NITTE (Deemed to be University) | NMAM INSTITUTE OF TECHNOLOGY

Off-Campus Centre of Nitte (Deemed to be University), Nitte

Department of Electrical & Electronics Engineering

Course Plan-EE3003-1: Signal Analysis and Processing (IPCC)

Semester	:	VI	Year	:	2025-26
Course Title	:	Signal Analysis and Processing	Course Type	:	IPCC
Course Code	:	EE3003-1	Credits	:	04
Teaching Hours/Week (L: T: P: S)	:	3:0:2:0	CIE	:	50
Total Teaching Hours	:	40+26	SEE Marks	:	50
Prepared By	:	Dr. Dinesh Shetty	Date		Date: 05-08-2022
Reviewed by	:	Dr. Suryanarayana K	Date	:	Date: 05-08-2022
Updated by	:	Dr. Dinesh Shetty	Date	:	Date: 24-09-2023
Reviewed by		Dr. Rajalakshmi Samaga B L	Date	:	Date: 24-09-2023
Updated by	:	Dr. Dinesh Shetty	Date	:	Date: 29-12-2024
Reviewed by		Mr. Anup Shetty	Date	:	Date: 31-12-2024
Updated by	:	Dr. Dinesh Shetty	Date	:	Date: 01-01-2026
Reviewed by		Dr. Rajalakshmi Samaga B L	Date	:	Date: 04-01-2026
Approved by	:	Dr. Suryanarayana K, HoD	Date	:	Date:04-01-2026

***One additional tutorial class will be allotted every week**

Prerequisites:

1. **MA2008-1:** PTNM,**MA2004-1**: Vector Calculus & Transform Techniques, **EE2005-1**: Network Analysis

Course Learning Objectives (CLO):

1. To understand the
   i. Basic operations on signals and properties of systems
   ii. Importance of sampling theorem in signal processing.
2. To explain the properties of linear time invariant systems in terms of impulse response description
3. To know the Fourier representation of
   i. Continuous time periodic & aperiodic signals and their properties
   ii. Discrete time periodic signals & aperiodic signals and their properties.
4. To evaluate
   i. DFT of various signals using its properties.
   ii. Effective computation of DFT using Fast Fourier Transform algorithms
5. To design and formulate the transfer functions for
   i. Infinite Impulse Response (IIR) digital filters using Bilinear Transformation
   ii. Linear phase Finite Impulse Response (FIR) filters using various window
   for a given problem specification.

Course Content

Course : Signal Analysis Processing **Course code : EE3003-1**

Lecture Hours	Topic	Text Book / Ref Book	Teaching Methodology Followed
UNIT – I			
1, L1.	Introduction to COs of the course, Definitions of signal, continuous time (CT) and discrete time (DT) signals	T1, R1, R2	BB, PPT
2, L2	Sampling of Continuous time signal, Nyquist criteria and Quantization	T1, R1, R2	BB, PPT
3, L3	Reconstruction of a signal from its samples using interpolation	T1, R1, R2	BB, PPT
4, T1	Tutorial 1	T1, R1, R2	BB
5, L4	Exponential and sinusoidal signals, unit impulse and unit step functions, Sinc Function	T1, T2	BB
6, L5	Classification of signals- Continuous and Discrete time, Even and Odd signals	T1, T2	BB
7, L6	Periodic and aperiodic signals, Power and Energy signals	T1, T2	BB
8, T2	**Tutorial 2**	T1, T2	BB
9, L7	Basic Operation: Transformation of independent variables: CT signals.	T1,R1, R2	BB
10, L8	Transformation of independent variables: DT signals	T1	BB
11, L9	Definition of system, Properties of System- Stability, Memory Causality, Invertibility, Linearity	T1	BB

12, T3	**Tutorial 3**	T1	BB
13,14 L10,L11	Continuous time LTI systems: Convolution Integral	T1	BB
15, T4	**Tutorial 4**	T1	BB
16, L12	Discrete time LTI system: Convolution Sum	T1	BB
17, L13	Discrete time LTI system: Convolution Sum	T1,T2	BB
18, T5	**Tutorial 5**	T1	BB
19, L14	Properties of LTI system, Causal LTI systems described by Difference equations	T1	BB
20, L15	Problems on solution of Difference Equations	T1	BB
UNIT-II			
21, L16	Fourier Representation of Continuous Time Periodic Signals: Introduction, Fourier representation of continuous-time periodic signals in exponential form. (CTFS)	T1	BB
22, L17	Fourier Representation of Periodic Signals: Introduction, Fourier representation of continuous-time periodic signals in exponential form. (CTFS)	T1	BB
23, T6	Continuous-time Fourier transform (CTFT)	T1	BB
24, L18	**Tutorial 6**	T1	BB
25, L19	Convergence of the Fourier series, Fourier representation of Discrete-time periodic signals (Properties excluded) (DTFS)	T1	BB
26, L20	Convergence of the Fourier series, Fourier representation of Discrete-time periodic signals (Properties excluded) (DTFS)	T1	BB

27, T7	**Tutorial 7**	T1	BB
28, L21	Discrete-Time Fourier Transform: Representations of aperiodic signals, duality.	T1	BB
29, L22	Systems characterized by Linear Constant Coefficient Difference equations	T1	BB
30, L23	Systems characterized by Linear Constant Coefficient Difference equations	T1	BB
31, T8	**Tutorial 8**	T1	BB
32, L24	Fourier representation of Finite duration sequences: Discrete Fourier Transform (DFT)	T1	BB
33, L25	Properties of DFT	T1	BB
34, L26	Properties of DFT	T1	BB
35, T9	**Tutorial 9**	T1	BB
36, L27	Computation of DFT: Decimation-in-Time FFT Algorithms (Radix-2)	T1	BB
37, L28	Computation of DFT: Decimation-in-Time FFT Algorithms (Radix-2)	T1	BB
38, L29	Computation of DFT: Decimation-in-Frequency FFT Algorithms (Radix-2)	T1	BB
39, L30	Computation of DFT: Decimation-in-Frequency FFT Algorithms (Radix-2)	T1	BB
40, T10	**Tutorial 10**	T1	BB
UNIT-III			
41, L31	Structure for discrete time systems: Block diagram representation of Linear Constant coefficient difference equations	T1,T2, R1	BB
42, L32	Structure for discrete time systems: Block diagram representation of Linear Constant coefficient difference equations	T1,T2, R1	BB

43, T11	**Tutorial 11**	T1,T2, R1	BB
44, L33	Basic structures for IIR systems (Direct Form-I and Direct Form-II)	T1,T2, R1	BB
45, L34	Design of Discrete time IIR filters from continuous time filters using Bilinear Transformation (Butterworth LPF only)	T2, R1	BB
46, L35	Frequency Transformation of Low pass IIR filters (theory only)	T2, R1	BB
47, T17	**Tutorial 12**	T2, R1	BB
48, L36	Design of FIR filters by rectangular window method (Low pass filter)	T2, R1	BB
49, L37	Design of FIR filters by Hamming window method (Low pass filter)	T2, R1	BB
50, L38	Design of FIR filters by Hanning window method (Low pass filter)	T2, R1	BB
51, L39	Basic Structure of FIR systems (Direct forms and Linear Phase)	T2, R1	BB
52, L40	Basic Structure of FIR systems (Direct forms and Linear Phase)	T2, R1	BB
53, T13	**Tutorial 13**	T2, R1	BB

Suggested List of Experiments

1.	Representation of basic signals and verification of properties of signals.
2.	Realization of Sampling theorem and Aliasing
3.	Finite and Infinite Response of an LTI System.
4.	Linear & Circular Convolution of two given sequences.
5.	Realization of Dirichlet Conditions for Fourier Series.
6.	Solution of difference equations. examples
7.	Verification of DFT properties: i) Frequency shift ii) Time shift iii) Linearity iv) Auto Correlation & Cross Correlation v) Parseval's Theorems.
8.	Computation of N point FFT of a given sequence.
9.	Design and Implementation of Analog and Digital IIR filter to meet the given specifications for the Low pass filter
10.	Design and implementation of FIR filter to meet the given specifications using Window function

Course Plan-EE3003-1: Signal Analysis and Processing (IPCC)

Course Outcomes:

