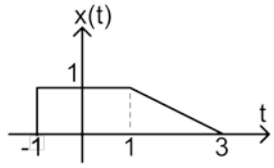
SAÜ, EEM

22.11.2017 İşaretler ve Sistemler Vize Soruları İ. YAZICI, G. ÇETİNEL

S.1.

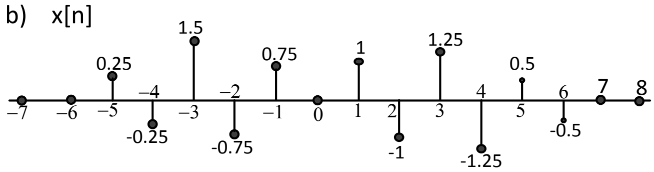
a)



Yanda verilen $x(t)$ işaretini dikkate alarak;

$x_1(t) = x(2t-1) + x\left(-\frac{t}{2}-1\right)\{u(t+1)+u(-t-3)\}$ işaretini işlem basamaklarını (öteleme,ölçekleme,tersleme) ayrı ayrı çizerek elde ediniz. **(12.5p)**

b)

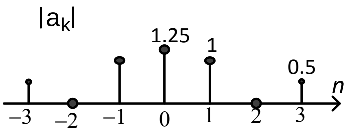


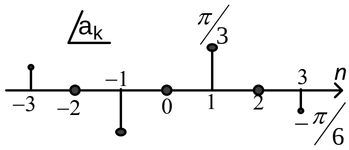
Yanda verilen $x[n]$ işaretini dikkate alarak;

$x_1[n] = x[2n-3]u[n+1] + x[-3n-3]u[-n-1]$

işaretini işlem basamaklarını (öteleme, ölçekleme, tersleme) ayrı ayrı çizerek elde ediniz. **(12.5p)**

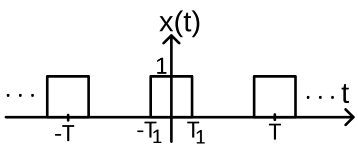
S.2. a)





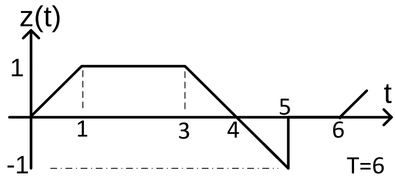
Genlik ve faz spektrumu yanda verilen $x(t)$ işaretini trigonometrik formda elde ediniz **(10p)**

b)



$$x(t) \overset{FS}{\longleftrightarrow} a_k$$

$$a_k = \sin\left(k\frac{2\pi}{T}T_1\right)\Big/ k\pi$$



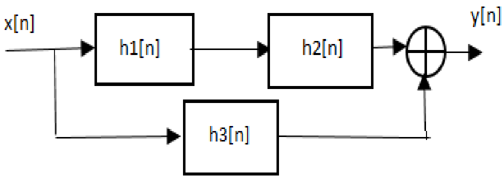
Yukarıda verilen, temel periyodu T=6 olan, $z(t)$ işaretinin Fourier Seri katsayılarını a_k cinsinden elde ediniz. **(15p)**

S.3. Aşağıdaki şekilde verilen doğrusal ve zamanla değişmeyen sistem için

a) Eşdeğer impuls cevabını bulunuz.**(10P)**

b) $x[n] = (\frac{1}{2})^n$(u[n]-u[n-3]) girişine cevabını hesaplayınız. **(10P)**

