K. S. SCHOOL OF ENGINEERING AND MANAGEMENT, BENGALURU - 560109

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

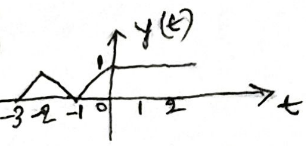
SESSION: 2021-2022 (EVEN SEMESTER)

QUESTION BANK-MODULE-1

Academic Year	**2021-2022**		
Batch	**2020-2024**		
Year/Semester/section	**II/IV/A**		
Subject Code-Title	**18EC45 – Signals & Systems**		
Name of the Faculty	**Mr. DILEEP J**	**Department**	**ECE**

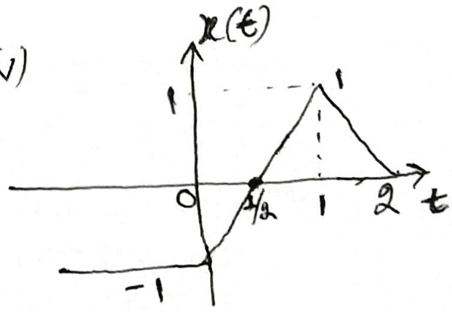
1. Make use of relevant expression and explain (i) Exponential Signal (ii) Sinusoidal Signal (iii) Triangular function (iv) Rectangular Function
2. Explain with an Example (i) Energy and Power Signal (ii) Even and Odd Signal (iii) Precedence rule (iv) Periodic and Aperiodic signals (v)Time Shifting (vi)Amplitude Scaling (vii) Time Scaling
3. Find the Even and Odd components of the following signals
   (i) $x(t) = e^{-2t}\cos(t)$
   (ii) y(t)= cos(t)-sin(t)-cos(t)sin(t)
   (iii) x(t)=t(2-t^2)(1+4t^2)
   (iv) x(n)={-1, 1, -1, 1, -1}
   (v) x(n)= e^n
   (vi) $x(n) = \sin\left(\frac{2\pi n}{7}\right)(1+n^2)$
4. Sketch the even and odd component of the following signal

(i)

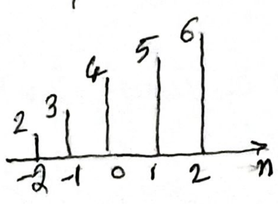


(ii)

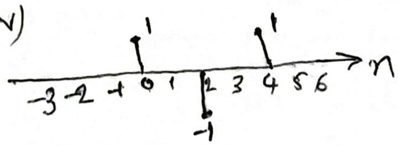
(v)



(iii)



(iv)



5. Determine whether the following signals are energy or power. If so find its energy and power value
   i) $x(t) = e^{-at}u(t)$ (ii) x(n)= $\cos(\pi n)$; -4 ≤ n ≤ 4
   (iii) x(t)=t u(t) (iv) x(n)= $e^{j(\pi n/2 + \pi/4)}$ (v) x(t)=$e^{j(2t + \pi/4)}$
   (vi) $x(n) = \left(\frac{1}{4}\right)^n u(n)$ (vii) $x(t) = A\cos(2\pi f t + \theta)$

(vi) $x(t) = 2t \quad , 0 \le t \le 2$

$2+t \quad , 2 \le t \le 4$

6) Identify whether the following signals are periodic or not. If Periodic find fundamental period.

(i) $x(n) = \cos(\pi n/6)\sin(\pi n/7)$

(ii) $y(t) = \sin^2 5t$

(iii) $x(t) = e^{(-1+j5)t}$

(iv) $x(n) = \cos(0.5n) + \cos(\pi n/8)$

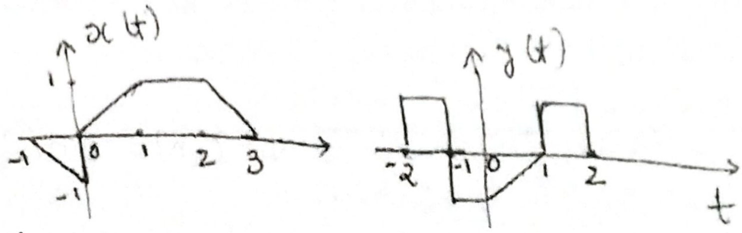
(v) $x(n) = 1 + e^{j4\pi n/7} - e^{-j3\pi n/5}$

(vi) $x(n) = \sin(\pi + 0.2n)$

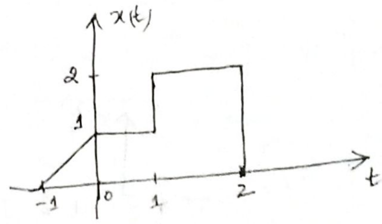
(vii) $x(t) = \cos 2t + \sin 3t$

7) Determine whether the continuous time signal is periodic or not. If periodic find the fundamental period where x1(t), x2(t), x3(t) have their periods 8/3, 1.26 and √2 respectively.