At the end of the course student will be able to

1.	Analyse signals and comprehend its properties
2.	Appreciate the properties of the system and analyse Discrete LTI systems to determine the impulse response
3.	Apply Fourier technique to obtain the frequency domain representation of continuous-time signals
4.	Apply Fourier technique to obtain the frequency domain representation of discrete-time signals
5.	Design of IIR and FIR filters to determine the filter coefficients for a given specification

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
↓ Course Outcomes												1	2
EE3003-1.1	3	3	-	-	3	-	-	2	2		1	-	-
EE3003-1.2	3	3	-	-	3	-	-	2	2		1	-	2
EE3003-1.3	3	3	-	-	3	-	-	2	2		1	-	2
EE3003-1.4	3	3	-	-	3	-	-	2	2		1	-	2
EE3003-1.5	3	3	-	-	3	-	-	2	2		1	-	2

1: Low 2: Medium 3: High

Textbooks:

1. Signals and Systems, Alan V Oppenheim, Alan S. Willsky and S. Hamid Nawab, PHI, 2nd edition, 2009
2. Discrete time signal processing, Alan V Oppenheim and Ronald W Schafer, PHI, 5th Indian Reprint, 2015

Reference books:

1. Digital Signal Processing Principles, Algorithms and Application, John G Proakis and Dimtris G Manolakis, Electronic Industry Press, 2013, 4th Edition.
2. Signals and Systems- Simon Haykin and Barry Van Veen, Wiley India Pvt Ltd, 2nd Edition 2008.
3. Signals and systems- S.Narayan Iyer, Cengage Learning,India,2011

E-Books / MOOC:

1. Signal Processing: Continuous and Discrete on MIT Open courseware
2. NPTEL Course on Principles of Signals and Systems by Prof. Aditya K. Jagannatham, IIT Kanpur
3. Digital Signal Processing - Course (nptel.ac.in) by Dr. Ramalingam, IIT Madras.

Evaluation Scheme (CIE)

Theory Assessment	**Weightage in Marks**
Mid Semester Examination (MSE) – I	20 Marks
Mid Semester Examination (MSE) – 2	20 Marks
Task Consisting of Quiz /Surprise Test/ Assignment **	10 Marks
Theory Marks	50 Marks
Weightage in CIE (60% of Total)	**30 Marks**
Laboratory Assessment	
Continuous Evaluation during regular Lab	30 Marks
Laboratory Mid Semester Examination (MSE)	20 Marks
Laboratory Marks	50 Marks
Weightage in CIE (40% of Total)	**20 Marks**
Total CIE	**50 Marks**

ASSESSMENT	**Weightage in Marks**
Mid Semester Examination (MSE) – I	20 Marks
Mid Semester Examination (MSE) – 2	20 Marks
Task Consisting of Quiz / Test/ Assignment **	10 Marks
Total	50Marks

Task Assessment:

1. Test (Task-1 for 4 Marks) on Unit-1 before MSE-1.
2. Test (Task-2 for 4 Marks) on unit-2 before MSE-2.
3. An assignment (Task-3 for 2 Marks) on Unit-3 after completion of half of the unit-3.

Rubrics for evaluation of Assignment:

Criterion	**Excellent – 4**	**Very Good – 3**	**Good – 2**	**Average – 1**	**Below Average – 0**
Completeness	Addresses all elements in the assignment	Addresses most of elements in the assignment	Addresses some elements in the assignment	Incomplete in most respects; does not address most of the elements of the assignment	Not Submitted

Writing Mechanics	Writing with clarity, conciseness, correctness; with relevant data /information; and well-organized	Writing with clarity and conciseness and contains only a few errors; with relevant data /information; and well-organized	Writing lacks clarity or conciseness and contains numerous errors; gives insufficient relevant data /information; lacks organization	Writing is unfocused, rambling, or contains serious errors; lacks relevant data / information; poorly organized	
Marks Awarded	$\frac{\sum Marks\ Obtained for\ two\ criterion}{2} =$				

Rubrics for evaluation of Test /MCQ

Test will have 4 Questions for 10 Marks and will be evaluated for 4 Marks with following Rubrics

Secured marks (out of 10)	Averaged Marks
8< Marks <10	4
6 < Marks < 8	3
4< Marks <6	2
2<Marks <4	1
Marks<2	0

Evaluation Scheme (SEE)

Semester End Examination (SEE) is a written examination of three hours duration of 100 marks with 50% weightage. The pattern of the Question Paper: There will be eight question with 3 questions from Unit1 and 2 and 2 questions from Unit-3. Answer any TWO questions from units 1 and 2, and any ONE question from unit 3.

Course Utilization for MSE and SEE

Unit	Contents	Lecturer + Tutorial Hours	No. of questions in MSE 1	No. of questions in MSE 2	No. of questions in SEE
1	Continuous time and discrete time signals. Transformation on independent variable	03+01 Hours	02		03
	Elementary Signals	01+0 1Hours			
	Sampling Theorem	02+01 Hours			
	Continuous time and Discrete time systems, Continuous Integral and Convolution sum	04+01 Hours			
	Properties of LTI System, Difference equation solutions	02+01 Hours			
2	Fourier representation of continuous-time periodic signals in exponential form.	03+01 Hours		02	03

	Fourier representation of Discrete-time periodic signals				
	Continuous-time Fourier transform: Properties of continuous-time Fourier transform Discrete-Time Fourier Transform	03+01 Hours			
	Fourier representation of Finite duration sequences:	03+01 Hours			
	Decimation-in Frequency FFT algorithms.	03+01 Hours			
3	Structure for discrete time systems: Block diagram representation of Linear Constant coefficient difference equations	02+00 Hours			02
	Discrete time IIR filters Design of FIRfilters by rectangularwindow and KaiserWindow method	05+02 Hours 05+01 Hours			

Bloom Levels	Level of Learning	Characteristics of Learning	Bloom Action Words
BL1	Remembering	Recognizing and recalling relevant knowledge from long term memory	List, Identify Outline, Define
BL2	Understanding	Constructing meaning from oral, written and graphic messages through interpreting, classifying, summarizing, inferring, comparing and explaining	Explain, Describe, Interpret, Distinguish
BL3	Applying	Carrying out or using a procedure through executing or implementing	Apply, Calculate, Solve
BL4	Analyzing	Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose through differentiating, organizing and attributing	Calculate, Analyze, Compare, Classify, Derive, Explain
BL5	Evaluating	Making judgements based on criteria and standards through checking and critiquing	Determine, Optimize, Evaluate
BL6	Creating	Putting elements together to form a coherent or function whole: recognizing elements into a new pattern or structure through generating, planning or producing	Formulate, Design, Create

Bloom's Taxonomy Levels (BL) Planned in MSE and SEE:

Sl. No.	Bloom's Taxonomy Levels (BL)	MSE 1	MSE 2	SEE
1	Remember	20%	20%	20%
2	Understand	50%	30%	30%
3	Apply	30%	40%	40%
4	Analyze	0%	10%	10%

Unit wise plan

Topic	Planned Hours (L-T-P)	Teaching Methodology
Unit- I – Introduction	**10-10-0**	
Definitions of continuous time and discrete time signals	1-0-0	BB/PPT
Transformation of independent variables CT signals and DT signals	1-1-0	
Transformation of dependent variable Numerical	1-1-0	
Exponential and sinusoidal signals, unit impulse and unit step functions	1-1-0	
Numerical Problems	0-1-0	
Sinc Functions, Reconstruction of a signal from its samples using interpolation	1-0-0	
The effect under sampling: Aliasing, Discrete time processing of continuous time signals.	1-1-0	
Continuous time and Discrete time systems, Properties of System	0-1-0	
Convolution Integral	2-1-0	
Convolution Sum	2-1-0	
Causal LTI systems described by Differential equation	1-0-0	
Causal LTI systems described by Difference equation	1-1-0	

Learning Outcomes: At the end of this unit students will be able to

1. Understand signals and their properties
2. Understand Sampling and reconstruction of signals
3. To explain the properties of linear time invariant systems in terms of impulse response description.

