INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad-500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

TUTORIAL QUESTION BANK

Course Name	:	**SIGNALS AND SYSTEMS**
Course Code	:	AECB14
Program	:	B.Tech
Semester	:	IV
Branch	:	Electronics and Communication Engineering
Section	:	A, B,C,D
Course Faculty	:	Dr. V Padmanabha Reddy, Professor, ECE Mr. P Sandeep Kumar, Assistant Professor, ECE Ms. V Bindu Sree, Assistant Professor, ECE

COURSE OBJECTIVES:

The course should enable the students to:	
I	Classify signals and systems and their analysis in time and frequency domains.
II	Study the concept of distortion less transmission through LTI systems, convolution and correlation properties.
III	Understand Laplace and Z-Transforms their properties for analysis of signals and systems.
IV	Identify the need for sampling of CT signals, types and merits and demerits of each type.

COURSE OUTCOMES (COs):

CO 1	Apply the knowledge of linear algebra to represent any arbitrary signals in terms of complete sets of orthogonal functions and classify the signals and systems based on their properties.
CO 2	Analyze the spectral characteristics of continuous-time periodic and a periodic signals using Fourier analysis.
CO 3	Understand the properties of linear time invariant system, ideal filter characteristics through distortion less transmission and its bandwidth, causality with convolution and correlation.
CO 4	Apply the Laplace transform and Z- transform and their Region of convergence (ROC) properties for analysis of continuous-time and discrete-time signals and systems respectively.
CO 5	Understand the process of sampling to convert an analog signal into discrete signal and the effects of under sampling and study correlation, spectral densities.

COURSE LEARNING OUTCOMES (CLOs):

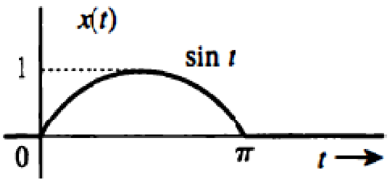
CLO Code	At the end of the course, the student will have the ability to:
AECB14.01	Apply the knowledge of vectors to find an analogy with signals.
AECB14.02	Understand Orthogonal signal space and orthogonal functions.
AECB14.03	Introduce the basic classification of signals in both continuous and discrete domain, exponential and sinusoidal signals, standard test signals
AECB14.04	Introduce the basic classification of systems in both continuous and discrete domain
AECB14.05	Representation of Fourier series for a periodic signal.

CLO Code	At the end of the course, the student will have the ability to:
AECB14.06	Deduce Fourier Transform from Fourier series
AECB14.07	Compute Fourier Transform of Periodic Signal
AECB14.08	Introduce the special transform-Hilbert transform
AECB14.09	Analyze time variance for linear systems.
AECB14.10	Understand the concept of distortion less transmission through a system
AECB14.11	Analyze Causality and Paley-Wiener criterion for physical realization.
AECB14.12	Understand the concept of convolution through graphical representation
AECB14.13	Introduce the concepts of Laplace transform for conversion to S-domain.
AECB14.14	Represent Region of Convergence for Laplace transforms and properties of Laplace Transforms.
AECB14.15	Understand the Z-Transform for discrete signals with issues of Region of Convergence
AECB14.16	Analyze the properties of Z-Transforms.
AECB14.17	Categorical analysis of sampling into different types.
AECB14.18	Understand how to reconstruct signals after sampling
AECB14.19	Understand cross correlation and auto correlation concepts.
AECB14.20	Analyze Power Spectral and Energy Spectral Characteristics

TUTORIAL QUESTION BANK

MODULE –I
SIGNAL ANALYSIS

PART – A (SHORT ANSWER QUESTIONS)