8) For the signal x(t) and y(t) shown below **Sketch** the following Signal (i) x(t+1) y(t-2) (ii) x(t) y(t-1)



9) A continuous time signal x(t) is shown, **sketch** each of the following (i) x(t) u(1-t) (ii) x(t)[u(t)-u(t+1)] (iii) x(t) (t-3/2)



10) sketch the following signal

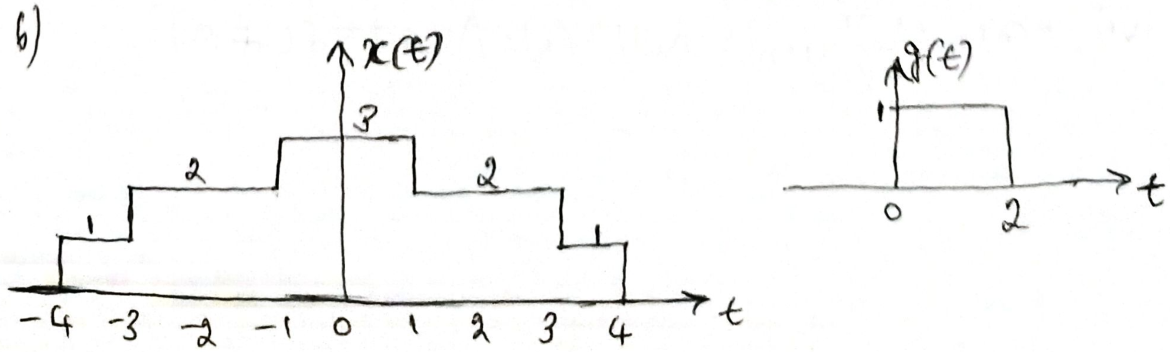
(i) if $x(n) = (8-n)[u(n)-u(n-8)]$; obtain $y1(n) = x(4-n)$ & $y2(n) = x(2n-3)$

(ii) $x(t) = r(t-4) - 2r(t-3) + 2r(t) - r(t+2)$

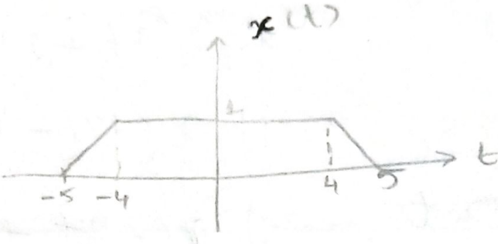
11. **Express** x(t) in terms of g(t) for given g(t) and x(t) below

a)

b)



12. The Trapezoidal pulse x(t) shown in the figure applied to differentiator y(t)= dx(t)/dt. **Obtain** the output of differentiator and obtain its energy and power value



13. Make use of necessary equations and explain properties/ Classification of the systems.

14. **Determine** whether the following systems are memoryless, causal, Time Invariant, Linear and stable.

(i) $y(n) = e^{x(n)}$ ii) y(n) = n x(n) (iii) y(t) = x(t/2)

iv) y(t) = $t^2 x(t-1)$ v) y(t)= x(t)+10 (vi) y(n)= (n + 1) x(n)

vii) $y(t) = \frac{1}{C}\int_{-\infty}^{t} x(\tau)d\tau$

15) Sketch the following

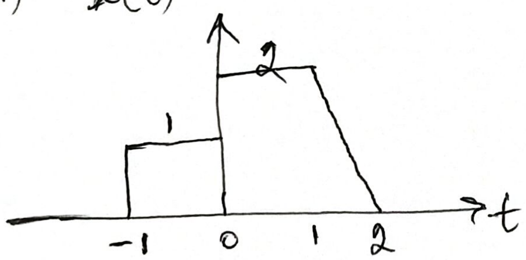
(i) $x(t) = u(t+1) - 2u(t) + u(t-1)$

(ii) $y(t) = r(t+2) - r(t+1) - r(t-1) + r(t-2)$

(iii) $x(t) = r(t+1) - r(t) + r(t-1)$

(iv) $x(t) = u(t+2) + u(t) - 2u(t-1)$; also sketch $x_e(t)$ & $x_o(t)$

(v) x(t)