1 The type of systems which are characterized by input and the output quantized at certain levels are called as

a.	Analog	**c.**	**discrete**
b.	Digital	d.	Continuous

2. An example of a discrete set of information/system is

a.	the trajectory of the Sun	c.	Movement of water through pipe
b.	**Data on CD**	d.	Continuous

3. A system is said to be defined as non causal, when

a.	**the output at the present depends on the input at a time instant in the future**	c.	the output at the present depends on the input at an earlier time
b.	the output at the present depends on the input at the current time	d.	the output at the present does not depend on the factor of time at all

4. The minimum sampling rate required to avoid aliasing for the analog signal

$$x(t) = 3\cos(100\pi t) \;\; is$$

a.	**100Hz**	c.	200Hz
b.	50Hz	d.	7Hz

5. Signals with finite total energy must have ____ average power,

a.	**zero**	c.	infinite
b.	finite	d.	finite but less than total energy

6. For a complex signal $x(t) = e^{j\omega t}$ at $\omega = 0$ the period of the signal is

a.	zero	c.	infinite
b.	**undefined**	d.	one

7. The Nyquist rate of the signal x(t)=1+cos(200πt)+sin(400πt) is

a.	**Fs=400 Hz**	c.	Fs<400 Hz
b.	Fs>200 Hz	d.	Fs=200

8. Which of the following is correct regarding to impulse signal?

a.	x[n]δ[n] = x[0]δ[n]	c.	x[n]δ[n] = x[0]
b.	x[n]δ[n] = x[n]δ[n]	d.	x[n]δ[n] = δ[n]

9. Which of the following system is linear ?

1)y(t)=sin(x(t))
2)y(t)=log(x(t))
3)y(t)=cos(x(t))
4) y(t) = dx(t)/dt

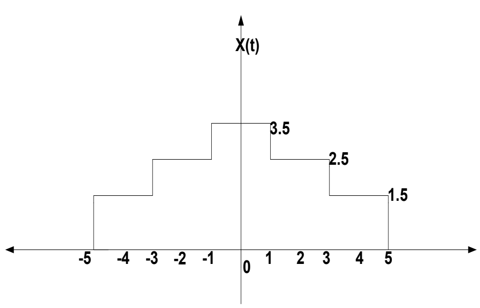
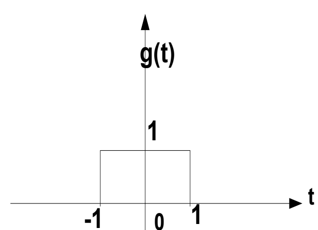
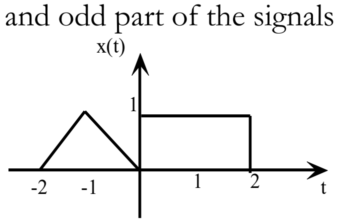
a.	1	c.	2
b.	3	d.	**4**

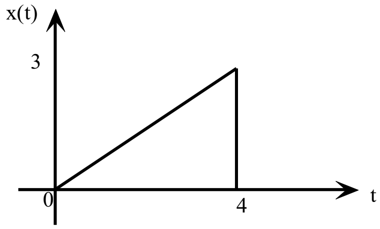
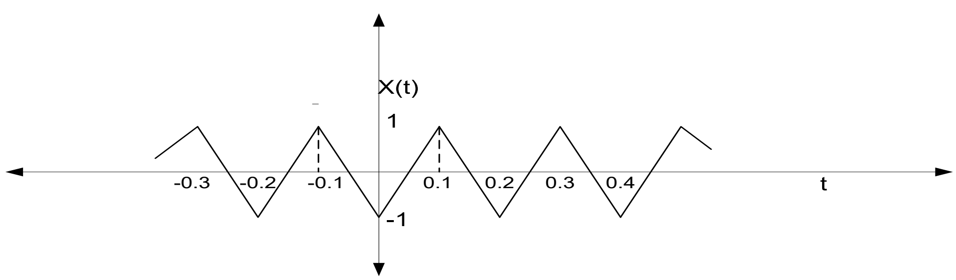
10 Which of the following systems is time invariant?

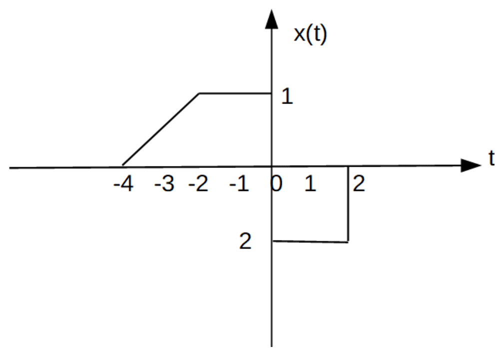
a)y(t)=x(2t)+x(t)
b)y(t)=x(t)+x(1-t)
c)y(t)=-x(t)+x(1-t)
d) y(t) = x(t) + x(t-1)

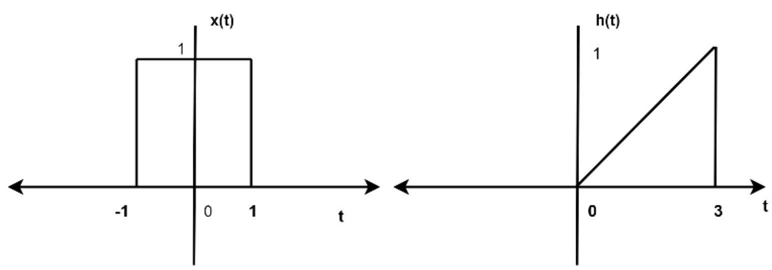
a.	1	c.	2
b.	3	d.	**4**

Review questions on Remembering (BTL1)		
1.	Define the basic form of the discrete time impulse and step signals and sketch the signals.	L1
2.	Calculate the power and energy of the following continuous and discrete time signals:	L1

	x[n] = n for $0 \leq n \leq 4$	
3.	Determine whether the given signal is periodic or not. If periodic what is the fundamental period? x(t)= cos(2πt)+ sin(10πt)	L1
4.	State and explain Sampling theorem	L1
5.	Determine whether or not each of the following signal is periodic or not. Find its fundamental period. x(t)=cos($\sqrt{2}$t)−cos(t)	L1
6.	Sketch i)$x[n] = 3u(n+4) - u(n) + 3u[n-3] - 5u[n-6]$.	L1
7.	Check whether the n signals are Power or energy signals i)$x(n) = (-0.5)^n u(n)$ ii) $x(n) = \sin\left(\frac{\pi}{4}n\right)$	L1
8.	Discuss the features of Dirac delta function with respect to continuous time signal.	L1
Review questions on Understanding (BTL2)		
1.	Are the following continuous and discrete time signal periodic, if so determine their period (and fundamental frequency for the continuous time signal): x(t) = je^{j5t} and x[n]=cos($\frac{\pi}{3}$n) cos($\frac{\pi}{5}$n)	L2
2.	A continuous time signals $x(t)$ *and* $g(t)$ shown in Figure 1a and Figure 1b. Express $x(t)$ in terms of $g(t)$  Figure 1 a  Figure 1 b	L2
3.	Determine and sketch the even and odd part of the signals shown in Figure 2  Figure 2	L2
4.	Perform the following operations on the signal shown in Figure 3	L2

	 Figure 3 (i) x(3t+2) (ii) x(2(t+2)) (iii) x(-2t-1) (iv) x(-2t+3)	
5.	Determine and sketch even and odd part of the signal x[n]=[-1,2,2,1,1,2,1,-1] ↑	L2
6.	Solve the homogeneous differential equation given $$\frac{d^2y(t)}{dt^2}+3\frac{dy(t)}{dt}+2y(t)=0, y(0)=0, y'(0)=2$$	L2
7.	Evaluate the following continuous time convolution integral and plot it y(t)=$u(t+1)*u(t-2)$	L2
8.	Find the average power of the triangular wave shown Figure 4  Figure 4	L2
9.	Find the natural response of the system described by the difference equation $$y(n)-\frac{9}{16}y(n-2)=x(n-1) \quad with\ \ y(-1)=1\ \ and\ y(-2)=-1$$	L2
10.	Evaluate the discrete time convolution sum given below x(n)={1, 2,3,4 } and h(n)={1,1,3,2} ↑ ↑	L2
11.	Evaluate the convolution integral for y(t)=u(t+1) $e^{(-2t)}$ u(t) Using graphical method	L2
12.	Find the total response of the system given by the differential equation $\frac{d^2y((t)}{dt^2}+5\frac{dy(t)}{dt}+4y(t) = \frac{dx(t)}{dt}$, y(0)=0; $\frac{dy(t)}{dt}\|_{t=0}$=1 and $x(t)=e^{-2t}u(t)$	L2
Review questions on Applying (BTL3)		

