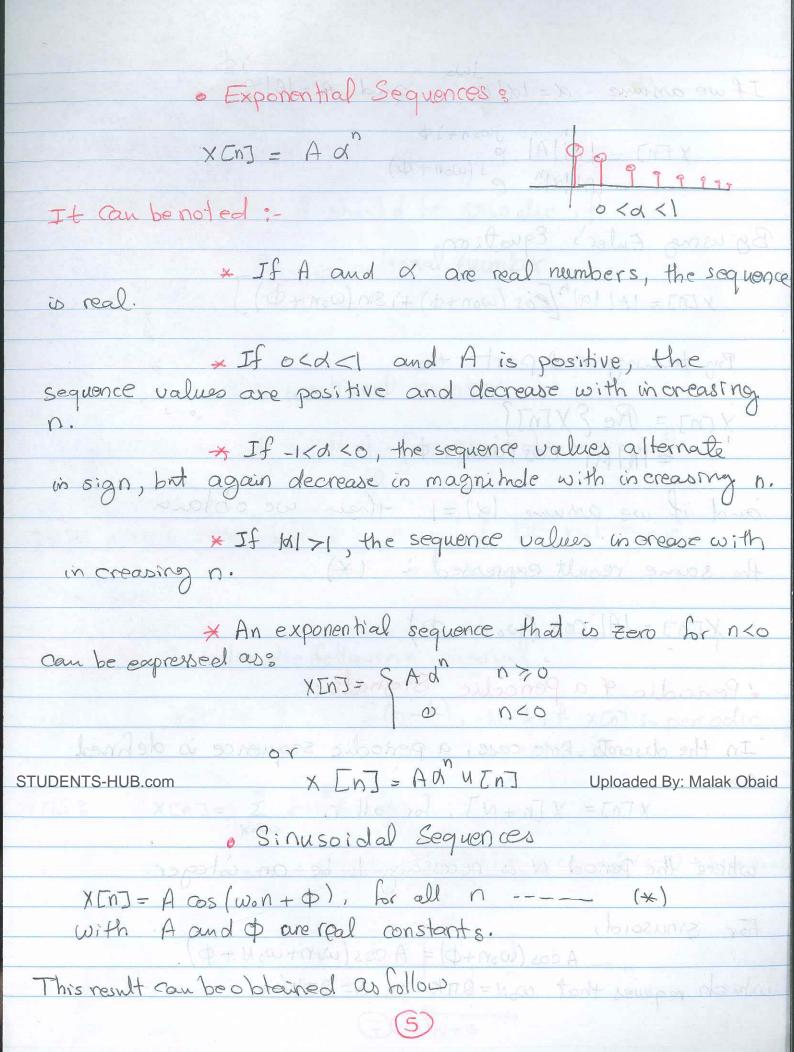
Queun Has Chapter Two: Discrete L. Time Signals and System + Andog Signals; both time and amplibude Inhoduction: · Signals : can be defined as me 1. A flow of information. aways on one a function of independent variable such as timel e.g: speech signal), position legi mage , etc. · Examples of signals: · Speech: 1-Dimension signal as a function of time s(t). · Grey-Scale mage : 2-Dimension signal es a function of space (crx) · Video: 3x3-Dimension signal as a function of space and time gr(x,y,+),g(x,y,+),b(x,y,+)} STUDENTS HUB Com ignals: Uploaded By: Malak Obaid The independent variable may be either continuous 2) or discret 9 mon pos no be \* Continuous - time signal low medonal mont or dot Discrete-time signals: are defined at discrete times and represented as a sequences of numbers.

or discrete \* Analog Signals: both time and amplitude are con knows. are continuous. Analog Signals: both time and amplitude XHI) Digital Signals: both are discrete. Sampled Discret-time signal a largiz moissemine some das Digital Signal had as a function signal as a him chion Sampled Sound Arms grant, promision signal as a limber STUDENTS-HUBSchml Signal Processing: Uploaded By: Malak Obaid with computers - So being measured as sequence of numbers. manipulation of signals and information, they contain.

Typical DSP System Components of Analog to Digital Converter Digital to Analog Convertor 0 + 0 (DAC) (ADC) X [n] = X (nT) · Discrete Signals and MXE-13 XEO? XIDIN & toll alow X Enj = X (nT) -0 < n < 00 where n is an integer of D. [8+1] X [2] T is called the sampling Period. EX-UJS[4]X S = [WIX Sequence Operations: 100 DD The product and sum of two sequences Y[n] and YEn]: Sampled - by - Sampland production and sum, respectively Multiplication of a sequence x [n] by a number multiplication of each sample value. STUDENTS-HUB.com . Delay or shift of a sequence X In Uploaded By: Malak Obaid y [n] = x [n-no] where n is an integer.

Basic Sequences: 1990
* Unit Sample sequence (Discrete-time empulse)
etrovad SEnje getipid n= o retrovad le senje golana
SEn Ja
(040) $0$ $0$ $0$ $0$ $0$ $0$ $0$ $0$ $0$ $0$
$(TN) \times = Cn \square \times$
Note that so Any sequence can be represented as a sum
of scaled, delayed impulses.
E evample:
Y 5-7 - 0 5 5 n + 27 + 0 5 5 n + 37 + 2 - + a 5 5 n - 5 7
-3 -3
Note that so Any sequence can be represented as a sum of scaled, delayed impulses:  Tor example:  X [n] = a S [n+3] + a S [n+3] + + a S [n-5]  More genearly:
More genearly: $\chi[n] = \sum_{k=\infty}^{\infty} \chi[k] S[n-k]$
$\chi(n) = \langle \chi(r) \rangle \langle (n-r) \rangle$
SEN SILE STREET AND SEE.
Wil Stop Sequence:
and YEND: Sampled - by- Sampled production and sum, respectively.
U[n] = 9 1 nzo
reduning of the constant of th
make the most or at each sample value.
Also, it can be written in terms of impulse sequences,
STUDENTS-HUB.com [ATX 90 noupel a for Higher to the Uploaded By: Malak Obaid
U[n] = S[n] + S[n-1] + S[n-2] +
utnj= 5 utkj Stn-kj= 2 Stn-kj
V=0
Ke'a
Conversely,
S[n] = u[n] - u[n-1]



