JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

Make-up Examination-Nov-2025

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

COURSE NAME: Signals & Systems

COURSE INSTRUCTORS: Dr. Vikas Baghel MAX. TIME: 1 Hour 30 Minutes

Note: 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. Define and prove whether the following signals are energy or power signals: *i.* $x_1(t) = e^{-2t}u(t) + e^{2t}u(-t)$ ii. $x_2[n] = \left(\frac{1}{2}\right)^n u[n]$ b. A signal $x(t)$ satisfies $x(t) = -x(-t+4)$. Determine whether it is even, odd, or neither, and sketch qualitatively. c. For a real-world sensor output modeled as $x(t) = 3 + 2sin(2\pi t) + 0.5w(t)$, where $w(t)$ is zero-mean Gaussian noise, identify and justify each classification (continuous/discrete, periodic/aperiodic, deterministic/random).	CO1	5
Q2	*a.* A system is described by: $y(t) = x^2(t) + 3x(t-2)$. Determine whether this system is linear, time-invariant, causal, stable, and memoryless, providing rigorous mathematical justification for each property. *b.* Consider a discrete-time system governed by: $y[n+1] - 0.8y[n] = x[n]$ Find the impulse response and verify whether it is BIBO stable. c. Derive a necessary and sufficient condition for a nonlinear system to exhibit time-invariance. Provide an example to illustrate your result.	CO1	5

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Q3	a. Find the output $y(t)$ of an LTI system with impulse response $h(t) = e^{-t}u(t)$ and input $x(t) = t\,e^{-2t}u(t)$. b. Prove that convolution in time domain corresponds to multiplication in frequency domain, starting from first principles (no Fourier transform properties to be assumed).	CO3	5
Q4	a. Derive the Fourier series coefficients for a signal $x(t)$ defined over one period as: $$x(t) = \begin{cases} t, & \text{for } 0 \le t < 1 \\ 2 - t, & \text{for } 1 \le t < 2 \end{cases}$$ with $x(t+2) = x(t)$. Hence, comment on the symmetry and convergence of the series. b. Given a continuous-time LTI system with impulse response $h(t) = e^{-2t}u(t)$, find its frequency response $H(j\omega)$ and magnitude–phase characteristics. c. Prove Parseval's theorem for Fourier Transform and use it to compute the energy of $x(t) = e^{-at}u(t), a > 0$.	CO2	5
Q5	a. Find the Discrete-Time Fourier Transform (DTFT) of $x[n] = (0.9)^n\, u[n]$ b. A discrete-time LTI system has frequency response: $$H(e^{j\omega}) = 1 - e^{-jw}$$ Find the corresponding impulse response $h[n]$. c. Show that if a discrete-time signal is periodic with period N, its DTFT is impulse-train periodic with period 2π. Prove rigorously	CO4	5