1.	 Figure 5 For the signal x(t) shown in Figure5 sketch i. $x_1(t) = x(2t-4)$ ii. $x_2(t) = 2x(2t+2)$ iii) Even and Odd components of x(t)	L3
2.	Determine the discrete time signal v[n] obtained by uniformly sampling at a sampling rate of 200Hz continuous time signal $v_a(t)$ composed of weighted sum of five sinusoidal signals of frequencies 30Hz, 150Hz, 170Hz, 250Hz, and 330Hz, as given below:$v_a(t) = 6\cos(60\pi t) + 3si\,n(300\pi t) + 2\cos(340\pi t) + 4\cos(500\pi t) + 10\sin(660\pi t)$	L3
3.	Evaluate convolution sum for the input signal x[n]= $(\frac{1}{2})^n$ u[n-2] and impulse response . Use Graphical Method h[n]=u[n]	L3
4.	Sketch the even and odd components of the signal x(t)=4e$^{(-0.5t)}$	L3
5.	Determine whether the given systems are i)Linear ii) Time Invariant iii)Memoryless iv) Memoryless V)causal Vi) stable. y(t)= x(t)+ x(t-100) y(n)=x[2n] y(t)=$\frac{d}{dt}(e^{-t}\,x(t))$ y(n)=x(-n+2) y(n)=nx(n)	L3
6.	Determine the zero state ,zero input and complete response of LTI system described by the difference equation $y(n) - y(n-1) - 2y(n-2) = x(n)$ with input $x(n) = 6u(n)$ and initial conditions y(-1)=-1 and y(-2)=4.	L3
7.	Consider an input x[n] and a unit impulse response h[n] given by $x[n] = 1$ for $0 \leqslant n \leqslant 4$ = 0 ; otherwise	L3

	$h[n] = \alpha^n$ for $0 \leqslant n \leqslant 6$ and $\alpha > 1$ Identify and plot the output y[n] = x[n] * h[n].	
8.	Consider an input x[n] and a unit impulse response h[n] given by x[n]= $(\frac{1}{2})^n$u[n-2] h[n]=u[n+2] Identify and plot the output y[n] = x[n] * h[n].	L3
9.	With suitable example for energy signal $x(t)$ with energy E, show that energy of $x(-t)$ and $x(t-t_0)$ is E and also Show that energy of an $x(at)$ as well as $x(at-b)$ is E/a but energy of $ax(t)$ is a^2E.	L3
10.	Determine graphically y(t)=x(t)*h(t) for the signals shown in Figure 6  Figure 6	L3

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Off-Campus Centre of Nitte (Deemed to be University), Nitte

Department of Electrical & Electronics Engineering

Course Plan-EE3003-1: Signal Analysis and Processing (IPCC)

MODEL QUESTION FOR MSE-1

USN | | | | | | | | | | |

NMAM INSTITUTE OF TECHNOLOGY, NITTE

Off Campus Centre of Nitte (Deemed to be University)

VI SEM B.E. (E&E) Mid Semester Examinations - I, February 2025

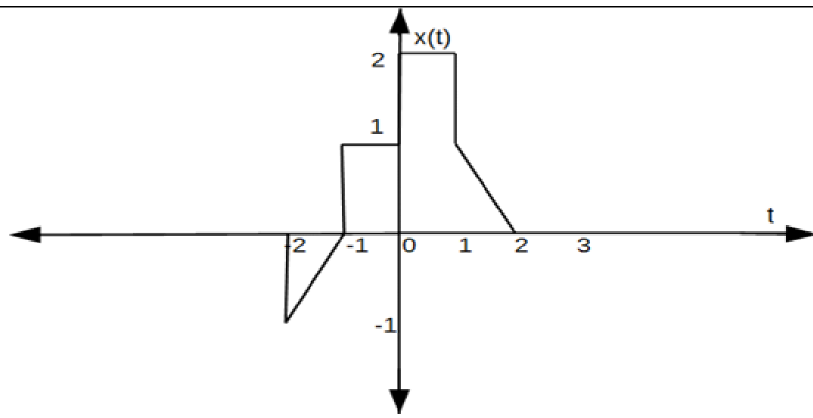
EE3003-1 – SIGNAL ANALYSIS AND PROCESSING

Duration: 1 Hour Max. Marks: 15

Part – A: Multiple Choice Questions (1*4 = 4 marks)

*Note: Answer all **Four** questions in the **Answer Book**. Each question carries equal marks.*

1.	The type of systems which are characterized by input and the output quantized at certain levels are called as			
	A)	Continuous	B)	discrete
	C)	analog	D)	digital
2.	The minimum sampling rate required to avoid aliasing for the analog signal $x(t) = 3\cos(100\pi t)$ *is*			
	A)	100Hz	B)	50 Hz
	C)	200Hz	D)	75 Hz
3.	An example of a discrete set of information/system is			
	A)	Data on CD	B)	the trajectory of the Sun
	C)	Movement of water through pipe	D)	Music played on system
4.	Which of the following is correct regarding to impulse signal?			
	A)	$x[n]\delta[n] = x[0]\delta[n]$	c.	$x[n]\delta[n] = x[0]$
	C)	$x[n]\delta[n] = x[n]\delta[n]$	D)	$x[n]\delta[n] = \delta[n]$

		Part – B: Descriptive Answer Questions (2*8 = 16 marks) *Note: Answer any **One** full question from **each Unit*** **Unit – I**	**Marks**	**BT***	**CO***	**PO***
1.	a)	 Figure.1 A continuous time signal x(t) shown in figure 1. Sketch and label the following signals a. $x(2-t)$ b. $[x(t)+x(-t)]u(t)$ c. $x(t)[\delta(t+\frac{1}{2})-\delta(t-\frac{1}{2})]$	04	L2	1	1,2
	b)	Determine whether or not each of the following signals is periodic. If the signal is periodic determine its fundamental period a. $x[n]=\cos(\frac{\pi}{5}n)\cos(\frac{\pi}{6}n)$	04	L1	1	1,2
2.	a)	Explain the process of discrete time processing of continuous time signal.	04	L1	1	1,2
	b)	Determine and sketch even and odd part of the signal $x[n]=[-1,2,2,1,1,2,1,-1]$ ↑	04	L2	1	1,2
		Unit – II				
3	a)	Compute and plot the convolution sum of $x[n]=\delta[n]+2\,\delta[n-1]-\delta[n-3]$ $h[n]=2\delta[n+1]+2\,\delta[n-1]$	05	L3	2	1,2

	b)	Solve the natural response for homogeneous differential equation given $$\frac{d^2y(t)}{dt^2}+3\frac{dy(t)}{dt}+2y(t)=0, y(0)=0, y'(0)=2$$	03	L1	2	1,2
4.	a)	Solve the following homogeneous difference equation with specified auxiliary conditions $$y[n]+\frac{3}{4}y[n-1]+\frac{1}{8}\,y[n-2]=0;\ y[0]=1, y[-1]=-6$$	04	L2	2	1,2
	b)	Compute and plot the convolution integral of $x(t)=u(t-3)-u(t-5)\ and\ h(t)=e^{-3t}u(t)$	04	L3	2	1,2

Topic	Planned Hours L-T-P	Teaching Methodology
UNIT-II	**10-10-0**	
The Continuous-time Fourier transform	1-0-0	**BB**
Properties of continuous-time Fourier transform,	1-0-0	**BB**
Numerical Problems	0-1-0	**BB**
Systems characterized by Linear Constant Coefficient Differential equations.	1-1-0	**BB**
The Discrete-Time Fourier Transform	1-1-0	**BB**
Numerical Problems	1-0-0	**BB**
Duality property	1-0-0	**BB**
Systems characterized by Linear Constant Coefficient Difference equations.	1-0-0	**BB**
Numerical Problems	0-1-0	**BB**
Fourier representation of Finite duration sequences ,Properties	1-0-0	**BB**
Properties of continuous-time Fourier transform,	1-0-0	**BB**
Systems characterized by Linear Constant Coefficient Differential equations	1-0-0	**BB**
Numerical problems	0-1-0	**BB**
Computation of DFT: Decimation-in-Time FFT algorithms,	1-0-0	**BB**
Numerical problem on Properties of DFT	0-1-0	**BB**
Decimation-in-Frequency FFT algorithms.	1-0-0	**BB**
Decimation-in-Frequency FFT algorithms.	1-0-0	**BB**
Numerical problems	0-1-0	**BB**
Learning Outcomes: At the end of this unit students will be able to		

1. To know the Fourier representation of continuous time & discrete time periodic & aperiodic signals and their properties.
2. To evaluate DFT of various signals using its properties.
3. To evaluate the effective computation of DFT using fast Fourier Transform algorithms

1.

