Reg No.:_______________ Name:__________________________

02000ECT204052104

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fourth Semester B.Tech Degree Examination July 2021 (2019 Scheme)

Course Code: ECT204

Course Name: SIGNALS AND SYSTEMS

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

PART A

(Answer all questions; each question carries 3 marks) Marks

		Marks
1	Determine energy of the signal $x(t) = e^{-2t} u(t)$	3
2	Plot the waveform of the following signal $x(t) = u(t + 1) - 2u(t) + u(t - 1)$	3
3	Perform linear convolution of signals $x_1[n] = [2, 2, 2, 2]$ and $x_2[n] = [1, 1, 1, 1]$	3
4	Find Laplace Transform and sketch ROC for the signal $x(t) = e^{2t} u(t) + e^{-3t} u(t)$	3
5	State sampling theorem of a band limited Continuous time signal.	3
6	Find the Nyquist rate and Nyquist interval of the following signal $x(t) = 3 \sin 100\pi t + 2 \cos 200\pi t$	3
7	Find DTFT of the signal $x[n] = \frac{1}{2}\left[\left(\frac{1}{2}\right)^n + \left(\frac{1}{4}\right)^n\right]u[n]$	3
8	State and prove differentiation property of DTFT	3
9	Derive the relation between DTFT and Z transform	3
10	Evaluate the transfer function H(z) of an LTI system described by $y[n] - \frac{1}{2}\ y[n-1] = 2x[n]$	3

PART B

(Answer one full question from each module, each question carries 14 marks)

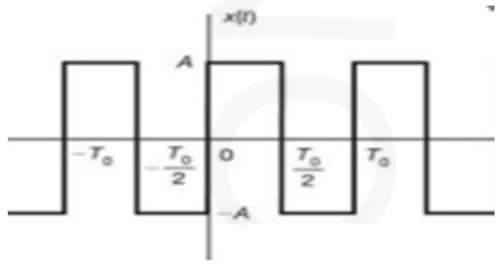
Module -1

11	a)	Test whether the following signals are periodic or not. If periodic, determine the fundamental period and frequency. 1) $x(t) = 3\cos(5t + \pi/6)$ 2) $x(t) = e^{(j\pi - 2)t}$	6
	b)	Evaluate the discrete-time convolution sum with required plots for the following signal $y[n] = 3^n u[-n + 3] * u[n - 2]$	8

12	a)	Evaluate the autocorrelation of the signal $x(t) = e^{-t} u(t)$	6
	b)	Evaluate the continuous time convolution integral for the following with proper plots. $y(t) = \{u(t) - u(t - 2)\} * u(t)$	8

Module -2

13	a)	Find the trigonometric Fourier Series of the given continuous time square wave x(t). Plot the magnitude and phase spectra.	7



	b)	Using the standard transforms and properties find Fourier Transforms of the following signals	
		i. $x(t) = t\, e^{-2t} u(t)$	7
		ii. $x(t) = \sin(2\pi t) e^{-t} u(t)$	
14	a)	A periodic signal has the Fourier series representation $x(t) \xleftrightarrow{FS;\, \pi} X(k) = -k2^{-\lvert k \rvert}$ Without determining x(t), find the Fourier series Y(k) and ω_0' for i. $y(t) = x(3t)$ ii. $y(t) = dx(t)/dt$ iii. $y(t) = x(t - 1)$	9
	b)	Find time domain signal represented by the Fourier Series coefficients $X(k) = j\delta(k - 1) - j\delta(k + 1) + \delta(k - 3) + \delta(k + 3),\ \omega_0 = 2\pi$	5

Module -3

15	a)	A second order LTI system is described by the given differential equation. Use Laplace Transform to determine the transfer function the system $\frac{d^2}{dt^2} y(t) + 4 \frac{d}{dt} y(t) + 3y(t) = 4\, x(t) + 2 \frac{d}{dt} x(t)$ Also find the output y (t) of the system for a given input $x(t) = e^{-2t} u(t)$.	8
	b)	An arbitrary band-limited continuous time signal x(t) is sampled with an impulse train. With spectral details, explain the following conditions (i) Oversampling (ii) Critical Rate (iii) Aliasing	6

