Assignment 1

Part 1: Theoretical

a) Xeven[n]= x[n]+x[-n]/2
   Xodd[n]=x[n]-x[-n]/2
   X[-n]= {1,3,7,8,$\underline{6}$,1}

   Xeven[n]= {4.5,$\underline{6}$,4.5,1,3,7}

   Xodd[n]= { −3.5,$\underline{0}$,3.5,0,0,0}

b) 2*1/2π= 0.31 not rational non-periodic

   3/4 π*1/2 π=3/8 rational periodic

   Periodic +non-periodic = not periodic so the whole signal is non periodic

c) Time invariance

y1[n]= n.x1[n]^2.cos[ω0 n]

y1[n-n0]=(n-n0)·x1[n−n0]^2·cos[ω0(n-n0)]

x2=x1[n-n0]

y2[n]=n.x2[n]^2.cos[ω0 n]=n.x1[n-n0]^2.cos[ω0 n]

y2[n] not equal y1[n-n0] so Time variant

linearity

y1[n]= $n.\ x1[n]$^2.cos[ω0 n]

y2[n]= $n.\ x2[n]$^2.cos[ω0 n]

αy1 [n] + βy2 [n] = αn.x1 [n]^2.cos [ω0n] + βn.x2 [n]^2cos [ω0n]

$x3\ [n]$ = α$x1\ [n]$ + β$x2\ [n]$

Y3[n]=n.x3[n]^2.cos[ω0 n]=n. (α$x1\ [n]$ + β$x2\ [n]$)^2.cos[ω0 n]

Y3[n] not equal α$y1\ [n]$ + β$y2\ [n]$ not linear

Causality

Casual n depends only on present and past values of the input doesn’t depend on future

Memory

memoryless if the output at time n depends only on x[n] and not on past or future values memoryless

BIBO Stability

Not stable -> a bounded input $|x[n]| < Bi < \infty\ , \forall n$

produces an unbounded output

|x[n]2|≤Bi^2 , |cos(ω0n)|≤1

n **grows unbounded** as n→∞ leading to: |y[n]|=|n·x[n]^2·cos(ω0n)|<=n. Bi^2.1

Question 2

$y(n)$ = k= −∞ ∞ ∑ $x(k)$. $h(n - k)$

Length=4+5-1=8

From -1 to 6

y[-1]=x[0].h[-1-0]=1*2=2

$y[0]= x[0]h[0]+x[1]h[-1]=1*2+(-2)*2=2-4=-2$

$y[1]= x[0]h[1]+x[1]h[0]+x[2]h[-1]=1*4+(-2)*2+0*2=4-4+0=0$

$y[2]= x[0]h[2]+x[1]h[1]+x[2]h[0]=1*-5+-2*4+0*2+3*2=-5-8+0+6=-7$

$y[3]=x[1]h[2]+x[2]h[1]+x[3]h[0]+x[4]h[-1]=-2*-$

$5+0*4+3*2+5*2=10+0+6+10=26$

$y[4]=x[2]h[2]+x[3]h[1]+x[4]h[0]=0*-5+3*4+5*2=0+12+10=22$

$y[5]=x[3]h[2]+x[4]h[1]=(3)(-5)+(5)(4)=-15+20=5$

$y[6]=x[4]h[2]=(5)(-5)=-25$

$y[n]=\{2,-\underline{2},0-7,26,22,5,-25\}$

Question 3

Length =5+4-1=8 from -3 to 6

$y[-3]= x1[3]x2[0]+x1[4]x2[1]=5*2+3*4=10+12=22$

$y[-2]=x1[2]x2[0]+x1[3]x2[1]+x1[4]x2[2]=1*2+5*4+3*1=2+20+3$

$=25$

$y[-1]=x1[1]x2[0]+x1[2]x2[1]+x1[3]x2[2]+x1[4]x2[3]=$

$2*2+1*4+5*1+3*8=4+4+5+24=37$

$y[0]=x1[0]x2[0]+x1[1]x2[1]+x1[2]x2[2]+x1[3]x2[3]=2*2+2*4+1*$

$1+5*8=4+8+1+40=53$

$y[1]=x1[0]x2[1]+x1[1]x2[2]+x1[2]x2[3]=2*4+2*1+1*8=8+2+$

$=18$

y[2]=x1[0]x2[2]+x1[1]x2[3]=2*1+2*8=2+16=18

y[3]=x1[0]x2[3]=2*8=16

y[n]={22,25,37,$\underline{53}$,18,18,16}

Question 4

a) x(z)=-5+z^-1+0+0+z^-4+5z^-5

ROC: z not equal 0

b) x(z)=0+z^2+5z^1+-5Z^0+z^-1+0

   ROC: z not equal 0 and ∞

c) x(z)=(1/1-1/8z^-1)+(1/1-1/9z^-1)

   x(z)=(z/z-8)+(z/z-9) converge if only |z|>8 and |z|>9 so ROC |z|>9