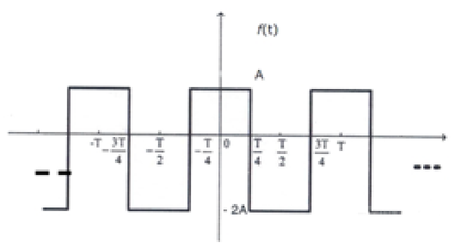


Figure 1

The trigonometric Fourier series for the waveform f(t) shown in figure 1 contains

a.	Only cosine terms and zero value for the dc component	c.	Only cosine terms and a positive value for the dc component
b.	**Only cosine terms and a negative value for the dc component**	d.	Only sine terms and a negative for the dc component

2. A signal $x(t)$has a Fourier transform X (w),If x(t) is a real and odd function of t, then X(w) is

a.	**An imaginary and odd function of w**	c.	A real and odd function of w
b.	A real and even function of w	d.	An imaginary and even function of w

3. Phase response of the Fourier Transform of x(t)=$e^{-a|t|}u(t)$; $a > 0$

a.	$\tan^{-1}\left(\frac{w}{a}\right)$	c.	$\boldsymbol{-\tan^{-1}\left(\frac{w}{a}\right)}$
b.	$-\tan^{-1}\left(\frac{a}{w}\right)$	d.	No Phase response

4. The Fourier transform of a function $x(t)$ is X(f). The Fourier transform of $\frac{dx(t)}{dt}$will be

	a.	$\frac{dX(f)}{dt}$	c.	$jfX(f)$
	b.	**$j2\pi fX(f)$**	d.	$\frac{X(f)}{jf}$

5. Which of the following cannot be the Fourier series expansion of a periodic signal?

a.	$x(t) = 2\cos t + 3\cos t$	c.	**$x(t) = 2\pi\cos t + 7\cos t$**
b.	$x(t) = \cos t + 0.5$	d.	$x(t) = 2\cos 1.5\pi t + \cos 3.5\pi t$

6. If x(n) and X(k) are an N-point DFT pair, then X(k+N)=?

a.	$X(-k)$	c.	$-X(-k)$
b.	**$X(k)$**	d.	$X(N)$

7. If x(n) is a real sequence and X(k) is its N-point DFT, then which of the following is true?

a.	X(N-k)=X(-k)	c.	X(N-k)=X*(k)
b.	X(-k)=X*(k)	d.	All of the mentioned

8. What is the circular convolution of the sequences X1(n)={2,1,2,1} and x2(n)={1,2,3,4}?

a.	{14,14,16,16}	c.	{14,16,16,14}
b.	**{14,16,14,16}**	d.	{16,16,14,14}

9. If X(k) is the N-point DFT of a sequence x(n), then what is the DFT of x*(n)?

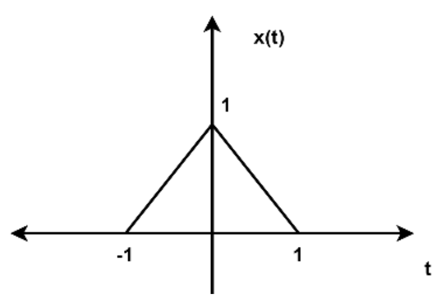
a.	X(N-K)	c.	X*(K)
b.	**X*(N-K)**	d.	X(-K-N)

10. The DFT is preferred for

1) Its ability to determine the frequency component of the signal
2) Removal of noise
3) Filter design
4) Quantization of signal

a.	1, 2 and 3 are correct	c.	1 and 2 are correct
b.	**1 and 3 are correct**	d.	1, 2 and 4 are correct

Review questions on Remembering (BTL1)		
1.	If x(t) is a periodic signal, describe the form of the basis functions that occur in the Fourier series representation of the time domain signal.	L1
2.	State and Prove time differentiation property of Fourier Transform	L1

3.	State and Prove Parseval's Theorem property of DTFT	L1
4.	Explain the quantization effect in the computation of DFT.	L1
5.	State and prove convolution property of Continuous time Fourier Series	L1
6.	List the methods to suppress the harmonics generated in synchronous machines.	L1
7.	Explain the Convergence of CTFS and mention the Dirichlet conditions.	L1
Review questions on Understanding (BTL2)		L2
1.	Calculate the Fourier series (coefficients) of the following periodic signals 1. x(t) = cos(t) 2. x(t) = 2+cos((2π/3)t)+4sin((5π/3)t) x(t) = 1 (where 0<=t<1) and –1 (where 1<=t<2), which is period 2.	L2
2.	Consider the causal, discrete time LTI system described by the following difference equation $y[n] + y[n-1] + \frac{1}{4}y[n-2] = x[n-1] - \frac{1}{2}x[n-2]$. Find the frequency response of the system. Show that the inverse system is not causal.	L2
3.	Find the circular convolution of the sequences $x[n] = [1\ 2\ 3\ 1]$ and $y[n] = [4\ 3\ 2\ 2]$ using frequency domain approach.	L2
4.	State and prove the Convolution property of the Continuous time fourier Transform	L2
5.	Find the frequency response and the impulse response of the system described by the differentiation equation $\frac{dy((t)}{dt} + 8y(t) = x(t)$	L2
6.	Find DTFT of the signal $x(n)=\{1, 3, \underset{\uparrow}{5}, 3, 1\}$	L2
Review questions on Applying (BTL3)		
1.	 Figure:1 Find the Fourier Transform for the signal $x(t)$ shown in Figure 1. And also sketch the signal $x_1(t) = x(t) * \sum_{k=-\infty}^{\infty} \delta(t-4k)$	L3
2.	Compute the Fourier Transform for the signal $x[n] = \frac{1}{3}^{\vert n\vert} u[-n-2]$	L3
3.	Let X[k] be a 14 point DFT of length 14 real sequence x$[n]$. The first 8 samples of $X[k]$ are given by	L3