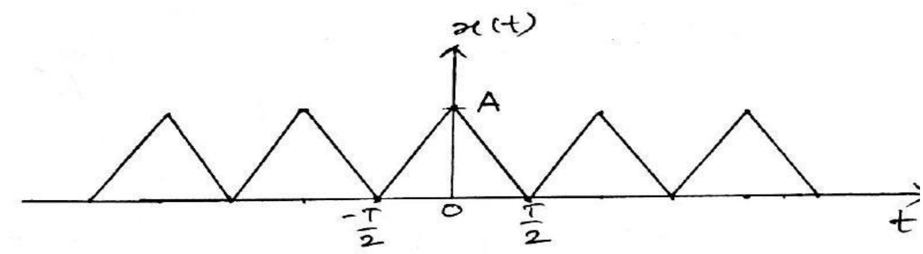
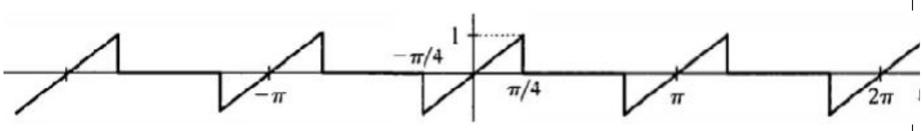
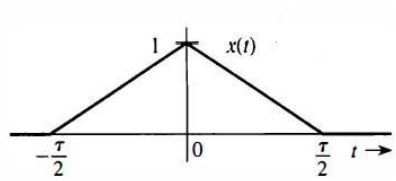
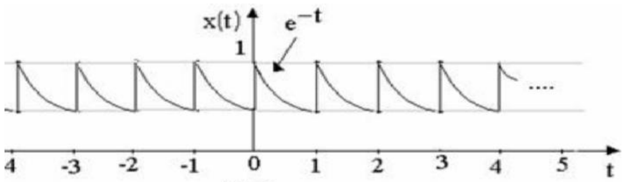
S No	Question	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes (CLOs)
1	What is an orthogonal function?	Remember	CO 1	AECB14.01
2	Define Mean Square Error.	Understand	CO 1	AECB14.02
3	List the types of systems.	Remember	CO 1	AECB14.04
4	Define even and odd components of the signal how do you get it.	Understand	CO 1	AECB14.03
5	How do you approximate a signal using orthogonal functions?	Understand	CO 1	AECB14.02
6	Sketch the unit step function and signum function bring the relation between them.	Remember	CO 1	AECB14.03
7	Define an impulse function and plot $\delta(t+2) – \delta(t-3)$.	Remember	CO 1	AECB14.03
8	Define a unit step function and plot u(t-2)	Understand	CO 1	AECB14.03
9	Find the even and odd components of the signal x(t) =sin2t + sin2t.cos2t +cos2t	Remember	CO 1	AECB14.03
10	Compute the energy of the signal x(t) shown below 	Remember	CO 1	AECB14.03
11	Explain time reversal and draw time reversed unit step function.	Understand	CO 1	AECB14.03
12	Define an even signal and check whether signum function is even or not?.	Understand	CO 1	AECB14.03
13	Define continuous time unit step and unit impulse.	Remember	CO 1	AECB14.03
14	Determine whether the sequence is periodic or not. $x_2(n)$ = sin(n/8).	Understand	CO 1	AECB14.03
15	Determine the continuous time version of a sinusoidal signal and bring out the relation between sinusoidal and complex exponential signals.	Remember	CO 1	AECB14.03
16	Determine whether the sequence is periodic or not. $x_1(n) = \sin(\pi n/8) + \cos(\pi n/6)$.	Understand	CO 1	AECB14.03
17	Write short notes on orthogonal functions.	Remember	CO 1	AECB14.02
18	Determine whether the sequence is periodic or not. $x_1(n) = \sin(6\pi n/7)$.	Understand	CO 1	AECB14.03
19	Define Signal and System. What are the major classifications of the signal?	Remember	CO 1	AECB14.04
20	Define continuous time unit step and unit impulse.	Understand	CO 1	AECB14.03

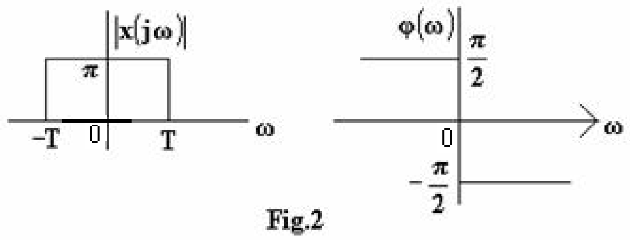
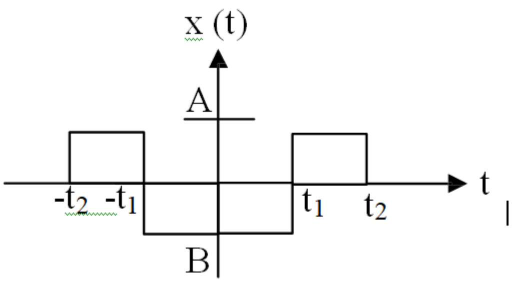
PART – B (LONG ANSWER QUESTIONS)

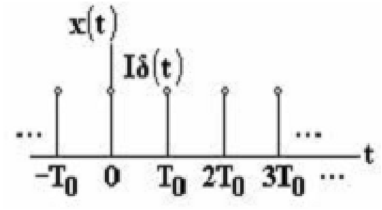
1	Derive an expression for computing Mean Square Error in approximating a function	Understand	CO 1	AECB14.02

	$f(t)$ by a set of n orthogonal functions.			
2	Explain about the set of complete orthogonal functions.	Understand	CO 1	AECB14.02
3	Explain orthogonality property between two complex functions $f_1(t)$ and $f_2(t)$ for a real variable t.	Understand	CO 1	AECB14.02
4	Define and derive the expression for evaluating mean square errors and its types.	Understand	CO 1	AECB14.02
5	Derive from the basics, how any continuous time signal $x(t)$ can be represented as an integral of impulses.	Understand	CO 1	AECB14.03
6	Discuss orthogonality in complex functions.	Understand	CO 1	AECB14.02
7	Present the analogy between vectors and signals.	Understand	CO 1	AECB14.01
8	Derive the expression for component vector of approximating the function $f_1(t)$over $f_2(t)$ and also prove that the component vector becomes zero if the $f_1(t)$ and $f_2(t)$ are orthogonal.	Understand	CO 1	AECB14.01
9	Define and sketch the following signals i) Truncated Exponential signal ii) Delayed Unit impulse function iii) Unit parabolic function iv) Sinc function	Understand	CO 1	AECB14.03
10	Define and sketch the following signals i) Unit Step function ii) Unit impulse function iii) Signum function	Understand	CO 1	AECB14.03
11	Test if the two signals $x_1(t)$ = A cos 100t , $x_2(t)$ = 2A cos 200t are orthogonal in the interval $0< t< T$ where T is time period of $x_1(t)$.	Understand	CO 1	AECB14.02
12	Prove that Sin n ω_0 t & Cos m ω_0 t are orthogonal to each other.	Understand	CO 1	AECB14.02
13	Prove that the complex exponential functions are orthogonal functions.	Understand	CO 1	AECB14.02
14	Derive the expression for component vector of approximating the function $f_1(t)$ over $f_2(t)$ and also prove that the component vector becomes zero if the $f_1(t)$ and $f_2(t)$ are orthogonal.	Understand	CO 1	AECB14.02
15	Approximate the function $f(t)$ by a set of Legendre polynomials and derive the expression for component vector.	Understand	CO 1	AECB14.01
16	Define the following basic signals with graphical representation i) Unit impulse Signalii) Unit Step Signal iii) Ramp Signaliv) Sinusoidal signal.	Understand	CO 1	AECB14.03
17	Define the error function 'f_e (t)' while approximating signals and hence derive the expression for condition for orthogonality between two waveforms $f_1(t)$ & $f_2(t)$.	Understand	CO 1	AECB14.02
18	Test Whether the impulse signal is either energy or power signal.	Understand	CO 1	AECB14.03
19	Verify the orthogonality of the following functions: $S_1(t) = 1$ and $S_2(t) = c(1-2t)$ in the interval [0 1].	Understand	CO 1	AECB14.02
20	Determine energy and power of the following signals i)10sin(10t)cos(30t) ii) 20cos(100t+60˚)	Understand	CO 1	AECB14.03
PART-C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)				
1	Find the even and odd components of the signal $x(t) = \cos(\omega_0 t + n/3)$.	Understand	CO 1	AECB14.03
2	Find the even and odd components of the signal $x(t) = tu(t)$	Understand	CO 1	AECB14.03
3	Find the even and odd components of the signal $x(t) = (1+t^2+t^3)\cos^2 10t$.	Understand	CO 1	AECB14.03
4	Test Whether the signal $x(n) = (½)^n u(n)$ energy or power signal.	Understand	CO 1	AECB14.03

