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JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT
TEST-3 EXAMINATION – 2026

B.Tech-IV Semester (ECE/EE-VLSI)

MAX. MARKS: 35

COURSE CODE (CREDITS): 25B11EC413/25B11EC419 (4)

COURSE NAME: Digital Signal Processing

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 calculators is allowed.

Q.No	Question	CO	Marks
Q1	(a) What is sampling? Explain how a continuous-time signal $x_c(t)$ is converted into a discrete-time sequence $x[n] = x_c(nT)$.	CO1	[2]
	(b) What is the system function $H(z)$ of a discrete-time system? In multirate processing, what is the meaning of $H(z^M)$ and $H(z^L)$ when a filter is moved across a downsampler or an upsampler?		[3]
Q2	(a) Differentiate FIR and IIR filters in terms of impulse response, feedback, and stability. Also identify whether the pre-emphasis filter $y[n] = x[n] - \alpha x[n-1], \quad 0.9 \leq \alpha \leq 0.97$ is FIR or IIR.	CO2	[3]
	(b) Define decimation and interpolation. What is the purpose of the anti-aliasing filter before downsampling and the interpolation filter after upsampling? Name any two practical interpolation filters discussed in the lectures.		[4]
Q3	(a) Compute the 4-point DFT of the sequence $x[n] = \{1, 0, -1, 0\}, \quad n = 0, 1, 2, 3.$ Write the values of $X[0], X[1], X[2], X[3]$ and comment on whether the spectrum is real-valued or complex-valued.	CO3	[4]

Q.No	Question	CO	Marks
	(b) State two differences between the DFT and the DTFT. What is the FFT complexity compared with direct DFT computation? Mention one speech-processing application and one image-processing application where frequency-domain analysis is useful.		[3]
Q4	(a) State the Shannon-Nyquist sampling theorem. What is aliasing, and why is an anti-aliasing lowpass filter used before sampling? (b) Explain non-integer sampling-rate conversion by a factor L/M . For $L = 2$ and $M = 3$, state the new sampling period and the ideal lowpass cutoff. Compare ZOH, linear interpolation, and truncated-sinc interpolation in terms of complexity and reconstruction quality.	CO4	[3] [5]
Q5	(a) What is power spectral density (PSD) of a wide-sense stationary signal? What does the periodogram estimate? (b) Briefly differentiate the Periodogram, Welch's method, and Blackman-Tukey method for PSD estimation. Why is windowing used in spectral estimation? Mention one DSP application where PSD or spectral analysis is useful.	CO3	[3] [5]