ZADATAK 1

DEF. PERIODIČNOSTI VREMENSKI KONTINUIRANOG SIGNALA

Periodičan vremenski kontinuirani signal, periode T_0, definiran je ka

$$f : \mathbb{R} \to \mathbb{R}$$

$$\forall t \in \mathbb{R}, \quad T_0 \in \mathbb{R}^+ \qquad f(t) = f(t+T_0)$$

ISPITIVANJE PERIODIČNOSTI I ODREĐIVANJE TEMELJNOG PERIODA

1) $x_1(t+T_0) = 2 = x_1(t)$

SIGNAL JE PERIODIČAN, ALI NEMA OSNOVNI PERIOD VEĆ JE $T_0 \in \mathbb{R}^+$

2) $x_2(t+T_0) = \sin\left(\frac{2\pi}{T}(t+T_0)\right) = \sin\frac{2\pi t}{T} \cdot \cos\frac{2\pi T_0}{T} + \cos\frac{2\pi t}{T} \cdot \sin\frac{2\pi}{T}$

SIGNAL JE PERIODIČAN AKO $\cos\frac{2\pi T_0}{T} = 1$ & $\sin\frac{2\pi T_0}{T} = 0$

tj. $T_0 = T$ I TO MU JE OSNOVNI PERIOD

3) $x_3(t+T_0) = \sin\left(\frac{2\pi}{T}(t+T_0)^2\right) = \sin\left(\frac{2\pi}{T} \cdot t^2 + \frac{2\pi}{T} 2tT_0 + \frac{2\pi}{T} T_0^2\right)$

$\frac{2\cancel{\pi}}{T} T_0 (2t + T_0) = 2k\cancel{\pi}$, $k \in \mathbb{N}$

$\frac{2tT_0 + T_0^2}{T} = k$, $T_0 = \text{Const}$ $\Rightarrow$ SIGNAL NIJE PERIODIČAN

ZADATAK 2

DEF. PERIODIČNOST VREMENSKI DISKRETNOG SIGNALA

Periodičan vremenski diskretan signal, periode N, definiran je kao

$$f: \mathbb{Z} \to \mathbb{R}$$

$$\forall n \in \mathbb{Z}, \quad N \in \mathbb{Z}^+ \qquad f(n) = f(n+N)$$

ISPITIVANJE PERIODIČNOSTI I ODREĐIVANJE TEMELJNOG PERIODA

1) $x_1(n+N_0) = 2 = x_1(n)$

SIGNAL JE PERIODIČAN, PERIOD BILO KOJI $N_0 \in \mathbb{Z}^+$

2) $x_2(n+N_0) = \sin\left(\frac{2\pi}{N}(n+N_0)\right) = \sin\frac{2\pi n}{N}\cdot\cos\frac{2\pi N_0}{N} + \cos\frac{2\pi n}{N}\cdot\sin\frac{2\pi N_0}{N}$

SIGNAL JE PERIODIČAN AKO $\cos\frac{2\pi N_0}{N} = 1$ & $\sin\frac{2\pi N_0}{N} = 0$

tj. OSNOVNI PERIOD JE $N_0 = N$

3) $x_3(n+N_0) = \sin\left(\frac{2\pi}{N}(n+N_0)^2\right) = \sin\left(\frac{2\pi}{N}(n^2+2nN_0+N_0^2)\right) = \sin\left(\frac{2\pi}{N}n^2\right.$

$$\frac{\cancel{2}\pi}{N}(2nN_0+N_0^2) = \cancel{2}k\pi \qquad k \in \mathbb{N}$$

$$\underbrace{\frac{N_0}{N}(2n+N_0)}_{} = k$$

ne smije biti razlomak $\Rightarrow \boxed{N_0 = N}$

SIGNAL JE PERIODIČAN

OSNOVNI PERIOD $N_0 = N$

KOD ZA CRTANJE SIGNALA

```
n=[0:1:30];
stem(sin((2*pi*n.^2)/5));
```

Temeljem dobivene slike se može ispitati je li signal periodičan ili nije obzirom da graf sadrži konačno mnogo vrijednosti za koje se može jednostavnim ispitivanjem svega nekolicine točaka utvrditi periodičnost signala.

$$f_1(n) = \sin\left(\frac{2\pi}{N_1} n\right)$$

$$f_2(n) = \sin\left(\frac{2\pi}{N_2} n\right)$$

$$f_1(n) \cdot f_2(n) = \sin\left(\frac{2\pi}{N_1} n\right) \cdot \sin\left(\frac{2\pi}{N_2} n\right) = \frac{1}{2}\left[\cos\left(2\pi n\left(\frac{1}{N_1} - \frac{1}{N_2}\right)\right) - \cos\left(2\pi n\left(\frac{1}{N_1} + \frac{1}{N_2}\right)\right)\right]$$

$$\cancel{2\pi} N\left(\frac{1}{N_1} - \frac{1}{N_2}\right) = \cancel{2\pi} k_1 \qquad k_1, k_2 \in \mathbb{Z}$$

$$\cancel{2\pi} N\left(\frac{1}{N_1} + \frac{1}{N_2}\right) = \cancel{2\pi} k_2$$

$$\frac{N}{N_1} - \frac{N}{N_2} = k_1$$

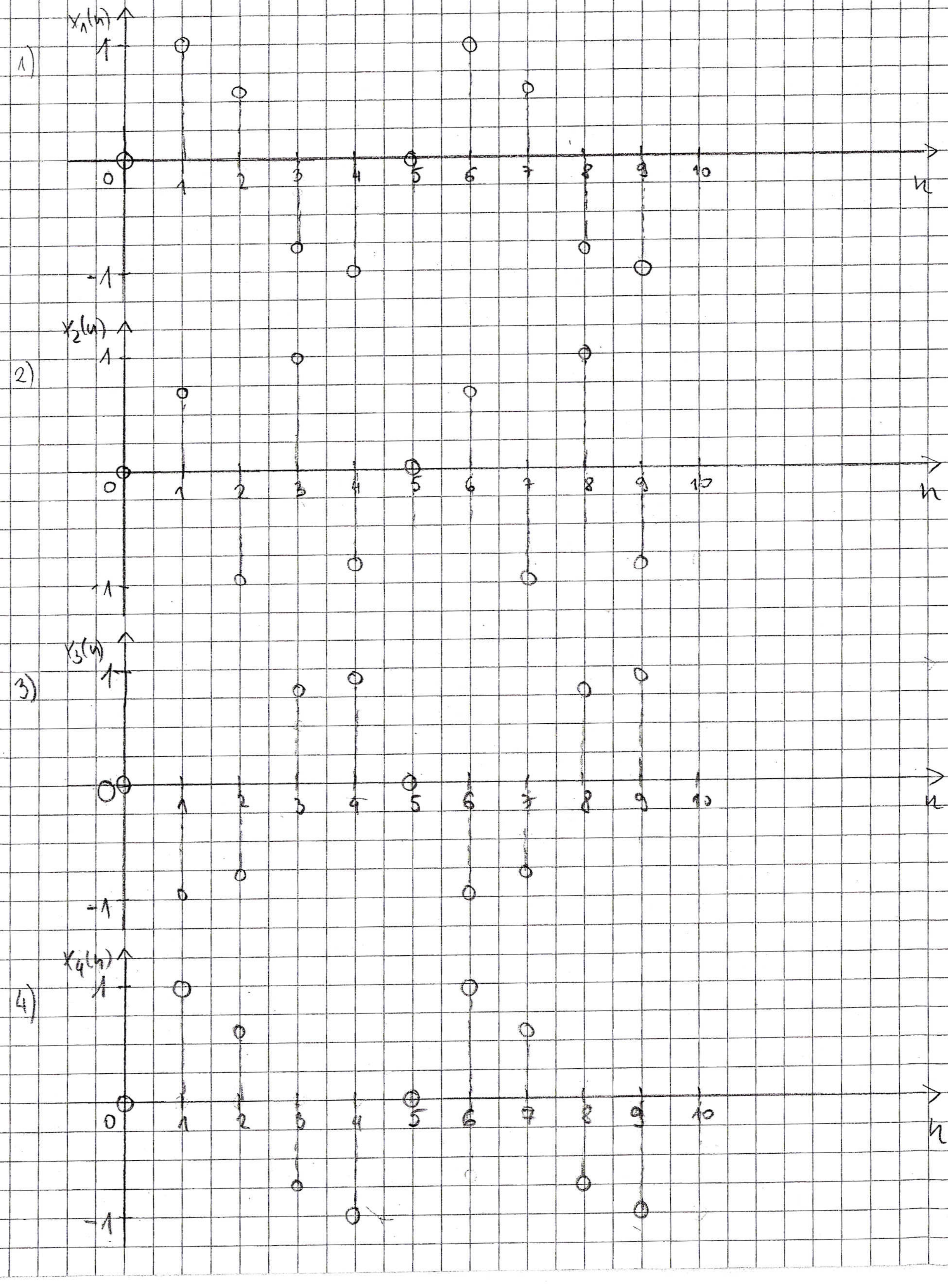
$$\frac{N}{N_1} + \frac{N}{N_2} = k_2$$

k mora biti cijeli broj, a to je samo kada je N najmanji zajednički višekratnik N_1 i N_2.

