

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST-2 EXAMINATION – 2026

B.Tech-IV Semester (ECE)

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

MAX. MARKS: 25

COURSENAME: DIGITAL SIGNAL PROCESSING

COURSE INSTRUCTORS: Dr. Vikas Baghel

MAX. TIME: 1 Hour 30 Min

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	<p>(a) Explain the significance of digital signal processing and discuss any two advantages of DSP systems over analog signal-processing systems.</p> <p>(b) Using the sequences</p> $x[n] = \{1, 2, 1, 0, 0, 0, 0\}, \quad h[n] = \{1, 1, 1\},$ <p>(i) Compute the 8-point DFT $X[k]$ and identify the dominant frequency bins, (ii) Explain how linear filtering $y[n] = x[n] * h[n]$ is implemented using DFT-based convolution.</p>	CO3	[1] [4]
Q2	<p>(a) For the digital filter with transfer function</p> $H(z) = \frac{1 - 0.5z^{-1} + 0.25z^{-2}}{1 - 1.2z^{-1} + 0.36z^{-2}},$ <p>construct the Direct Form-I and Direct Form-II structures, and determine which structure requires fewer delay elements.</p> <p>(b) The roundoff error is defined as $e = x - x_B$. Derive the roundoff step-size bound</p> $\Delta = \frac{\text{range}}{\text{number of steps}} = \frac{2X_m}{2^{B+1}} = \frac{X_m}{2^B}.$ <p>For $X_m = 1$ (Q15 format), evaluate the value of Δ.</p>	CO2	[3] [3]

Q.No	Question	CO	Marks
Q3	<p>(a) Obtain a digital IIR filter corresponding to the given analog filter with system function</p> $H_a(s) = \frac{s-2}{(s+3)^2+9}$ <p>using the impulse invariance method..</p> <p>(b) Convert the analog filter with system function</p> $H_a(s) = \frac{s+0.1}{(s+0.1)^2+16}$ <p>into a digital IIR filter using the bilinear transformation. Ensure that the digital filter has a resonant frequency of $\omega_r = \pi/2$.</p>	CO4	[3]
Q4	<p>(a) Convert the single-pole lowpass Butterworth filter with system function</p> $H(z) = \frac{0.245(1+z^{-1})}{1-0.509z^{-1}}$ <p>into a bandpass filter with upper and lower cutoff frequencies ω_u and ω_l, respectively. Assume the lowpass filter has 3-dB bandwidth $\omega_p = 0.2\pi$.</p> <p>(b) Design an FIR linear-phase digital filter that approximates the ideal frequency response</p> $H_d(\omega) = \begin{cases} 1, & \omega \leq \frac{\pi}{6}, \\ 0, & \frac{\pi}{6} < \omega \leq \pi \end{cases}$ <p>(i) Determine the coefficients of a 25-tap filter using the window method with a rectangular window.</p> <p>(ii) Compute and plot the magnitude and phase response of the filter.</p>	CO4	[3]