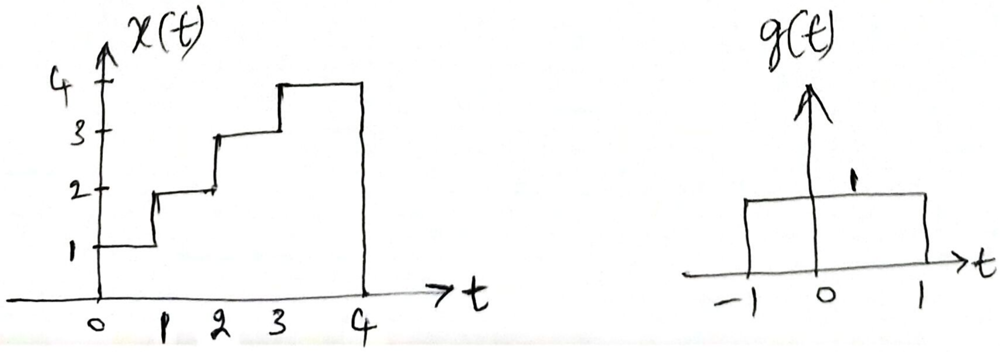


Find

a) $x(-2t+3)$

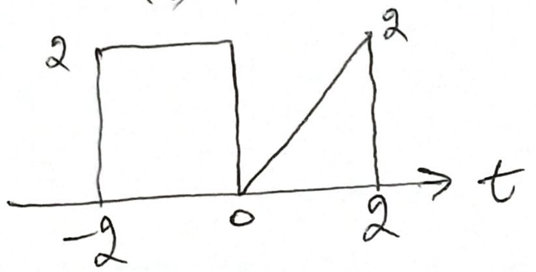
b) $x(0.5t-2)$

(vi) Express x(t) interms of g(t)



16) Sketch the following

$x(t) \Rightarrow$



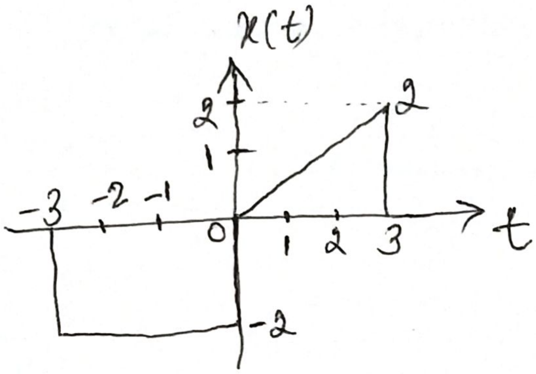
a) $x(2t+2)$

b) $x(t/2-1)$

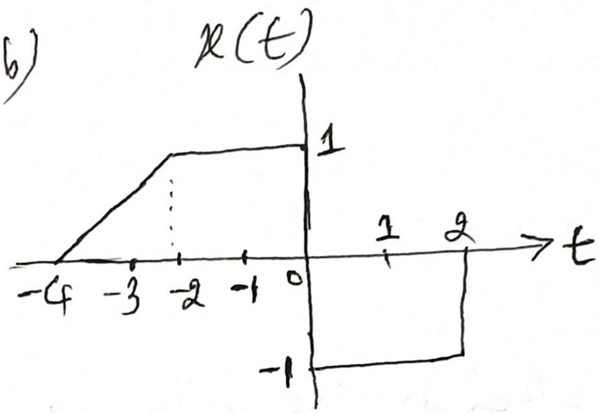
c) $x(-3t-2)$

17) Sketch Even & odd Components of :

a)

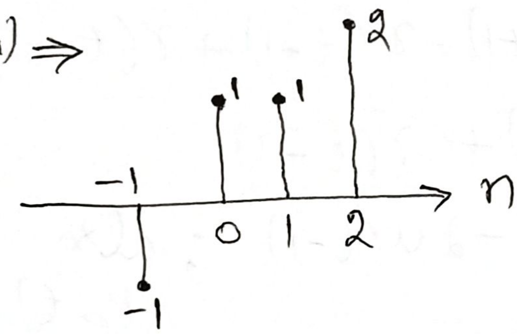


b)



18) $x_e(n)$ & $x_o(n)$ needs to be found for

$x(n) \Rightarrow$



COURSE INCHARGE

K. S. SCHOOL OF ENGINEERING AND MANAGEMENT, BENGALURU - 560109

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SESSION: 2021-2022 (EVEN SEMESTER)

QUESTION BANK-MODULE-2

Academic Year	**2021-2022**		
Batch	**2020-2024**		
Year/Semester/section	**II/IV/A**		
Subject Code-Title	**18EC45 – Signals & Systems**		
Name of the Faculty	**Mr. DILEEP J**	**Department**	**ECE**