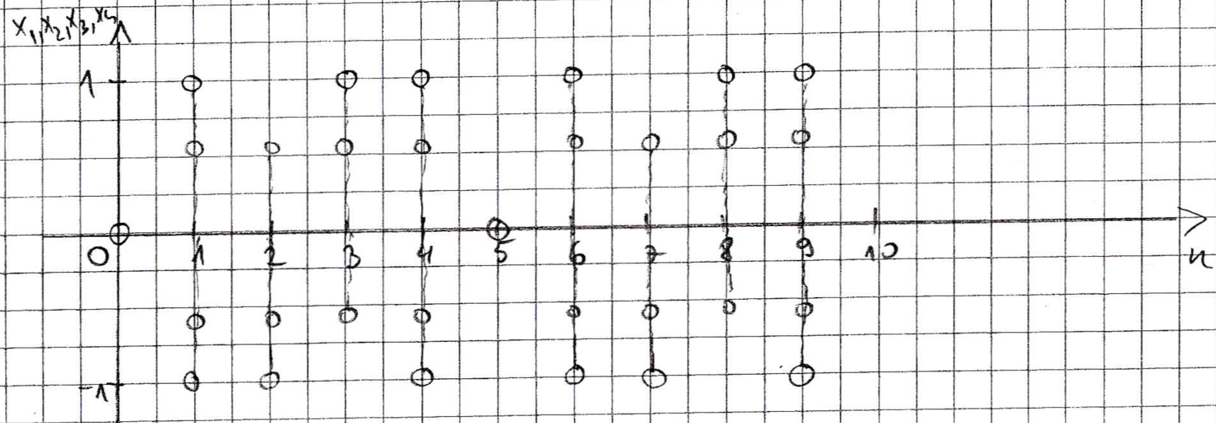
Temeljni period je upravo N tj. najmanji zajednički višekratnik N_1 i N_2.

ZADATAK 3

$$x_k(n) = \sin(\omega_k n) \quad ; \quad \omega_k = \frac{2\pi k}{5}$$



5)



b) Nacrtao sam 3 različita signala.

c) Signali $x_1(n)$ i $x_4(n)$ su jednaki zbog aliasinga (frekvencijskog preklapanja)

$$\left.\begin{aligned} \omega_{k_1} &= \frac{2\pi}{5} \\ \omega_{k_2} &= \frac{12\pi}{5} = 2\pi + \frac{2\pi}{5} \end{aligned}\right\} \text{ALIASING}$$

ZADATAK 4

DEF. ENERGIJE I SNAGE KONTINUIRANOG VREMENSKOG SIGNALA

Energija vremenski kontinuiranog signala, za signale f, definiran na vremenskom intervalu $[t_1, t_2] \subset \mathbb{R}$, definira se kao

$$E_{[t_1, t_2]} = \int_{t_1}^{t_2} |f(t)|^2 \, dt \quad ; \quad L = t_2 - t_1$$

Srednja snaga vremenski kontinuiranog signala f, definiranog u vremenskom intervalu $[t_1, t_2] \subset \mathbb{R}$, definira se kao

$$P_{[t_1, t_2]} = \frac{1}{L} \int_{t_1}^{t_2} |f(t)|^2 \, dt \quad ; \quad L = t_2 - t_1$$

DEF. ENERGIJE I SNAGE DISKRETNOG VREMENSKOG SIGNALA

Energija vremenski diskretnog signala (niza) y, definiranog na intervalu $[n_1, n_2] \subset \mathbb{Z}$, definira se kao

$$E_{[n_1, n_2]} = \sum_{n=n_1}^{n_2} |y(n)|^2$$

Srednja snaga vremenski diskretnog signala y, definiranog na intervalu $[n_1, n_2] \subset \mathbb{Z}$, definira se kao

$$P_{[n_1, n_2]} = \frac{1}{n_2 - n_1 + 1} \sum_{n=n_1}^{n_2} |y(n)|^2$$

$$x_1(t) = \cos\left(\frac{\pi}{3} t\right) \qquad x_2(n) = \sin\left(\frac{\pi}{7} n\right)$$

$$E_\infty = \int_{-\infty}^{\infty} |f(t)|^2 dt = \int_{-\infty}^{\infty} \cos^2\left(\frac{\pi}{3} t\right) dt = \int_{-\infty}^{\infty} \left(\frac{1}{2} + \frac{\cos \frac{2\pi}{3} t}{2}\right) dt =$$

$$= \frac{1}{2} t + \frac{3}{4\pi} \sin\left(\frac{2\pi}{3} t\right) \Big|_{-\infty}^{\infty} = \underline{\underline{\infty}}$$

$$P_\infty = \lim_{L \to \infty} \frac{1}{L} \int_{-\frac{L}{2}}^{\frac{L}{2}} |f(t)|^2 dt = \lim_{L \to \infty} \frac{1}{L} \int_{-\frac{L}{2}}^{\frac{L}{2}} \left(\frac{1}{2} + \frac{\cos\left(\frac{2\pi}{3} t\right)}{2}\right) dt =$$

$$= \lim_{L \to \infty} \frac{1}{L} \left(\frac{L}{2} + \frac{\cancel{6}^{3}}{\cancel{4\pi}_{2}} \sin\left(\frac{\cancel{2}\pi L}{\cancel{6}_3}\right)\right) = \lim_{L \to \infty} \left(\frac{1}{2} + \frac{1}{2} \frac{\sin \frac{\pi L}{3}}{\frac{\pi L}{3}}\right) = \underline{\underline{\frac{1}{2}}}$$

$$E_\infty = \sum_{n=-\infty}^{\infty} |y(n)|^2 = \sum_{n=-\infty}^{\infty} \sin^2\left(\frac{\pi}{7} n\right) = \sum_{n=-\infty}^{\infty} \left(\frac{1}{2} - \frac{\cos\left(\frac{2\pi}{7} n\right)}{2}\right) =$$

$$= \frac{1}{2} \sum_{n=-\infty}^{\infty} \left(1 - \cos\left(\frac{2\pi}{7} n\right)\right) = \underline{\underline{\infty}}$$

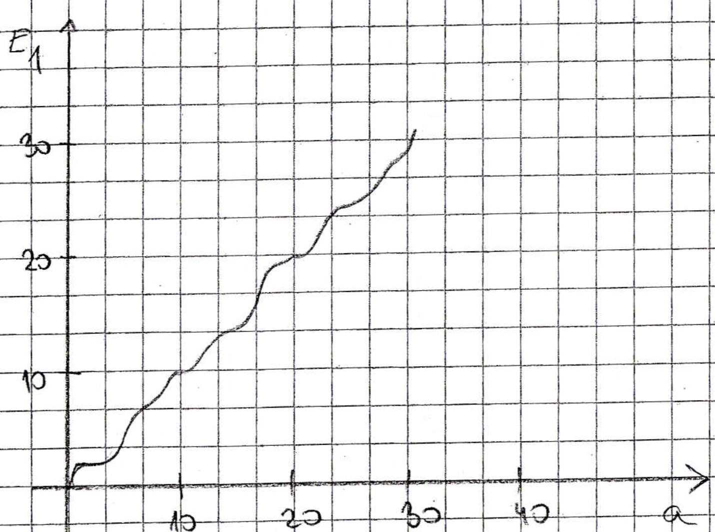
$$P_\infty = \lim_{M \to \infty} \frac{1}{2M+1} \sum_{n=-M}^{M} |y(n)|^2 = \lim_{M \to \infty} \frac{1}{2M+1} \sum_{n=-M}^{M} \left(\frac{1}{2} - \frac{\cos\left(\frac{2\pi}{7} n\right)}{2}\right) = \underline{\underline{\ldots}}$$

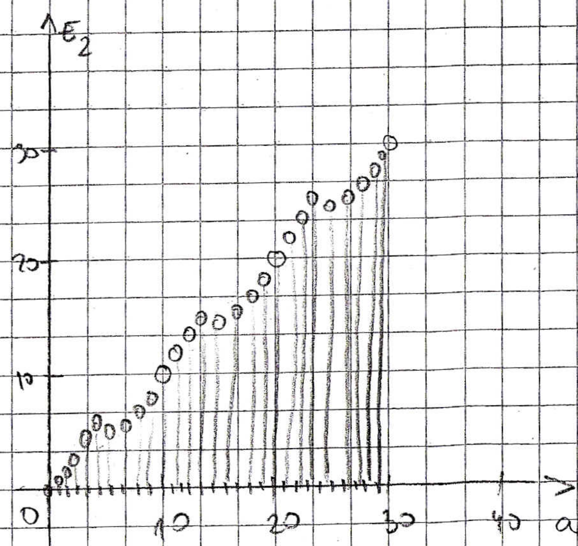
ZADATAK 4 DIO II

d)
```
syms t a ;
E1= int( cos(pi*t/5)*cos(pi*t/5) , t, -a, a);
E1= a + (5*sin((2*pi*a)/5))/(2*pi);

syms X n ;
X= sin((pi/7)*n);
```