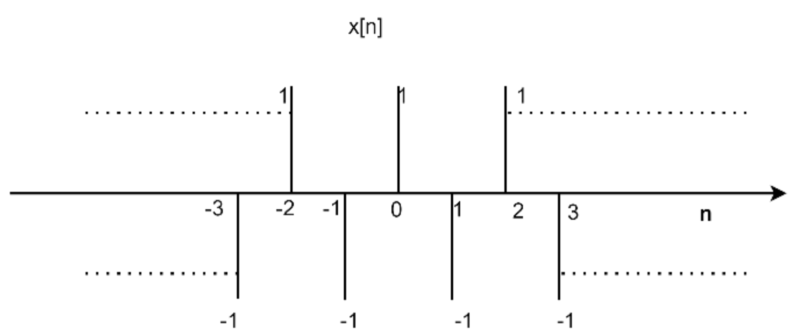
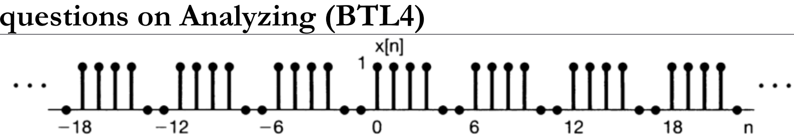
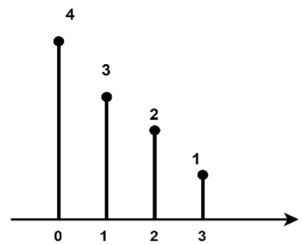
	$X(0) = 12,\quad X(1) = 1 + j3,\quad X(2) = 3 + j4,\quad X(3) = 1 - j5,\quad X(4) = -2 + j2,$ $X(5) = 6 + j3, X(6) = -2 - j3, X(.7) = 10.$ Find the remaining sequences of X[k] and evaluate x(0).	
4.	Find 8 point DFT of a real sequence $x[n] = [0.707, 1, 0.0707, 0, -0.707, -1, -0.707, 0]$ using decimation in time FFT algorithm.	L3
5.	Consider an LTI system whose response to the input $x(t) = [e^{-t} + e^{-3t}]u(t)$ is $y(t) = [2e^{-t} - 2\,e^{-4t}]u(t)$ i. Determine the frequency response of the system ii. Determine the impulse response of the system	L3
6.	Determine and sketch the spectrum of the signal shown in Figure 2 using DTFS  Figure 2	L3
7.	Find the DTFT of the following signals i. $x[n] = \left(\frac{1}{4}\right)^n u(n+4)$ ii. $x[n] = (-1)^n u(n)$	L3
8.	Find the circular convolution of the sequences $x[n] = [1\ 2\ 3\ 1]$ and $y[n] = [4\ 3\ 2\ 2]$ using frequency domain approach.	L3
9.	Determine and sketch the Fourier spectrum for discrete time signal $x[n] = (-1)^n\ ; -\infty < n < \infty$	L3
10.	Find the Fourier series coefficient for the periodic signal $x(t)$ with period 2 given by $x(t) = e^{-t}$; for $-1 < t < 1$	L3
11.	Obtain the Fourier Transform of $x(t) = e^{-a\|t\|}$; $a > 0$. Draw the spectrum.	L3
12.	Evaluate the DTFT of the signal i. $x(n) = \delta(6 - 3n)$ ii. $x(n) = a^{\|n\|}$; $\|a\| < 1$	L3
Review questions on Analyzing (BTL4)		
1.	 	L4

	Figure-3 Determine the Fourier series coefficients for the discrete time signal shown in Figure 3 .Plot the magnitude and phase.	
2.	 Figure-4 For the signal x$[n]$ shown in Figure 4.Sketch the finite length sequence $y[n]$ whose 6-point DFT is $Y[k] = W_6{}^{4k}X[k]$ where $X[k]$ is the 6-point DFT of x$[n]$ and also find the sequence w$[n]$ whose 6-point DFT is X$[k] = real\ (X[k])$	L4
3.	The impulse response of a continuous time LTI system given by $h(t) = \frac{1}{RC} e^{-t/_{RC}}\ u(t)$. Find the frequency response and plot the magnitude and phase spectrum	L4
4.	Using Partial fraction expansion determine the inverse DTFT of the signal $X(e^{j\Omega}) = \dfrac{3 - \frac{1}{4}e^{-jw}}{(-\frac{1}{16}e^{-j2w}) + 1}$	L4

MODEL QUESTION FOR MSE-2

USN | | | | | | | | | | |

NMAM INSTITUTE OF TECHNOLOGY, NITTE

(An Autonomous Institution affiliated to VTU, Belagavi)

VI SEM B.E. (E&E) Mid Semester Examinations -II, March 2025

EE3003-1 – SIGNAL ANALYSIS AND PROCESSING

Duration: 1 Hour Max. Marks: 16

Part – A: Multiple Choice Questions (1*4 = 4 marks)

*Note: Answer all **Four** questions in the **Answer Book**. Each question carries equal marks.*

1.	What is the circular convolution of the sequences X1(n)={2,1,2,1} and x2(n)={1,2,3,4}?			
	A)	{14,14,16,16}	B).	{14,16,16,14}
	C)	{14,16,14,16}	D).	{16,16,14,14}
2.	A signal x(t)has a Fourier transform X(w),If x(t) is a real and odd function of t, then X(w) is			
	A)	**An imaginary and odd function of w**	B).	A real and odd function of w
	C)	A real and even function of w	D).	An imaginary and even function of w
3.	If x(n) and X(k) are an N-point DFT pair, then X(k+N)=?			
	A)	$X(-k)$	B)	$X(N)$
	C)	$-X(-k)$	D)	$\mathbf{X(k)}$
4.	If x(n) is a real sequence and X(k) is its N-point DFT, then which of the following is true?			
	A)	X(N-k)=X(-k)	B)	X(N-k)=X*(k)
	C)	X(-k)=X*(k)	D)	All of the mentioned

Part – B: Descriptive Answer Questions (2*8 = 16 marks)
Note: Answer any ***One*** *full question from* ***each Unit***

		Unit – I	Marks	BT*	CO*	PO*
1.	a)	Explain the Dirichlet Condition for convergence of Fourier series	03	L1	3	1,2
	b)	Find the Fourier transform of the signal and obtain the expression for magnitude and phase spectrum $x(t) = te^{-t}u(t)$	05	L2	3	1,2
2.	a)	Find the DTFT of the following signals iii. $x[n] = \left(\frac{1}{4}\right)^n u(n+4)$ iv. $x[n] = (-1)^n u(n)$	05	L2	3	1,2
	b)	Explain the Parseval's theorem?	03	L1	3	1,2
		Unit – II				
3.	a)	Find 4 point DFT of a real sequence $x[n] = [0.707, 1, -0.707, 0]$ using decimation in Frequency FFT algorithm.	06	L3	4	1,2
	b)	Explain the quantization effect in the computation of DFT.	02	L1	4	1,2
4.	a)	Find 4 point DFT of a real sequence $x[n] = [1, 1, 2, 3]$ using decimation in Time FFT algorithm.	6	L2	4	1,2
	b)	Assume if complex multiplications takes 6μs and that the amount of time taken to compute N -point DFT is determined by the amount of time it takes to perform all the multiplications. i. How much time it takes to compute 32 point DFT directly? ii. How much time is required if an FFT is used?	2	L4	4	1,2

Topic	**Planned Hours L-T-P**	**Teaching Methodology**
Unit III	**10-5-0**	**BB**
Structure for discrete time systems: Block diagram representation of Linear Constant coefficient difference equations	1-1-0	**BB**
Basic structures for IIR systems	2-0-0	**BB**
Design of Discrete time IIR filters from continuous time filters using Bilinear Transformation	2-1-0	**BB**
Numerical Problems	0-1-0	**BB**
Frequency Transformation of Low pass IIR filters	1-0-0	**BB**
Numerical Problems	0-1-0	**BB**
Design of FIR filters by rectangular window method.	1-0-0	**BB**
Design of FIR filters by Hamming window method.	1-1-0	**BB**
Design of FIR filters by Hanning window method.	1-0-0	**BB**
Basic Structure of FIR systems	1-0-0	**BB**

Learning Outcomes: At the end of this unit students will be able to

1. Design infinite impulse response digital filters using bilinear transformation techniques.
2. Understand the procedures used for the design of linear phase FIR filters using rectangular window

Review questions on Remembering (BTL1)		
1.	What are the properties of FIR filter? State their importance.	L1
2.	Determine the unit impulse response of the ideal low pass filter.	L1
3.	Write the design procedure for the design of IIR filter.	L1
Review questions on Understanding (BTL2)		
1.	Determine the order and the poles of a lowpass Butterworth filter that has a 3-dB bandwidth of 500Hz and attenuation of 40dB at 100Hz.	L2
2.	Sketch Direct -II from structure for the following system $$H(z) = \frac{4z^2 + 3z}{(z^2 + 2)}$$	L2
3.	Explain the procedure for FIR filter design using kaiser window	L2
Review questions on Applying (BTL3)		L3
1.	Design a single-pole low pass digital filter with a 3-dB bandwidth of 0.2π, using a bilinear transformation applied to the analog filter $$H(s) = \frac{\Omega_c}{s + \Omega_c}$$ Where Ω_c, is the 3-dB bandwidth of the analog filter.	L3
2.	Design a low pass filter that will operate at 1dB at cut off frequency of 200Hz and at 400Hz stopband attenuation of 20dB with monotonic shape past 200Hz. radian	L3