5	Obtain the condition under which two signals f1(t) and f2(t) are said to be orthogonal to each other. Hence prove that Sin nw_0t and Cos mw_0t are orthogonal to each other for all integer values of m,n	Understand	CO 1	AECB14.02
6	A rectangular function f(t) is defined by f(t) = 1 for $0<t<\pi$ = -1 for $\pi<t<2\pi$ Approximate this function by a waveform sint over the interval $(0, 2\pi)$ such that the mean square error is minimum.	Understand	CO 1	AECB14.02
7	Define and sketch the unit step function and signum function. Bring out the relation between these two functions.	Remember	CO 1	AECB14.03
8	Show that whether $x(t) = A e^{-\alpha(t)} u(t)$, $\alpha > 0$ is an energy signal or not.	Understand	CO 1	AECB14.03
9	The rectangular function f(t) is approximated by the signal $\frac{4}{\pi}\sin(t)$. Show that even function $f_e(t) = f(t) - \frac{4}{\pi}\sin(t)$ is orthogonal to the function sin(t) over the interval $(0,2\pi)$.	Understand	CO 1	AECB14.02
10	Find the power and rms value of signal $x(t)=20\cos 2\pi t$.	Understand	CO 1	AECB14.03
MODULE-II FOURIER SERIES				
PART – A (SHORT ANSWER QUESTIONS)				
1	Compare Fourier series and Fourier transform.	Remember	CO 2	AECB14.05
2	State the dirichilet's conditions for existence of Fourier series.	Understand	CO 2	AECB14.05
3	Find the Fourier transform of $x(t) = e^{-at} u(t)$.	Understand	CO 2	AECB14.06
4	Distinguish between Series and Transform in the Fourier representation of a signal.	Understand	CO 2	AECB14.06
5	Determine the Fourier transform of $x(t) = e^{-at} (\cos\Omega t) u(t)$.	Understand	CO 2	AECB14.07
6	Define Hilbert transform of a signal x(t).	Remember	CO 2	AECB14.08
7	State the condition for convergence of Fourier series.	Remember	CO 2	AECB14.06
8	Obtain the Fourier transform of the impulse function $\delta(t)$.	Understand	CO 2	AECB14.06
9	State and prove time shift property of Fourier transform.	Remember	CO 2	AECB14.06
10	Find the Fourier transform of x(t) = u(2t), where u(t) is the unit step function.	Understand	CO 2	AECB14.06
11	State and prove time scaling property of Fourier transform.	Remember	CO 2	AECB14.06
12	Obtain the trigonometric Fourier series for the signal $x(t) = \sin 2t + \cos^3 t$	Understand	CO 2	AECB14.05
13	Find the Fourier transform of $x(t) = e^{j2\pi ft}$	Understand	CO 2	AECB14.06
14	Find the Fourier Transform of a signal given by $10\sin^2(3t)$.	Understand	CO 2	AECB14.07
15	Find the Fourier transform of the signal x(t) = 20 sinc (20t).	Understand	CO 2	AECB14.07
16	If the Fourier series coefficient of x(t) is C_n, find the Fourier series coefficient of $x^*(t)$.	Understand	CO 2	AECB14.06
17	How can you say Fourier series is a complete set of orthogonal signals.	Understand	CO 2	AECB14.05
18	Define continuous time Fourier series. List out some of its properties.	Understand	CO 2	AECB14.05
19	What are the applications areas of Fourier Series and Fourier Transforms.	Understand	CO 2	AECB14.06
20	What is Fourier Transform of signum function?	Remember	CO 2	AECB14.06