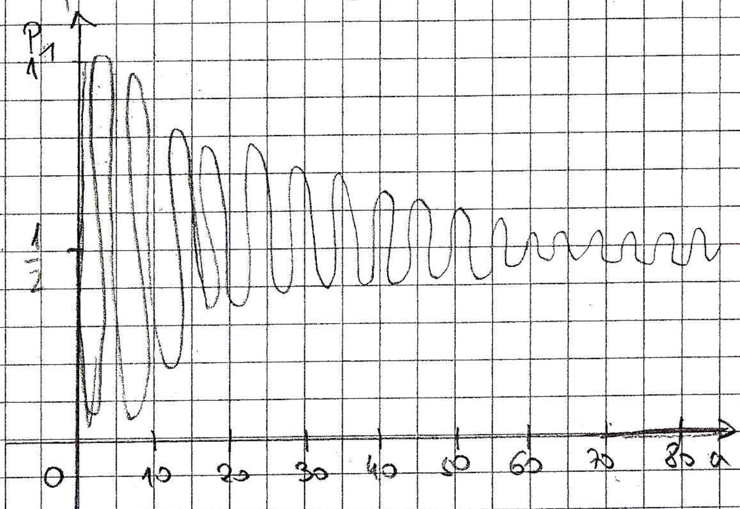
RAČUNANJE ENERGIJE NA INTERVALU [-a, a]

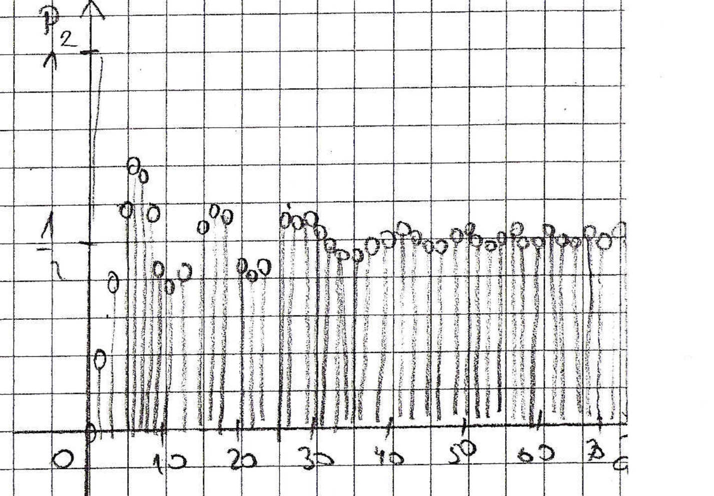
```
function E2 = energija (a)
for i=-a:a
    E(i)=(sin(pi*i/7)).^2;
end
E =sum(E);
end
```





Energija signala raste zajedno sa parametrom a jer je signal periodičan stoga ako $a \to \infty$ onda : $E \to \infty$





Kako se parametar a povećava tako se signal ustaljuje tj. teži prema $\frac{1}{2}$. Očekujem da kada $a \to \infty$ da snaga signala iznosi $\frac{1}{2}$.

ZADATAK 5

Vremenski kontinuiran Fourierov red (CTFS)

ANALIZA:

$$X_k = \frac{1}{T_0} \int_{T_0} x(t) \cdot e^{-j\omega_0 k t} dt \quad , \forall k \in \mathbb{Z}$$

$x(t)$ - signal

X_k - spektar

T_0 - period signala

t - nezavisna varijabla signala (vrijeme)

k - nezavisna varijabla spektra (red harmo

SINTEZA:

$$x(t) = \sum_{-\infty}^{\infty} X_k e^{j\omega_0 k t}$$

$e^{j\omega_0 k t}$ - kompleksna eksponencijala

$$x(t) = 110 \sin(120\pi t) + 50 \cos\left(360\pi t + \frac{\pi}{3}\right)$$

$$\left.\begin{aligned} T_1 &= \frac{2\pi}{120\pi} = \frac{1}{60} \\ T_2 &= \frac{2\pi}{360\pi} = \frac{1}{180} \end{aligned}\right\} \quad T_0 = 2 \cdot \frac{1}{60} = \frac{1}{30}\, s \qquad \omega_0 = \frac{2\pi}{T_0} = 60\pi \ rad/s$$

$$110 \sin(120\pi t) = \frac{110}{2j}\left(e^{j2\omega_0 t} - e^{-j2\omega_0 t}\right) = -j55\left(e^{j2\omega_0 t} - e^{-j2\omega_0 t}\right)$$

$$= 55 e^{-j\frac{\pi}{2}} e^{j2\omega_0 t} + 55 e^{+j\frac{\pi}{2}} e^{-j\omega_0 2 t}$$

$$50 \cos\left(360\pi t + \frac{\pi}{3}\right) = 25\left(e^{j6\omega_0 t + j\pi/3} + e^{-j6\omega_0 t - j\pi/3}\right) =$$

$$= 25 e^{j\pi/3} e^{j6\omega_0 t} + 25 e^{-j\pi/3} e^{-j6\omega_0 t}$$

$$x(t) = 55e^{-j\pi/2} e^{j120\pi t} + 55e^{j\pi/2} e^{-j120\pi t} + 25e^{j\pi/3} e^{j360\pi t} + 25e^{-j\pi/3} e^{-j360\pi t}$$

$$x(t) = \sum_{-\infty}^{\infty} X_k e^{jk\omega_0 t}$$

$$\boxed{\begin{array}{lcl} k=2 & \rightarrow & X_2 = 55e^{-j\pi/2} \\ k=-2 & \rightarrow & X_{-2} = 55e^{j\pi/2} \\ k=6 & \rightarrow & X_6 = 25e^{j\pi/3} \\ k=-6 & \rightarrow & X_{-6} = 25e^{-j\pi/3} \end{array}}$$

OSTALI KOEFICIJENTI SU $\emptyset$

b) RAČUNANJE CTFS-a

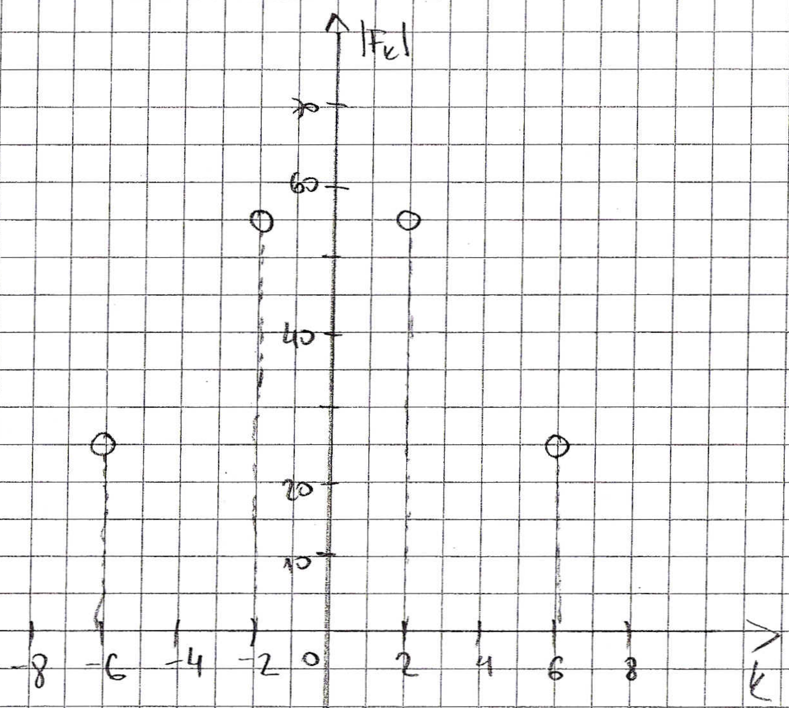
```
syms t To k ;
x = 110 * sin((4*pi*t)/To) + 50 * cos(12*pi*t/To + pi/3);
Fk = int(x*exp(-2*pi*j*k*t/To), -To/2, To/2)/To;
Fk = subs(Fk, To, 1/30);

Fk = -(sin(pi*k)*((k*i)/2 - 3*3^(1/2))*50*i)/(pi*(k^2-36))
   (30*((sin(2*pi*k)*11*i)/3 - (22*sin(pi*k)^2/3*
   sin(pi*k)*i + 2*sin((pi*k)/2)^2-1))/(pi*(k^2-4)) ;
```

