GURU NANAK INSTITUTE OF TECHNOLOGY
An Autonomous Institute under MAKAUT
2022
SIGNALS & SYSTEMS
EC401

TIME ALLOTTED: 3 HOURS **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)	If a signal $f(t)$ has energy E, the energy of the signal $f(2t)$ is equal to a) E b) $\frac{E}{2}$ c) 2E d) 4E	1	CO1
	(ii)	The time period of the signal $x(t) = \cos 2\pi t + \sin 5\pi t$ is a) 2 sec b) 5 sec c) 10 sec d) 2.5 sec	1	CO1
	(iii)	The signal $x(n) = \cos 2n$ is a) periodic with period π b) periodic with period 2 c) periodic with period 4π d) aperiodic	1	CO1
	(iv)	A system with an input $x(t)$ and output $y(t)$ is described by the relation $y(t) = tx(t)$. This system is a) linear and time invariant b) linear and time variant c) nonlinear and time invariant d) nonlinear and time variant	1	CO2
	(v)	Which of the following represent a stable system? (1) Impulse response of the system decreases exponentially (2) Area with the impulse response is finite. (3) Eigen values of the system are positive and real. (4) Roots of characteristic equation of the system are real and negative. Select the correct answer using the codes given below a) 1 and 4 b) 1 and 3 c) 2, 3 and 4 d) 1, 2 and 4	1	CO2

(vi) The trigonometric Fourier series of an even function of time does not have the — 1 — CO2
a) dc term
b) cosine terms
c) sine terms
d) odd harmonic terms

(vii) A periodic signal $x(t)$ of period T_0 is given by — 1 — CO2

$x(t) = 1 \quad |t| < T_1$

$= 0 \quad T_1 < |t| < \frac{T_0}{2}$

The dc component of $x(t)$ is
a) $\frac{T_1}{T_0}$
b) $\frac{T_1}{2T_0}$
c) $\frac{2T_1}{T_0}$
d) $\frac{T_0}{T_1}$

(viii) DTFT performs — 1 — CO3
a) continuous time domain to continuous frequency domain transformation
b) continuous time domain to discrete frequency domain transformation
c) discrete time domain to continuous frequency domain transformation
d) discrete time domain to discrete frequency domain transformation

(ix) The region of convergence of the z-transform of a unit step function is — 1 — CO4
a) $|z| > 1$
b) $|z| < 1$
c) (Real part of z) > 0
d) (Real part of z) < 0

(x) The z-transform of the following real exponential sequence — 1 — CO4

$x(n) = a^n \quad n \geq 0$

$= 0 \quad$ for $n < 0$ is given by

a) $1 - az^{-1};\ |z| > a$
b) $\frac{1}{1-az^{-1}};\ |z| > a$
c) $-\frac{1}{1-az};\ |z| > a$
d) $1 + az^{-1};\ |z| < a$

(xi) The discrete Fourier transform of $x^*(n)$ is — 1 — CO3
a) $X^*(k)$
b) $X^*(-k)$
c) $X(N-k)$
d) $X^*(N-k)$

(xii) The spectral density of white noise is — 1 — CO5
a) Exponential
b) Uniform
c) Poisson
d) Gaussian

GROUP – B
(Short Answer Type Questions)
Answer any ***three*** from the following: **3×5=15**

			Marks	CO No
2.		Explain in detail about the following functions: Triangular pulse function and Gaussian function	5	CO1
3.		What is time reversal operation on a signal and draw the following signal: $u(n+2)-u(n-3)$	5	CO2
4.	(a)	What is probability density function (PDF)?	2	CO5
	(b)	A random variable has a probability distribution function given by $F(x)=0 \quad -\infty < x \le 0$ $=1-e^{-2x} \quad 0 \le x < \infty$ Find the probability that $X > 0.6$	3	CO5
5.		Explain the properties of Region of Convergence (ROC) of $X(z)$.	5	CO4
6.	(a)	What are the necessary conditions of Fourier transform?	2	CO2
	(b)	Find out the Fourier transform of $x(t)=1-e^{-\|t\|}\cos\Omega_0 t$	3	CO2

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

			Marks	CO No
7.	(a)	Define static and dynamic systems.	2	CO1
	(b)	Check whether the following two systems are causal or not $y(n)=x(n)+\frac{1}{x(n-1)}$ and $y(t)=x(t-2)+x(2-t)$	5	CO2
	(c)	Check whether the following system is linear or not and time-invariant or not $y(t)=e^{x(t)}$	8	CO2
8.	(a)	What is the importance of convolution operation in a discrete-time system?	5	CO2
	(b)	Determine the convolution sum of two sequences: $x(n)=\{1,\ 4,3,2\} \ : \ h(n)=\{1,3,2,1\}$ $\uparrow$	5	CO2
	(c)	Find the discrete-time Fourier transform of $x(n)=\{1,-1,2,2\}$	5	CO3
9.	(a)	Calculate the coefficients of Trigonometric Fourier Series.	9	CO2
	(b)	Find the Fourier transform of Signum function defined by Sgn(t) = 1, if t>0 = -1, if t<0	6	CO4
10.	(a)	State and prove initial and final value theorem of z-transform.	5	CO4
	(b)	Find the z-transform and ROC of the following signal: $x(n)=\left(\frac{1}{2}\right)^n u(-n)$	5	CO4
	(c)	Determine the inverse z-transform of $X(z)=\frac{1+2z^{-1}}{1-2z^{-1}+z^{-2}}$ Assume signal x(n)to be causal.	5	CO4
11.		Write short notes on any ***three*** of the following:	3x5=15	
	(a)	Energy and power signals	5	CO1
	(b)	Stability of a system	5	CO2
	(c)	Gibb's phenomenon	5	CO3
	(d)	Nyquist Sampling Theorem	5	CO5
	(e)	Significance of ROC	5	CO4