PART – B (LONG ANSWER QUESTIONS)				
1	If x (t) has Fourier transform pair X (w). Deduce the Fourier Transform of X (at-t_0).	Understand	CO 2	AECB14.06
2	Obtain the Fourier transform of the following functions :a) Impulse Signal b) Single symmetrical Gate Pulse.	Understand	CO 2	AECB14.06
3	Determine the exponential form of the Fourier series representation of the signal  	Remember	CO 2	AECB14.05
4	Find the trigonometric Fourier series for the signal x(t) shown below.  	Remember	CO 2	AECB14.05
5	Compute the Fourier transform of the signal x(t) applying differentiation in time property of Fourier transform.  	Remember	CO 2	AECB14.06
6	State and prove any four properties of Fourier Transform.	Remember	CO 2	AECB14.06
7	Determine the Fourier series representation of the signal show in Figure 1. Sketch its magnitude and phase spectra.  Fig.1	Understand	CO 2	AECB14.05
8	Bring out the relationship between Trigonometric and Exponential Fourier series.	Understand	CO 2	AECB14.05
9	Discuss the properties of Fourier series.	Understand	CO 2	AECB14.05

10	The Magnitude and phase of the Fourier Transform of a signal x(t) are shown in Figure 2.Find the signal x(t).  Fig.2	Understand	CO 2	AECB14.06
11	Write the Dirichlet's conditions to obtain Fourier series representation of any signal. Find the trigonometric Fourier series for half wave rectified sine wave.	Understand	CO 2	AECB14.05
12	Determine the Fourier Transform for double exponential pulse whose function is given by $y(t) = e^{-2\|t\|}$ Also draw its magnitude and phase spectra	Understand	CO 2	AECB14.06
13	State and prove the following properties of Fourier transform i) Multiplication in time domain ii) Convolution in time domain	Understand	CO 2	AECB14.06
14	Find the exponential Fourier series of a signal $x(t)= \cos 5t \sin 3t$.	Understand	CO 2	AECB14.07
15	Signal x(t) has Fourier Transform x(f) = [j2πf] / [3+(j / 10)] . What is total net area under the signal x(t).	Understand	CO 2	AECB14.07
16	State and prove the following properties of Fourier transform. i) Duality ii) Time shifting	Understand	CO 2	AECB14.06
17	Find the Fourier transform of $x(t) = e^{-at} u(t)$	Understand	CO 2	AECB14.06
18	Find the exponential Fourier series of the signal x(t) = 5cos 5t+10 sin 15t.	Understand	CO 2	AECB14.05
19	Find the Fourier Transform of $v(t) = 100e^{-10t}$.	Understand	CO 2	AECB14.06
20	Explain in detail how Fourier Transform is developed from Fourier series.	Understand	CO 2	AECB14.09
PART-C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)				
1	Find the exponential Fourier series of the signal x(t) = 5cos 5t+10 sin 15t.	Understand	CO 2	AECB14.05
2	Approximate a rectangular pulse of width T, amplitude A which is symmetric about origin using sint, sin2t, sin3t and sin4t.	Understand	CO 2	AECB14.05
3	Determine the Fourier Series representation of the signal $x(t) = 2 \sin(2\pi t - 3) + \sin(4\pi t)$	Understand	CO 2	AECB14.05
4	Find the Fourier transform of the signal shown below, where A=1, B=-1, t_1=1, t_2=2. 	Understand	CO 2	AECB14.06

5	Find the Fourier series of the following Figure 1 periodic impulse train?  Figure 1	Understand	CO 2	AECB14.05
6	An AM signal is given by $f(t) = 15 \sin(2\pi\, 10^6\, t) + [\, 5 \cos 2\pi\, 10^3\, t + 3 \sin 2\pi 10^2 t]\ \sin\ 2\pi\, 10^6$ t. Find the Fourier Transform and draw its spectrum.	Understand	CO 2	AECB14.06
7	Find the FT of the function i) $f(t)=e^{-a\|t\|}\sin(t)$ ii) f(t)= cos at	Understand	CO 2	AECB14.07
8	Expand the following function over the interval (-4, 4) by a complex Fourier Series $f(t)=1;\ -2 \le t \le 2$ = 0; else where	Understand	CO 2	AECB14.05
9	Using the properties of FT, compute the FT for the following signals i) $x(t) = \sin(2\pi t)e^{-t}\ u(t)$ ii) $x(t)=t\ e^{-3\|t-1\|}$	Remember	CO 2	AECB14.06
10	Determine the Fourier transform of a two sided exponential pulse $x(t) = e^{-\|t\|}$.	Remember	CO 2	AECB14.06

MODULE-III

SIGNAL TRANSMISSION THROUGH LINEAR SYSTEMS

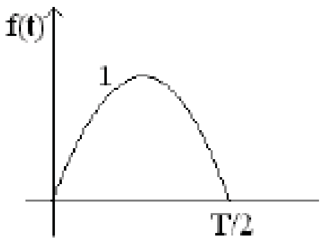
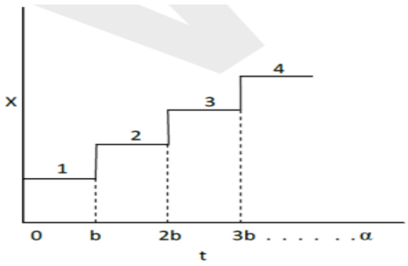
PART – A (SHORT ANSWER QUESTIONS)

