JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION- 2025

B.Tech-III Semester (ECE)

COURSE CODE (CREDITS): 25B11EC311 (4) MAX. MARKS: 35

COURSE NAME: Signals and Systems

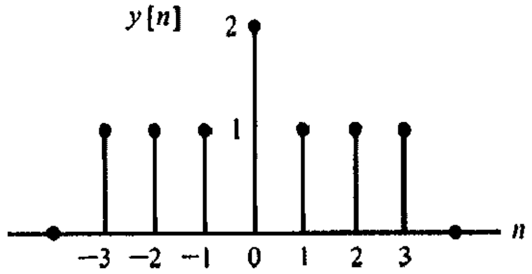
COURSE INSTRUCTORS: Dr. Vikas Baghel MAX. TIME: 2 Hours

Note: *(a) All questions are compulsory.*

(b) The candidate is allowed to make Suitable numeric assumptions wherever required for solving problems

(c) Use of a standard scientific calculator is allowed.

Q.No	Question	CO	Marks
Q1	**a)** Show that $$\left[2^{-n}\cos\left(\frac{\pi}{3}n\right)\right]u[n-1] \Leftrightarrow \frac{0.25(z-1)}{z^2-0.5z+0.25}$$	[CO4]	[3]
	b) By expanding $X[z]=\frac{\gamma z}{(z-\gamma)^2}$ as a power series in z^{-1}, show that $x[n]=n\gamma^n u[n]$.		[3]
	c) Find the output $y[n]$ of an LTID system: $2y[n+2]-3y[n+1]+y[n]=4x[n+2]-3x[n+1]$ given $y[-1]=0$, $y[-2]=1$, and $x[n]=4^{-n}u[n]$.		[3]
Q2	**a)** For each of the systems specified by the following transfer functions, find the differential equation relating the output $y(t)$ to the input $x(t)$: $H(s)=(s+5)/(s^2+3s+8)$.	[CO4]	[2]
	b) For an LTIC system with zero initial conditions, if an input $x(t)$ produces an output $y(t)$, then show that: i. The input $\frac{dx(t)}{dt}$ produces an output $\frac{dy(t)}{dt}$, ii. The input $\int_0^t x(\tau)d\tau$ produces an output $\int_0^t y(\tau)d\tau$. iii. Hence, show that the unit step response of a system is an integral of the impulse response; that is $\int_0^t h(\tau)d\tau$.		[3]
	c) Derive the Initial Value Theorem (IVT) for the Laplace Transform.		[3]

Q3	**a)** Consider the signal $y[n]$ in figure. Find the signal $x[n]$ such that $Even\{x[n]\} = y[n]$ for $n \geq 0$ and $Odd\{x[n]\} = y[n]$ for $n < 0$.  	[CO3]	[3]
	b) Find the FS coefficients of signal $$x(t) = [1 + \cos(2\pi t)] \sin\left(10\pi t + \frac{\pi}{6}\right)$$ Also plot the magnitude and the phase spectrum.		[3]
	c) Consider the discrete time system described by the difference equation $$y[n] = \sum_{k=-\infty}^{n} (-1)^{n-k} x[k]$$ Find out its impulse response $h[n]$ and frequency response $H(\Omega)$.		[3]
Q4	**a)** Derive the cutoff frequency of a first-order RC high-pass filter.	[CO1]	[3]
	b) A low-pass RC filter has $R = 1\ k\Omega$ and $C = 0.1\ \mu F$. i. Compute the cutoff frequency f_c. ii. For a $1\ V\ rms$ input at $f = f_c$, compute the output amplitude using $-3\ dB$ definition.		[3]
	c) Draw the signal-flow structure of given IIR filter: $$y[n] = 1.2y[n-1] - 0.36y[n-2] + x[n] + 0.5x[n-1]$$ Also find whether this filter is stable or not.		[3]