c) AMPLITUDNI I FAZNI SPEKTAR

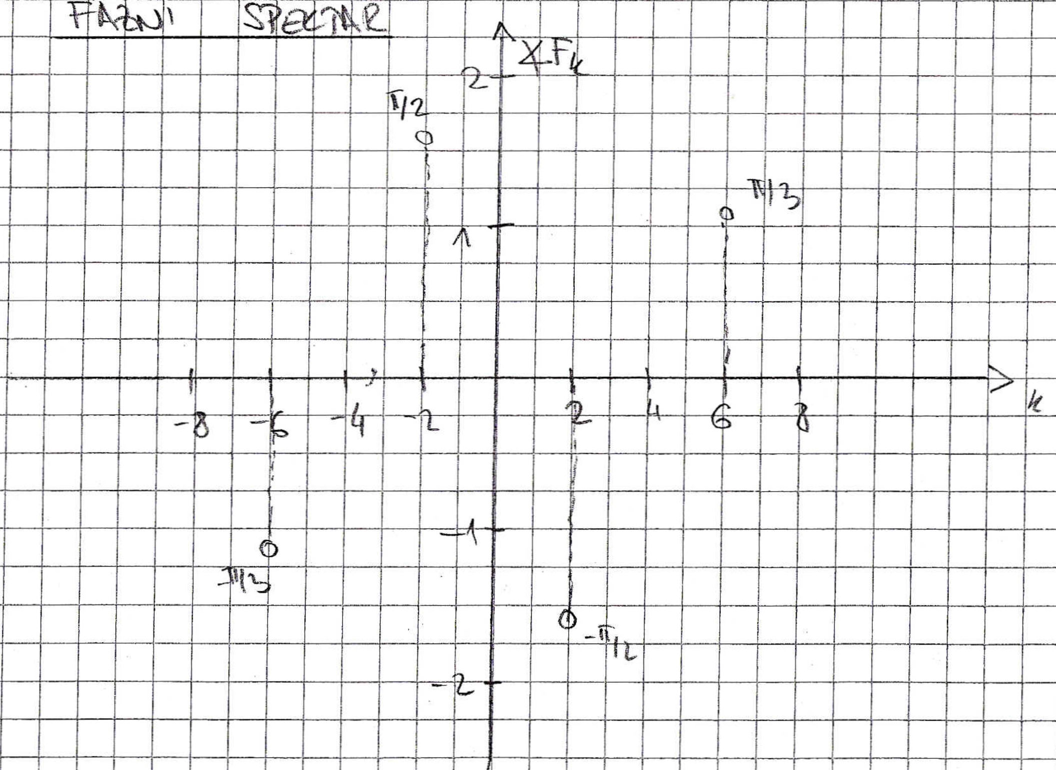
```
A = zeros(1,51);
for n=-25:25
    A(n+26) = subs(Limit(Fk, k, n));
end
stem([-25:25], abs(A));
stem([-25:25], angle(A));
```

ZADATAK 5 DIO I

AMPLITUDNI SPEKTAR



FAZNI SPEKTAR



ZADATAK 6

SPEKTRALNA GUSTOĆA SNAGE (CTFS)

$$P = \frac{1}{T_0} \int_{T_0} \underbrace{x(t)\, x^*(t)}_{|x(t)|^2}\, dt = \sum_{k=-\infty}^{\infty} \underbrace{X_k X_k^*}_{|X_k|^2}$$

$x(t)$ - signal

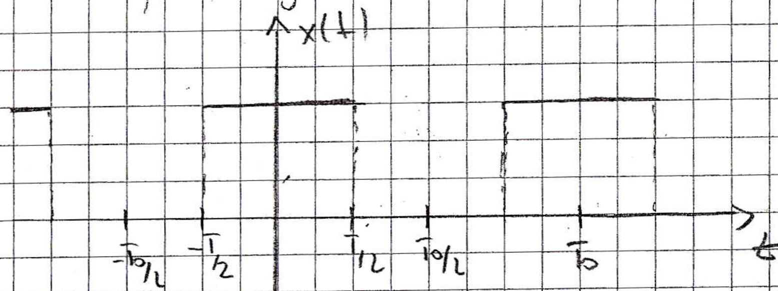
X_k - spektar

T_0 - period signala

t - nezavisna varijabla signala (vrijeme)

k - nezavisna varijabla spektra (red harmoni

a)



$$X_k = \frac{1}{T_0} \int_{-T/2}^{T/2} e^{-j\omega_0 k t}\, dt = \frac{1}{T_0} \left(\frac{1}{-j\omega_0 k} e^{-j\omega_0 k t} \Big|_{t=-T/2}^{T/2} \right) =$$

$$= -\frac{1}{j \underbrace{T_0 \omega_0}_{2\pi} k} \left(e^{-j\omega_0 k T/2} - e^{+j\omega_0 k T/2} \right) = \frac{\sin(\omega_0 k T/2)}{k\pi}$$

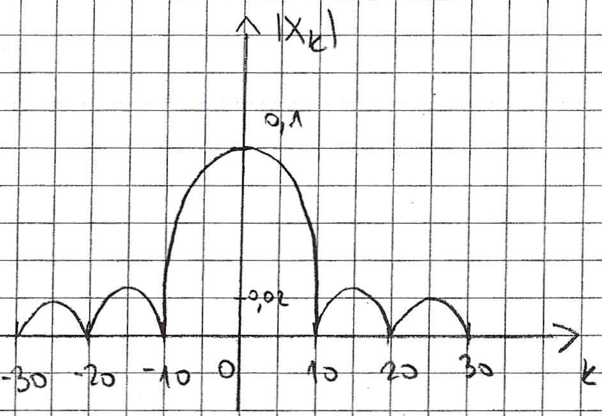
$$= \frac{\sin\left(\frac{2\pi}{T_0} \cdot k \cdot \frac{T}{\cancel{2}}\right)}{k\pi} = \frac{\sin \frac{\pi k T}{T_0}}{k\pi} = \frac{T}{T_0} \cdot \frac{\sin \frac{\pi k T}{T_0}}{\frac{\pi k T}{T_0}}$$

b) X_k = sin((pi*T*k)/T0)/(pi*k)

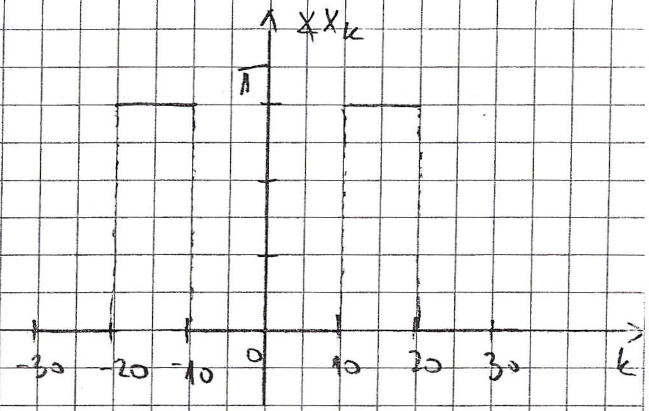
Matlabovo rješenje se poklapa s rezultatom iz a) podzadatka.

