8. Unit wise Question Bank

S NO	Short Answer Questions	Blooms Taxonomy Level	Course Outcome
	UNIT-I		
1.	Which analogy helps in signal analysis?	Understand	1
2.	What are orthogonal functions?	Understand	1
3.	What is orthogonal vector space?	Understand	1
4.	What is orthogonal signal space?	Understand	1
5.	Show that the following signals are orthogonal over an interval [0, 1] X1(t)=2 and x2(t)=√3(1-2t)	Knowledge	1
6.	Define unit step function.	Understand	1
7.	Define unit parabolic function.	Understand	1
8.	Define unit ramp signal.	Understand	1
9.	Define unit impulse signal.		
10.	Define complex exponential signal?	Understand	1
11.	What is real exponential signal?	Understand	1
12.	Define Sinusoidal function.	Understand	1
13.	Define Signum function.	Understand	1
14.	Define Sinc function.	Understand	1
15.	Sketch the following signals. a)u(-t+2) b)-2u(t+2) c)4r(t)	Knowledge	1
16.	What are the major classifications of the signal?	Understand	1
17.	Define continuous time signals and classify them	Knowledge	1
18.	Define discrete time signals and classify them	Knowledge	1
19.	Define periodic signal and non-periodic signal.		1
20.	Write the expressions for total energy E and average power P of a signal.	Understand	1
21.	Distinguish between causal and non-causal signals.	Knowledge	1
22.	Write the expressions for even and odd parts of a signal.	Understand	1
23.	Define energy and power signals?	Understand	1
24.	Define even and odd signal?	Understand	1
25.	Define the Parseval's Theorem?	Understand	1
	UNIT II		
	Fourier series:		
1.	What are Dirichlet's conditions for Fourier series? State them.	Knowledge	2
2.	What are the types of Fourier series?	Understand	2
3.	What is trigonometric Fourier series and write their	Understand	2

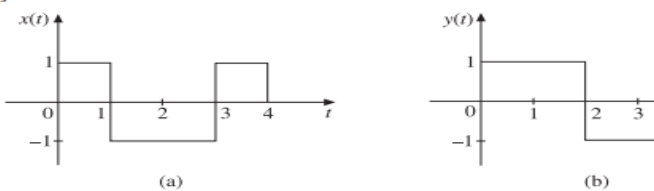|	coefficients equations?		
4.	What is exponential Fourier series and write their coefficients equations?	Understand	2
5.	Write alternative form of the Trigonometric Fourier series and its coefficients equations	Understand	2
6.	How do you obtain trigonometric Fourier series coefficients from exponential Fourier series coefficients?	Understand	2
7.	How do you obtain exponential Fourier series coefficients from trigonometric Fourier series coefficients?	Understand	2
8.	How do you obtain cosine Fourier series from exponential Fourier series coefficients?	Understand	2
9.	What is the Fourier Spectrum	Understand	2
10.	What do you mean by Gibbs phenomenon?	Understand	2
11.	Write down the exponential form of the Fourier series representation of a Periodic signal?	Understand	2
12.	Write down the trigonometric form of the Fourier series representation of a Periodic signal?	Apply	2
13.	State Time Shifting property in relation to series.	Apply	2
Fourier transform			
14.	What is the use of Fourier transform?	Knowledge	2
15.	What are the merits of Fourier transform?	Knowledge	2
16.	What are the limitations of Fourier transform?	Knowledge	2
17.	What are the differences between the Fourier series and the Fourier transform?	Understand	2
18.	What are Dirichlet's conditions for Fourier transform? State them	Apply	2
19.	Define Fourier transform pair	Knowledge	2
20.	State Convolution property of Fourier Transform.	Apply	2
21.	Write and explain Time Reversal Property of Fourier Transform.	Apply	2
22.	Find the fourier transform of x(t)=sin(wt)	Understand	2
23.	What is the effect of Hilbert transform?	Apply	2
UNIT-III			
Signal Transmission through Linear Systems			
1.	Define continuous time and discrete time systems.	Understand	3
2.	Define time invariant and time varying systems.	Understand	3
3.	Define static and dynamic systems.	Understand	3
4.	Define causal and non-causal systems.	Understand	3
5.	Define Linear and non linear systems.	Understand	3
6.	Define Stable and unstable systems.	Understand	3
7.	Is the system describe by the equation y(t) = x(2t)	Understand	3