If we assume d= ldle and AzIAle X [n] = |a||A| p [won+i] By using Euler's Equation x [n] = IAL Ial (Eis (wonto) +) Sm (wonto) By taking real part them X[n] = Re {X[n]} and if we assume |x|=1 then we obtain the same result expressed in (x) XENJ= 1A1 cos (wont o) ladoscoxanA · Periodic & a Periodic Signals: In the discrete-time case, a periodic sequence is defined stupents-HUB.com Uploaded By: Mala Uploaded By: Malak Obaid X[n] = X[n+N], for all n where the period N is necessary to be an integer. For sinusoid, adoption la  $A \cos(\omega_0 n + \phi) = A \cos(\omega_0 n + \omega_0 N + \phi)$ which requires that cooN = 2TK or N= 2TK/WO

where K is an integer. length phrough aft rebread arrangement
Note that: (\$\phi + \alpha \omega) and A = [\alpha]x
Y The state of the
The sian Dale Hollan out and a Draw from
. The signal should be priodic if
11 DT Sonal humber
K w rational number. Tox 77
DON'T
H = 1 = 1 = 1 = 1 = 1 = 1 = 1 = 1 = 1 =
otherwise Wirational number
M: irrational number
=> The signal will be a periodic signal
=> The signal will be a periodic signal
Cotos of I reduct I had to
Take care: N and k should be integer  numbers.
Restroy & Manual IVI Could be a second of
number(3.9)
I NIVAL X
Example: Consider the following signal
Example: Consider the following signal  X[n] = \( \frac{\tangle}{-11} \) \( \frac{\tangle}{\tangle} \), \( \text{heck} \) \( \frac{\tangle}{-1} \) \( \text{speriodic} \)
Example: Consider the following signal  X[n] = \( \frac{\tangle}{(-1)} \) S(n-k), check it x(n) is periodic  K=\( \text{or not} ?\)
Example: Consider the following signal  X[n] = \( \frac{\tau}{\tau} \) (-1) \( \frac{\tau}{\tau} \), \( \text{heck if } \tau \) (n) \( \text{is periodic} \)  STUDENTS-HUB.com  Definition of \( \frac{\tau}{\tau} \)  Uploaded By: Malak Obaid
Example: Consider the following signal $X[n] = \sum_{k=\infty}^{\infty} (-1) S(n-k)$ , check if $X(n)$ is periodic or not?  STUDENTS-HUB.com  Ans: $X[n] = \sum_{k=\infty}^{\infty} (-1)^k S(n-k)$ Uploaded By: Malak Obaid $X[n] = \sum_{k=\infty}^{\infty} (-1)^k S(n-k)$
Example: Consider the following signal  X[n] = \( \frac{\tau}{\tau} \) (-1) \( \frac{\tau}{\tau} \), \( \text{heck if } \tau \) (n) \( \text{is periodic} \)  STUDENTS-HUB.com  Definition of \( \frac{\tau}{\tau} \)  Uploaded By: Malak Obaid
Example: Consider the following signal $X[n] = \sum_{k=\infty}^{\infty} (-1) S(n-k)$ , check if $X(n)$ is periodic or not?  STUDENTS-HUB.com  Ans: $X[n] = \sum_{k=\infty}^{\infty} (-1)^k S(n-k)$ Uploaded By: Malak Obaid $X[n] = \sum_{k=\infty}^{\infty} (-1)^k S(n-k)$
Example: Consider the following signal  X[n] = \( \frac{1}{2} \) \( (-1) \) \( \frac{1}{2} \) \( (n-k) \), \( \text{check if } \) \( \text{X(n)} \) is periodic  \[ \text{STUDENTS-HUB.com} \\ \text{Ans:} \( \text{X[n]} = \text{\textsuperiodic} \) \( \text{V=00} \)  \[ \text{V=00} \]
Example: Consider the following signal $X[n] = \sum_{k=\infty}^{\infty} (-1) S(n-k)$ , check if $X(n)$ is periodic $X[n] = \sum_{k=\infty}^{\infty} (-1) S(n-k)$ , where $X(n)$ is periodic $X[n] = \sum_{k=\infty}^{\infty} (-1)^k S(n-k)$
Example: Consider the following signal $X[n] = \sum_{k=\infty}^{\infty} (-1) S(n-k)$ , check if $X(n)$ is periodic $X[n] = \sum_{k=\infty}^{\infty} (-1) S(n-k)$ , where $X(n)$ is periodic $X[n] = \sum_{k=\infty}^{\infty} (-1)^k S(n-k)$
Example: Consider the following signal $X[n] = \sum_{k=\infty}^{\infty} (-1) S(n-k)$ , check if $X(n)$ is periodic $X[n] = \sum_{k=\infty}^{\infty} (-1) S(n-k)$ , where $X(n)$ is periodic $X[n] = \sum_{k=\infty}^{\infty} (-1)^k S(n-k)$
Example: Consider the following signal $X[n] = \sum_{k=\infty}^{\infty} (-1) S(n-k)$ , check if $x(n)$ is periodic $X[n] = \sum_{k=\infty}^{\infty} (-1) S(n-k)$ , where $X[n]$ is periodic $X[n] = \sum_{k=\infty}^{\infty} (-1)^k S(n-k)$