c) Sistemin nedenselliğini ve kararlılığını inceleyiniz.**(5P)**

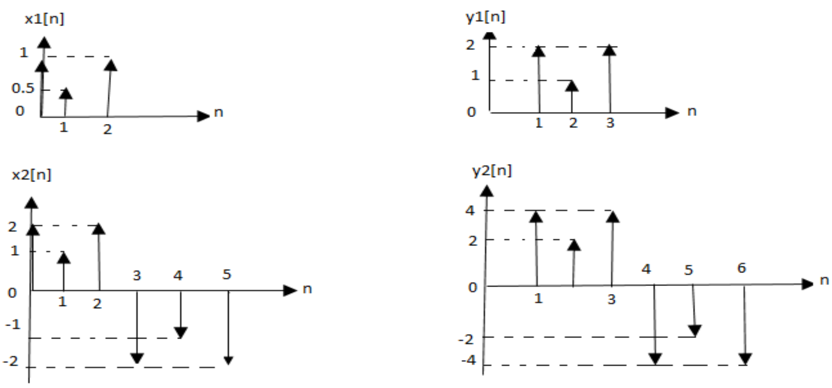


$$h1[n] = \left(\frac{1}{2}\right)\delta[n] - \left(\frac{1}{4}\right)\delta[n-1]$$

$$h2[n] = 2.\delta[n]$$

$$h3[n] = \left(\frac{1}{2}\right)\delta[n-1] + 2\sum_{k=1}^{3}\delta[n-k]$$

S.4. a) Ayrık zaman bir sisteme ait girişler ve çıkışlar aşağıdaki şekillerde gösterilmiştir. Bu şekillere göre sistemin doğrusallığını, zamanla değişmezliğini, nedenselliğini, hafızasızlığını ve kararlılığını açıklayarak inceleyiniz. **(15P)**



b)Giriş çıkış ilişkisi aşağıda verilen doğrusal zamanla değişmeyen sistemlerin blok diyagram gösterilimlerini en az eleman ile elde ediniz. **(10P)**

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

$$y(t) + \left(\frac{1}{2}\right)\frac{dy(t)}{dt} = 4\frac{dx(t)}{dt} + x(t)$$

Formüller:

$$x(t) = \sum_{k=-\infty}^{\infty} a_k e^{jk\omega_0 t} = \sum_{k=-\infty}^{\infty} a_k e^{jk(2\pi/T)t} \qquad a_k = \frac{1}{T}\int_T x(t)e^{-jk\omega_0 t}dt$$

$$x(t-t_0) \overset{FS}{\leftrightarrow} e^{-jk\omega_0 t_0}a_k \qquad x(-t) \overset{FS}{\leftrightarrow} a_{-k} \qquad \frac{dx(t)}{dt} \overset{FS}{\leftrightarrow} jk\omega_0 a_k = jk\frac{2\pi}{T}a_k$$

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

$$x[n] * h[n] = \sum_{k=-\infty}^{\infty} x[k]h[n-k]$$

Sınav Süresi: 90 dakikadır.

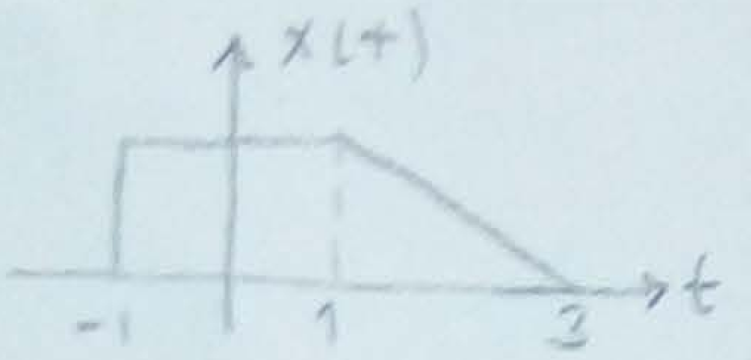
İlk 25 dk sınav salonundan çıkmayınız. **<u>CEP Telefonlarını kapalı tutunuz.</u>**

Soru kağıtlarını alabilirsiniz.

Başarılar Dileriz.