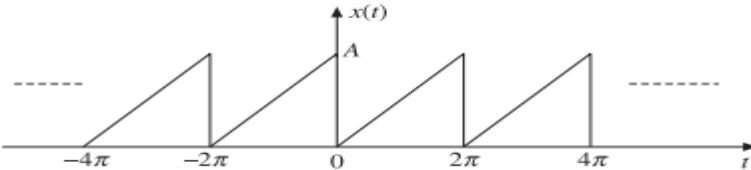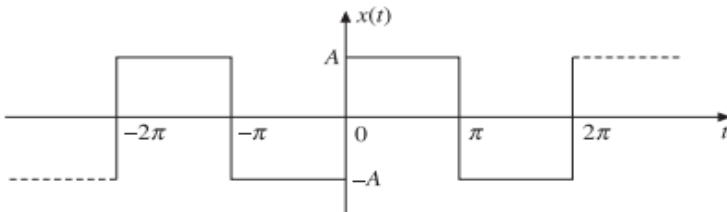|			
	Time invariant or not? Why?		
8.	What is the period T of the signal x(t) = 2cos (n/4)?	Knowledge	3
9.	Is the system y (t) = y(t-1) + 2t y(t-2) time invariant ?	Understand	3
10.	Is the discrete time system describe by the equation y (n) = x (-n) causal or non causal? Why?	Understand	3
11.	What is the periodicity of x (t) = e j100IIt?	Understand	3
12.	Define LTI CT, LTI DT systems	Understand	3
13.	Define LTV CT, LTV DT systems	Knowledge	3
14.	What is the condition of LTI system to be stable?	Understand	3
15.	When the LTICT system is said to be causal?	Understand	3
16.	When the LTICT system is said to be dynamic?	Understand	3
17.	Define impulse response of a linear time invariant system.	Knowledge	3
18.	Find the unit step response of the system given by h (t)= 1/RC e-t/RC u(t)	Understand	3
19.	What is the impulse response of the system y(t)= x(t-to)	Understand	3
20.	What are the Conditions for a System to be LTI System?	Understand	3
21.	Define transfer function in CT systems.	Knowledge	3
22.	What is a filter? How they are classified?	Understand	3
23.	The impulse response of the LTI-CT system is given as h(t) = e-t u(t).Determine transfer function and check whether the system is causal and stable series?	Understand	3
24.	What is signal bandwidth and system bandwidth?	Understand	3
25.	State Paley-Wiener criterion?	Understand	3
26.	What is the relation between bandwidth and rise time?	Understand	3
27.	Define convolution integral.	Understand	3
28.	What are the properties of convolution?	Understand	3
29.	Determine the convolution of the signals X(n)={2,-1,3,2} & h(n)={1,-1,1,1}	Understand	3
	UNIT – IV		
	Laplace Transforms		
1.	What is the use of Laplace transform?	Knowledge	4
2.	What are the types of Laplace transform?	Knowledge	4
3.	Define Bilateral and unilateral Laplace transform.		4
4.	Define inverse Laplace transform.	Understand	4
5.	Region of convergence of the Laplace transform	Knowledge	4
6.	What are the Properties of ROC?	Understand	4
7.	What is the relation between the Laplace transform and Fourier transform?	Understand	4
8.	What is pole zero plot.	Understand	4
9.	Find the Laplace transform of standard signals.	Understand	4
10.	State initial value theorem and final value theorem for Laplace transform	Understand	4