1	What is Linear Time invariant system?	Remember	CO 3	AECB14.09
2	Define impulse response of a linear system.	Remember	CO 3	AECB14.09
3	Define linearity and time invariant properties of system.	Understand	CO 3	AECB14.09
4	Define causality and stability properties of linear system.	Remember	CO 3	AECB14.09
5	What is system band width?	Remember	CO 3	AECB14.09
6	What is signal band width?	Remember	CO 3	AECB14.09
7	What is relationship between band width and rise time?	Understand	CO 3	AECB14.09
8	What are the requirements to be satisfied by an LTI system to provide distortion less transmission of signal?	Understand	CO 3	AECB14.10
9	State the conditions for distortion less transmission of signal.	Remember	CO 3	AECB14.10
10	Draw the frequency response of ideal low pass filter.	Understand	CO 3	AECB14.10
11	Draw the frequency response of ideal high pass filter.	Understand	CO 3	AECB14.10
12	Draw the magnitude and phase response of distortion less transmission system.	Remember	CO 3	AECB14.10
13	What is the steady state response of linear system?	Remember	CO 3	AECB14.09

14	Draw the ideal characteristics band pass filter.	Understand	CO 3	AECB14.10
15	Draw the ideal characteristics band stop filter.	Remember	CO 3	AECB14.10
16	Define lower and upper cut off frequency of filter.	Remember	CO 3	AECB14.10
17	Define transfer function of LTI system.	Remember	CO 3	AECB14.09
18	List and State properties of convolution integral.	Remember	CO 3	AECB14.12
19	State Paley – wiener criterion for physical reliability.	Remember	CO 3	AECB14.11
20	What conclusions can be drawn from Paley – wiener criterion?	Remember	CO 3	AECB14.11
PART – B (LONG ANSWER QUESTIONS)				
1	Explain the frequency response of a linear system.	Remember	CO 3	AECB14.10
2	Explain the impulse response of a linear system.	Remember	CO 3	AECB14.10
3	What is linear time invariant (LTI) system? Derive an expression for the transfer function of LTI system.	Understand	CO 3	AECB14.09
4	Show that an LTI system combined with time scaling property may results in time variant system.	Understand	CO 3	AECB14.09
5	Define an LTI system and state its properties.	Remember	CO 3	AECB14.09
6	Obtain the conditions for distortion less transmission through a system.	Remember	CO 3	AECB14.10
7	Explain the ideal filter characteristics of linear system.	Understand	CO 3	AECB14.10
8	Explain signal bandwidth and system bandwidth.	Understand	CO 3	AECB14.10
9	Verify the Bounded input and Bounded output (BIBO) stability of linear system.	Understand	CO 3	AECB14.09
10	Derive the expression for the step response of a Linear Time Invariant System.	Remember	CO 3	AECB14.09
11	Derive the relationship between rise time and bandwidth.	Understand	CO 3	AECB14.09
12	Explain the requirements to be satisfied by LTI system to provide distortion less transmission of signal.	Understand	CO 3	AECB14.09
13	Sketch the frequency response of ideal low pass, high pass, band pass and band reject filters.	Understand	CO 3	AECB14.10
14	What is Paley – Wiener criterion? Explain.	Remember	CO 3	AECB14.11
15	What is a distortion less transmission system? Explain.	Understand	CO 3	AECB14.11
16	Show that the output of an LTI system is given by the linear convolution of input signal and impulse response of the system.	Understand	CO 3	AECB14.12
17	Derive an expression for convolution integral and state its properties.	Understand	CO 3	AECB14.12
18	Explain the graphical approach for computing the convolution integral.	Understand	CO 3	AECB14.12
19	What do you understand causality and stability of linear systems.	Understand	CO 3	AECB14.11
20	List and prove any five properties of convolution integral.	Understand	CO 3	AECB14.12
PART-C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)				

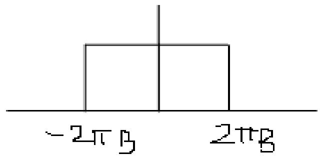
1	Examine the following systems with respect to the properties i) linearity (ii) invariant (iii) Causality (iv) stability. $(a)\ y(t) = x^2(t)$ $(b)\ y(t) = \log_{10}\lvert x(t)\rvert$.	Remember	CO 3	AECB14.09
2	Check the following systems with respect to the properties i) linearity (ii) invariant (iii) Causality (iv) stability. $(a)\ y(t) = \sin x(t)$ $(b)\ y(t) = \int_{-\infty}^{t} x(\tau)\, d\tau$.	Remember	CO 3	AECB14.09
3	For an LTI system with impulse response $h(t) = u\,(t-2)$. Determine the response of system for the input $x(t) = u\,(t+1)$.	Remember	CO 3	AECB14.09
4	Compute and sketch the output $y(t)$of continuous time LTI system with impulse response $h(t) = 2[\,u(t) - u(t-2)]$ for given input$x(t) = u(t+2) - u(t-2)$.	Remember	CO 3	AECB14.09
5	Find the impulse response of the RC high pass filter shown in figure. Also find the transfer function. What would be its frequency response?	Understand	CO 3	AECB14.10
6	Find the impulse response of the RC low pass filter shown in figure. Also find the transfer function. What would be its frequency response?	Remember	CO 3	AECB14.10
7	A stable LTI system is characterized by differential equation $\frac{d^2y(t)}{dt^2} + 6\,\frac{dy\,(t)}{dt} + 8\,y(t) = 2\,x(t)$.find the frequency response of this system if $x(t) = t\,e^{-2t}\,u(t)$.	Remember	CO 3	AECB14.10
8	For low pass signal, the essential band width may be chosen as the frequencies where the amplitude spectrum of the signal decays to 5% of its peaks value. Determine the essential bandwidth of $f(t) = e^{-3t}\,u(t)$.	Remember	CO 3	AECB14.10
9	The transfer function of an LTI system is $(\omega\,) = \frac{1}{j\omega+2}$. What is the output of the system for an input of $(0.8)^t\,u(t)$?	Understand	CO 3	AECB14.12
10	Consider two functions $x(t) = u(t+1)and\ h(t) = u(t-2)$. Find convolution of $x(t)and\ h(t)$ using graphical method.	Remember	CO 3	AECB14.12
MODULE-IV **LAPLACE TRANSFORM AND Z-TRANSFORM**				
PART – A (SHORT ANSWER QUESTIONS)				
1	Define Laplace transforms and its inverse.	Remember	CO 4	AECB14.13
2	List out the properties of Laplace transform.	Understand	CO 4	AECB14.13
3	Write time scaling property of Laplace transform.	Remember	CO 4	AECB14.13
4	Define ROC and state its properties of the Laplace Transform.	Remember	CO 4	AECB14.14
5	Determine the function of time x(t) of the Laplace Transform and the ROC of $\frac{s}{s^2+9}$.	Remember	CO 4	AECB14.14
6	What is meant by of region of convergence (ROC) in Laplace transforms?	Understand	CO 4	AECB14.14