Examples Consider the following signal X[n] = A Sin (won+ Ф) check if XInj is periodic or not? Ans: If X [n] is periodic with fundamental period N WON= QTH, k=1,2,3, N = 2TT should be rational number If N is irrational number then X [n] is a periodic. · Rational Number ( Note 1 where 9 to) Finite fractional part Rational Number (N) could be -Infinite fractional part which is cyclic OR: ratio of two integer is always rational. STUDENTS-FUBLCOMO con honal number : Uploaded By: Malak Obaid

Example: Check the periodicity of each signal. In case of periodic signal, specify the value of k, and 1. X [n] = 3 cos(0.2 Tm) 11/12 W.O.17 Ans: X [n] = 3 cos (0.2 Tm) where wo = 0.2 The long of shoring of  $\frac{2}{K} = \frac{2\pi}{100} = \frac{2\pi}{0.2\pi} = \frac{10}{1000} \Rightarrow \text{ rational Number}$ where N=10 and K=1 => periodic a N=10 and where the hundamental period (nTE.0) nizz = [This x. ] Mr. May Nas ---- Mr. orespectively son x[n] = s Sin (0.3πn) where wo = 0.3 TI  $\Rightarrow \frac{N}{K} = \frac{2\pi}{0.3 \, \text{TT}} = \frac{20}{3} \Rightarrow \text{ rational number}$   $\text{periodic } \Rightarrow \text{N=20 and } \text{K=3}$ Notego STUDENTS-HUB.com If we assume  $k=1 \Rightarrow N = \frac{20}{30}$  Uplobated Byi Majak Obaid If we assume K=2,  $\Rightarrow N=\frac{40}{3}$  (Not integer humber) If we assume K=3,  $\Rightarrow$  N=20 (K and N

9

/ are integer)

Remember: For periodic signal K and N shoulded be integer Numbers 3. X[n] = 4 cos (0.5 n) Ans: X[n] = 4 cos (o.5n) where we = 0.5 abone od lin [mx lange of  $\Rightarrow \frac{N}{K} = \frac{2\pi}{\omega_0} = \frac{2\pi}{0.5} = 4\pi \Rightarrow \text{ wrational number}$ >> X [n] is a periodic Signal . OF = TATEX 4. X[n] = 8 Sin (T, n) 9 01 - [n] X w  $X[n] = 8 \sin \left(\frac{\pi}{\sqrt{2}}n\right)$ where  $\omega_0 = \frac{\pi}{\sqrt{2}} (\pi 1.1) \alpha 12 L + (\pi 1.1) 100 = 9$  $\Rightarrow N = \frac{2\pi}{K} = \frac{2\pi}{W_0} = \frac{2\pi}{T/\sqrt{2}} = 2\sqrt{2} \Rightarrow irrahonal number$ STUDENTS-HUBROOM X [n] is a periodic signal. Uploaded By: Malak Obaid 5- X [n] = 10 ely Borners schong a toxix Ans: -j1.1 TT n

where XINJ can be written in form bones not and many of X [n] = A e 6 X [M] = 4 cos (0.5 M) ⇒ wo= 1.1 TT N = 27 = 27 (=120 200 H = [N]X The signal XINJ will be periodic signal when K=11 and N=20. = N = 2π = 2π = 4π = mational rumber κ ων κ (1-n) πι·ιί-6. X [n] = 10. engil siboned to di [n] X/ Ans:  $w_1 = 8 \sin\left(\frac{\omega}{4}v\right)$ where  $e = \cos(1.1\pi) + i\sin(1.1\pi) \quad \pi = 000 \quad \text{such the }$ Word 1.1 The Form of the Part of the Sound STUDENTS-HUB.com  $2\pi$  =  $\frac{20}{K}$  = rational number Uploaded By: Malak Obaid XIMI is periodic signal a N=20 and k=11

-11.17 (n-1) Examples (head the (1-1) at the of a summer -)1·17 (n-1) X[n] = 10 @ u(n-1) X [n] = 3 cos (0.2 Mn) KINJ is a periodic Signal. The - we make · Periodicity of Composite Signal: X[n] = X,[n] + Xa[n] + X3[n]+----+ where the hundamental period for each signal is NI, N2, N3, ----, NK, respectively. XENT = S SIN (0.3 TIN) N = 2.7 = 2.0 = regional number periodica vessional k STUDENTS-HUB.com mumber) If WE assume K=2, = N= 49 (Not integer If we assume K= 3, = N=20 (K and N cure integer)

Example: Check the periodicity of each signal. In case of periodic signal, specify the values of k, and N 1. X[n] = 4 cos (0.211n) - 3 sin (0.311n) + 5 cos (0.411n) Ans: X [n+N] = X [n] He = (Y (3.8) MOL = M 0.2TN = 27 K, NI = 2 NI 2002 10: NIE 10 = and XK = 18 STOTING PAKE 0.3 Th No = 12 Th kg

No = 120 | = 10 And = 10Reduced the second of = 10Reduced the s aporto die signal and MEN & Remoid subchas A & 0.41/ N3 = 0 21/ k3 + MT. P.O 200 0 - MT. 1.0200 01 = [10] X H  $N_3 = 2 = 20/= 5 \Rightarrow N_3 = 5 \text{ and } k_3 = 1$ Constant . 2. saborraq salooning STUDENTS-HUB.com Uploaded By: Malak Obaid and other services  $X = 3 \sin \left(\frac{\pi}{4}n\right) + 5 \cos \left(\frac{\pi}{3}n\right) - 7 \sin \left(\frac{\pi}{2}n\right)$ #N=27k1=> N1=8 and K1=1  $\frac{\pi}{3}N_2 = 2\pi k_2 \implies N_2 = 6 \implies N_2 = 6$  and  $k_2 = 1$ 

Example: Check the periodicity of each signal: AIR Greek III.