işaretler 2017/18
Vize

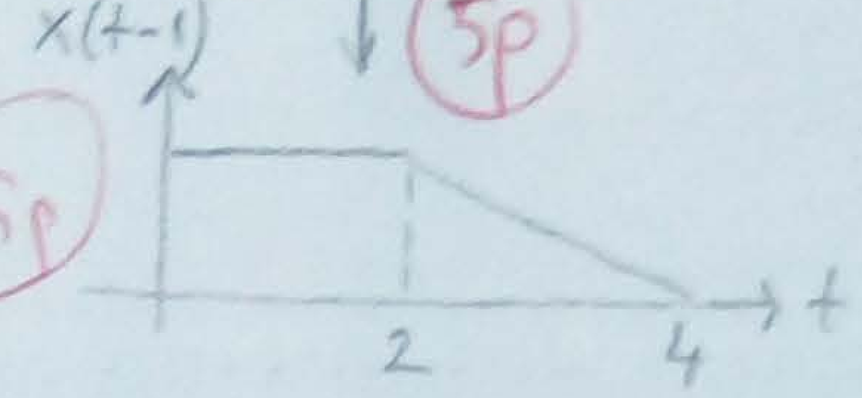
C.1



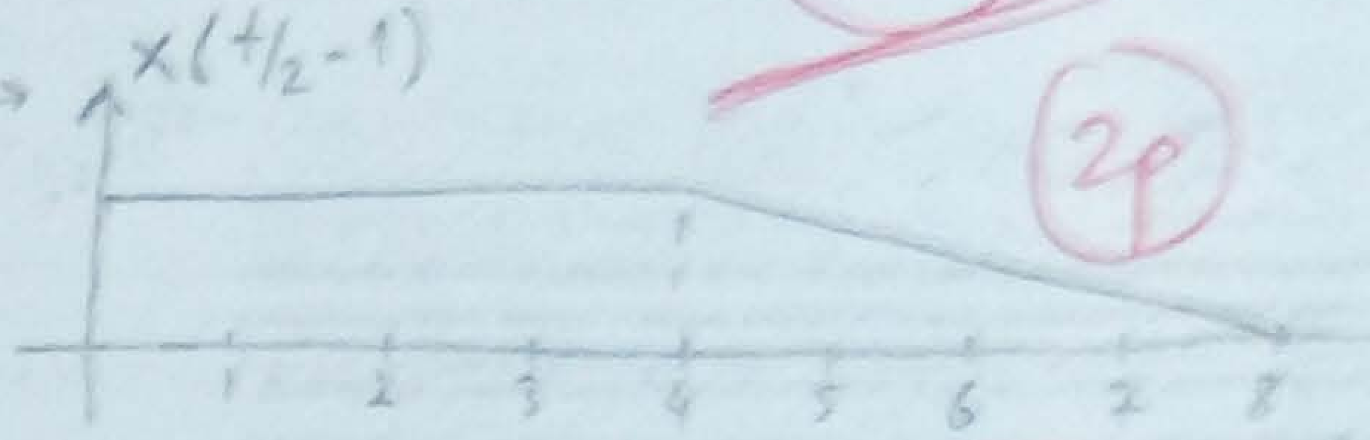
$$x_1(t) = \underbrace{x(2t-1)}_{x_{1a}(t)} + \underbrace{x\left(-\frac{t}{2}-1\right)\{u(t+1)+u(-t-3)\}}_{x_{1b}(t)}$$