	frequencies past 250 rad/sec.Take T=1/2000 sec.(normalized filter coefficients are b0=0.4931,b1=1.23841 and b3=0.98834)	
3.	Draw the block diagram representation of direct -I and Direct-II form realization for IIR filter described by the system function $$H[z]=\frac{6-3z^{-1}+10z^{-2}\ -\ 20z^{-3}}{1-.25z^{-1}+0.3z^{-2}-0.75z^{-3}}$$	L3
4.	Design a linear phase FIR low pass filter using rectangular window by taking 7 samples of window sequence and with cutoff frequency, $\omega_c=0.2\pi$ rad/sample	L3
5.	Realize the linear phase FIR Filter having the following impulse response $$h[n]=\delta[n]+\frac{1}{4}\delta[n-1]-\frac{1}{8}\delta[n-2]+\frac{1}{4}\delta[n-3]+\delta[n-4]$$	L3
Review questions on Applying (BTL4)		
1.	A digital low pass filter is required to meet following specifications : Pass band ripple $:\leq 3.01dB$,Pass band edge frequency $\omega=0.5\pi$ Stop band attenuation $:\geq 15dB$,stop band edge frequency $\omega=0.75\pi$ The filter must haVIe a maximally flat frequency response .Find H(z) using bilinear transformation. Choose analog cut off frequency $\Omega_c=1$ rad/sec.	
2.	A LPF is to be designed with frequency response $$H_d(e^{jw})=H_d(w)=e^{-j3w}\ ,\frac{\pi}{4}<\lvert w\rvert<\pi$$ $$0\qquad \frac{-\pi}{4}<\lvert w\rvert<\frac{\pi}{4}$$ Determine $h_d(n)$ and $h(n)$ if $w(n)$ is a rectangular window, $w_R(n)$ =1 , $0\leq n\leq 4$. Also , find frequency response ,H(w) of the resulting FIR filter.	
3.	Determine the order and the poles of a lowpass Butterworth filter that has a 3-dB bandwidth of 500Hz and attenuation of 40dB at 100Hz. c. Design an IIR filter with magnitude characteristics $$A_d(\omega)=\begin{cases} sin\omega, & 0\leq\lvert\omega\rvert\leq\frac{\pi}{2} \\ 0, & \frac{\pi}{2}\leq\lvert\omega\rvert\ \leq\ \pi\end{cases}$$ and a constant enVIelop delay in the passband.	
4.	Design a digital low pass filter when used in an A/D-h(z)-D/A structure gives an equivalent analogue filter with the following specifications Passband ripple$\leq 3.01dB$ Passband Edge:500Hz Stopband attenuation: $\geq$ 15dB Stopband edge:750Hz Sample rate:2KHz. The filter is to be designed by performing Bilinear transformation on an analogue system function, use Butterworth prototype.	

NITTE (Deemed to be University) | NMAM INSTITUTE OF TECHNOLOGY

Off-Campus Centre of Nitte (Deemed to be University), Nitte

Department of Electrical & Electronics Engineering

Course Plan-EE3003-1: Signal Analysis and Processing (IPCC)

Model Semester End Examination Question Paper

NMAM INSTITUTE OF TECHNOLOGY, NITTE

Off-Campus Centre of Nitte (Deemed to be University)

Sixth Semester B.Tech. (Electrical) (Credit System) Degree Examinations

EE3003-1 – SIGNAL ANALYSIS AND PROCESSING

APRIL-2025

Duration: 3 Hours | **Max. Marks: 100**

1.	Check whether following signal $(0.6)^n(2u[n]-u[n-1]-\delta[n])$ is			
	A) Periodic and energy		B) Periodic and Power	
	C) Non-Periodic and Power		D) Non-Periodic and Energy	
2.	If DFT of $y[n]=x(n-2)_4$ is [0,0,4,0] then $x(n)$ is			
	A) (-1,2,-1,2)		B) (1,-1,1,-1)	
	C) (-1,-1,1,1)		D) (-2,1,2,-1)	
3.	The fundamental period of the signal Y(t)= cos(10πt) + sin(12πt) is			
	A) 1		B) 1.5	
	C) 2		D) 4	
4.	Energy of unit step signal u[n] is			
	A) 0		B) 0.5	
	C) 1		D) infinity	
5.	If system is defined by $\int y(t)dt+k=x(t)$ with y(t) as an output and x(t) as an input therefore the system is			
	A) Time invariant and Memoryless		B) Time variant and Memory	
	C) Time invariant and not memoryless		D) Time variant and Memoryless	
6.	The Fourier transform of unit impulse function is			
	A) 0		B) U(t)	
	C) 1		D) infinity	

7. The output y(t) of an ideal low pass filter which has cut off frequency $w=1000\pi$ rad/sec is impulse sampled with the following sampling period

A)	$T_s = 1.5 \text{ X } 10^{-3}$	B)	$T_s = 0.5 \text{ X } 10^{-3}$
C)	$T_s = 2 \text{ X } 10^{-3}$	D)	$T_s = 5 \text{ X } 10^{-2}$

8. For a linear system with its impulse response is defined by

h(t)= 6 for $0 \leq t \leq 6$

= 0 otherwise .

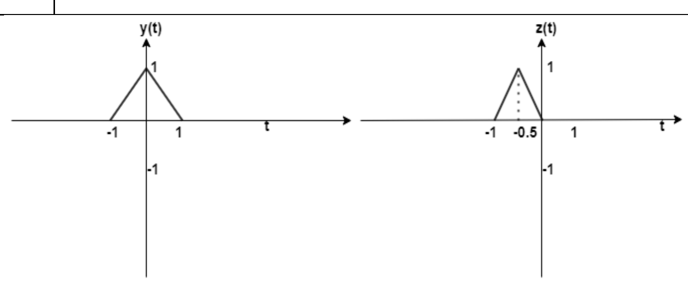
& the steady state output if the input is 10 u(t).

A)	255 to 256	B)	359 to 361
C)	389 to 390	D)	450 to 455

9. Select the Linear time invariant system , consider zero initial conditions

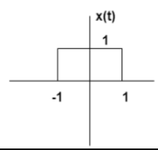
A)	$y[n] = \frac{2x[n]}{4} + \frac{(-1)^n x[n]}{4}$	B)	$y[n] = x[n+6] - x[n-4]$
C)	$y[n] = \sin\pi n + x[n-6]$	D)	$y[n] = 0.5^n x[n]$

10.



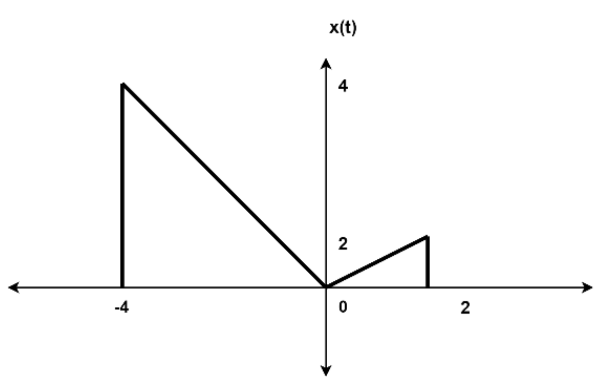
Z(t) is derived from y(t) is

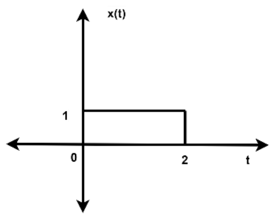
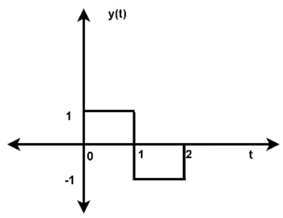
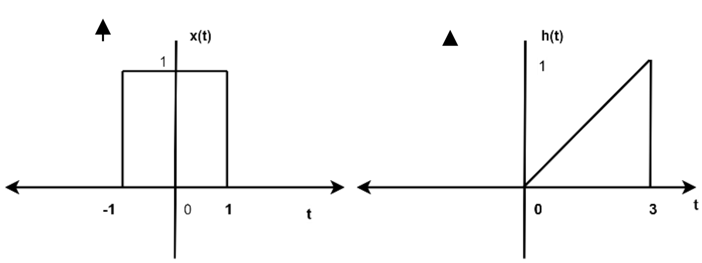
A)	z(t)=y(2t+1)	B)	z(t)=y(-2t-1)
C)	z(t)=y(-2t+1)	D)	z(t)=y(2t-1)