16 a) Determine a differential equation description for a system with the following transfer function 6

$$H(s) = \frac{2(s-2)}{(s+1)^2\ (s+3)}$$

b) Determine whether the system described by the following system is 8

i. Both causal and stable

ii. Whether a causal and stable inverse systems exist or not?

$$H(s) = \frac{(s+1)(s+2)}{(s+1)(s^2+2s+10)}$$

Module -4

17 a) i. Find convolution of the following two sequences using DTFT 8

$$x_1[n] = [\ 1, 2, 3, 1\ ]$$

$$x_2[n] = [\ 1, 2, 1, -1\ ]$$

ii. Find Inverse DTFT of

$$|H(\omega)| = 1 \qquad -\omega_0 \le \omega \le \omega_0$$

$$0 \qquad \text{otherwise}$$

b) Compute DTFS coefficients of the given discrete time signal. Plot its magnitude and frequency spectrum. 6

$$x[n] = \cos\left(\frac{6\pi}{13}n + \frac{\pi}{6}\right)$$

18 a) Use the defining equation for the DTFS to determine the time domain signal represented by the following DTFS coefficients by inspection 7

$$X[k] = 2j\sin(\frac{4\pi}{19}k) + \cos\left(\frac{10\pi}{19}k\right)$$

b) Given DTFT of $x[n] = n(3/4)^{|n|} \longleftrightarrow X(e^{j\Omega})$. 7

Using properties of DTFT, find y[n] for the following $Y(e^{j\Omega})$

i. $Y(e^{j\Omega}) = \frac{d}{d\Omega}X(ej\Omega)$

ii. $Y(e^{j\Omega}) = X(e^{j\Omega}) * X(e^{j(\Omega - \pi/2)})$

Module -5

19 a) Determine the Z Transform and ROC for the following signal. Sketch the ROC, poles and zeroes in the Z-plane. 8

$x[n] = (2/3)^{|n|}$

b) Write the impulse response of the system function whose algebraic expression is given below. Also check and justify the causality and Stability. 6

$$H(z) = \frac{1}{\left(1 - \frac{1}{2}z^{-1}\right)} + \frac{1}{(1 - 2z^{-1})}, \qquad \frac{1}{2} < |z| < 2$$

20 a) Evaluate the inverse Z-Transform by partial fraction method for the given X(z). 7

$$X(z) = \frac{3 - \frac{5}{6}z^{-1}}{\left(1 - \frac{1}{4}z^{-1}\right)\left(1 - \frac{1}{3}z^{-1}\right)}, \qquad |z| > \frac{1}{3}$$

b) Evaluate Z-Transform of the following. 7

i. $x[n] = [r^n cos\omega_0 n]\, u[n]$

ii. $x[n\ ] = n\left(\frac{1}{3}\right)^n u[n]$

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fourth Semester B.Tech Degree Examination June 2022 (2019 scheme)

Course Code: ECT204

Course Name: SIGNALS AND SYSTEMS

Max. Marks: 100 Duration: 3 Hours

PART A

(Answer all questions; each question carries 3 marks) Marks

1	Sketch the signal $x(t) = [e^{-t}u(t)]\sum_{n=-\alpha}^{\alpha}\delta(t - nT)$ where T is any positive integer.	3
2	What is the output sequence of an LTI system with impulse response h(n)=[2 , 2] to the input x(n)=[1, 2,3, 1]?	3
3	State the Dirichlet's conditions for the convergence of Fourier series.	3
4	Prove time-shifting property of Laplace transform.	3
5	A continuous time signal $x(t) = cos\,40t - cos\,60t$ is sampled with a time period T. Can $x(t)$ be recovered from the samples $x(nT)$ for $= \pi/30$? State the reason for the same.	3
6	Find the frequency response $H(\omega)$ and impulse response of an LTI system characterized by the differential equation $$\frac{dy(t)}{dt} + ay(t) = x(t); a > 0$$	3
7	Define Energy Spectral Density of a discrete time signal? How can you relate it to the DTFT of the signal?	3
8	Determine the Fourier series coefficients of the signal $x(n) = 2 + \cos\left(\frac{\pi}{3}n + \frac{\pi}{4}\right)$.	3
9	If the ROC of system function of an LTI system is **|z| >0.8,** comment on the stability and causality of the system with proper justification.	3
10	Give the relation between DTFT and z-transform of a discrete time signal.	3

