GURU NANAK INSTITUTE OF TECHNOLOGY
An Autonomous Institute under MAKAUT
2021
DIGITAL SIGNAL PROCESSING
EE605A

TIME ALLOTTED: 3HR **FULL MARKS:70**

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable

GROUP – A
(Multiple Choice Type Questions)

Answer any ***ten*** from the following, choosing the correct alternative of each question: **10×1=10**

			Marks	CO No
1.	(i)	The digital system in y(n) = n.x(n) is a) linear and causal. b) linear and non causal. c) non linear and causal. d) non linear and non causal.	1	CO2
	(ii)	The Z-transform of $a^n u[-n-1]$ is a) $1/(1-aZ^{-1})$ b) $Z/(a-Z)$ c) $a1/[aZ(1-Z^{-1})]$ d) $(1+aZ^{-1})$	1	CO2
	(iii)	The ROC of an infinite causal sequence is the a) interior of a circle. b) exterior of a circle. c) entire z plane except z = 0. d) entire z plane except z = ∞.	1	CO2
	(iv)	The s plane and z plane are related as a) $z = e^{sT}$ b) $z = e^{2sT}$ c) $z = 2e^{sT}$ d) $z = e^{sT}/2$	1	CO2
	(v)	Zero padding of a signal a) reduces aliasing. b) increase time resolution. c) increase frequency resolution. d) has no effect.	1	CO4
	(vi)	DFT is applied to a) Infinite sequences b) Continuous finite sequences c) Finite discrete sequences d) Periodic continuous time signals	1	CO1
	(vii)	FIR filter is a) recursive and linear. b) non recursive and linear. c) recursive and non linear. d) none of these.	1	CO5

	(viii)	For rectangular window used for designing FIR filters, the peak amplitude of the side lobe is a) - 41 dB b) - 3 dB c) 0 dB d) - 13 dB	1	CO5
	(ix)	Overlap save method is used to find a) circular convolution. b) linear convolution c) DFT d) Z- transform.	1	CO4
	(x)	The speech signal is obtained after a) Analog to digital conversion b) Digital to analog conversion c) Modulation d) Quantization	1	CO5
	(xi)	Poles of Butterworth filter lie on a) Circle b) Ellipse c) Circle and Ellipse d) none of these.	1	CO3
	(xii)	Infinite memory system is also known as a) FIR system b) IIR system c) Digital system d) Analog system	1	CO3

GROUP – B

(Short Answer Type Questions)

Answer any ***three*** from the following: **3×5=15**

		Marks	**CO No**
2.	Find the DFT of the sequence x(n) = {1,1,0,0}	5	CO1
3.	For the following system determine whether it is linear, causal and time invariant $y(n) = x(n) + 3u(n-1)$	5	CO2
4.	What do you mean by Quantization and how it affects on digital filter?	5	CO4
5.	Find the circular convolution using concentric circle method of the two finite duration sequence $x_1(n) = \{1,-1,-2,3,-1\}$ and $x_2(n) = \{1,2,3\}$.	5	CO4
6.	A DTLTI system with impulse response h[n]={1,1,1} is excited by a sequence x[n]={4,3,2,1}. Determine the output y[n] of the system.	5	CO2

GROUP – C

(Long Answer Type Questions)

Answer any ***three*** from the following: **3×15=45**

			Marks	**CO No.**
7.	(a)	Prove that the energy of a real valued energy signal is equal to the sum of the energies of the	4	CO1

		even and odd components i.e. $E_s = E_e + E_o$		
	(b)	Find the inverse transform of $X(z) = \frac{z}{3z^2 - 4z + 1}$, , where the ROC is (a) $\|z\| > 1$, (b) $\|z\| < (1/3)$, (c) $(1/3) < \|z\| < 1$	6	CO2
	(c)	If x(n) ={1,-2,1} and h(n) = {1,1,1,1,1,1}, then find x(n)*h(n) using Z-transform method.	5	CO2
8.	(a)	x(n) = {1,2,-1,2,3,-2,-3,-1,1,1,2,-1} , h(n) = {1,2}. i. Using linear convolution find y(n). ii. Compare the result by solving the problem using overlap add method.	8	CO4
	(b)	Determine the inverse Z-transform of $X(z) = \frac{z+2}{2z^2 - 7z + 3}$. If the ROCs are a. $\|z\| > 3$, b. $\|z\| < ½$, c. $½ < \|z\| < 3$.	7	CO2
9.	(a)	Using linear convolution find y(n) = x(n)*h(n) for the sequence x(n) = (1,2, -1,2,3,-2,-3,-1,1,1,2,-1). and the impulse response of the system is h (n) = (1,2). Compare the result by solving the problem using (a) Overlap -save method (b) Overlap-add method.	10	CO3
	(b)	Write short notes on the following : (Any one) i. Recursive and non-recursive systems. ii. Aliasing and sampling rate in signal processing. iii. TMS320C 5416/6713 processor	5	CO2,CO1
10.	(a)	Design a Butterworth Filter using Impulse invariant method for the following specifications. Given T = 1 sec. $0.8 \le \|H(e^{j\omega})\| \le 1$ $0 \le \omega \le 0.2\pi$ $\|H(e^{j\omega})\| \le 0.2$ $0.6\pi \le \omega \le \pi$	10	CO5
	(b)	Find the order of the Butterworth Filter that has a -2 dB passband attenuation at a frequency of 20 rad/sec and -10 dB stopband attenuation at 30 rad/sec.	5	CO3
11.	(a)	A lowpass filter is to be designed with the following desired frequency response $H_d(e^{j\omega}) = e^{-j2\omega}$ $-\pi/4 \le \omega \le \pi/4$ $= 0$ $\pi/4 < \omega \le \pi$ Determine the filter coefficient $h_d(n)$ if the window function is defined as $w(n) = 1$ $0 \le n \le 4$	10	CO5

	= 0 otherwise Also determine the frequency response $H(e^{j\omega})$ of the designed filter.		
(b)	Given sequences $x_1(n)= \{1,2,3,1\}$ and $x_2(n) = \{4,3,2,2\}$, find $x_3(n)$ such that $X_3(k) =X_1(k)\, X_2(k)$	5	CO1, CO4