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11.	State the linearity property for Laplace transforms.	Understand	4
12.	State the time shifting property for Laplace transforms.	Understand	4
	Z transforms		
13.	Define Z transform.	Understand	4
14.	What are the two types of Z transform?	Understand	4
15.	Define unilateral Z transform.	Understand	4
16.	What is the relation between discrete time Fourier transform and z- transform	Understand	4
17.	What is ROC of Z-transform?	Knowledge	4
18.	State convolution property of Z transforms.	Understand	4
19.	What is the differentiation property in Z domain	Understand	4
20.	State multiplication property in relation to Z transform	Understand	4
21.	What is the time shifting property of Z transform?	Understand	4
22.	State the methods to find inverse Z transform	Understand	4
	UNIT - V		
	Sampling theorem		
1.	What is meant by sampling?	Knowledge	5
2.	State Sampling theorem.	Understand	5
3.	What is meant by aliasing?	Understand	5
4.	What are the effects aliasing?	Understand	5
5.	What are all the blocks are used to represent the CT signals by its samples?	Understand	5
6.	Mention the types of sampling.	Understand	5
7.	Define Nyquist's rate.	Understand	5
8.	What is the condition for avoid the aliasing effect?	Understand	5
9.	What is an anti-aliasing filter?	Understand	5
10.	What is the Nyquist's Frequency for the signal x(t) =3 cos 50t +10 sin 300t – cos100t ?	Understand	5
11.	What is the period of the signal x(t) = 10sin 12t + 4 cos18t	Knowledge	5
12.	Define Nyquist's interval.	Understand	5
	Correlation		
13.	Explain about Auto correlation?	Understand	5
14.	Explain about Cross correlation?	Understand	5
15	Properties of Auto correlation	Understand	5
16.	Properties of Cross correlation	Knowledge	5
17.	Define Energy spectral density	Understand	5
18.	Define Power spectral density	Understand	5
19.	What is relation between the convolution and correlation?	Understand	5

		Long Answer Questions	Taxonomy Level	Outcome
		UNIT – I Signal Analysis		
1.		Present the analogy between vectors and signals.	Apply	1
2.		Show that the functions $\sin nw_0t$ and $\cos mw_0t$ are orthogonal over any interval $\{t0$ to $[t0 + (2p/w0)]\}$ for integral values of n and m.	Apply	1
3.		Prove that the signals x(t) and y(t) given in Figure are orthogonal over the interval [0, 4] 	Apply	1
4.		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.	Apply	1
5.		Derive an expression for computing Mean Square Error in approximating a function f(t) by a set of n orthogonal functions.	Understand	1
6.		Prove that the complex exponential functions are orthogonal functions.		1
7.		What are the basic operations on signals? Illustrate with an example each of them	Apply	1
8.		Define Even and Odd signal .Find the even and odd components of the following signals i) x(t)= $1 +2t+ 3t^2+ 4 t^3$ ii) x(t) =u (t+2)	Apply	1
9.		Define and sketch the following signals i) Unit Step function ii) Unit impulse function iii) Signum function iv)unit Ramp v) Exponential function	Apply	1
10.		Examine whether the following signals are periodic or not? If periodic determine the fundamental period. i) sin $12\pi t$ ii) cos2t+ sin √3 t iii) sin $(0.02\pi$ n)	Apply	1
11.		Examine whether the following signals are periodic or not? If periodic determine the fundamental period .i) sin10t+ cos20ptm ii) u(t) – 2u(t – 5) iii) 3u (t) 2 sin 2 t	Knowledge	1
12.		Determine the energy and power for the following signals and hence determine whether the signal id energy or power signal i) x(t)=e^{-3t} ii) x(t)=$e^{-3|t|}$ iii) x(t)= e^{-10t} u(t) iv) x(t)=A $e^{j2\pi at}$		1