7	Write the time scaling property of Laplace transform.	Understand	CO 4	AECB14.14
8	State initial and final value theorems with respect to Laplace transform.	Remember	CO 4	AECB14.14
9	List the advantages and limitations of the Laplace transform.	Remember	CO 4	AECB14.14
10	When is the function x(t) said to be Laplace transferable.	Remember	CO 4	AECB14.14
11	What is condition for existence of Z- transform?	Remember	CO 4	AECB14.15
12	What is meant by region of convergence in Z Transform?	Remember	CO 4	AECB14.16
13	Find the Z transform of x[n] = u[-n].	Remember	CO 4	AECB14.15
14	Find the Z-transform and its ROC of $\delta\ (n+k)$.	Remember	CO 4	AECB14.16
15	Find the Z-transform of the sequence u[n].	Understand	CO 4	AECB14.15
16	Write the time reversal property of z transform.	Understand	CO 4	AECB14.16
17	List out the properties of Z-Transform.	Understand	CO 4	AECB14.16
18	State initial and final value theorems with respect to Z- transform.	Understand	CO 4	AECB14.16
19	What are methods by which the inverse Z – transform can be found.	Remember	CO 4	AECB14.15
20	State and prove differentiation properties of Z- transform.	Remember	CO 4	AECB14.16
PART – B (LONG ANSWER QUESTIONS)				
1	Explain the properties of ROC for Z Transforms.	Understand	CO 4	AECB14.15
2	Distinguish between one sided and two sided Z- transform and their ROC.	Remember	CO 4	AECB14.15
3	State and prove integration and differentiation properties of Z – Transform.	Understand	CO 4	AECB14.16
4	State and prove Linearity, time shifting and time convolution properties of Z – Transform.	Understand	CO 4	AECB14.16
5	Explain the properties of ROC for Z Transforms.	Understand	CO 4	AECB14.16
6	Distinguish between one sided and two sided Z- transform and their ROC.	Understand	CO 4	AECB14.16
7	State and prove integration and differentiation properties of Z – Transform.	Understand	CO 4	AECB14.16
8	State and prove Linearity, time shifting and time convolution properties of Z – Transform.	Remember	CO 4	AECB14.16
9	Explain the properties of ROC for Z Transforms.	Remember	CO 4	AECB14.16
10	Distinguish between one sided and two sided Z- transform and their ROC.	Remember	CO 4	AECB14.15
11	State and prove integration and differentiation properties of Z – Transform.	Remember	CO 4	AECB14.16
12	State and prove Linearity, time shifting and time convolution properties of Z – Transform.	Understand	CO 4	AECB14.16
13	Explain the properties of ROC for Z Transforms.	Understand	CO 4	AECB14.15
14	Distinguish between one sided and two sided Z- transform and their ROC.	Understand	CO 4	AECB14.15
15	State and prove integration and differentiation properties of Z – Transform.	Understand	CO 4	AECB14.16
16	State and prove Linearity, time shifting and time convolution properties of Z – Transform.	Understand	CO 4	AECB14.16
17	Explain the properties of ROC for Z Transforms.	Understand	CO 4	AECB14.15
18	Distinguish between one sided and two sided Z- transform and their ROC.	Understand	CO 4	AECB14.15
19	State and prove integration and differentiation properties of Z – Transform.	Understand	CO 4	AECB14.15
20	State and prove Linearity, time shifting and time convolution properties of Z – Transform.	Understand	CO 4	AECB14.15

PART-C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)				
1	Find the Laplace transform following signals and its ROC (i) $x(t) = \delta(t) - \frac{4}{3}e^{-t}u(t) + \frac{1}{3}e^{2t}u(t)$ $(ii)\ x(t) = e^{-\lvert a \rvert t}$.	Understand	CO 4	AECB14.14
2	Find the Laplace transform following signals and its ROC $(i)\ e^{-5t}[u(t) - u(t-5)]$ $(ii)\ x(t) = e^{-2t}(4\cos 5t -$ $3\sin 5t)\ u(t)$.	Understand	CO 4	AECB14.14
3	Find the Laplace transform of wave form $f(t)$ shown in fig  Figure 4	Understand	CO 4	AECB14.14
4	Find the Laplace transform of the stair case wave form shown in fig 	Understand	CO 4	AECB14.14
5	Find inverse Laplace transform of following functions $(i)\ F(s) = \frac{1+e^{-2s}}{3s^2+2s}$ $(ii)\ F(s) = \ln\left(\frac{s+a}{s+b}\right)$	Understand	CO 4	AECB14.14
6	Find inverse Laplace transform of following functions $(i)\ X(s) = \frac{s}{(s^2+1)^2}$ $(ii)\ X(s) = \frac{1-e^{\pi s/2}}{1+s^2}$.	Understand	CO 4	AECB14.14
7	Determine the initial value and final value of Laplace transform of signal $X(s) = \frac{2s+5}{s(s+3)}$.	Understand	CO 4	AECB14.14