Periodic signal, epecify the values of 10 and N

N3 - 4 - N3 = 4 and K3 = 1 (UIL X [U] = H COS (O. FLU) - 8 STU (O. 8 LU) + 2 COS ENTA) N = LCM (8,6,4) = 24 ENJX : [N+N]X :8MA 3.= > | X[n] = 2 cos: (\[ \frac{7}{2} \] \[ \text{In} \] + 5 Sin 2\[ \frac{7}{2} \] \[ \text{In} \] V2 1/N, = 21/k, 2/21/N2 = 27/k2 E = 5 1 Klond 100 millional number: K2 V2 E irraking number aporio dic signal -> A periodic Signal 4. X[n] = 10 cos 0.1 Tin - 6 cos 0.9 Tin + 5 sm 0.7 m 1110 0.1 \$\frac{1}{1} = 2\frac{1}{1} \frac{1}{1} = 2\frac{1}{1} \frac^{1} = 2\frac{1}{1} \frac{1}{1} = 2\frac{1}{1} \frac{1}{1} = 2\fr  $\frac{N_1}{K_1} = \frac{2}{2} = \frac{20}{100} \quad \frac{N_2}{M_1} = \frac{2}{9} = \frac{20}{9} \quad \frac{N_3}{K_7} = \frac{2\pi}{0.7}$ Periodic periodic irrational Uploade**d Byd Mal**ak Obaid STUDENTS-HUB.com . a periodic (NI) 0:2 F-(NI) 200 Z + (NI) 0:28 = FNJX

> A periodic Signal

| = 12| K = 8 = M = 8 = M = 12 7 N = 2 t K2 = N2 = 6 => N5 = 6 . and K2 = 1

Discrete - time Systems progon produced a
A transformation or operator that maps input into output
con be expressed as tructure provides no ai so mando
In other words, scalling the this by should be admired
Myd + (Myo = [XEN]] = TENJX d + CMX o ? T
$CT\{X_3[GI]\} = CY_3[GI]$
. Examples on Discrete-time Systems
Control of the second s
a white meters The lideal delay system when : elamox 3
defined by the following in pit - Output equation
defined by the following in pat- Output equations  y[n] = X[n-nd] x = [n]y
A memory less system
The state of the s
check top n >0 - 1 track of track pre- track
Properties of Discrete-time Systems  STUDENTS-HUB.com  Uploaded By: Malak Obaid
· Properties of Discrete-time Systems
/ 31 - 1 - A - A - A - A - A - A - A - A -
1. Linear and Non-Linear System
LA FORT & PORT & PORT A KALED F COLLEGE
A system is linear if and only if the following properties are
achieved:
@ additivity property
Standard of the constant of the
T { X, [n] + X2 [n] } = T { X, [n] } T + { (n] , X } T = [ (n] _ X + [n] _ X ] T

(b) Scaling Property 20001216 smit - 9+372219
Tfaxtmili= autofx[n]=1949 EnJogo 20 noil provod aport A
where a is an arbitrary constant 20 bessenges and not
In other words, scaling and additioning should be achieved as
T a x, [n] + b x [n] = a ( / [n] + a ( / x2[n]) = a y, [n] + by [n]
$CT[X_s[n]] = cy_3[n]$
Examples on Discrete time Systems
Example: Consider the following accumulator system which is defined by the following input-Output equation  yend = \( \frac{2}{2} \times \tau_k \)
check the linearity of the System
Ans: dy, [n] = 2 d, x, [k]  k=intend omit -stance to esiting of
STUDENTS-HUR com [n] = \(\frac{5}{2} \text{ At } \text{ [h]}\)  Uploaded By: Malak Oba
$A, y, [n] + A_2 y_2 [n] = \sum_{k=0}^{\infty} [A, X, [k] + A_2 X_2 [k]]$
day Ja [n] day Xa [k] housing
> The System is linear

(6)

Example: Consider the system defined by The system is time-variant WENT = log (IXENTI) and check the linearity of the system. much religion religion Ans: 0, WIEN] = 10910 (10, X, EN) TrudzwzEnJ = 109 ( (dz XzEnJ)) - and a metale elt ti head a, w, [n] + d2 w2 [n] = 109,0 (1d, X, En71) + 109,0 (1d2 X2 [n]) # 109 ( /d3 0 [n] 1) = d3 W3 [n] 109 ( | d1 X1 EN] + d2 X2 EN] ) X2 [K] " Delay of the orpud The system is Non-linear. I [n-no] = 4 [n-no] = The sustem is time invariant. 2. Time-invariant Systems · For which a time shift or delay of the coput sequence causes a corresponding shift in the output sequence STUDENTS, HUB. compressor system which land ded to Malak Obaid by the relation y [n] = X [Mn] check if the system is time-invariant or time-variant time shift" Y, [n-no] = X, [M[n-no]] D Ya [n-no] = Xa [Mn-no] Delay of the cirput sequence