PART B

(Answer one full question from each module, each question carries 14 marks)

Module -1

11	a)	Determine whether the following system is static , time invarient, linear and causal. (x and y denote input and output respectively). Give explanation for each. $$y(t) = t^2\,x(t) + x(t-2)$$	8
	b)	Check whether the following signals are energy or power signals. i) $x(t) = e^{-a\|t\|}$; a>0 ii) $x(t) = tu(t)$	6
12	a)	Find the output of an LTI system with impulse response h(t) to the input x(t). Given $x(t) = u(t) - u(t-2)$ and h(t) is shown in Figure 1.	8

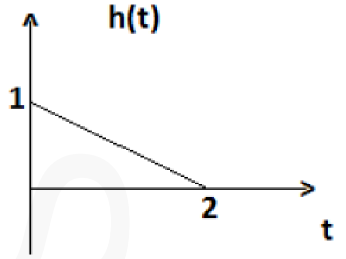

Figure 1

	b)	Sketch the signals (i) $y(t) = u(0.5t+2)$ (ii) $y(n) = u(n) + u(n-5)$	6

Module -2

13 a) 8

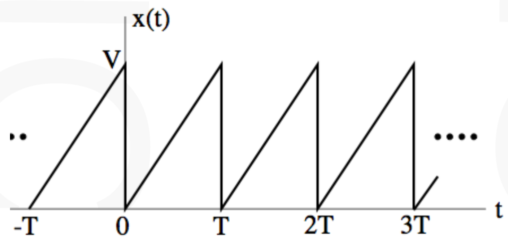

Figure 2

Find the complex exponential Fourier series of the periodic signal shown in Figure 2.

	b)	If $x(t)$ has a Fourier Transform , find the Fourier Transform of i) $x_1(t) = x(4t-3)$ ii) $x_2(t) = \frac{d}{dt}x(t-3)$	6

14	a)	Find the Fourier Transform of the signal $x_1(t)$ shown in Figure 3 using convolution property and time shift property of Fourier Transform.	8

Figure 3

	b)	Find the Laplace Transform and ROC of the signal	6

$$x(t) = (e^{-2t} + 3e^{-3t})u(t)$$

Module -3

15	a)	Find the impulse response and step response of a system with transfer function	7

$$H(s) = \frac{3s}{2s^2 + 10s + 12}$$

	b)	Determine the Nyquist rate of sampling for the signals	7

i) $x(t) = cos\ (150\pi t)\sin\ (50\pi t)$

ii) $x(t) = sin(150\pi t) + sinc^2\ (150\pi t)$

16	a)	A continuous time LTI system is described by the differential equation	7

$$\frac{dy(t)}{dt} + 5y(t) = x(t)$$

Determine the response of the system to the input $x(t) = e^{-2t}u(t)$using Fourier Transform.

	b)	Consider the continuous time signal $(t) = cos\ (200\pi t) + \sin\ (320\pi t)$. What will be the Nyquist rate of sampling for the signal? If the signal is sampled at 300samples/sec, write the discrete time signal $x[n]$ obtained after sampling. What will be the frequency components at the output if the sampled signal is passed through an ideal low pass filter with cut off frequency 250Hz?	7

Module -4

17	a)	Find the DTFT of the following sequences using properties given $x(n)$ has a DTFT $X(e^{j\omega})$	7

(i) $x_1(n) = x(1-n)$

(ii) $x_2(n) = e^{j\frac{\pi}{4}n}x(n-2)$

b) Consider an LTI system that is characterized by the difference equation 7

$$y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n)$$

Find the frequency response $H(e^{j\omega})$ and the impulse response h(n) of the system.