1. Determine whether the following systems are memoryless, causal, Time Invariant, Linear and stable.

(i) $y(n) = e^{x(n)}$ ii) y(n) = n x(n) (iii) y(t) = x(t/2) (x) $y(t) = e^{-t} u(t)$

iv) $y(t) = t^2 x(t-1)$ v) y(t)= x(t)+10 (vi) y(n)= (n + 1) x(n)

vii) $y(t) = \frac{1}{C}\int_{-\infty}^{t} x(\tau)d\tau$ (viii) $y = \log[x(n)]$ (ix) $y(t) = x(t^2)$

2. Make use of necessary equations and explain properties/ Classification of the systems.

3. Show that convolution is Commutative, Associative & Distributive for Convolution Sum

4. Use the definition of convolution integral to prove the following properties

(i) $x(t) * u(t) = \int_{-\infty}^{t} x(\tau)d\tau$

(ii) $x(t) * \delta(t - t_0) = x(t - t_0)$

5. Find the convolution sum of

i) $x_1(n) = a^n\, u(n)$ and $x_2(n) = u(-n)$

ii) $x(n) = \left(\frac{1}{2}\right)^n$[u(n)-u(n-3)] & h(n)= $\left(\frac{1}{3}\right)^n$[u(n+1)-u(n-2)]

iii) $x(n) = (\alpha)^n$[u(n)] & h(n)= $(\beta)^n$[u(n)] ; $|\alpha| < 1, |\beta| < 1$

iv) $x(n) = (a)^{|n|}$, $0 < a < 1$ & h(n)= u(n+2)

(v) $x(n) = u(n+1) - u(n-3)$ & $h(n) = u(n) - u(n-3)$

6. Determine the output of an LTI system for an

i) $x(t) = u(t) - u(t-2)$ and $h(t) = u(t) - u(t-2)$

ii) $x(t) = e^{-3t}[u(t) - u(t-2)]$ and $h(t) = e^{-t}u(t)$

iii) x(t) = u(t) - u(t - 2) and h(t) = t[u(t) - u(t - 4)]

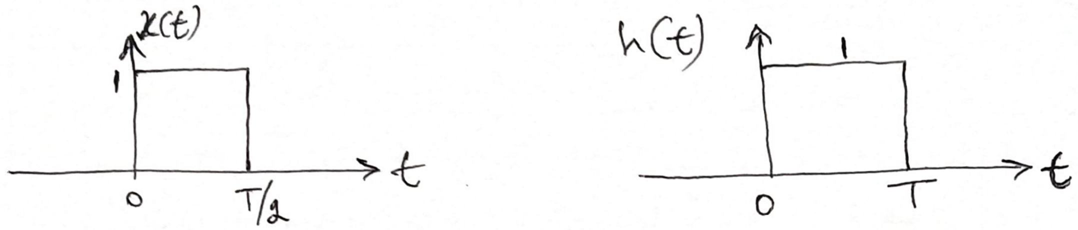
iv) $x(t) = e^{-3t}[u(t)]$ and h(t) = u(t+2)

7. Show that convolution is Commutative, Associative & Distributive for Convolution Integral

8. Find $x_1(t) * x_2(t)$ if $x_1(t) = \begin{cases} 1; & 0 \le t \le 2 \\ 0; & otherwise \end{cases}$ $x_2(t) = \begin{cases} t; & 0 \le t \le 1 \\ 0; & otherwise \end{cases}$

9. Find Convolution of :

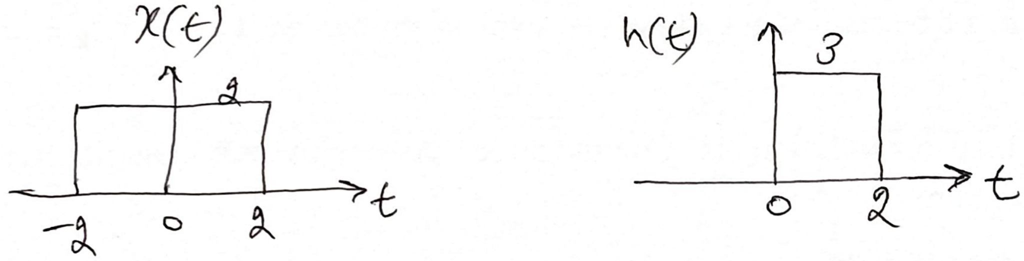
a)



b) $x(n) = 2\delta(n) + 3\delta(n-1) + 4\delta(n-2)$

$h(n) = 2u(n) + 3u(n-1)$

c)