c) $$X_k = \frac{\sin\frac{k\pi}{10}}{k\pi}$$

AMPLITUDNI SPEKTAR

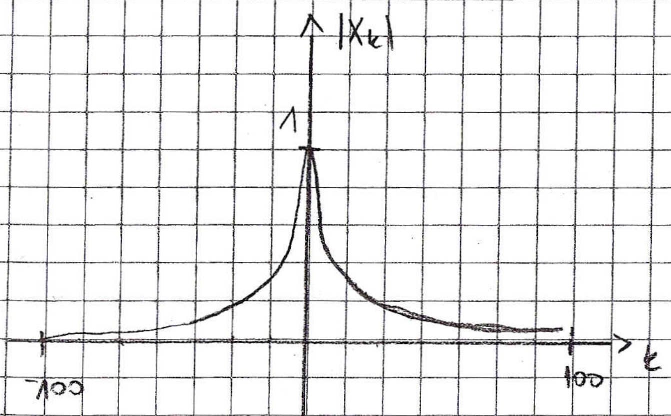


FAZNI SPEKTAR

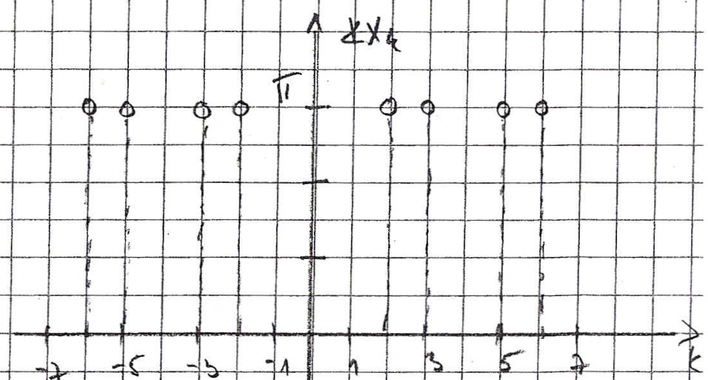


$$X_k = \frac{\sin\frac{2k\pi}{3}}{k\pi}$$

AMPLITUDNI SPEKTAR



FAZNI SPEKTAR

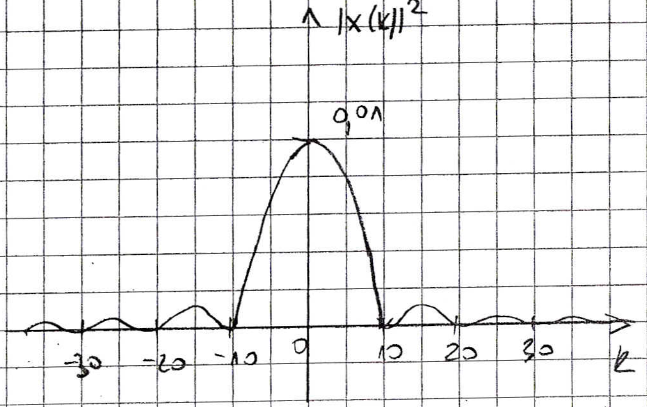


ZADATAK 6 — II DIO

c)

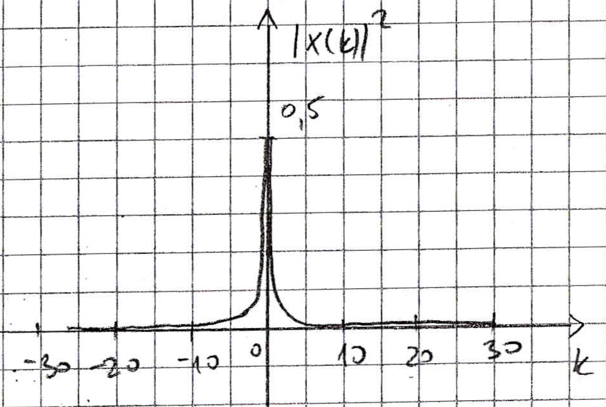
$$X_k = \frac{\sin \frac{k\pi}{10}}{k\pi}$$

SPEKTRALNA GUSTOĆA

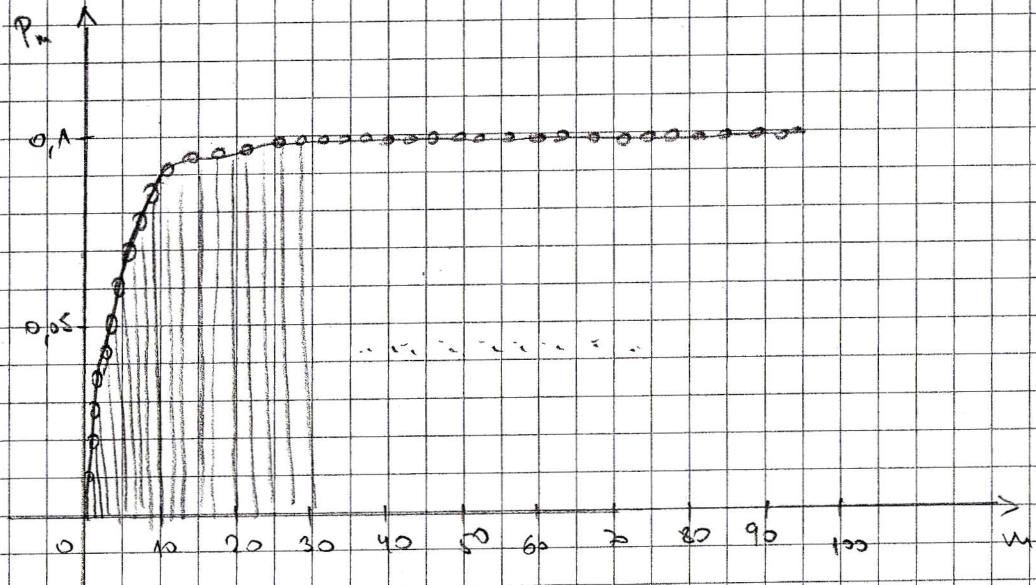


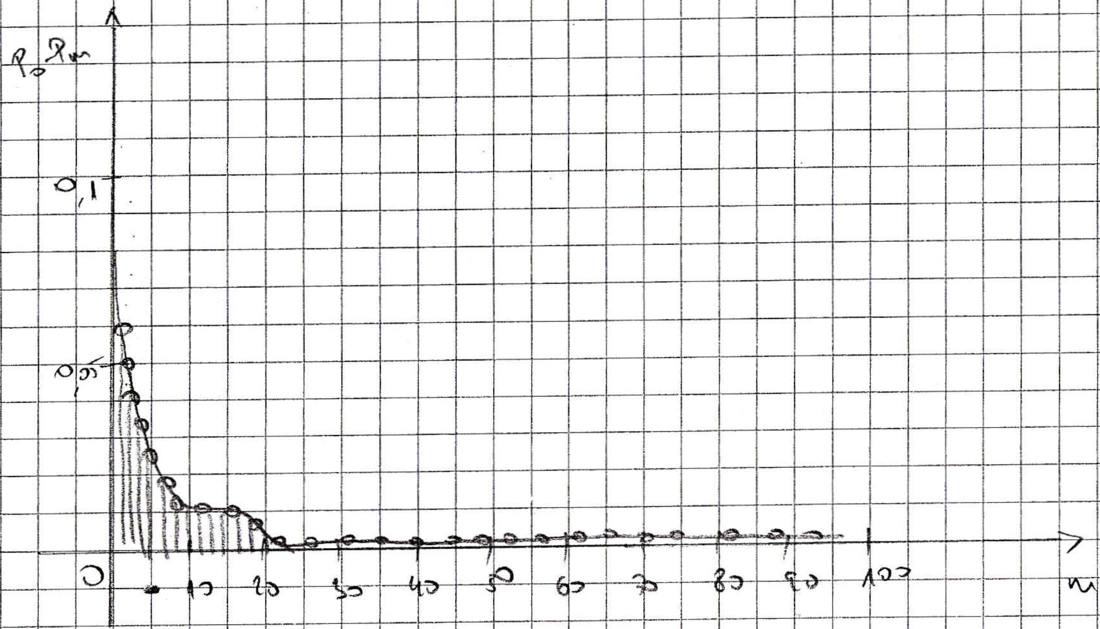
$$X_k = \frac{\sin \frac{2k\pi}{2}}{k\pi}$$

SPEKTRALNA GUSTOĆA



d)





Kada $n \to \infty$ tada razlika snaga teži prema $\emptyset$.

ZADATAK 7

Vremenski kontinuirana Fourierova transformacija (CTFT)

ANALIZA:

$$X(j\omega) = \int_{-\infty}^{\infty} x(t)\, e^{-j\omega t}\, dt \quad , \forall \omega \in \mathbb{R}$$

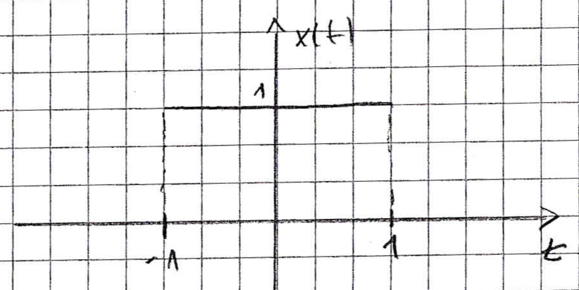
$x(t)$ - signal $\qquad$ t - nezavisna varijabla signala (vrijeme)

$X(j\omega)$ - spektar $\qquad$ ω - nezavisna varijabla spektra (kružna frekven

SINTEZA:

$$x(t) = \frac{1}{2\pi} \int_{-\infty}^{\infty} X(j\omega)\, e^{j\omega t}\, dt \quad , \forall t \in \mathbb{R}$$

a)