18 a) Find the DTFT of the given signal $x(n)$ 7

$$x[n] = \begin{cases} 1, & |n| \leq N_1 \\ 0, & |n| > N_1 \end{cases}$$

b) State and prove the convolution property of DTFT. 7

Module -5

19 a) Determine the z-transform for the following signal. Sketch the pole-zero plot and indicate the ROC. 7

$$x(n) = \left(\frac{1}{2}\right)^{n-1} u(n+3)$$

b) For the LTI system with system function H(z) find the impulse response so that the system is stable. 7

$$H(z) = \frac{5 - 10z^{-1}}{1 - 3.5z^{-1} + 1.5z^{-2}}$$

Can this system be both stable and causal?

20 a) Find the inverse z-transform of 10

$$X(z) = \frac{2z^2 + 16}{(z+1)(z-2)}$$

for all possible ROCs.

b) Write down any four properties of ROC for Z transform. 4

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fourth Semester B.Tech Degree Supplementary Examination June 2023 (2019 scheme)

SNS SNS

Course Code: ECT204

Course Name: SIGNALS AND SYSTEMS

Max. Marks: 100 Duration: 3 Hours

PART A

(Answer all questions; each question carries 3 marks) Marks

1	Demonstrate the relationship between Unit step, Unit ramp and Unit Impulse functions.	3
2	Determine the period if the signal, $cos\left(\frac{\pi}{3}n\right) + sin\left(\frac{\pi}{4}n\right)$ is periodic.	3
3	State and prove differentiation property of CTFT.	3
4	Find the Laplace Transform of $x(t) = e^{-2t}\,[\,u(t) - u(t-2)\,]$	3
5	Using convolution property of Laplace transform, determine the Laplace transform of system response when the input signals and impulse responses are: $x(t) = u(t),\ h(t) = e^{-t}u(t) + e^{-2t}u(t)$.	3
6	Describe the aliasing effect in sampling with the help of sketches.	3
7	Define Discrete-Time Fourier Transform (DTFT) of a signal $x[n]$. Prove that the DTFT is periodic with period 2π.	3
8	Determine Discrete Time Fourier Series of function $x[n] = 3cos\left(\frac{\pi}{8}n\right)$	3
9	Find the Z transform of $x(n) = r^n\, cos\, \omega n\, u(n)$	3
10	Determine the impulse response of the system described by the difference equation $y(n) = ay(n-1) + x(n)$	3

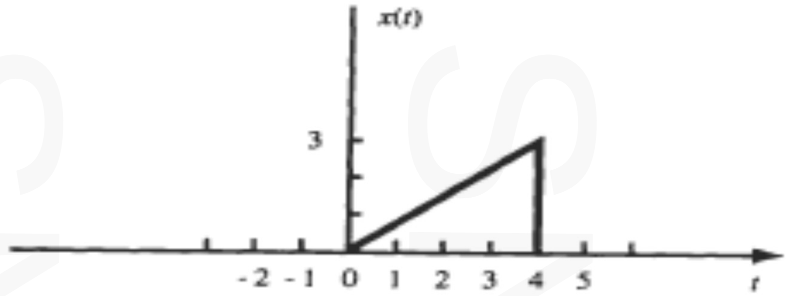
PART B

(Answer one full question from each module, each question carries 14 marks)

Module -1

11 a) A continuous-time signal $x\,(t)$ is shown in Fig below. Sketch and label each of the following signals. 8

(i) $x(t - 2)$ (ii) $x(2t)$ (iii) $x(t/2)$ (iv) $x\,(-t\,)$



b) A discrete time sequence is given by $x(n) = (\underline{1},1,1,1,2,2)$. Sketch — 6

(i) $x(n) - x(n-2)$

(ii) $x(n)\,u(n+2)$

12 a) Define an LTI system. Check whether the following system is an LTI system or not. — 6

$y(t) = 3x(t) + 5$

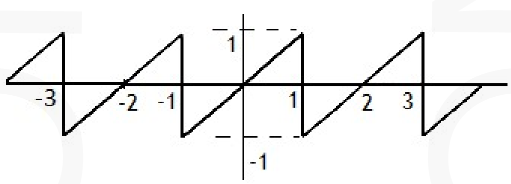
b) Find the convolution of signals given by — 8