Since y, [n-no] + yol[n+no] refere out relocated asolgmon
=> The system is time-variant
(ItaxI) pol = [xau ]
Example: Consider accumulator system which is defined by
y [n] = Z x [k] :3MA
Sent K= io ( and X , X , X ) pol & [ and w )
check if the system is time-invariant or stime-variant
d, with 1 + downth = 109 on (do x [m]) + [0] () do x [m])
Ans:   y [n-no] = Z X [k] "Time shift"  (I [n] =
= do Wo [M] (   do
Yz [n-no] = Z Xz [k] "Delay of the input  K= a room Sequence" and
K= a roomil -mov sequence"
⇒ Yı [n-no] = yo [n-no] > The system is time invariant.
2. Time-circumt Systems
3. Causal and Non-Causal System.
sequence causes a corresponding shift in the output sequence
The system will be rousal if the output sequence value
STUDENTS-HUB comy none depends on ly the one the first Juple aded By: Malak Obaid
STUDENTS-HUBICHEX n=no. depends only the on the inputus leaped pre-Malak Obaid
values for n <= no nother set yet
$\Im \operatorname{EnJ} = X \left[ \operatorname{MnJ} \right] = -\infty < n < \infty$
Example: The following system  thomas - amit y [n] = x [n-ha] / - ox (n < o
TOURSU-SMIT TO TOURSUND-SMIT GENTEX EN-NaTI TOURS NCO
will be :
will be ? "  Causal Not no >=0-07 !
ouper trade out to po Non-causal for and cold

Example: Consider the forward difference system defined by the	
retationship that does a sulou sting	
y Enj = X En+I] - X Enj	
check it the system is causal or non-causal	
take and the top in bounded in put there exist	
Ans: To check if the system is causal or non-causal.	
Assume n = 1	
output Future present value	
1 Present	
Value Tuture	
Example: Check the stability of the following systems	1
=> The system is non-causal	
S(to(X)) = to(Y)	
Example: Consider the backward difference system, defined as	
ANS: 14[m] = 1x[m] < B; < 00	
$V[n] = V[n] \times V[n]$	
check if the system is causal or non-causal 0878	
Ans: To check if the system is consal or non-causal.	
Assume n=1	
ANS: COJ X EIJ - X EOJ	
Output Present Paster 200 2017	
TUDENTS-HUB.com Value	aic
> causal System	
8. 2007 = 5 NEXT	
4. Stability	ے۔
clark it the system of great the delivers the	-172
· A system is stable in the bounded-input, bounded output (BIBO)	
sense it and only if every bounded input sequence produces a bounded	1
of Montput sequence (1+1) tent your of a sind of this or is part	

The input X [n] is bounded if there exists a fixed positive.
finite value Bx such that
For all n
check it the system is coused or non-coural
stability requires that, for every bounded in put, there exist
a fixed positive finite value By such as the body Time
Assume n=1
[1]   y [n]   By < 00 for all n
out put traver present
Example: Check the stability of the following systems
$  \cdot y   = (X   x)^2$
Example: Consider the backdard allfordige system, defined as
ANS:  y[n] =  x [n]   < Bx < 00
$\Box - N \exists \times - \Box \alpha^T \exists \times = f N \exists Y$
>> BIBO >> The system is stable
Ans: To check if the s(((n)x) gol = (n) by . Couses.
Assembly the Hard to the Mary Design of the Second
Ans: FOIX - CIIX = CIIY
The system is unstable since y [n] = -00
STUDENTS-HUB.com [n] = 0 . Uploaded By: Malak Obaid
maland lazur on the
3. y[n] = { U[x]
H. Stability nost
50000
sense it and only if every bounded input sequence produces a bounded
There is no finite choice for By such that (n+1) < By < 00 for all n's

thus the system is unstable. [IIX 3 = (max) T.

Examples. For each of the systems, determine whether the system is (1) stable, (2) causal, (3) linear, (4) time invariant, and (\*) memory  $(x, 0) \ge (x, 0) \ge (x, 0) = (x, 0)$ 

a. T(X[n]) = g[n] X[n] with g[n] is given.

The system will be non council in ourse of n>no 1. The system will be stable if 18 End (00 since 1x Cn) (M<00

2. The system is causal since the system depends on the present value of n. [30 XXX = COTIN A

3. The system is linear, becaus:

a, y, [n] = a, g [n] x, [n] ) = [m] x T h + [m] x T h d2 y2[n] 2 d2 9 En] X2[n] (1/4/2n] + 12 /2 En] = 9 En] (1/4 En] + d2 X2 En])

> asy[n] = g[n] as xs cn] 4. The system is kno-various since

> The sostem is linear

TIXMOOD = 5 X [E-NO] = 5 X [E) STUDENTISHUB govern is time variant, be cause:

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T[x(n-no)] = g[n] x [n-no]

(4) X C = [ ON-17 ] M. A.

trop ent # my [m-no] = 09 [n-no] x [n-no] moment in metale out

5. The ystem is Memorgles because

y [n] = T (x [n]) depends only on the nth value of x.

b. T(XCM) = \( \times X[k] \) thus the system is unstable. a my The system will be unstable when out to mos rot assignment (1) stable, (2) Causal. (3) Winear, (4) time invariant, and T(X[n]) | < [ | X[k] | < | (n-no) | M -> 00 (XTA) = 9 END XEND WITH 9 END is give 2. The system will be non caused in case of n>no The system will be stable it 18 [1] < 00 sing 1x (10) (M < 00) 3. The system is linear since 2. The system is causal since the system depends on the di y, [n] = Z x X, Ck] di T [X2[n]] = E d2 X2[k] sold. Repoll di motores est LITEXIENT] + do T [XI [N] = E (X, X, [N] + di XI[K]) 43 T [X3[n]] A3 X3 [n] MORX DE EDUNG TOTHER 4. The system is time-variant since  $T[X[n-no]] = \sum_{k=0}^{\infty} X[k-no] = \sum_{k=0}^{\infty} X[k]$  k=0 k=0 yUploaded By: Malak ObaidSTUDENTS-HUB.com # y [n-no] = 2 x [x] EN-MIX CNIR = k=no-mx 17 5. The system is Memory since it depends on the past value n>no. s. The yelem is Memorales because yas = T (xas) depends only on the nth value of x

