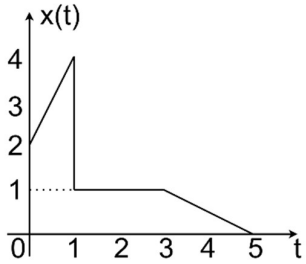
BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: B.Tech. **SEMESTER: IV**
BRANCH: EEE **SESSION: SP/2023**

SUBJECT: EE305 DIGITAL SIGNAL PROCESSING

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data handbook/Graph paper etc. to be supplied to the candidates in the examination hall.

		Marks	CO	BL
Q.1(a)	Consider the signal $x(t) = e^{j120\pi t} + e^{j360\pi t}$.The signal $y(t) = x(5t - 25)$ is formed. Determine the Nyquist sampling rate of $y(t)$.	[2]	01 & 02	03
Q.1(b)	Let $X(\omega)$ is the Fourier transform of signal $x(t)$.  If $\int_{-\infty}^{+\infty} \lvert X(\omega)\rvert^2 d\omega = \alpha$ and $\int_{-\infty}^{+\infty} X(\omega) e^{j0.5\omega}\, d\omega = \beta$. Determine the value of $\alpha + \beta$.	[3]	01, 02 &03	03
Q.1(c)	The transfer function of a causal LTI system is $H(s) = 1/s$. If the input to the system is $x(t) = \left[\frac{\sin(t)}{\pi t}\right] u(t)$. Estimate the system output $y(t)\ as\ t \to \infty$? Determine the direct Form II realization for third order IIR transfer function $H(z) = \frac{0.28z^2 + 0.319z + 0.04}{0.5z^3 + 0.3z^2 + 0.17z - 0.2}$.	[5]	03 & 04	04
Q.2(a)	Determine the z-transform of *X(z)* of the signal. $x(n) = 0.5[n^2 + n](0.5)^{n-1}u(n-1)$	[2]	02 &03	04
Q.2(b)	Let $x(n) = \{2, 5, 0, 4\}$ and $h(n) = \{4, 1, 3\}$. Perform the linear convolution using circular convolution. Consider $Y(k)$ be a 14-point DFT of a length-14 real sequence $y(n)$. The first eight samples are given by $Y(0) = 12, Y(1) = -1 + j3, Y(2) = 3 + j4, Y(3) = 1 - j5, Y(4) = -2 + j2, Y(5) = 6 + j3, Y(6) = -2 - j3\ and\ Y(7) = 10$. Evaluate the function $\sum_{n=0}^{13} e^{\frac{j4\pi n}{7}} y(n)$.	[3]	04	05
Q.2(c)	Compute the 8-point DFT of the sequence $x(n) = \cos\left(\frac{n\pi}{2}\right)$ using the DIT-FFT algorithm. Show all the intermediate values.	[5]	03	04
Q.3(a)	Write the comparison between Impulse Invariant and Bilinear Transformation technique.	[2]	01 & 02	02
Q.3(b)	Obtain the recursive relation to determine the Chebyshev polynomial. Write the key properties of Type-1 Chebyshev filter.	[3]	03	04

PTO

Q.3(c)	Design an HPF with the following specifications: $Passband: 0.8 \leq \left\|H(e^{j\omega})\right\| \leq 1 \qquad 0.7\pi \leq \|\omega\| \leq \pi$ $Stopband: \left\|H(e^{j\omega})\right\| \leq 0.2 \qquad 0 \leq \|\omega\| \leq 0.2\pi$ Design the IIR filter using Bilinear Transformation method. Assume a Butterworth characteristic for the filter and T=1 s.	[5]	05	05,06
Q.4(a)	Compare the differences between Finite Impulse response and Infinite Impulse response filters?	[2]	03	04
Q.4(b)	Obtain the transfer function and impulse response of a causal Type-3 linear-phase FIR filter of minimum length if it has a zero at $z = j$ and two zeros at $z = 1$.	[3]	04	03,04
Q.4(c)	Determine the frequency response (DTFT) of the Causal Rectangular window. Using a rectangular window, design a causal LPF with a pass-band gain of unity, cut-off frequency of 1000 Hz, and working at a sampling frequency of 5 KHz. Take the length of the impulse response as 7.	[5]	05	05,06
Q.5(a)	Describe Barrel shifter? Implement 4-bit shift right barrel shifter.	[2]	01 & 02	02
Q.5(b)	Explain the various addressing modes used in DSP processors.	[3]	01 & 02	02
Q.5(c)	Explain the TMS320C family. Differentiate between fixed-point and floating-point DSP processors.	[5]	03	04

:::::27/04/2023 M:::::