8	Find the Z transform of signal $(i)\ x(n) = \begin{cases} (0.33)^n & n \geq 0 \\ -2^n & n \leq -1 \end{cases}$ $(ii)\ x(n) = n^2\, u(n) using\ differenciation\ property.$	Understand	CO 4	AECB14.16
9	Prove that the sequence $(i)\ x(n) = a^n u(n)$ $(ii)\ x(n) = -a^n u(-n-1)$ have the same X(z) and differ only ROC . Also plot their ROCs.	Understand	CO 4	AECB14.16
10	Determine the inverse Z transform of $X(z) = \frac{z}{3z^2 - 4z + 1}\ if\ ROC\ is\ (a)\ \lfloor z \rfloor > 1\ (b) \lfloor z \rfloor < \frac{1}{3}\ \left((c)\ \frac{1}{3} < \lfloor z \rfloor < 1 \right).$	Understand	CO 4	AECB14.16
MODULE-V **SAMPLING THEOREM**				
PART – A (SHORT ANSWER QUESTIONS)				
1	What is meant by sampling?	Remember	CO 5	AECB14.17
2	State Sampling theorem.	Remember	CO 5	AECB14.17
3	What is meant by aliasing?	Remember	CO 5	AECB14.17
4	What are the effects aliasing?	Understand	CO 5	AECB14.17
5	What are all the blocks are used to represent the CT signals by its samples?	Understand	CO 5	AECB14.17
6	Mention the types of sampling.	Remember	CO 5	AECB14.17
7	Why CT signals are represented by samples.	Understand	CO 5	AECB14.17
8	Define Nyquist's rate.	Remember	CO 5	AECB14.17
9	What is the condition for avoid the aliasing effect?	Understand	CO 5	AECB14.18
10	What is an antialiasing filter?	Understand	CO 5	AECB14.18
11	What is the Nyquist's Frequency for the signal $x(t)$ =3 cos 50t +10 sin 300t – cos100t ?	Understand	CO 5	AECB14.18
12	Why sampling theorem is called low pass sampling theorem?	Understand	CO 5	AECB14.17
13	What is sampling period?	Understand	CO 5	AECB14.17
14	Define sampling of band pass signals.	Remember	CO 5	AECB14.18
15	What is the Nyquist's Frequency for the signal $x(t)$ =3 cos 100t +10 sin 30t – cos50t ?	Remember	CO 5	AECB14.17
16	What do you understand by the term 'guard band'?	Remember	CO 5	AECB14.19
17	Explain about Auto correlation?	Remember	CO 5	AECB14.19
18	What is Cross correlation?	Remember	CO 5	AECB14.19
19	List the properties of Auto correlation	Remember	CO 5	AECB14.19
20	Define convolution integral.	Remember	CO 5	AECB14.19
PART – B (LONG ANSWER QUESTIONS)				
1	A signal x(t)=2cos 400πt+6 cos 640πt is ideally sampled at f_s=500Hz, if the sampled signal is passed through an ideal LPF with a cut off frequency of	Understand	CO 5	AECB14.17

	400Hz, what frequency components will appear in the output.			
2	The signal x(t)=cos 5πt+0.3 cos 10πt is instantaneously sampled. Determine the maximum interval of the sample	Understand	CO 5	AECB14.17
3	Show that a band limited signal of finite energy which has no frequency components higher than f_m Hz is completely described by specifying values of the signals at instants of time separated by 1/2 f_m seconds. Also show that if the instantaneous values of the signal are separated at intervals larger than 1/2f_m seconds, they fail to describe the signal. A band pass signal has spectral range extending from 20kHz to 80kHz; find the acceptable range of sampling frequency f_s.	Understand	CO 5	AECB14.18
4	A flat-top sampling system samples s signal of maximum frequency 1kHz with 2.5 Hz sampling frequency. The duration of the pulse is 0.2s. Compute the amplitude distortion due to aperture effect at the highest signal frequency. Also determine the equalization characteristic.	Understand	CO 5	AECB14.17
5	The signal x(t)=cos 5πt+0.3 cos 10πt is instantaneously sampled. The interval between the samples is T_s a) Find the maximum allowable value for T_s b) If the sampling signal is $S(t) = \sum_{k=-\alpha}^{\alpha} \delta(t-0.1k)$, the sampled signal $v_s(t)$= v(t).S(t) consists of a train of impulses, each with a different strength $v_s(t) = \sum_{k=-\alpha}^{\alpha} I_k\delta(t-0.1k)$, find I_0, I_1, I_2 c) To reconstruct the signal $v_s(t)$ is passed through a rectangular LPF. Find the minimum filter bandwidth to reconstruct the signal without distortion	Understand	CO 5	AECB14.18
6	For the analog signal x(t)=3 cos 100πt a) Determine the minimum sampling rate to avoid aliasing b) Suppose that the signal is sampled at the rate, f_s=200Hz, what is the discrete time signal obtained after sampling c) Suppose that the signal is sampled at the rate, f_s=75Hz, what is the discrete time signal obtained after sampling What is the frequency $0<f< f_s/2$ of a sinusoid that yields samples identical to those obtained in (c) above	Analysis	CO 5	AECB14.17
7	Determine the convolution of two functions x(t)=a e^{-at} ; y(t)= u(t)	Understand	CO 5	AECB14.19
8	Find the autocorrelation, power, RMS value and sketch the PSD for the signal x(t)=(A+ sin 100t) cos 200t	Remember	CO 5	AECB14.20
9	Determine the auto and cross correlation and PSD and ESD of the following signal x(t)=Asin(wt+Ø)	Remember	CO 5	AECB14.20
10	Find the convolution of the two continuous-time functions x(t)= 3 cos2t for all t and $y(t)=e^{-\|t\|} = \begin{cases} e^{t}; t<0 \\ e^{-t}; t \geq 0 \end{cases}$	Understand	CO 5	AECB14.19
11	State and prove the properties of auto correlation function	Understand	CO 5	AECB14.19
12	Prove that for a signal, auto correlation and PSD form a fourier transform pair	Remember	CO 5	AECB14.20
13	Show that the relation between correlation and convolution	Remember	CO 5	AECB14.19
14	Derive the Parseval's theorem from the frequency convolution property	Remember	CO 5	AECB14.19
15	Find the power spectral density of a periodic signal?	Understand	CO 5	AECB14.19
16	A filter has an input x(t)=e^{-2t} u(t) and transfer function, H(w)=1/(1+jw). Find the ESD of the output?	Understand	CO 5	AECB14.20