C.  $T[XCnJ] = \sum_{k=n-n} x[k] [-n-n]x = (Em]x]T.$ The system is stable since of [xcn] | < 1200+1/14 < 00 BIBO. g. The system will be causal it noto, otherwis it is non-coursel 2. The System is Non-rausal since it depends on the future The onstern is linear since [1] x to sell 3. The system is linear since Lon-MIX 10 = (MIXX) To TON-MI X do = ( CMIX xx) T dit(x [m]) = [d, x, [k] lon-nd [en-nd x, b) = ([n] x do + [m] x p)  $T (d_2 X_2 [n]) = \sum_{k=n-no}^{n+no} d_2 X_2 [n]$   $k = n-no} \int_{n+no}^{n+no} (x_1 x_2 x_3 x_4 x_5) T$ T (d, X, En) + d2 X2 En) = E (d, X, En) + d2 X2 En)  $T \left( \alpha_3 \times_3 \text{EnJ} \right) = \sum_{k=n-n} \alpha_3 \times_3 \text{EnJ} = \left( \text{En-m} \times \right) T$ 4. The system is Time-invariant since Iliu moleno odt the system is memory.  $T(X[n-n_0]) = \sum_{k=n-n_0} X[k-n_0]$ STUDENTS-HUB.com = [ ( Conf) ] / [ R ] DO 10 y = [ A = n ] mot ago ant K= n-2n. a The onstem is causal. 5. The system is memory since it depends on different values of XINJ. T(ayxy) = C and T (axx, ca) =

C. T(X[n]) = X[n-n]X = ([n]X)T.O1. The system is stable since | T (x[n]) ≤ |X[n-no]| ≤ M (00 2. The system will be causal it no to, otherwis it is non-consal The system is Non-coursed orace 3. The oystem is linear since 3. The system is linear since [on-n] IX is = ([n] IX) T T (x2 X2[N]) = d2 X2 [n-no] T (a, X, [n] + d2 X2 [n]) = d, X, [n-no] + d2 X2 [n-no] T ( 03 X3 [n] ) = 03 X3 [n-no] [MJ(X, En] + do Xo [m] 4. The oystem is Time-invariant since T(X[n-nd]) = XEK-2no X[n-nd-no] = y[n-nd] 5. The system will be memoryles only it in =0, otherwise the system is memory. TORONO = (CON-DX) T E. T(x Cn) = exch] The system is stable since  $|T(xEnJ)| = |e| \le e < \infty$ 108-11 = A 2. The oystem is causal. 3. The system is non-linear since momen motive out .? and T (42 X, [n]) = e  $T(\alpha_1 X_1 D \overline{D}) = e$ 

d, X, [n] d2X2[n] > T(a, x, En] + d2 X2 [n]) = e motores of . T ( 03 X3 [N]) == 1.8 + 1.03 X3 [M] = 1.14 @ M = 1.14 @ M = 1.14 4. The system is Time-invariant since T(x [n-no]) = ex[n-no] = y [n-no]

T(x [n-no]) = ex[n-no]

T(x [n-no]) present value of XINJ.  $H \cdot T(X[n]) = X[n] + 3u[n+1]$ F. T (X[n]) = a x[n] + b 1. The system is stable since 1. The system is stable since |T(X [n]) |= |a x [n]+b|

1. The system is stable since |T(X [n]) |= |a x [n]+b| where a, and b are finite values. 2. The system is coursal. 8. The system is non-linear 3. The system is non linear 4. The system is time-invariant 4. The system is Time-variant since 5. The system is memoryless. STUDENTS-HUB.com G+ oT-(XEM) = - (X-E-M) X = - CON-N) N + 1. The system is stable since IT (X [n]) = |X [-n] | < M<00 2. The system is ausal