d) $x(n) = (1/3)^n u(n)$ & $h(n) = u(n) - u(n-5)$

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

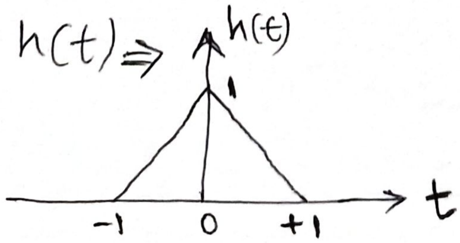
f) $x(t) = 2[u(t) - u(t-1)]$ & $h(t) = 2[u(t) - u(t-1)]$

g) $x(n) = \beta^n u(n)$ with $|\beta| < 1$ & $h(n) = u(n-3)$

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

(i) $x(t) = \delta(t-1) + \delta(t-2) + \delta(t-3)$

& $h(t) \Rightarrow$



Course Incharge

K. S. SCHOOL OF ENGINEERING AND MANAGEMENT, BENGALURU - 560109

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SESSION: 2021-2022 (EVEN SEMESTER)

QUESTION BANK-MODULE-3

Academic Year	2021-2022		
Batch	2020-2024		
Year/Semester/section	II/IV/A		
Subject Code-Title	18EC45 – Signals & Systems		
Name of the Faculty	Mr. DILEEP J	Department	ECE

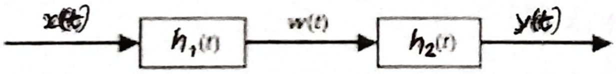
1. Determine whether the following LTI system is memoryless, causal, stable.
A) $h(t)=\cos(\pi t)u(t)$ B) $h(t) = e^{-2|t|}$ C) $h(t) = e^{2t}u(t-1)$
D) $h(n) = 2^n u(n-1)$ E) $h(n)=\left(\frac{1}{2}\right)^n [u(n+3)-u(n-3)]$

2. Obtain step response of LTI system having impulse response

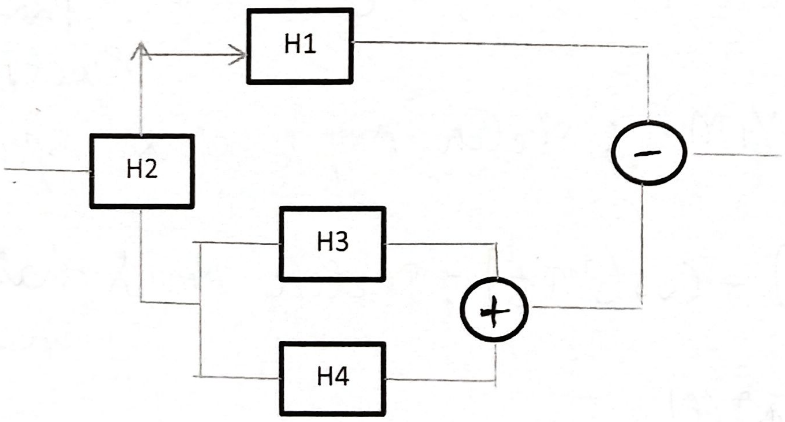
a) $h(t) = t^2 u(t)$ b) $h(t) = u(t-1) + u(t+1)$

b) $h(n) = \left(\frac{2}{3}\right)^n [u(n-2)]$ d) $h(n) = 0.25^{|n|}$

3. The system shown below is formed by connecting two systems in cascade. Impulse responses of systems are given by $h_1(t)$ = e^{-2t} u(t) and $h_2(t)$ = $2e^{-t}u(t)$. Determine the overall impulse response of the system.



4. Find overall Impulse response of a system described by



H1= 2u(n)+3u(n-2)

H2 = 2 u(n+2)

H3= δ(n)+0.5δ(n-1)

H4= 4δ(n-2)

5. Check for causality, stability and memory for $h(t) = e^{-2t}u(t-1)$

6. Find step response for $h(n) = \left(\frac{1}{3}\right)^n [u(n+2)]$

7. Check for causality, stability and memory for

i) $h(n) = \sin \pi n + \delta(n)$

ii) $h(t) = t\,u(t)$

iii) $h(t) = e^{-|t-2|}$

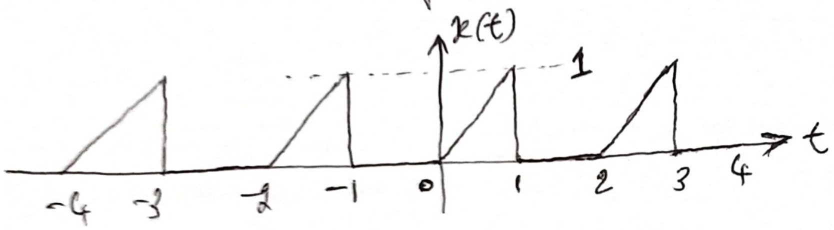
iv) $h(n) = \{\, 2, \underset{\uparrow}{1}, -1, 3 \,\}$

8. Find step response for $h(t) = te^{-at}\,u(t)$

9. $h(n) = \delta(n) + 4\delta(n-2) + 3\,\delta(n-3)$; Find the output y(n) of the system for the input $x(n) = u(n) - 2u(n-2) + u(n-4)$. Sketch x(n), h(n) and y(n) & Verify whether system is causal, memory and stable.

