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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:<br>$\frac{dy(t)}{dt} + 2y(t) = x(t)$<br>Find the impulse response of the system. | 2  | K4    |
| c.    | Using Fourier transform, find the convolution of the following signals<br>$x_1(t) = e^{-4t} u(t)$ , $x_2(t) = e^{-8t} u(t)$           | 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:<br>i. Linearity<br>ii. Time-invariance<br>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    |



Paper id: 252566

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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 $h(t) = e^{-6t} u(t)$<br>1. Determine the step response $s(t)$ of the system.<br>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:<br>$X(S) = \frac{2}{(s+4)(s-1)}$ ; if the region of convergence is $-4 < \text{Re}\{s\} < 1$ | 3  | K4    |
| b.    | Analyze the Discrete Time Fourier Transform of the following:<br>$x(n) = 0.5^n u(n) + 2^{-n} u(-n - 1)$                                 | 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<br>$H(z) = \frac{0.2z}{(z + 0.4)(z - 0.2)}$ ; 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.<br>i. Determine whether aliasing will occur.<br>ii. Justify your answer using the Nyquist criterion.<br>iii. If aliasing occurs, compute the aliased frequency. | 5  | K3    |