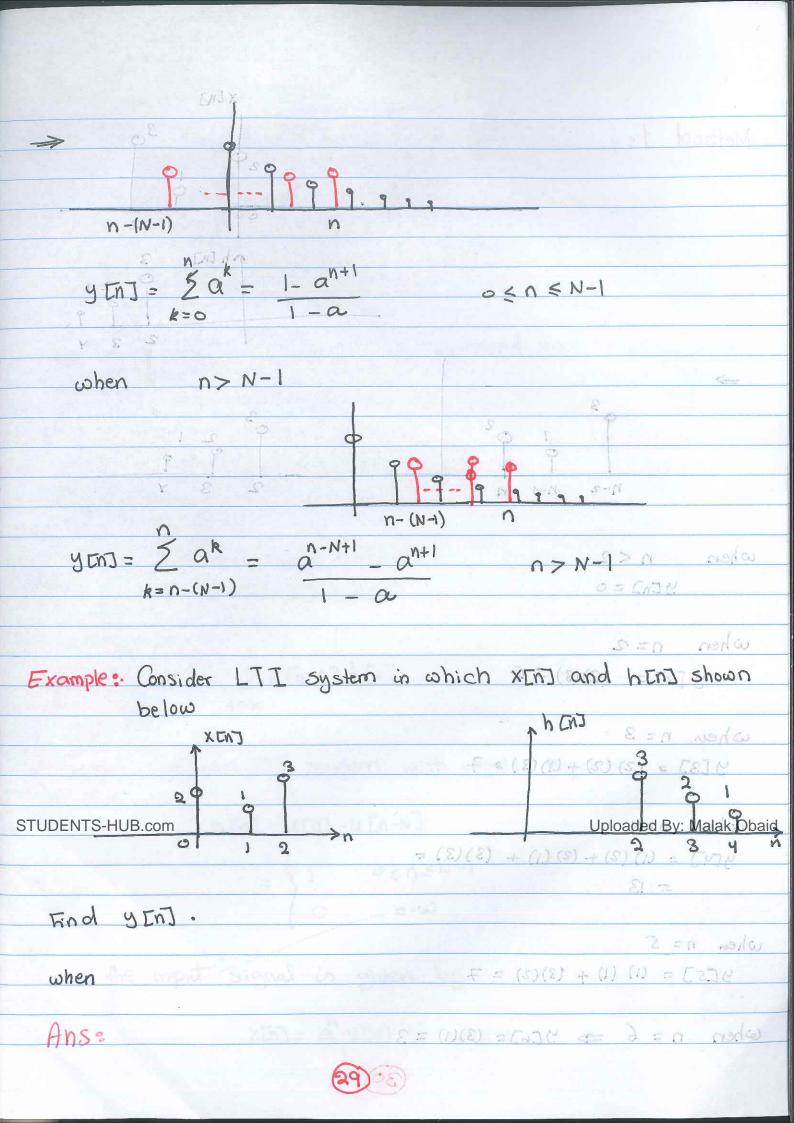
the system is ausal

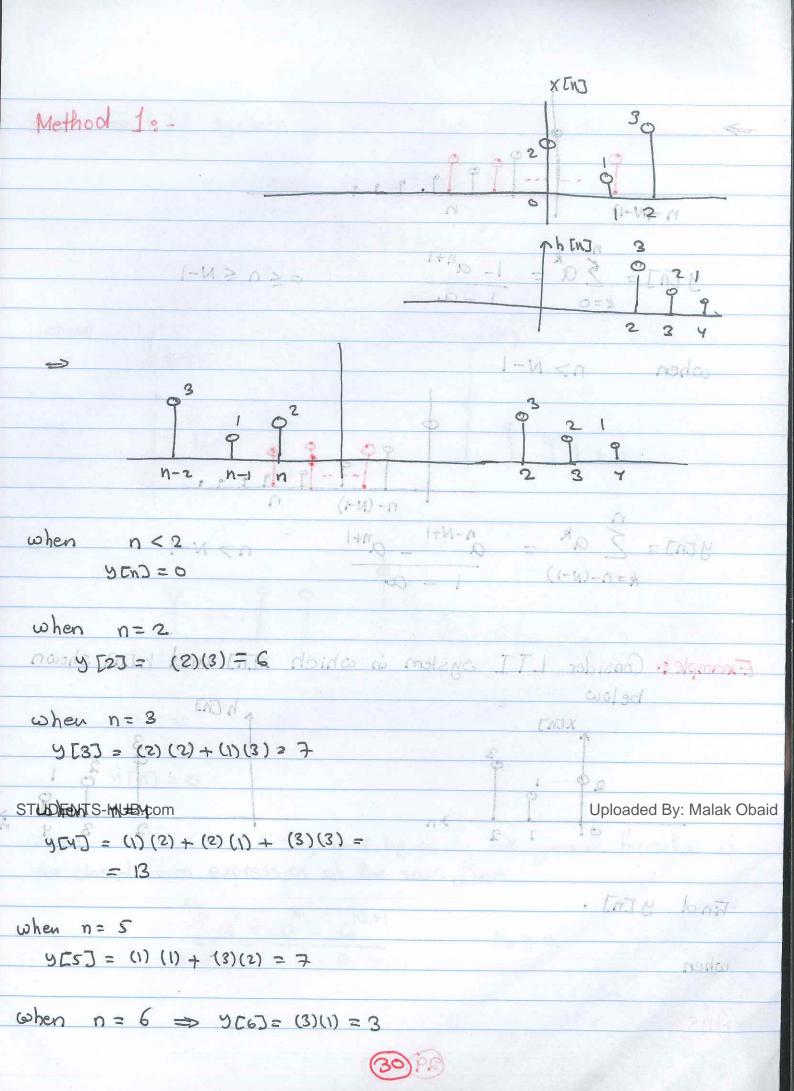
TNI V W TNI V W
3. The system is Slinear 9 = (IM) st st + IM IX ID) T
Did y h that we have
4. The system is time warrant since (MIXXX) T
1110 073.01.
T(x[n-no])=x[-n-no] + y[n-no]= x[-n+no]
TON-NIX (PON-NIX) T
5. The system is Memory for all values export in except
3. The system is memoraless since it depend and the
present value of XINI.
H. T(X[n]) = X[n] + 3u[n+1]
d+EMIXD = (TNIX) T .T
The sustain in stable since
d+[MXp] = ([MXX)] =   qXMJ+b
d+[MXD] =   ([M]X) T   = 0 M   0   0   0   0   0   0   0   0   0
where a and to are finite values.
where a and b are brille values.  1-> n rot M > I((rilx)) T   bus
One and and the
2. The system is causal
8. The system is non-linear
3. The system is nonlinear
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4. The system is Time-variant since
a The system is memorpless.
STUDENTS-HUB. $com[n-no]$ ) = $X[n-no] + 3u[n+1]$ Uploaded By: Malak Obaid
# y[n-no] = X[n-no] + 3u[n-no+1]
Mig. The system to Memoryless oldots a moters of .
2. The Enstean will be non-course it neos a theraise
the system is ausal

· Linear Time-Invariant Systems motors IT 1 707 -: 2014
For LTI system shown below = 1719
X Ch J h En J la y Ch J
of the second se
The output signal yend can be expressed as:
Y [n] = x [n] * h [n]
where
where * represents convolution operation
→ · · · · · · · · · · · · · · · · · · ·
y Inj = x Inj * h Inj
= 3 x CkJ h [n-k]
or will
or willing
YENT = ZX [n-k] h [k]
kz ão
o > n nado
Example: Consider LTI system with impulse response
0=(216)=0
STUDENTS-HUB.com h [n] = U[n] - U[n-N] Uploaded By: Malak Obaid
when o < n < N-1, and by wing the general formula of
= SN 0 < 0 < N = 1
(ο ο.ω
8 0 = 0 = 0 = 0
and the input signal is given by
out the albert of Albert of
$X[n] = a^n u[n]$ ; o.ca<1
ruis = a uliis, o(a<)