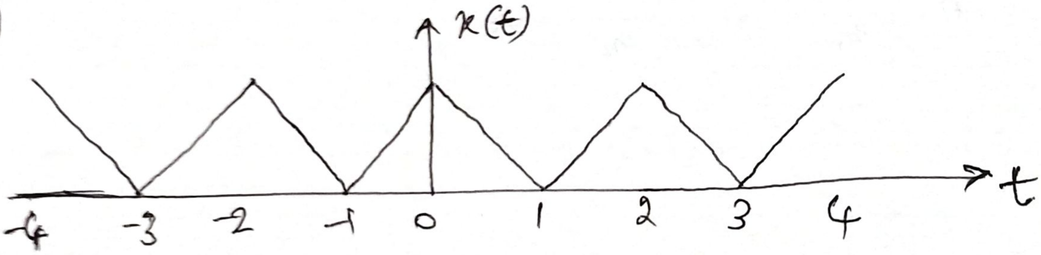
10. Find Fourier Series of :

a)



Plot Amplitude spectrum.

b)

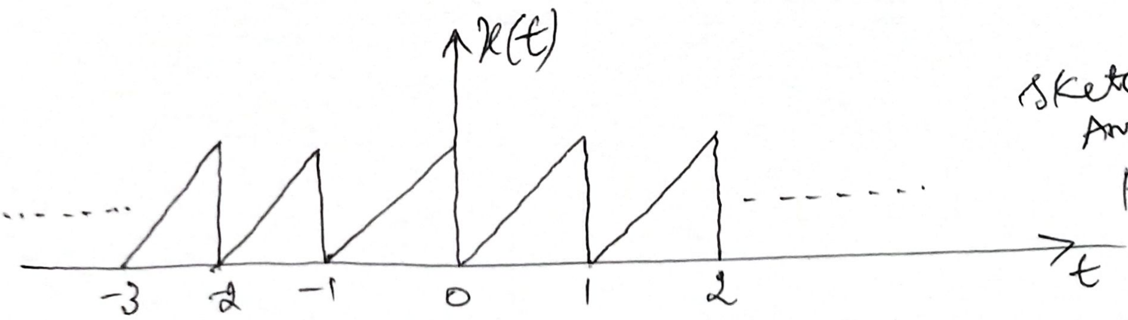


Plot Amplitude & Phase Spectra

c) $x(t) = \sum_{m=-\infty}^{\infty} \delta(t - \frac{1}{2}m)$; Sketch Amp & phase Spectra

d) $x(t) = \sin(2\pi t) + \cos(3\pi t)$; Sketch Amp & phase Spectra.

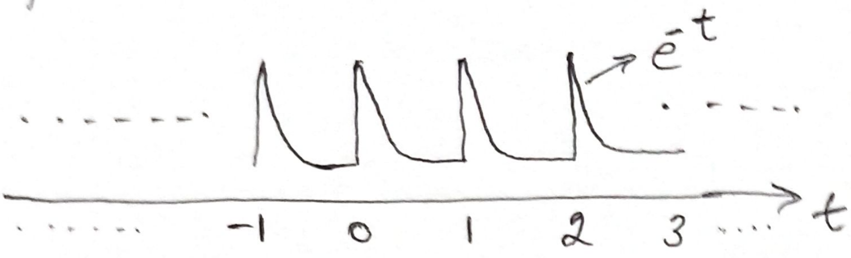
e)



Sketch Amp & phase spectra

(11) Compute Fourier Series of.

a)



$x(t) = e^{-t}$

b) $x(t) = 2\sin(2\pi t - 3) + \sin(6\pi t)$

(12) prove following properties of Fourier Series.

a) Time shift property

b) parsvel's theorem

c) Convolution

(13) Find Fourier Series representation for discrete time signal.

$$x(n) = 1 + \sin(0.25\pi n) + 3\cos(0.25\pi n) + \cos(0.5\pi n + 0.5\pi)$$

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K. S. SCHOOL OF ENGINEERING AND MANAGEMENT, BENGALURU - 560109

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SESSION: 2021-2022 (EVEN SEMESTER)

QUESTION BANK-MODULE-4

Academic Year	2021-2022		
Batch	2020-2024		
Year/Semester/section	II/IV/A		
Subject Code-Title	18EC45 – Signals & Systems		
Name of the Faculty	Mr. DILEEP J	Department	ECE