7,5p

5p

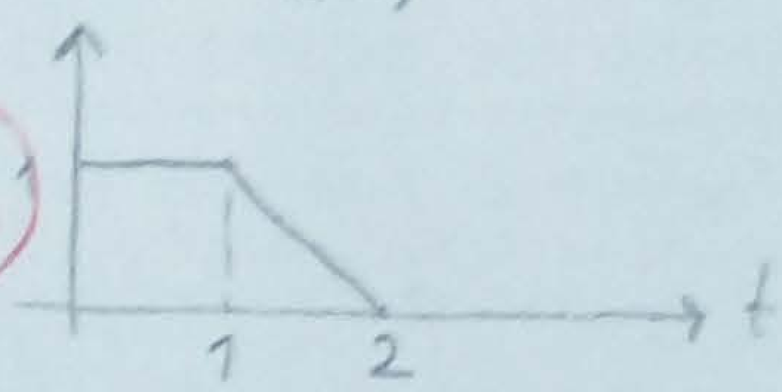


2,5p

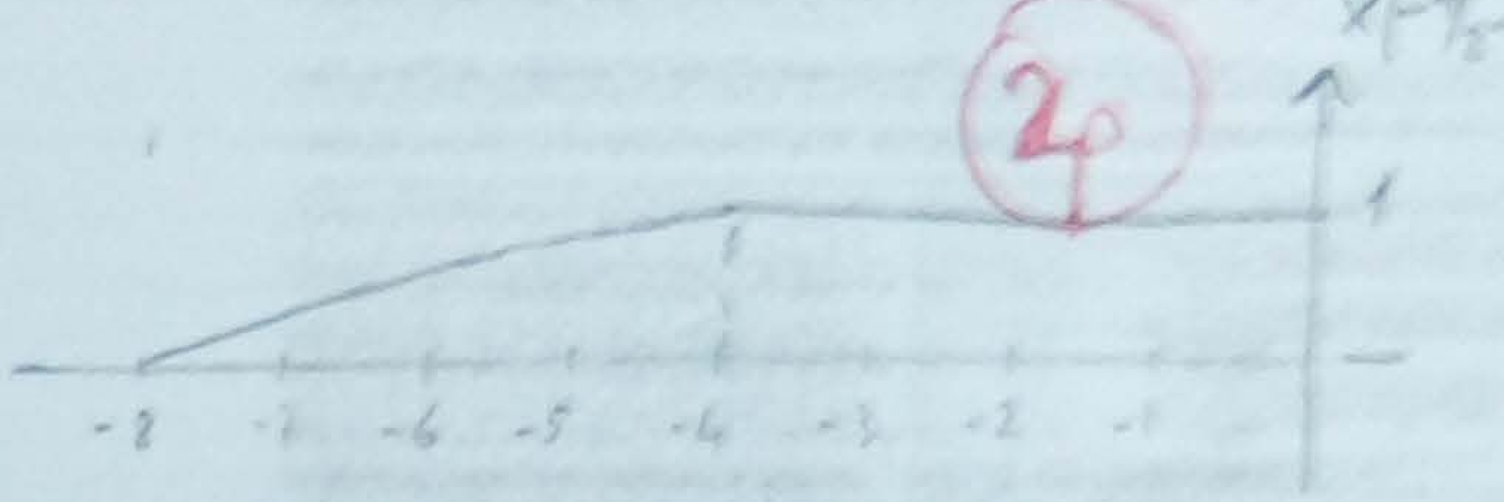


2p

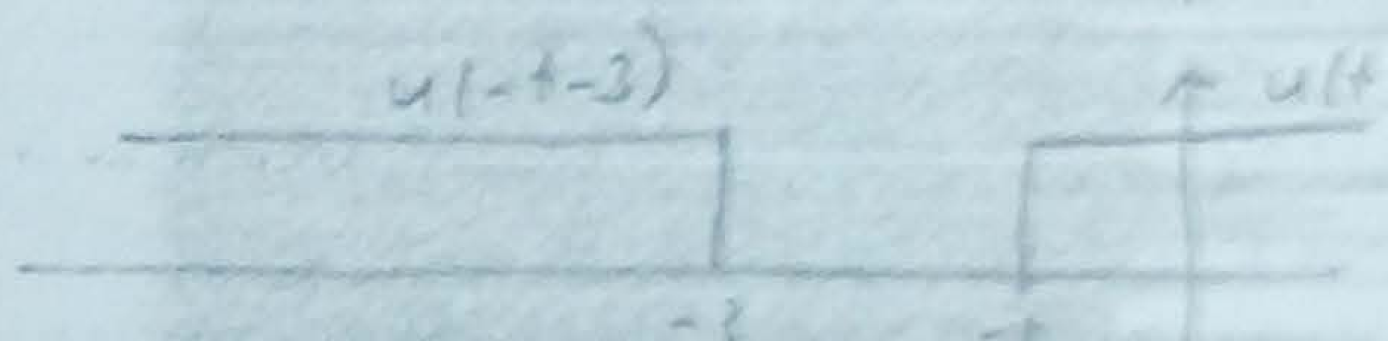
