GURU NANAK INSTITUTE OF TECHNOLOGY
An Autonomous Institute under MAKAUT
2022
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)	A digital signal is, a) Continuous in time , discrete in amplitude b) Discrete in time, continuous in amplitude c) Continuous in time, continuous in amplitude d) Discrete in time, discrete in amplitude	1	CO2
	(ii)	The product of two odd signals is a) Odd b) Even c) Both (a) and (b) d) Zero	1	CO4
	(iii)	The z-transform of the sequence $\mathbf{x(n)=a^n u(n)}$ **is** a) $\frac{1}{1-az}$ b) $\frac{1}{1-az^{-1}}$ c) $\frac{-z}{z-a}$ d) $\frac{1}{z-a}$	1	CO2
	(iv)	Which of the following is the characteristic of the power signal? a) Power signal is infinite b) Power signals are time-limited c) Aperiodic signals are power signals d) None of the above	1	CO2
	(v)	Zero padding of a signal a) reduces aliasing b) increase time resolution c) increase frequency resolution d) has no effect	1	CO1

(vi) The direct evaluation DFT requires _____complex multiplications. 1 CO1
a) N(N-1)
b) N^2
c) N(N+1)
d) $\frac{N(N-1)}{2}$

(vii) FIR filter is 1 CO5
a) recursive and linear
b) non recursive and linear
c) recursive and non linear
d) none of these

(viii) For rectangular window used for designing FIR filters, the peak amplitude of the side lobe is 1 CO5
a) - 41 dB
b) - 3 Db
c) 0 dB
d) - 13 dB

(ix) The twiddle factor satisfy the following properties 1 CO4
a) $w^r = -w^{r\pm N}$
b) $w^r = w^{r\pm N}$
c) $w^r = -w^{r\pm\frac{N}{2}}$
d) none of these.

(x) The speech signal is obtained after 1 CO5
a) Analog to digital conversion
b) Digital to analog conversion
c) Modulation
d) Quantization

(xi) Poles of Butterworth filter lie on 1 CO3
a) Circle
b) Ellipse
c) Circle and Ellipse
d) none of these

(xii) A system is said to be stable if 1 CO2
a) $\sum_{n=-\infty}^{\infty}|h(n)| < \infty$
b) $\sum_{n=-\infty}^{\infty}|h^2(n)| < \infty$
c) $\sum_{n=-\infty}^{\infty}|h(n)| = \infty$
d) $\sum_{n=-\infty}^{\infty}|h^2(n)| = \infty$

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

		Determine the systems described by the following equations are causal or non-causal. a) $y(n) = x(n) + \frac{1}{x(n-1)}$ b) (ii) $y(n)=x(n^2)$	5	CO2
4.		Find out the z-transform and ROC of the following sequence, $x(n)=0.8^n u(-n-1)$	5	CO2
5.		Find the circular convolution using Matrix Multiplication 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.		What is Gibb's phenomenon? What are its effect in digital filter and how to reduce it.	5	CO5

GROUP – C
(Long Answer Type Questions)
Answer any ***three*** from the following: **3×15=45**

			Marks	CO No.
7.	(a)	Determine the values of power and energy of the following signals. Find whether the signals are power, energy or neither energy nor power signals. (i) $x(n) = \left(\frac{1}{3}\right)^n u(n)$ (ii) $x(n) = x(n) = e^{j\left(\frac{\pi}{2}n + \frac{\pi}{4}\right)}$	4	CO2
	(b)	Determine the output response y(n) if h(n)={1,1,1} and x(n)={1,2,3,1} by using Linear convolution.	6	CO5
	(c)	Consider an LTI system critically at rest described by the difference equation y(n)=1/4 y(n-2)+x(n). Determine the impulse response of the system.	5	CO2
8.	(a)	Find the output y(n) of a filter whose impulse response is h(n)={1,1,1} and input signal x(n)={3,-1,0,1,3,2,0,1,2,1} using (i) overlap-save and (ii) overlap-add method.	8	CO1, CO5
	(b)	Determine the inverse z-transform of the function, $\mathbf{X(z)} = \frac{3+2z^{-1}+z^{-2}}{1-3z^{-1}+2z^{-2}}$	7	CO2
9.	(a)	Given x(n) = {1,2,3,4,4,3,2,1}. Find X(k) using DIF - FFT algorithm.	10	CO1, CO4
	(b)	Write short notes on the following : (Any one) i. Comparison between IIR and FIR filters. ii. Relationship between S-plane and Z-plane. iii. Aliasing and sampling rate in signal processing.	5	CO5,CO2
10.	(a)	Design a Butterworth Filter using Impulse invariant method for the following specifications. Given T = 1 sec. $0.8 \le \lvert H(e^{j\omega}) \rvert \le 1 \quad 0 \le \omega \le 0.2\pi$ $\lvert H(e^{j\omega}) \rvert \le 0.2 \quad 0.6\pi \le \omega \le \pi$	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 $H_d(e^{j\omega}) = e^{-j2\omega} \quad -\pi/4 \le \omega \le \pi/4$ $= 0 \quad \pi/4 < \omega \le \pi$ Determine the filter coefficient $h_d(n)$ if the window function is defined as $w(n) = 1 \quad 0 \le n \le 4$ $= 0$ otherwise Also determine the frequency response $H(e^{j\omega})$ of the designed filter.	10	CO5
	(b)	Write a short note on Quantization and its effect on digital filter.	5	CO3