$x(t) = \begin{cases} 1, & 0 \le t \le 2 \\ 0, & else\ where \end{cases}$ $\qquad$ $h(t) = \begin{cases} 1, & 0 \le t \le 3 \\ 0, & else\ where \end{cases}$

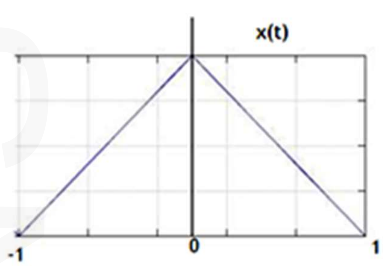
Plot the output signal also.

Module -2

13 a) Determine the Trigonometric Fourier Series of the following waveform. — 8



b) Use the differentiation property to determine the FT of the triangular pulse given. — 6



14	a)	Find the Fourier Transform of (i) **$\cos(\omega_0 t)\, u(t)$** (ii) **$e^{-t}\sin(5t)u(t)$**	8
	b)	Determine the Laplace Transform of $\begin{cases} x(t) = A, 0 < t < \frac{T}{2} \\ = -A, -\frac{T}{2} < t < T \end{cases}$	6

Module -3

15	a)	The input and output of a causal LTI system is described by the equation $$\frac{d^2y(t)}{dt^2} + 3\frac{dy}{dt} + 2\,y(t) = x(t)$$ Determine (i) Frequency response (ii) Impulse Response (iii) Response of the system if **$x(t) = t\, e^{-t}u(t)$**	8
	b)	Consider the LTI system with input **$x(t) = e^{-t}\, u(t)$** and impulse response **$h(t) = e^{-3t}\, u(t)$.** (i)Using Convolution property, determine the Laplace Transform, Y(s), of the output y(t). (ii) Find y(t), from the Y(s) obtained in (i).	6
16	a)	Explain with the help of figures, the effect of sampling in the frequency domain for the following cases: (i) Spectrum of sampled signal with $w_s > 2w_M$; (ii) Spectrum of sampled signal with $w_s < 2w_M$. Assume an arbitrary message signal spectrum. Here w_s is the sampling frequency and w_M is the maximum frequency present in the signal.	8
	b)	Consider the signal x(t) = cos 2000πt + 10 sin 10000πt+ 20 cos 5000πt. Determine (i) Nyquist rate for this signal (ii) If the sampling rate is 5000 samples per second, then what is the discrete time signal $x(nT_s)$ obtained after sampling, where T_s is the sampling period and n is an integer.	6

Module -4

17	a)	Fourier series coefficients of a discrete time periodic signal x[n] is given by	6

$C_k = cos\,\frac{k\pi}{4} + sin\,\frac{3k\pi}{4}$. Period of x[n] is N=8. Determine the sequence x[n].

b) Determine and sketch the magnitude and phase spectra of the following periodic signal x[n]= $cos\,\frac{2\pi}{3}n + sin\,\frac{2\pi}{5}\,n$ 8

18 a) Determine the DTFT of the signal $x[n]$ as give below. 9

$$x = [n] = \begin{cases} 3, & -10 \le n < 0 \\ -3, & 0 \le n \le 10 \\ 0, & elsewhere \end{cases}$$

Obtain the final expression of DTFT in terms of trigonometric functions.

Find the magnitude and phase spectra of $x[n]$.

b) Using DTFT, determine the impulse response of the discrete time system described by the difference equation **y[n-2]=x[n-1]+3y[n-1]-2y[n]** 5

Module -5

19 a) Determine the Z transform and plot the ROC of the function given by 6

x(n) = $(\frac{1}{2})^n\, u(n) + (\frac{1}{3})^n\, u(n)$

b) Determine the inverse z transform of the function given by 8

X(z) = $\frac{3+2z^{-1}+z^{-2}}{1-3z^{-1}+2z^{-2}}$

20 a) A certain LTI system is described by the following system function 4

H(z) = $\frac{(z+\,^1/_2)}{(z-1)(z-\,^1/_2)}$

Find the system response to the input **x(n) = 4** $^{-(n+2)}$ **u(n)**

b) Determine the transfer function of the system given by the difference equation. 10

y(n) + $\frac{1}{4}y(n-1) = x(n) - x(n-1)$

Calculate the frequency response from its transfer function. Express the same in terms of trigonometric functions. Also obtain the magnitude and phase responses of the given system.