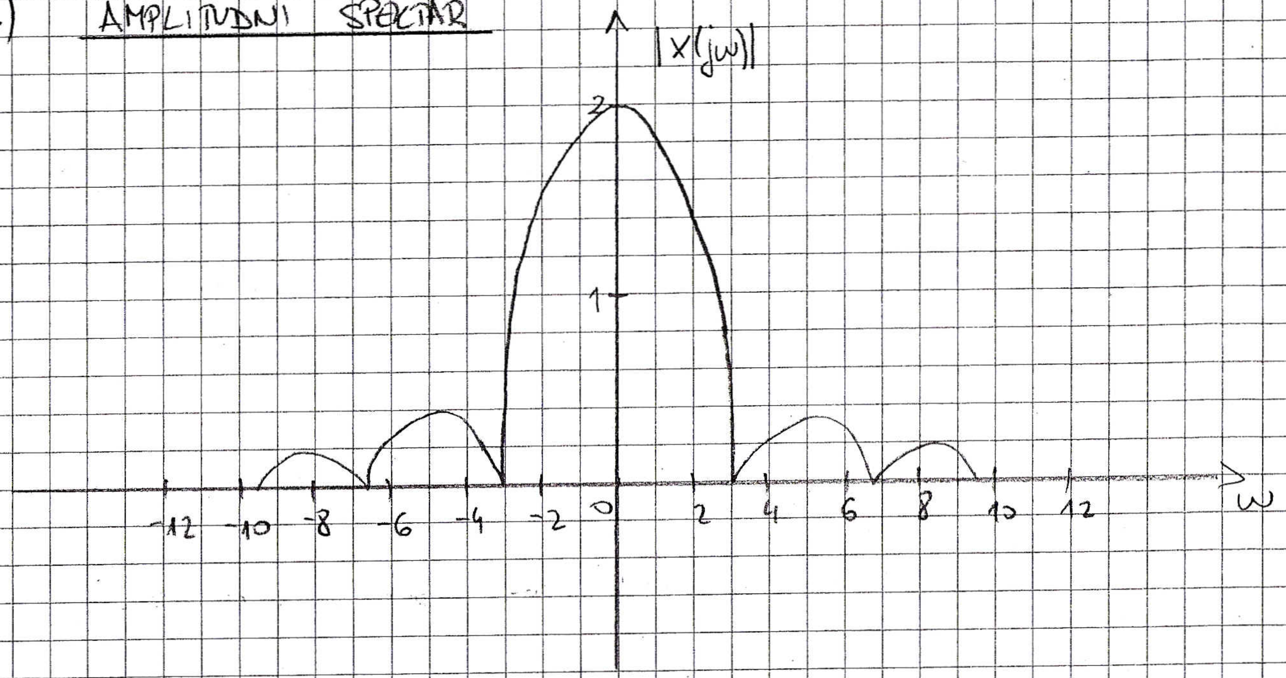


$$X(j\omega) = \int_{-1}^{1} e^{-j\omega t}\, dt = -\frac{1}{j\omega} e^{-j\omega t}\Big|_{t=-1}^{1} = -\frac{1}{j\omega}\left(e^{-j\omega} - e^{j\omega}\right)$$

$$= \frac{2}{\omega} \cdot \frac{e^{j\omega} - e^{-j\omega}}{2j} = 2\, \frac{\sin \omega}{\omega}$$

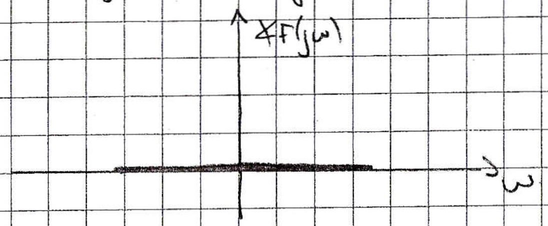
b) x = (2*sin(w))/w

c) AMPLITUDNI SPEKTAR



FAZNI SPEKTAR

$$\measuredangle F(j\omega) = \operatorname{arctg} \frac{Im(X)}{Re(X)} = \operatorname{arctg} 0 = 0$$



Spektar je u 6.c diskretan (iako je na slici kontinuiran) a u 7c je kontinuiran. Oblikom su vrlo slični. Širine latice se razlikuju.

ZADATAK 8

DIRICHLETOVI UVJETI

Periodičan signal $\forall f \in$ KontPeriod T_0 zadovoljava Dirichletove uvjete

a) ako je apsolutno integrabilan u bilo kojoj periodi tj:

$$\int_{T_0} |f(t)|\, dt < \infty$$

b) ako ima konačan broj maximuma i minimuma na bilo kojoj periodi

c) ako ima konačan broj diskontinuiteta na bilo kojoj periodi

d) na mjestu diskontinuiteta $(f(t_d^+) \neq f(t_d^-))$, signal konvergira $\frac{f(t_d^+)+ \ldots}{2}$

$x(t) = 110 \sin(120\pi t) + 50 \cos(360\pi t + \pi/3)$

b)

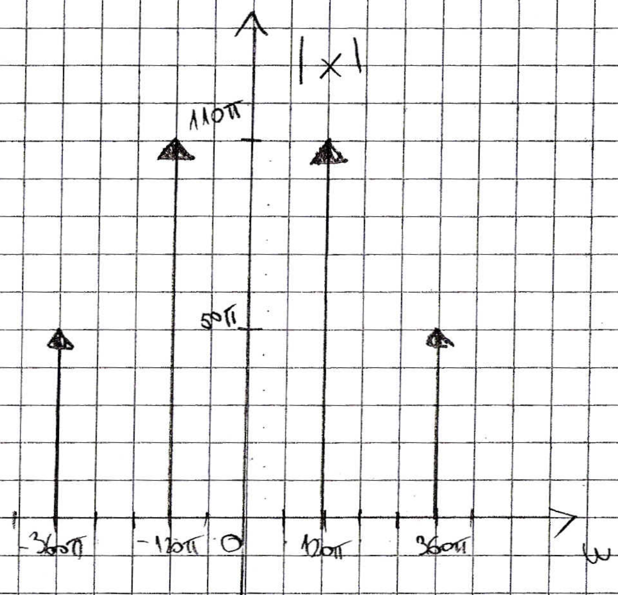
```
syms x t ;
x= 110*sin(120*pi*t) + 50*cos(360*pi*t + pi/3);
x= fourier(x);
x= simplify(x);
pretty(x);
```

$110\ pi\ (dirac(-120\ pi - w) - dirac(120\ pi - w))i +$

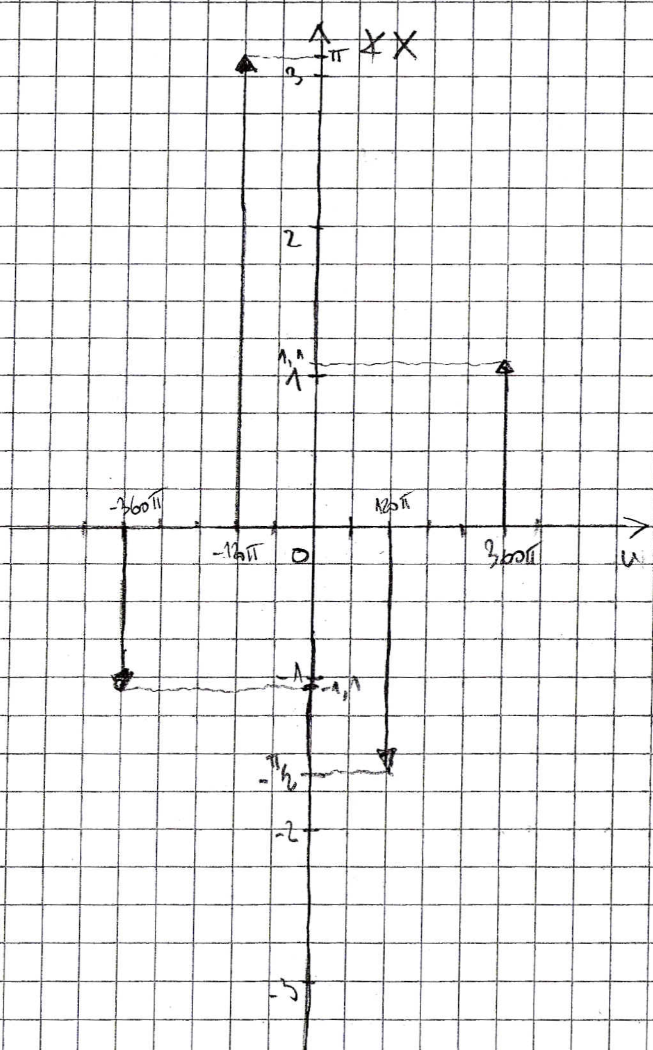
$-50\ pi\ \left(dirac(-360\ pi - w)\left(-\frac{1}{2} + \frac{3^{1/2} i}{2}\right) - dirac(360\ pi - w)\left(\frac{1}{2} + \frac{3^{1/2} \ldots}{2}\right.\right.$

c)

AMPLITUDNI SPEKTAR



FAZNI SPEKTAR



Razlikuju se u amplitudi.