1. Obtain Fourier Transform of following and obtain magnitude and phase spectrum
   i) $x(t) = e^{-at}u(t)$; $a > 0$
   ii) $x(t) = e^{-3t}u(t-1)$

2. Find Fourier Transform using Appropriate Properties

$$x(t) = \frac{d}{dt}(te^{-2t}sint\, u(t))$$

3. Find the Inverse Fourier transform of : $X(jw) = \frac{5jw+12}{((jw)^2+5jw+6)}$

4. Find DTFT of the signal x(n)={1,3,$\underset{\uparrow}{5}$,3,1} and evaluate $X(e^{j\Omega}) at\ \Omega = 0$

5. Prove Time Shift, Convolution, Frequency Differentiation and Parsvel's Theorem for Fourier transform (FT)

6. Prove Linearity, Frequency Shift, Modulation, Time Differentiation properties of Fourier transform (FT)

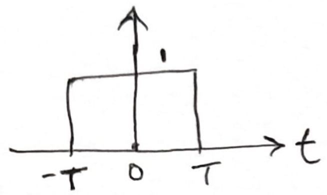
7. Find fourier transform for
   i) x(t) = u(t)
   ii) x(t) = δ(t)

8. Find fourier transform of signum function (x(t) = sgn(t)) and draw the magnitude and phase spectrum.

9. Prove Time Shift, Convolution, Frequency Differentiation and Parsvel's Theorem for Fourier transform (DTFT)

10. Prove Linearity, Frequency Shift, Modulation, Time Differentiation properties of Fourier transform (DTFT)

(11) Determine FT & draw the spectrum



(12) $X(j\omega) = \dfrac{j\omega}{-\omega^2 + 7j\omega + 6}$. Find Fourier Transform of

(i) $x(4t-8)$ (ii) $\int_{-\infty}^{t} x(\tau)\, d\tau$ (iii) $e^{-j100t} x(t)$

(13) Find Inverse FT. $X(j\omega) = \dfrac{j\omega}{(2+j\omega)^2}$

(14) Find DTFT of: a) $x(n) = \alpha^n u(n)$; $|\alpha| < 1$

& Draw Magnitude spectrum

b) $x(n) = a^{|n|}$; $|a| < 1$

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

(15) Find DTFT of following sequences.

i) $x(n) = n\,(0.5)^n u(n)$ (ii) $x(n) = \left(\frac{1}{4}\right)^n u(n-4)$

(iii) $x(n) = \left(\frac{1}{4}\right)^n u(n) * \left(\frac{1}{3}\right)^n u(n)$

(iv) $y(n) = (1 + \cos n\pi)\, x(n)$ (v) $y(n) = (-1)^n x(n)$

(16) Find Inverse DTFT of $X(e^{j\Omega}) = \dfrac{6}{e^{-j2\Omega} - 5e^{-j\Omega} + 6}$

(17) Find Fourier Transform for

i) $g(t) = e^{-a|t|}$

ii) $x(t) = 1 - |t|$ for $-1 < t < +1$

18) The o/p of a Continuous time system is $y(t) = 2e^{-3t}u(t)$ for the input system $x(t) = e^{-2t}u(t)$. Find frequency response & impulse response of the system. Find the energy for both i/p & o/p sig's.

(19) Find Inverse DTFT of $X(e^{j\Omega}) = (1+\cos\Omega)e^{-j2\Omega}$

20) Find Inverse Fourier Tranform :

(i) $$X(j\omega) = \frac{5(1+j\omega)}{6+5j\omega-\omega^2}$$

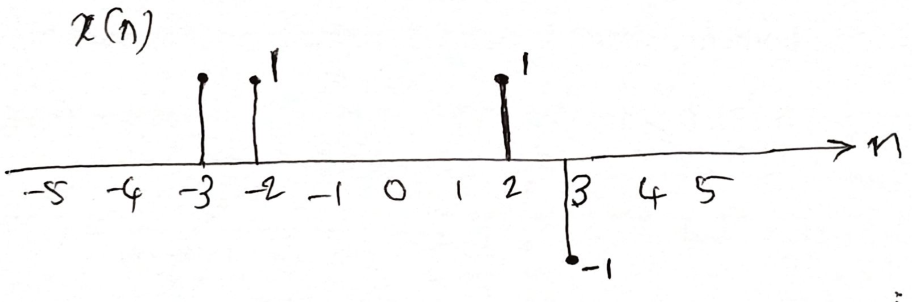
(ii) $$X(j\omega) = \frac{5+j\omega}{6+j\omega}$$