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Reg No.:_______________ Name:__________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S4 (R,S) / S4 (PT) (R,S) Examination June 2023 (2019 Scheme)

Course Code: ECT204

Course Name: SIGNALS AND SYSTEMS

Max. Marks: 100 Duration: 3 Hours

PART A

(Answer all questions; each question carries 3 marks)

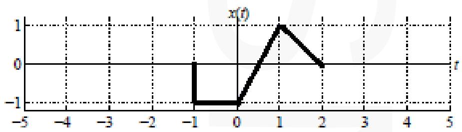
		Marks
1	Sketch the following waveform. **$x(t) = t.[u(t)-u(t-4)]$**	3
2	Check for shift invariance & linearity the systems represented by $y(t) = x^2(t-1)$	3
3	State and prove the time scaling property of CTFT.	3
4	Determine LT of $\mathbf{x(t) = e^{-4t}\,u(t) - e^{-4(t-1)}\,u(t)}$	3
5	Explain the role of Laplace Transform in determining the system function.	3
6	What should be the minimum sampling frequency for the correct sampling of the signal $\mathbf{x(t) = 4\sin(2\pi t) + \cos(5\pi t+0.1) + \cos(\pi t)}$	3
7	Determine DTFT of $x(t) = \mathbf{\partial(n+3) - \partial(n-3)}$	3
8	State and Prove the Convolution property of DTFS	3
9	Find the Z transform of $x(n)= \mathbf{r^n \sin \omega_n\, u(n)}$	3
10	What is the final value of x(n), if $\mathbf{X(Z)} = \frac{z^2}{(z-1)(z-0.2)}$	3

PART B

(Answer one full question from each module, each question carries 14 marks)

Module -1

11 a) Given x(t). Sketch a . x(-t), b. x(t+2),c. x(t-1), d. x(t/2), e. x(2t) . 10



b) Check whether the signals given are periodic or not. If periodic, Find the 4 fundamental periods.

a. x(t)= sin2t+ cos 3πt

b. sin2πt+ cos √2πt

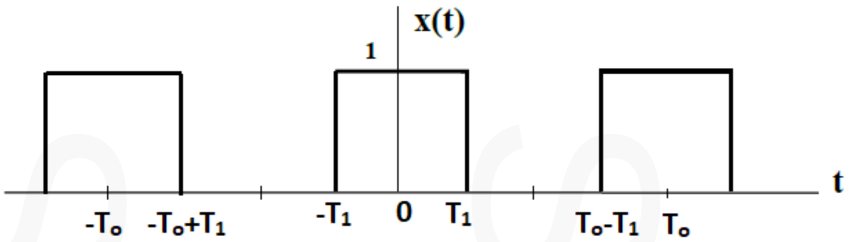
12 a) Find the response of an LTI system whose input x(t) and impulse response h(t) are given 8

$$x(t) = u(t)$$
$$h(t) = e^{-at}u(t)$$

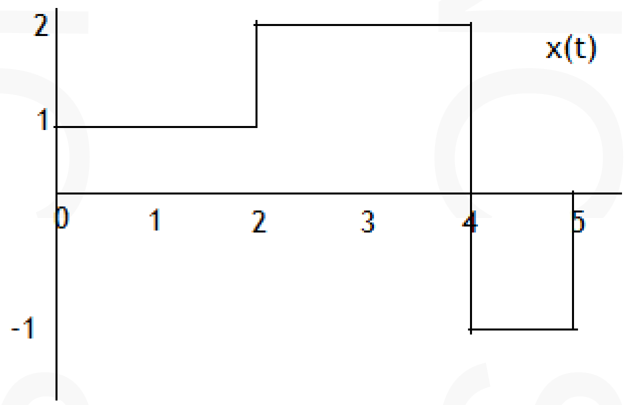
b) What is the output y(n) for a LTI system with impulse response h(n)=(1,2,1) for an input sequence x(n)=(1,3,3,2,1). 6