13.	Define the following: a) i) Energy-type signals ii) Power-type signals	Understand	1
	UNIT-II		
	Fourier series		
1.	Write the Dirichlet's conditions to obtain Fourier series representation of any signal.	Understand	2
2.	Derive the expression for trigonometric Fourier series and derive the Fourier Co-efficient's	Understand	2
3.	Find the trigonometric Fourier series for half wave rectified sine wave.	Understand	**2**
4.	Find the cosine Fourier series for the waveform shown in Figure	Understand	2
5.	Obtain the exponential Fourier series for the waveform shown in Figure Also draw the frequency spectrum.	Understand	2
6.	Determine the fourier series expansion of the square wave function as $f(t) = 1 \quad -1/2 < t < 1/2$ $\quad\quad\quad -1, \quad 1/2 < t < 3/2$	Understand	2
7.	Find the exponential fourier series for the full wave rectified sine wave for the interval $(0, 2\pi)$ with an amplitude of 'A'	Understand	2
8.	state and prove the following properties of Fourier series a) Linearity property b) Time shifting property c)Time Reversal Property d) Time scaling Property e)Time differentiation Property f)Time integration Property g)Convolution theorem h)Multiplication Property i) Parseval' theorem	Apply	2
9.	Derive the polar fourier series from the exponential fourier series representation and hence prove that Dn=2 |Cn|	Understand	2
10.	Write a short note on exponential fourier spectrum	Understand	2
	Fourier Transforms		
11.	Distinguish between the exponential form of the Fourier series and Fourier transform. What is the nature of the 'transform pair' in the above two cases	Understand	2

12.	What is Fourier Transform of signum function?	Understand	2
13.	What is Fourier Transform of Rectangular function?	Understand	2
14.	Find the Fourier transforms of a) cos wt u(t) b) sin wt u(t) c) cos (wt+Ø) d) e^{jwt}	Apply	2
15.	Find the Fourier transform of standard signals.	Understand	2
16.	write and Explain the properties of Fourier transform a)Time scaling b) Time differential c) Time integral d)Linearity property e) Time shifting property f)Frequency shifting property g)Time reversal property h) Frequency differentiation i)convolution property j)Multiplication property k)Duality property l)Modulation property m)conjugation property	Understand	2
17.	Find the Fourier transform of the following a) real exponential, $x(t) = e^{-at} u(t)$, a>0 b) rectangular pulse, $x(t) =$ 1, -T <t< T 0, otherwise c) $x(t)= e^{at} u(-t)$, a>0	Apply	2
18.	a) Find the Fourier transform of a gate function $x(t) =$ 1, |t|< 1/2 0, |t| > 1/2 b) Find the Fourier transform of x(t)=1	Knowledge	2

UNIT - III

Signal Transmission through Linear Systems

1. 1.	Determine whether the following input-output equations are linear or non linear. a) $y(t)= x(t^2)$ b) $y(t)=e^{x(t)}$ c) $y(t)=t^2 x(t-1)$ d) $y(t)=x(t)\cos 50\pi t$	Understand	3
2. 2.	Find whether the following systems are causal or non-causal a) y(t)=x(-t) b) y(t)=x(t+10)+x(t) c) y(t)=x(sin(t)) d) y(t)=x(t) sin(t+1)	Understand	3
3. 3.	Determine whether the following systems are time-varying or time-invariant a) y(t)=tx(t) b) y(t)=t2 x(t-1) c) $y(t)=a[x(t)]2+bx(t)$ d) $y(t)=x(t) \cos 50\pi t$	Understand	3
4. 4.	Show that the following systems are LTI systems a) y(t)=x(t/4) b) y(t) = x(t) +x(t-4) t>0 = 0 t<0	Understand	3
5. 5.	Find whether the following systems are stable or unstable a) $y(t)=e^{x(t)}$; |x(t)|<10 b) y(t)=(t+10) u(t)	Understand	3
6.	Write notes on filter characteristics of linear systems.	Understand	3
7.	Obtain the conditions for distortion less transmission through a system.	Understand	3
8.	Derive the relation between rise time and bandwidth of a low	Understand	3