ZADATAK 9

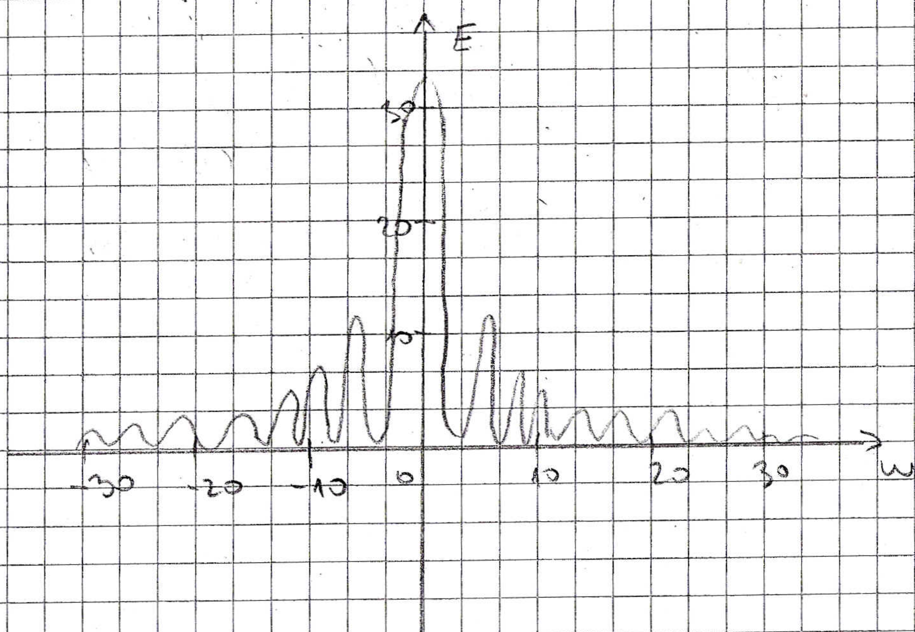
SPEKTRALNA GUSTOĆA ENERGIJE (CTFT)

$$E = \int_{-\infty}^{\infty} \underbrace{x(t)\, x^*(t)}_{|x(t)|^2}\, dt = \frac{1}{2\pi} \int_{-\infty}^{\infty} \underbrace{X(j\omega)\, X^*(j\omega)}_{|X(j\omega)|^2}\, d\omega$$

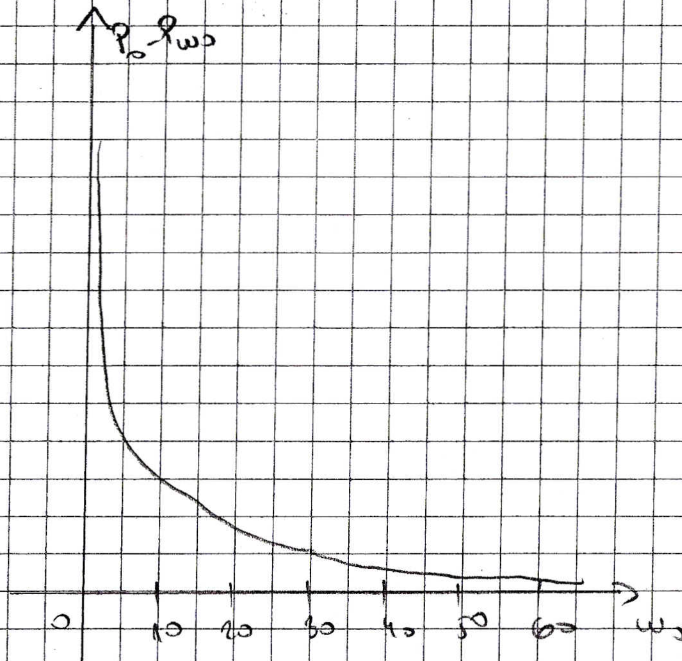
$x(t)$ - signal | t - nezavisna varijabla signala (vrijeme)

$X(j\omega)$ - spektar | ω - nezavisna varijabla spektra (kružna frekvencija

a) X= (4*abs(sin(w))^2)/abs(w)^2



b)



Kada $w_0 \to \infty$ tada razlika sugo teži prema $\emptyset$

ZADATAK 10

Vremenski diskretna Fourierova transformacija (DTFT)

ANALIZA:

$$F(e^{j\Omega}) = \sum_{n=-\infty}^{\infty} f(n) e^{-j\Omega n}$$

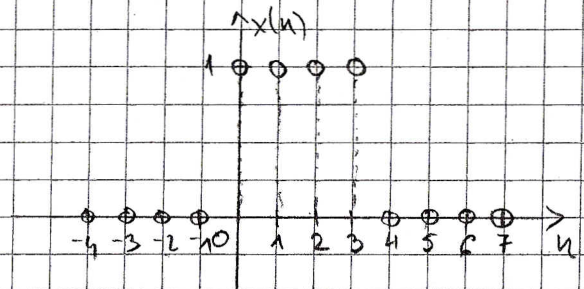
$f(n)$ - signal — n - nezavisna varijabla signala (vrijeme)

$F(e^{j\Omega})$ - spektar — Ω - nezavisna varijabla spektra (kružna frekvencija)

SINTEZA

$$f(n) = \frac{1}{2\pi} \int_{-\pi}^{\pi} F(e^{j\Omega}) e^{j\Omega n} \, d\Omega$$

a)



$A = 1$

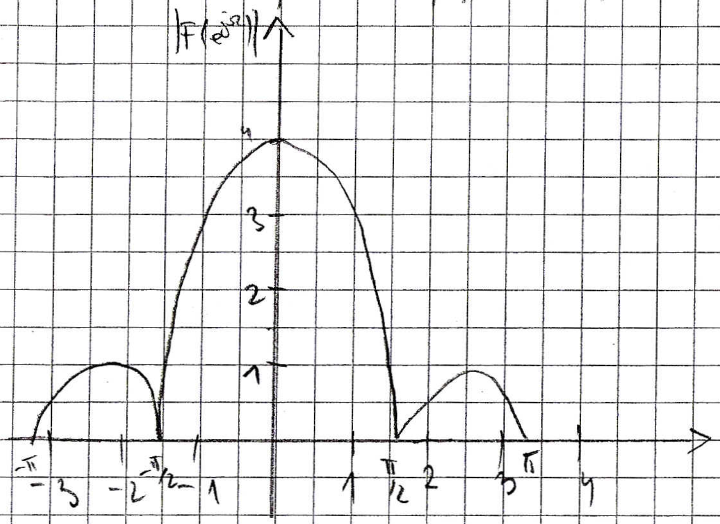
$L = 4$

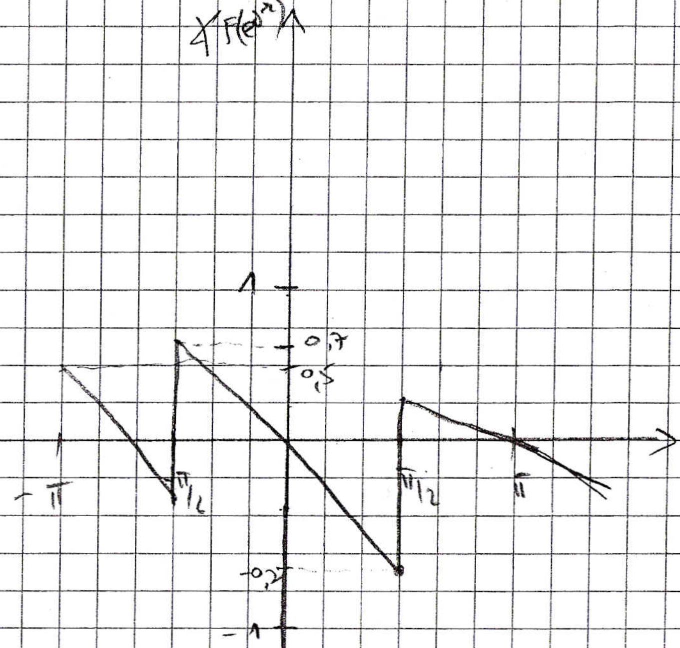
$$F(e^{j\Omega}) = \sum_{n=-\infty}^{\infty} f(n) e^{-j\Omega n} = \sum_{n=0}^{3} e^{-j\Omega n} = \frac{1 - e^{-j4\Omega}}{1 - e^{-j\Omega}} = \frac{\sin(2\Omega)}{\sin(\frac{\Omega}{2})} \cdot e^{-j\frac{3}{2}\Omega}$$

$$|F(e^{j\Omega})| = \begin{cases} 4, & \Omega = 0 \\ \frac{\sin(2\Omega)}{\sin(\frac{\Omega}{2})}, & \text{inače} \end{cases}$$

$$\measuredangle F(e^{j\Omega}) = \measuredangle 1 - \frac{3}{2}\Omega + \measuredangle \frac{\sin(2\Omega)}{\sin(\frac{\Omega}{2})} =$$

b)
```
n = [1 1 1 1];
[H, w] = freqz(n,1);
H = H.*exp(-j*w*5);
plot(w, abs(H))
plot(w, phase(H))
```





d) Ako mijenjamo trajanje signala, amplitudni i fazni spektar postaju gušći sa povećanjem N-a.

e) Ako mijenjamo korak u kojem signal počinje tada amplitudni spektar ostaje isti dok fazni spektar sve više počinje ličiti na pravac.