Module -2

13 a) Find the complex exponential Fourier series for the function shown for T_o=4,8. 8



b) Determine FT of the signal given below. 6



14 a) (i) Using the frequency shifting property find FT of **x(t)=** e^{j2t}**u(t)** 8

(ii) Using Time reversal property find FT of **x(t) = u(-t)**

b) Determine the Laplace Transform and express the ROC of the signal 6

x(t) = e^{-t} **u(t) +**e^{-2t}**u(t)**

Module -3

15 a) A certain continuous LTI system is described by the following differential equation. $\frac{dy(t)}{dt} + 5\,y(t) = x(t)$ 6

Determine y(t) using Fourier Transform for the following inputs.

(i) $x(t) = e^{-2t}\,u(t)$

(ii) $x(t) = \partial(t)$

b) Using convolution property of the Laplace Transform determine the system response for the following input x(t) and impulse response h(t) 8

(i) $x(t) = e^{-2t}\,u(t),\ h(t) = e^{-3t}\,u(t)$

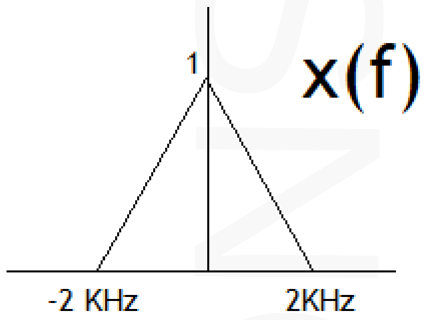
(ii) $x(t) = e^{-2t}\,u(t),\ h(t) = (1+e^{-3t})\,u(t)$

16 a) Find the Nyquist rate of the signal 6

(i) $x(t) = \sin 20\pi t - 2\cos 100\pi t$

(ii) $x(t) = \cos 150\pi t.\ \sin 100\pi t$

b) Consider the continuous time band-limited signal x(t) with a spectrum x(f) as shown in figure above. Sketch the spectrum of the discrete time signals $x_1[n]$ and $x_2[n]$ obtained from x(t) by sampling at 5 KHz and 3 KHz respectively. 8



Module -4

17 a) A signal x[n] has the DTFT, $X(\omega) = \frac{1}{1-ae^{-j\omega}}$. Find x[n]. Determine the DTFT of 8

(i) $x[n+1]$

(ii) $x[n]*x[-n]$ **,** * stands for convolution

b) Find the DTFT of the discrete time signal $x(n) = a^{|n|},\ -1 < a < 1$ 6

18 a) Determine the Discrete Time Fourier series representation for the sequences 8

(i) $x[n] = \frac{\cos\pi}{3}n + \frac{\sin\pi}{4}n$

(ii) $x[n] = \cos^2[\frac{\pi}{8}n]$

	b)	Find the impulse response of the system using DTFT, described by the difference equation. $\mathbf{y[n]= x[n]+\frac{1}{2}\, x[n-1] + \frac{1}{2}\, y[n-1]}$	6

Module -5

19	a)	Determine z transform of the function **x(n) = (n+0.5)**$\mathbf{(1/3)^n\, u(n)}$	6
	b)	Obtain the transfer function and impulse response for a stable and causal system with difference equation $y[n] + \frac{1}{6}y[n-1] - \frac{1}{6}y[n-2] = 3x[n] - \frac{1}{6}x[n-1]$	8
20	a)	Determine inverse Z transform of (i) $\boldsymbol{X(z) = \frac{0.5z}{(z-1)(z-0.5)}}$ $(ii)\ \boldsymbol{X(z) = \frac{z}{z^2-z+1}}$	8
	b)	Draw the pole zero plot and comment on the stability of the system given by **x(n) = (1/4)^n u(n) + (-1/2)^n u(n)**	6

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