	pass filter		
9.	Write short notes on a)signal bandwidth b)system bandwidth	Understand	3
10.	Explain causality and physical realizability of a system and hence give Paley-wiener criterion.	Understand	3
11. 6.	Find the voltage of the RC LPF for an input voltage of te^{-at}	Apply	3
12. 7.	The impulse response of a continuous time system is expressed as h(t)=1/RCe$^{-t/RC}$u(t) .find the frequency response and plot the magnitude and phase plots.	Understand	3
13. 8.	A system produces an output of y(t)= e^{-t} u(t) for an input of x(t)= e^{-2t} u(t). Determine the impulse response and frequency response of the system	Understand	3
14. 9.	The input voltage to an RC circuit is given as x(t)=te$^{-t/RC}$ u(t) and the impulse response of this circuit is given as h(t)=(1/RC) e$^{-t/RC}$ u(t). Determine the output y(t)	Understand	3
15. 10.	For a system excited by x(t)=e^{-2t} u(t), the impulse response is h(t)=e^{-t} u(t)+e^{2t} u(-t), find the output y(t) for this system	Understand	3
16. 11	Consider a causal LTI system with frequency response H(w)=1/3+jw For a particular input x(t), the system is observed to produce the output, y(t)=e^{-3t}u(t)- e^{-4t} u(t), find the input x(t)?	Apply	3
17.	Determine the convolution of two functions x(t)=a e^{-at} ; y(t)= u(t)	Apply	3
18.	Write the procedure to find the convolution of two signals graphically.	Understand	3
	UNIT-IV **Laplace Transforms**		
1.	What is ROC? Discuss about ROCs of various classes of signals. Write the properties of ROC for Laplace transforms.	Understand	4
2.	Compare Laplace and Fourier transforms.	Understand	4
3.	Find the Laplace Transforms of the following functions a) exponential function b) unit step function c) hyperbolic sine & cosine d) damped sine and cosine e) damped hyperbolic cosine & sine f) Impulse function g)ramp function h)parabolic function i)sine and cosine functions	Understand	4
4.	State and prove the properties of Laplace transform		
5.	Determine the function of time x(t) for each of the following Laplace transforms and their associated region of convergence	Understand	4

	i)$(s+1)^2/s^2-s+1$ Re [s] $> 1/2$ ii) $s^2-s+1 / (s+1$ Re [s] > -1		
6.	Consider the following signals, find Laplace transform and region of convergence for each signal a) $e^{-2t} u(t) + e^{-3t} u(t)$ b) $e^{-4t} u(t) + e^{-5t} \sin 5t\, u(t)$	Understand	4
7.	Determine the function of time x(t) for each of the following Laplace transforms a) $1/s^2+9$ Re[s]>0 ; b) s/s^2+9 Re[s]<0 c) $(s+1)/ (s+1)^2+9$ Re[s]<-1	Knowledge	4
8.	Determine the Laplace transform and associated region of convergence for each of the following functions of time i) x(t) = 1; $0 \le t \le 1$ iii) x(t)= cos wt	Understand	4
9.	Find the inverse Laplace transform of the functions i) Y(s)= $10s /(s+2)^2(s+8)$ ii) Y(s)= $10s /(s+2)^3 (s+8)$	Understand	4
10.	Find the inverse Laplace transform of the functions i) Y(s)= $2s^2+6s+6/(s+2)(s^2+2s+2)$ ii) Y(s)= $s^4+5s^3+12s^2+7s+15/(s+2)(s^2+1)^2$	Understand	4
11.	A certain function f(t) is known to have a transform F(s)= $6s^2+8s+5/s(2s^2+ 6s+5)$, find f(t) find also values of f(t) at t=0 and t=∞	Understand	4
12.	Find x(t) if X(s)= $1/(s^2+a^2)^2$ using convolution	Understand	4
13.	For an initially inert system, the impulse response is $(e^{-2t}+e^{-t})$ u(t). find the excitation to produce an output of t. e^{-2t} u(t)	Understand	4
14.	Find the Laplace transform of the following function , x(t)= $(1/t) \sin^2$ wt	Understand	4
15.	Find the Laplace Transform of cos wt and sin wt using frequency shifting property	Knowledge	4
16.	Determine the Laplace transform and associated region of convergence and pole-zero plot for the following function of time. x(t)= e^{-2t} u(t) + e^{3t} u(t)	Knowledge	4
17.	Verify Parseval's theorem for the energy signal x(t)= e^{-at} u(t), a>0	Apply	4
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	Understand	4
19.	Find the z-transform of the following sequences i) x[n]= a^{-n} u[-n-1] ii) x[n]= u[-n] iii) x[n]= $-a^n$ u[-n-1]	Understand	4
20.	Compare Fourier, Laplace and Z-transforms	Understand	4
21.	What are the ROCs of finite duration sequences? Write the	Understand	4

