

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)**

CLASS: BTECH
BRANCH: ECE

SEMESTER : III
SESSION : MO/2025

SUBJECT: EC24207 SIGNALS AND SYSTEMS

TIME: 3 Hours

FULL MARKS: 50

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
 2. Attempt all questions.
 3. The missing data, if any, may be assumed suitably.
 4. Before attempting the question paper, be sure that you have got the correct question paper.
 5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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- | | CO | BL |
|--|-------|----------|
| Q.1(a) Categorize the following signal as an energy or power signal and find the energy or power of the signal:
$x(t)=t$ for $0 \leq t \leq 1$
$=3-t$ for $1 \leq t \leq 2$
$=0$ otherwise. | [5] | 1,2
1 |
| Q.1(b) i) Determine the periodicity of the signal $x(n)=\cos(\pi n/5)\sin(\pi n/3)$.
ii) Given the signal $x(n)$ in Fig.1, sketch the signal $x(3n-1)$. | [2+3] | 1,2
2 |

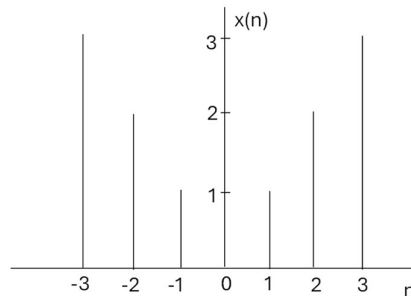


Fig.1

- | | | |
|---|---------------|----------------|
| Q.2(a) What do you mean by impulse response of a system? How is it related to system output? Find the convolution between two sequences $x_1(n)$ and $x_2(n)$ using any method, where, | [5] | 1,2
1 |
| $x_1(n) = \{2 \ 3 \ 4 \ 1 \ 1\}$ <div style="display: flex; justify-content: center; gap: 100px;"> ↑ ↑ </div> | | |
| $x_2(n) = \{1 \ 2 \ 3 \ 2 \ 1\}$ <div style="display: flex; justify-content: center; gap: 100px;"> ↑ ↑ </div> | | |
| Q.2(b) Draw block diagram system representation corresponding to the following discrete-time state variable descriptions. Write the state equations. | [5] | 1,2
2 |
| $A = \begin{bmatrix} 1 & -\frac{1}{2} \\ \frac{1}{3} & 0 \end{bmatrix}, \quad b = \begin{bmatrix} 1 \\ 2 \end{bmatrix}, \quad c = [1 \quad -1], \quad D = [0].$ | | |
| Q.3(a) i) State and prove the convolution property of the Fourier Transform.
ii) Let $x(t)=(1/\pi t)\sin(\pi t)$ and $h(t)= (1/\pi t)\sin(2\pi t)$. Find | [2.5
+2.5] | 1,2,
3
2 |
| $y(t) = x(t) * h(t)$ | | |
| Q.3(b) State Parseval relation regarding Fourier Transform. Use 'Duality' property of Fourier Transform to find the Fourier transform of signal $x(t)=1/(2+jt)$. | [2+3] | 1,2,
3
3 |
| Q.4(a) i) Mention the main advantage of Laplace Transform over Fourier Transform.
ii) Consider the signal $x(t) = e^{-5t}u(t) + e^{-\beta t}u(t)$, and its Laplace transform by $X(s)$. What are the constraints placed on the real and imaginary parts of β if the region of convergence of $X(s)$ is $\Re\{s\} > -3$? | [2+3] | 2,3,
4
2 |

PTO

Q.4(b) Determine the inverse Laplace transform of [5] 2,3, 3

$$X(S) = \frac{2(s+1)}{s^2+7s+12}$$
 where ROC is: $\Re\{s\} > -3$. Plot the poles and zeros and ROC in the s-plane.

Q.5(a) Define stability and causality in Z-domain. Evaluate the output $y(n)$ of the LTI [2+3] 3,4, 3
 system defined as: $y[n] - \frac{1}{2}y[n-1] = x[n]$;
 with input $x[n] = \left(\frac{1}{2}\right)^n u(n)$; and initial condition: $y[-1] = 1$

Q.5(b) Determine the impulse response corresponding to the following transfer functions if [5] 3,4, 3
 i) The system is stable ii) The system is causal

$$H(z) = \frac{4z}{z^2 - \frac{1}{2}z + \frac{1}{16}}$$

::::24/11/2025::::E