(27)

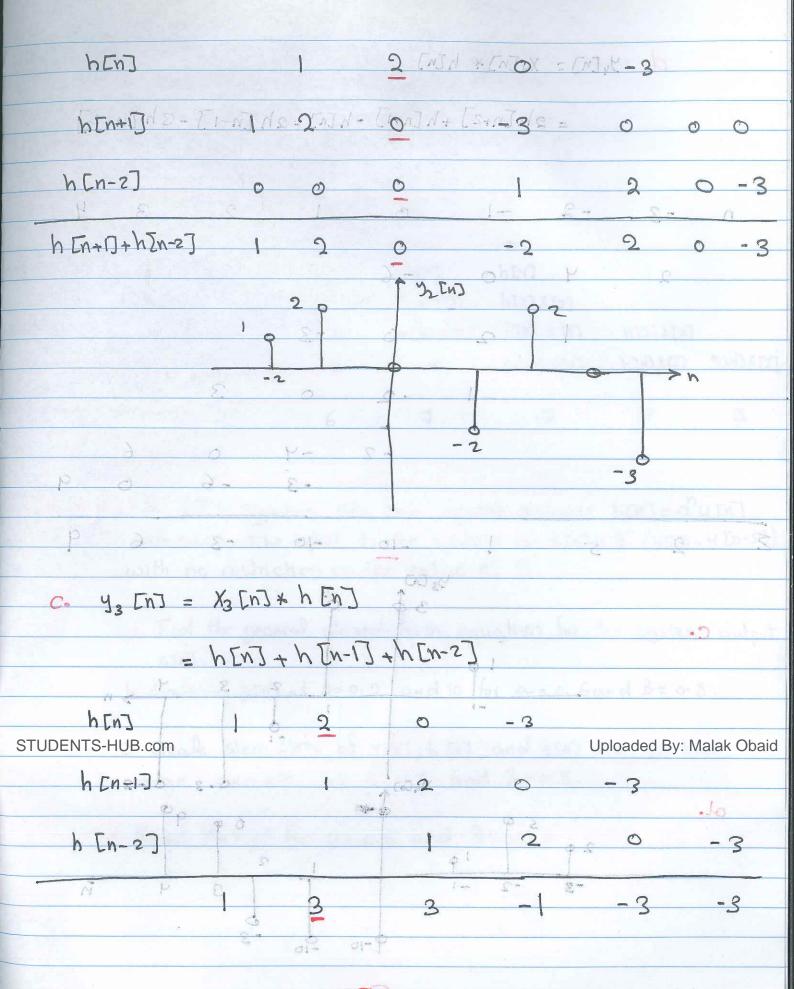
Ans: - for LTI system smotored transport smit monit For LII system should hat Chilx = Chily = ZX[k] h[n-k] The output signal course con be expressed as c. where KINJ n-(N-1) when n < 0 Example: - Consider LTI system with impulse response y[n] = 0 しい Uploaded By: Malak Obaid STUDENTS-HUB.com when 0 < n < N-1, and by using the general formula of the closed form expression of the sum where, XINJ = QUILDING COCK





An LTI system has the impulse response Fin I nadous the underline locates the n=0 value. For euro. = [+7] sequence below find the output sequence 4500 - XINT & 10 200 Method Queou on all mideline the new views books n 0 o End = Send o [S] X X II] X COJX X [m] he23 he33 h[4] hcn3 (SIX [SIA CIIX (SIA COIX [S) A (SIX (SIA (II X [SIA CO)X (S) A PINIKED MENIKED MENIKED 6 (5-15-71-11.29 13 NX 17 5 0 Exercise: An LTI system has the impulse response hin] = au in] with laid. The input to the system is XINJ = B" (4 [N - 4 [n-5]) with no restriction on the value of B. a Find the general closed-form equation for the system output · ENJ W b. Evaluate yEn] at n=0,2, and 10 for a=0.6 and B=0.8. STUDENTS-HUB. cope ate stem plots of x Inj, h Inj, and y Inj Unleaded By/Malak Obaid range ocn <10 for a = 0.6 and B = 0.8. d. Repeat Part (c) for a = 0.6 and B = -0.8 MATH & FRICK = FRICK [N] N X GIS-NJZ + GI+NJZ ] -TS-NJN+ D+NTN-

Examples An LTI system has the impulse response hIn] = {1,2,0,-3}; the underline locates the n=0 value. For each input sequence below, find the output sequence y Ind = XINJ & h Ind expressed both as a list (underline the n=0 value) and as a stem plot. a. XITA] = S [n] b x2 [n] = 5 [n+1] + 8 [n-2] DUXONA DOXOGO X2 COT BESS 1, 1, 13 d x4 [1]= {2, 1,-1,-2,-3} Ans: An LTI system has [n] + En] \* En] = ceusing with louist. The copy to that \* End \* Ludy + End \* (4003 - 4 [0.5]) = h [n] lo= \$ 1,2,0,=133 on the STUDENTS-HUB.com Cord long In A This to stold male Juploaded By: Malak Obaid 18:0= & love 2.0=0.6 pard B=0.8. of Report Part (2) for a= 0.6 and B= -0.8 b. YouTing = Xo [n] \* h [n] = (S[n+1] + S[n-2]) x h[n] = h [n+1] + h [n-2]



de - Yy[n] = Xy[n] + h[n] [5-4] 45-[1-1] 45-[1] - PLUJ - PLUJ - SHEN-2] C. Uploaded By: Malak Obaid STUDENTS-HUB.com Yy Cn7