	properties of ROC of X(z)		
22.	Constraints on ROC for various classes of signals?	Apply	4
23.	A finite series sequence x[n] is defined as $x[n]=\{5,3,-2,0,4,-3\}$.find X[z] and its ROC.	Understand	4
24.	Find the z-transform of the following i) $x[n]= \cos nw. u[n]$ ii) $x[n]= a^n \sin nw. u[n]$ iii) $x[n]= a^n u [n]$	Understand	4
25.	Find the z-transform of the following i) $x[n]= \cos nw. u[n]$ ii) $x[n]= a^n \sin nw. u[n]$ iii) $x[n]= a^n u [n]$	Understand	4
26.	Find the z-transform and ROC of the following sequences i) $x[n]=[4(5n)-3(4n)] u(n)$ ii) $(1/3)^n u[-n]$ iii) $(1/3)^n [u[-n]-u[n-8]]$	Understand	4
27.	State and prove Properties of Z-transforms?		4
28.	Find the inverse Z-transform of $X(z)= z/z(z-1)(z-2)^2$; $|z|>2$ using partial fraction	Apply	4
29.	Find the inverse z-transform of $X(z)= (z-1)2/z^2-0.1z-0.56$		

<table>
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Sampling theorem</td></tr>
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1.	State and prove the sampling theorem for band-limited signals.	Understand	5
2.	State and explain the sampling theorem for band pass signals.	Understand	5
3.	What is zero order hold? Obtain the transfer function of zero order hold	Understand	5
4.	A signal $x(t)=2\cos 400\pi t+6 \cos 640\pi t$ is ideally sampled at fs=500Hz, if the sampled signal is passed through an ideal LPF with a cut off frequency of 400Hz, what frequency components will appear in the output.	Knowledge	5
5.	Determine the Nyquist's rate and interval corresponding to each of the following signals i) $x(t)= \sin 4000\pi t/\pi t$ ii) $x(t) =1+\cos 2000\pi t+\sin 4000\pi t$	Apply	5
6.	The signal $x(t)=\cos 5\pi t+0.3 \cos 10\pi t$ is instantaneously sampled. Determine the maximum interval of the sample	Understand	5
7.	For the analog signal $x(t)=3 \cos 100\pi t$ a) Determine the minimum sampling rate to avoid aliasing b) Suppose that the signal is sampled at the rate, fs=200Hz, what is the discrete time signal obtained after sampling c) Suppose that the signal is sampled at the rate, fs=75Hz, what is the discrete time signal obtained after sampling d) What is the frequency 0<f< fs/2 of a sinusoid that yields samples identical to those obtained in (c) above	Understand	5
8.	A signal $x(t)=2\cos 400\pi t+6 \cos 640\pi t$ is ideally sampled at fs=500Hz, if the sampled signal is passed through an ideal	Understand	5

	LPF with a cut off frequency of 400Hz, what frequency components will appear in the output.		
9.	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, fs=200Hz, what is the discrete time signal obtained after sampling c) Suppose that the signal is sampled at the rate, fs=75Hz, what is the discrete time signal obtained after sampling d) What is the frequency 0<f< fs/2 of a sinusoid that yields samples identical to those obtained in (c) above	Apply	5
10.	Show that a band limited signal of finite energy which has no frequency components higher than fm Hz is completely described by specifying values of the signals at instants of time separated by 1/2 fm seconds. Also show that if the instantaneous values of the signal are separated at intervals larger than 1/2 fm 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 fs.	Knowledge	5
11.	Explain the signal recovery (reconstruction) from its sampled signals	Understand	5
12.	a) Explain the impulse sampling method. b) Explain the flat top sampling method. c) Explain the natural sampling method.	Understand	5
13.	Show that R(t) and ESD form a Fourier transform pair	Understand	5
14.	Show that R(t) and PSD form a Fourier transform pair	Understand	5
15.	Write the properties of ESD and PSD	Understand	5
16.	Explain the detection of periodic signals in the presence of noise by cross correlation.	Understand	5
17.	Explain the extraction of a signal from noise by filtering	Understand	5
18.	Find the autocorrelation, power, RMS value and sketch the PSD for the signal x(t)=(A+ sin 100t) cos 200t	Understand	5