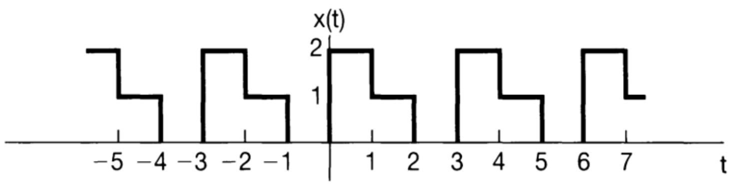
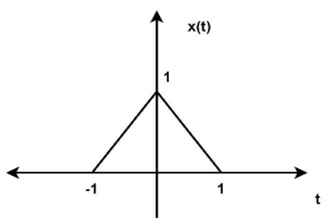
11.	Even component and odd component of the signal Y(t)= cos(t)+sin(t) +sin(t) cos(t) is			
	A)	Cost & sin(t) (1+cost)	B)	cost & sin(t) (1+sint)
	C)	Sint & sin(t) (1-cost)	D)	sint & sin(t) (1+cost)
12.	DTFT of y[n]= 2u[n]-u[n-1]-δ[n] is			
	A)	a) $\frac{1}{1-e^{-j\omega}}$	B)	$\frac{1}{j\omega}+\pi\delta(\omega)$ $-\pi \leq \omega \leq \pi$
	C)	$\frac{1}{1-e^{-j\omega}}+\pi\delta(\omega)$	D)	$\frac{1}{j2}\text{cosec}(\frac{\omega}{2})+\pi\delta(\omega)$
13.	If the impulse response $h(t)=\frac{dx(t)}{dt}$ then the frequency response is 			
	A)	$2-\cos\omega$	B)	$1-\sin\omega$
	C)	$1-2\cos\omega$	D)	$1-2\cos\omega$
14.	For a given discrete time sequence of 9 point x[-3]=3, x[-2]=0, x[-1]=1,x[0]=-2,x[1]=-3,x[2]=4,x[3]=1,x[4]=0,x[5]=-1 Computed DTFT for $\int_{-\pi}^{\pi}\lvert X(e^{j\omega})\rvert^2 d\omega$ is			
	A)	70π	B)	85π
	C)	72π	D)	82π
15.	What is a key characteristic that distinguishes IIR filters from FIR filters?			
	A)	IIR filters have linear phase response	B)	FIR filters are always stable
	C)	IIR filters have feedback	D)	FIR filters are implemented using feedback loops
16.	Which technique is commonly used for designing IIR filters that maintains the frequency response of analog filters?			
	A)	Impulse invariant transformation	B)	Rectangular windowing
	C)	Fourier transformation	D)	Bilinear transformation

17.	Which windowing technique is commonly used in FIR filter design to attenuate the side lobes of the frequency response?			
	A)	Rectangular window	B)	Hanning window
	C)	Impulse invariant window	D)	Bilinear window
18.	Which of the following is an advantage of using FIR filters over IIR filters?			
	A)	FIR filters have linear phase response	B)	FIR filters can be easily implemented with feedback loops
	C)	FIR filters require fewer coefficients	D)	FIR filters are more computationally efficient
19.	What is the purpose of using windowing techniques in FIR filter design?			
	A)	To reduce the order of the filter	B)	To adjust the cutoff frequency
	C)	To minimize the passband ripple	D)	To improve the frequency response and reduce side lobes
20.	Which transformation technique is preferred when designing digital filters to maintain stability and preserve the frequency response of analog filters?			
	A)	Fourier transformation	B)	Impulse invariant transformation
	C)	Bilinear transformation	D)	Laplace transformation

PART - B: DESCRIPTIVE ANSWER QUESTIONS

		Unit – I	Marks	BT*	CO*	PO*
1.	a)	Sketch the following signals for the signal shown in figure 1 $x_1(t) = x(t-4)$ $x_2(t) = x(t/1.5)$ $x_3(t) = x(2t-4)$ $x_4(t) = \frac{dx(t)}{dt}$  Figure01	08	L2	1	1,2,5

	b)	Find the energies of the pair of the signals $x(t)$ and y(t) depicted in the figure-2a & 2b. Sketch and find energies of the signals $x(t)+y(t)$ and $x(t)-y(t)$. Comment on your observation.  Figure 2 a  Figure 2 b	08	L2	1	1,2,5
2.	a)	Determine whether or not the following signals are periodic. If periodic find the fundamental period $$\mathrm{x[n]} = \cos\left(\frac{2\pi n}{5}\right) + \cos\left(\frac{2\pi n}{7}\right)$$ $$\mathrm{x(t)} = \text{evencomponent}\left((\sin\ 4\pi t)\,u(t)\right)$$	04	L1	1	1,2,5
	b)	Sketch even and odd part of the signal $\mathrm{x[n]} = \cos\left(\frac{\pi n}{2}\right) u[n]$	04	L2	1	1,2,5
	c)	Consider the analog signal $\mathrm{x(t)} = 4\cos 300\pi t + 6\sin 800\pi t + 8\cos 1200\pi t$. What is the Nyquist rate for this signal? Assume that we sample the signal with the sampling rate of Fs=1000 samples/s. What is the discrete time signal obtained after sampling?	08	L3	1	1,2,5
3.	a)	Determine whether the given systems are i)Linear ii) Time Invariant iii)Memoryless iv) Memoryless v)causal vi) stable. a. y(t)= x(t)+ x(t-100) b. y(n)=x[2n]	08	L2	2	1,2,5
	b)	Determine graphically $y(t) = x(t) * h(t-1)$ for the signals shown in figure 3  Figure 3	08	L3	2	1,2,5

		Unit – II				
4	a)	Determine the Fourier series representation of the signal $x(t)$ shown in figure 5  Figure-5 Determine the impulse response of the system	8	L2	3	1,2,5
	b)	Compute 4 point circular convolution of the following sequences using time domain approach and verify the result using DFT. $x_1[n] = \{1,2,3,1\}$ and $x_2[n] = \{4,3,2,2\}$	8	L2	4	1,2,5
5.	a)	 Figure:4 Find the Fourier Transform for the signal $x(t)$ shown in Figure 4.	6	L3	3	1,2,5
	b)	Find 8 point DFT of a real sequence $x[n] = [1, 1, 1,0,0,1,1,1, -1]$ using decimation in time FFT algorithm.	10	L3	4	1,2,5
6.	a)	Let X[k] be a 14 point DFT of length 14 real sequence x$[n]$. The first 8 samples of $X[k]$ are given by $X(0) = 12,\ X(1) = 1 + j3,\ X(2) = 3 + j4,\ X(3) = 1 - j5,\ X(4) = -2 + j2, X(5) = 6 + j3, X(6) = -2 - j3, X(.7) = 10.$ Find the remaining sequences of X[k] and evaluate x(0).	10	L3	4	1,2,5
	b)	Compute the Fourier Transform for the signal $$x[n] = \frac{1}{3}^{\lvert n\rvert} u[-n-2]$$	6	L3	3	1,2,5
		Unit – III				
7.	a)	Draw the block diagram representation of direct -I and Direct-II form realization for IIR filter described by the system function $$H[z] = \frac{6 - 3z^{-1} + 10z^{-2} - 20z^{-3}}{1 -.25z^{-1} + 0.3z^{-2} - 0.75z^{-3}}$$	8	L3	5	1,2,5
	b)	A LPF is to be designed with frequency response	8	L4	5	1,2,5

		$$H_d(e^{jw}) = H_d(w) = e^{-j2w} \quad ,\|w\| < \frac{\pi}{4}$$ $=0, \frac{\pi}{4} < \|w\| < \pi$ Determine $h_d(n)$ and $h(n)$ if $w(n)$ is a rectangular window, $w_R(n) = 1$, $0 \le n \le 4$. Also , find frequency response ,H(w) of the resulting FIR filter.				
8.	a)	Design a digital low pass filter when used in an A/D-h(z)-D/A structure gives an equivalent analogue filter with the following specifications Passband ripple$\le 3.01dB$ Passband Edge:500Hz Stopband attenuation: $\ge 15Db$ Stopband edge:750Hz Sample rate:2KHz. The filter is to be designed by performing Bilinear transformation on an analogue system function, use Butterworth prototype.	10	L4	5	1,2,5
	b)	Explain the frequency mapping of S plane into Z plane in bilinear transformation	06	L3	5	1,2,5