ZADATAK 11

SPEKTRALNA GUSTOĆA ENERGIJE (DTFT)

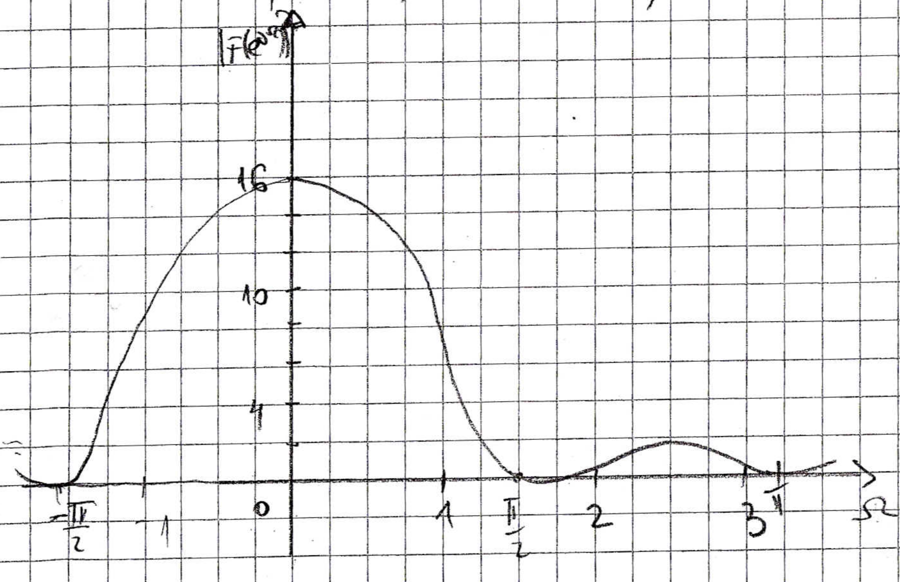
$$E = \sum_{n=-\infty}^{\infty} \underbrace{f(n)\, f^*(n)}_{|f(n)|^2} = \frac{1}{2\pi} \sum_{n=-\infty}^{\infty} \underbrace{F(e^{j\Omega})\, F^*(e^{j\Omega})}_{|F(e^{j\Omega})|^2}$$

$f(n)$ - signal — n - nezavisna varijabla signala (vrijeme)

$F(e^{j\Omega})$ - spektar — Ω - nezavisna varijabla spektra (kružna frekvencija)

a)

```
h=[0 0 0 1 1 1 1 0 0 0 0];
[H,w]=freqz(h,1);
H= H.*exp(-j*w*4);
plot(w, abs(H.^2));
```



ZADATAK 12

Vremenski diskretan Fourierov red (DTFS)

ANALIZA:

$$F_k = \frac{1}{N} \sum_{n=0}^{N-1} f(n)\, e^{-jk\frac{2\pi}{N}n}$$

$f(n)$ - signal

F_k - spektar

n - nezavisna varijabla signala (vrijeme)

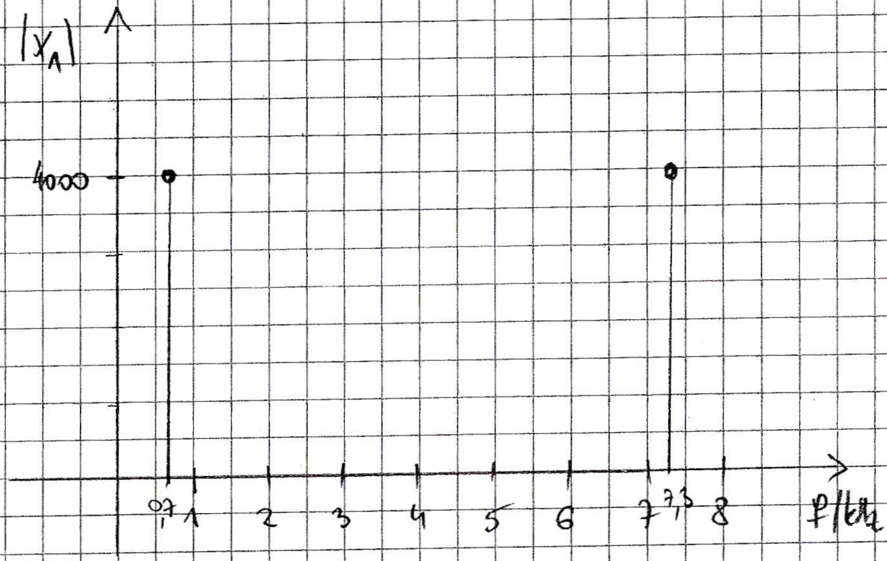
k - nezavisna varijabla spektra (red harmonika

SINTEZA:

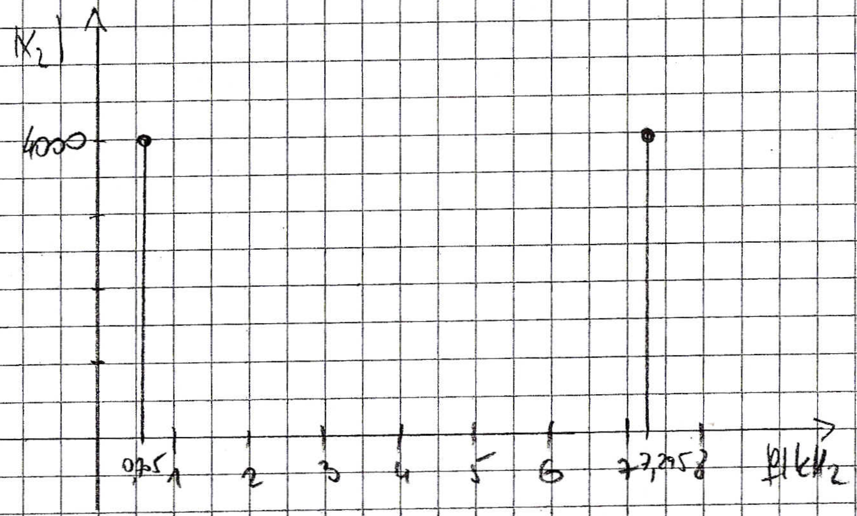
$$f(n) = \sum_{k=0}^{N-1} F_k\, e^{jk\frac{2\pi}{N}n}$$

```
t = [0 : 1/8000 : 1-1/8000]
x = sin(2*pi*700*t);
X = fft(x);
N = length(x);
w = ([1:N]-1)/N*8000;
A = abs(X);
plot(w, A);
```

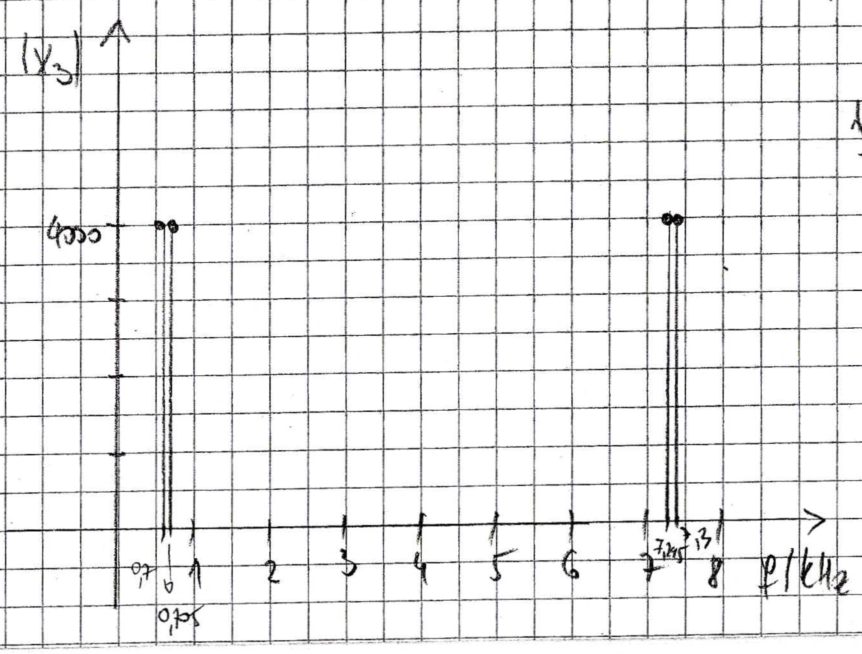
AMPLITUDNI SPEKTAR



d) AMPLITUDNI SPEKTAR



e) AMPLITUDNI SPEKTAR



f) spektar e) je dobiven zbrajanjem i superponiranjem b i d