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BTECH
(SEM IV) THEORY EXAMINATION 2024-25
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.	Define energy and power signals with examples.	1	K1
b.	State and explain the properties of linear systems.	1	K2
c.	What is convolution? Write its significance in LTI systems.	2	K2
d.	Compare the Fourier series and the Fourier Transform.	3	K4
e.	Define Region of Convergence (ROC) in Z-transform.	4	K1
f.	Explain aliasing in the context of sampling.	5	K2
g.	What are eigenfunctions of LSI systems?	3	K2

SECTION B

2. Attempt any three of the following:

07 x 3 = 21

Q no.	Question	CO	Level
a.	Define even and odd signal. Determine the even and odd components of the signal: $x(t) = \cos(t) + \sin(t) + \cos(t) \cdot \sin(t)$	1	K3
b.	An LTI system is described by differential equation: $\frac{dy(t)}{dt} + 2y(t) = x(t)$ Find the impulse response of the system.	2	K4
c.	Using Fourier transform, find the convolution of the following signals $x_1(t) = e^{-4t} u(t)$, $x_2(t) = e^{-8t} u(t)$	3	K3
d.	State and prove the time-shifting and frequency-shifting properties of the Z-transform. Illustrate each property with an example.	4	K5
e.	Explain the reconstruction of a signal from its samples using Interpolation.	5	K2

SECTION C

3. Attempt any one part of the following:

07 x 1 = 07

Q no.	Question	CO	Level
a.	Test the system defined by $y(t) = t \cdot x(t)$ for the following properties: i. Linearity ii. Time-invariance iii. Causality	2	K4
b.	A signal $x(t) = e^{-5t} u(t)$ is given. Determine whether it is an energy or a power signal, and determine its energy and power.	2	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 on the signals $x(t) = e^{-3t} u(t)$ and $h(t) = u(t)$.	3	K3
b.	A system has an impulse response given by $h(t) = e^{-6t} u(t)$ 1. Determine the step response $s(t)$ of the system. 2. Check whether the system is BIBO stable and causal or not.	3	K4

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

Q no.	Question	CO	Level
a.	Find the inverse Laplace of the following: $X(S) = \frac{2}{(s+4)(s-1)}$; if the region of convergence is $-4 < \text{Re}\{s\} < 1$	3	K4
b.	Analyze the Discrete Time Fourier Transform of the following: $x(n) = 0.5^n u(n) + 2^{-n} u(-n - 1)$	3	K5

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

Q no.	Question	CO	Level
a.	Determine the Z transform of $x(n) = \sin(\omega_0 n) u(n)$ and sketch the ROC.	4	K4
b.	Determine the inverse Z transform of the following function $H(z) = \frac{0.2z}{(z + 0.4)(z - 0.2)}$; ROC : $ z > 0.4$	4	K5

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

Q no.	Question	CO	Level
a.	State and prove the Sampling theorem and discuss the effect of under-sampling.	5	K4
b.	A continuous-time signal $x(t) = \cos(500\pi t) + \sin(700\pi t)$ is sampled at a rate of 400 Hz. i. Determine whether aliasing will occur. ii. Justify your answer using the Nyquist criterion. iii. If aliasing occurs, compute the aliased frequency.	5	K3