17	A power signal g(t) has a PSD $S_g(w)=N/A^2$, $-2\pi B \le w \le 2\pi B$, shown in figure  below, where A and N are constants	Understand	CO 5	AECB14.20
18	Find the power for the following signals i) A cos wt ii)a+f(t), a is a constant and f(t) is a power signal with zero mean	Remember	CO 5	AECB14.20
19	Consider the signal $x(t) = (\frac{\sin 50\pi t}{\pi t})$ which is to be sampled with a sampling frequency of $\omega_s=150\pi$ to obtain a signal g(t) with fourier transform G(jw). Determine the maximum value of w_0 for which it is guaranteed that G(jw)=75X(jw) for $\|w\|\le w_0$, where X(jw) is F.T of x(t)	Remember	CO 5	AECB14.20
20	A signal e^{-3t} u(t) is passed through an ideal LPF with cut-off frequency of 1 rad/s i) Test whether the input is an energy signal Find the input and output energy	Understand	CO 5	AECB14.20
PART - C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)				
1	Suppose that the signal x(t)= u(t+0.5)-u(t-0.5) and the signal h(t)= e^{jwt} a) Determine a value of w which ensures that y(0)=0, where y(t)=x(t)*h(t) Is your answer to the previous part unique?	Analysis	CO 5	AECB14.19
2	a) If x(t)=0, $\|t\|>T_1$ and h(t)=0, $\|t\|>T_2$ then x(t)*h(t)=0, $\|t\|>T_3$ for some positive number T_3. Express T_3 in terms of T_1 and T_2 Consider a discrete-time LTI system with the property that if the input x[n]=0 for all n≥10, then the output y[n]=0 for all n≥15. What condition must h[n], the impulse response of the system, satisfy for this to be true?	Understand	CO 5	AECB14.19
3	a) Find the PSD of the integral of a function f(t) b) Find the PSD of the derivative of a function f(t)	Analysis	CO 5	AECB14.20
4	a) compute the auto correlation function for each of the two signals $x_1(t)$ and $x_2(t)$ as shown in fig-a b) let x(t) be a given signal, and assume that x(t) is of finite duration—i.e., that x(t)=0 for t<0 and t>T. Find the impulse response of an LTI system so that $\emptyset_{xx}$(t-T) is the output if x(t) is the input c) The system determined in fig-b is a matched filter for the signal x(t). Let x(t) be as in fig-b, and let y(t) denote the response to x(t) of an LTI system with real impulse response h(t). Assume that h(t)=0 for t<0 and for t>T. show that the choice for h(t) that maximizes y(T), subject to the constraint that $\int^{T} h^2(t)dt = M; a\ fixed\ positive\ number$	Evaluate	CO 5	AECB14.19
5	What are the disadvantages of under-sampling? For a signal x(t), calculate Nyquist rate and Nyquist interval. x (t) = 3cos 25πt - 10 sin200πt + cos300πt.	Evaluate	CO 5	AECB14.17
6	A continuous time signal is given as t tx π 200cos8)(= .Determine i) Minimum sampling rate ii) If fs=400Hz, what is discrete time signal obtained after sampling. iii) If fs=150Hz, what is discrete time signal obtained after sampling.	Evaluate	CO 5	AECB14.17
7	What is an energy density spectrum and power density spectrum? Derive the relation between autocorrelation and power spectral density.	Evaluate	CO 5	AECB14.20
8	Determine the Nyquist sampling rate and Nyquist sampling interval for i) $x(t) = 2sinc(100\Pi t)$ ii) $x(t) = sinc(80\Pi t)sinc(120\Pi t)$	Understand	CO 5	AECB14.17
9	Find the energy spectral density of the signal x(t) = 10 Sinc 10t. Also find its total energy.	Evaluate	CO 5	AECB14.20

10	For the signal g(t) = 2a/(t2+a2),determine the essential Band width B Hz of g(t) such that the energy contained in the spectral components of g(t) of frequencies below B Hz is 99% of signal energy.	Apply	CO 5	AECB14.20

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