JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION- 2025

B.Tech-VII Semester (CSE/IT)

COURSE CODE (CREDITS): 18B1WEC636 (2) MAX. MARKS: 35

COURSE NAME: Fundamentals of Digital Signal Processing & Applications

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) A continuous-time signal $x(t) = 3\cos(3000\pi t)$ is sampled with sampling frequency $fs = 4\,kHz$. Derive the corresponding discrete-time signal $x[n]$ and discuss how the chosen sampling frequency affects the resulting sequence, specifically addressing whether aliasing occurs.	[CO1]	[3]
	b) For the filter $H(z) = \frac{1+z^{-1}}{1-0.5z^{-1}}$, find the poles and zeros and sketch their approximate z-plane positions.		[2]
Q2	a) Describe the design steps of a linear-phase FIR filter using the windowing method.	[CO3]	[3]
	b) An FIR filter has coefficients $h[n] = \{1, -1, 2, -2\}$. Compute its magnitude response at $\omega = \pi/2$ and explain the result.		[3]
Q3	a) Discuss the bilinear transform method for converting analog filters into digital filters.	[CO2]	[3]
	b) Using the bilinear transform, derive the difference equation of a digital integrator obtained from $H(s) = \frac{1}{s}$.		[3]

Q4	a) Compare Decimation-in-Time (DIT) FFT and Decimation-in-Frequency (DIF) FFT algorithms in detail. b) Compute the $8-point$ DFT of $x[n] = \{1,1,1,1,0,0,0,0\}$ using either DIT or DIF, showing all major steps.	[CO2]	[3] [3]
Q5	a) Compute the IDFT of the sequence $X[k] = \{4,0,0,0\}$ and describe the resulting time-domain signal. b) Perform circular convolution of $x[n] = \{1,2,3,4\}$ and $h[n] = \{4,3,2,1\}$.	[CO2]	[3] [3]
Q6	a) A linear FMCW radar sweeps from $100\,MHz$ to $120\,MHz$ in $1\,ms$. Calculate the sweep rate in Hz/s and interpret its physical significance. b) A VoIP communication system records voice at a sampling rate of $8\,kHz$ and processes the audio in frames, each $20\,ms$ long. After encoding, every frame generates $64\,bytes$ of data. Determine the bit rate of the encoded voice stream in bits per second.	[CO4]	[3] [3]