = \{1, 2, 1, 1\}$.	1	K3
b.	An LTI system is characterized by the differential equation: $\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6y(t) = x(t)$. Determine the step response $s(t)$ of the system, assuming initial conditions are zero.	2	K4
c.	Using the Fourier transform, find the convolution of $x_1(t) = e^{-at}u(t)$ and $x_2(t) = e^{-bt}u(t)$.	3	K3
d.	Find the Z-transform and the ROC of the sequence $x(n) = (1/3)^n u(n) + (1/2)^n u(-n-1)$.	4	K3
e.	State and prove the sampling theorem for low-pass signals.	5	K4

SECTION C

3. Attempt any *one* part of the following: **07 x 1 = 07**

Q no.	Question	CO	Level
a.	Check the system $y(t) = x^2(t) + 2$ for linearity, causality, and time-invariance.	1	K4
b.	Determine the fundamental period of the signal $x(t) = \cos(10\pi t) + \sin(20\pi t)$, if it is periodic.	1	K3

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4. Attempt any *one* part of the following: 07 x 1 = 07

Q no.	Question	CO	Level
a.	Compute the convolution integral of $x(t) = u(t)$ and $h(t) = e^{-2t}u(t)$.	2	K3
b.	Find the impulse response $h(t)$ of an LTI system that produces the output $y(t) = (e^{-2t} - e^{-4t})u(t)$ when the input is $x(t) = e^{-t}u(t)$.	2	K4

5. Attempt any *one* part of the following: 07 x 1 = 07

Q no.	Question	CO	Level
a.	Find the inverse Laplace transform of $X(s) = \frac{s+2}{(s+1)(s+3)}$ for the ROC $-3 < Re\{s\} < -1$.	3	K4
b.	State and prove Parseval's theorem for the continuous-time Fourier transform.	3	K4

6. Attempt any *one* part of the following: 07 x 1 = 07

Q no.	Question	CO	Level
a.	Determine the Z-transform and sketch the ROC for $x(n) = a^n \sin(\omega_0 n)u(n)$.	4	K4
b.	Use the partial fraction method to find the inverse Z-transform of $H(z) = \frac{z}{(z-0.5)(z-0.25)}$ for $\lvert z \rvert > 0.5$.	4	K5

7. Attempt any *one* part of the following: 07 x 1 = 07

Q no.	Question	CO	Level
a.	Explain the reconstruction of a signal from its samples using an ideal interpolation filter.	5	K2
b.	A signal $x(t) = sinc(100\pi t) + 3sinc^2(60\pi t)$ is to be sampled. (i) Identify the maximum frequency component, (ii) Calculate the Nyquist sampling rate and Nyquist sampling interval.	5	K3