21) Find DTFT of (i) $x(n) = \left(\frac{1}{2}\right)^n u(n) - \left(\frac{1}{3}\right)^n u(-n-3)$

(ii) $x(n) = u(n) - u(n-6)$

(iii) $x(n) = -a^n u(-n-1)$

22) Find DTFT of The signal shown



23) Find Inverse DTFT of $$X(e^{j\Omega}) = \frac{\frac{5}{6}e^{-j\Omega}+5}{1+\frac{1}{6}e^{-j\Omega}-\frac{1}{6}e^{-j2\Omega}}$$

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K. S. SCHOOL OF ENGINEERING AND MANAGEMENT, BENGALURU - 560109

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SESSION: 2021-2022 (EVEN SEMESTER)

QUESTION BANK-MODULE-5

Academic Year	2021-2022		
Batch	2020-2024		
Year/Semester/section	II/IV/A		
Subject Code-Title	18EC45 – Signals & Systems		
Name of the Faculty	Mr. DILEEP J	Department	ECE

1. What is ROC in Z-Transformation? Prove all the 5 Properties of ROC with one numerical example each
2. Prove Linearity, Scaling, Convolution, Time Shift, Time Reversal & Differentiation properties of Z-Transformation
3. Find the Z-Transformation of
   i) $x(n) = n^2(3)^n[\mathrm{u(n)}]$
   ii) $x(n) = (n+3)^2\left(\frac{1}{2}\right)^{n+3}[\mathrm{u(n+3)}]$
   iii) $x(n) = n\,(\sin\frac{\pi}{2}n)\,[\mathrm{u(n)}]$
   iv) $x(n) = n\,(\cos\frac{\pi}{2}n)\,[\mathrm{u(-\,n)}]$ (v) $x(n) = [\sin \Omega n]\, u(n)$
4. Using power series or long division method, find inverse Z transform of
   i) $X(z) = \frac{z}{(2z^2-3z+1)}$ for ROC $|z| < 0.5$
5. Find Inverse Z transform using partial fraction method
   i) $X(z) = \frac{4+2z^{-1}}{(4-z^{-1})(2-z^{-1})(1-z^{-1})}$ for ROC $|z| < 0.25,\ 0.5 < |z| < 1$
   ii) $X(z) = \frac{\frac{1}{4}z^{-1}}{(1-\frac{1}{2}z^{-1})(1-\frac{1}{4}z^{-1})}$ for ROC $|z| > 0.5,\ 0.25 < |z| < 0.5$
6. A system has impulse response h(n)=$(0.5)^n u(n)$. Determine the input to the system if the output is given by $y(n) = \frac{1}{3}u(n) + \frac{2}{3}\left(\frac{-1}{2}\right)^n u(n)$

7. Find i) Transform function ii) impulse response iii) Step response for the equation y(n) + 3y(n-1) + 2y(n-2) = 6x(n)

8. Find the impulse response for the following difference equation:

i) y(n) – 4y(n-1) + 3y(n-2) = x(n) + 2x(n-1)
ii) y(n) = 0.7y(n-1) – 0.12y(n-2) + x(n-1) + x(n-2)

9. Find convolution using Z- transformation : $x_1(n) = n(0.5)^n$ u(n)

$x_2(n) = (-3)^n$ u(- n - 1)

10. Find Convolution using Z- transformation: $x_1(n) = \{2,1,-2\}$

$x_2(n) = \{1, \underset{\uparrow}{2}, 1,\}$

11. $Find\ x(n)\ for\ X(z) = \frac{2z^2+3z}{(z+2)(z-3)(z+4)}$ for ROC $|z| < 2,\ 3 < |z| < 4$

12. $Find\ x(n)\ using\ power\ series\ method\ for\ X(z) = \log(1 + az^{-1})$

$|z| > 0$

13. Find Z-Transform of (i) $x(n) = -a^n u(-n-1)$

(ii) $x(n) = \left(\frac{1}{3}\right)^n \sin\left(\frac{\pi}{4}\right)n\ u(n)$

(iii) $x(n) = a^{n-1}\ u(n-1)$

(iv) $x(n) = n\left(\frac{5}{8}\right)^n u(n)$

(v) $x(n) = (0.9)^n u(n) * (0.6)^n u(n)$

(vi) $x(n) = n(n+1)u(n)$

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

14. Find IZT

(i) $X(Z) = \frac{Z(Z^2-4Z+5)}{(Z-3)(Z^2-3Z+2)}$

(ii) $X(Z) = \frac{1}{1-1.5Z^{-1}+0.5Z^{-2}}$

(iii) $X(Z) = \frac{Z^2}{(Z+1/2)(Z-3)^2}$

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