$x(2t-1) = x_{1a}(t)$



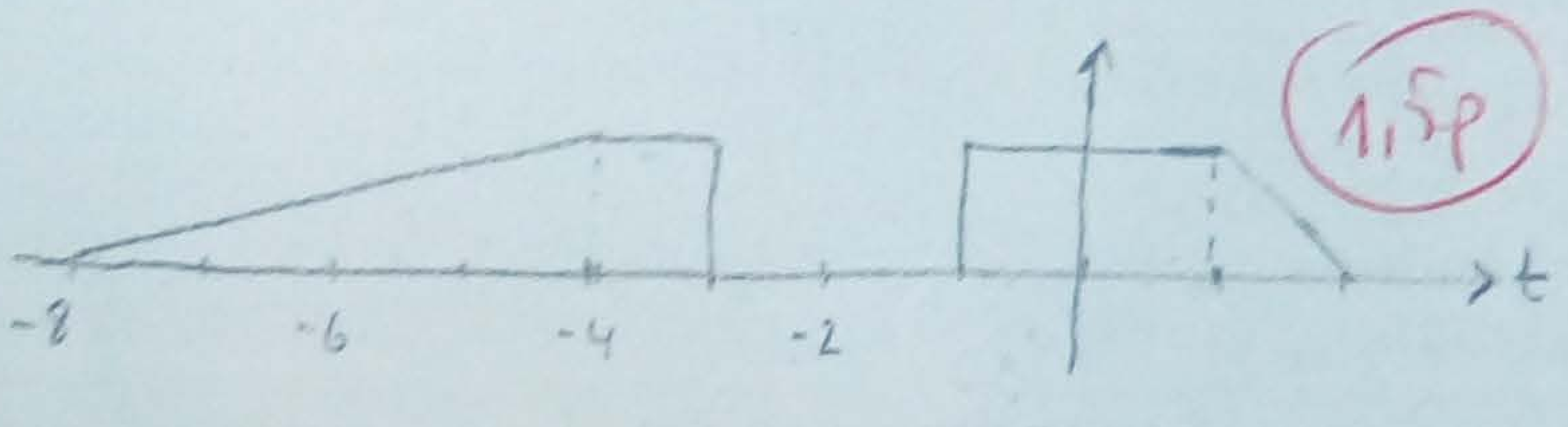
2,5p



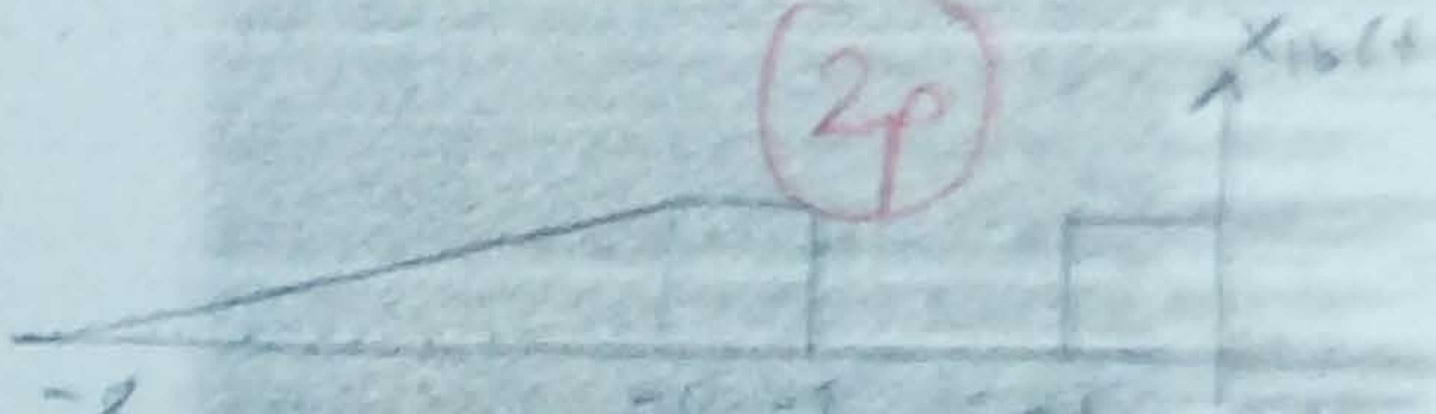
2p



$x_1(t) = x_{1a}(t) + x_{1b}(t)$

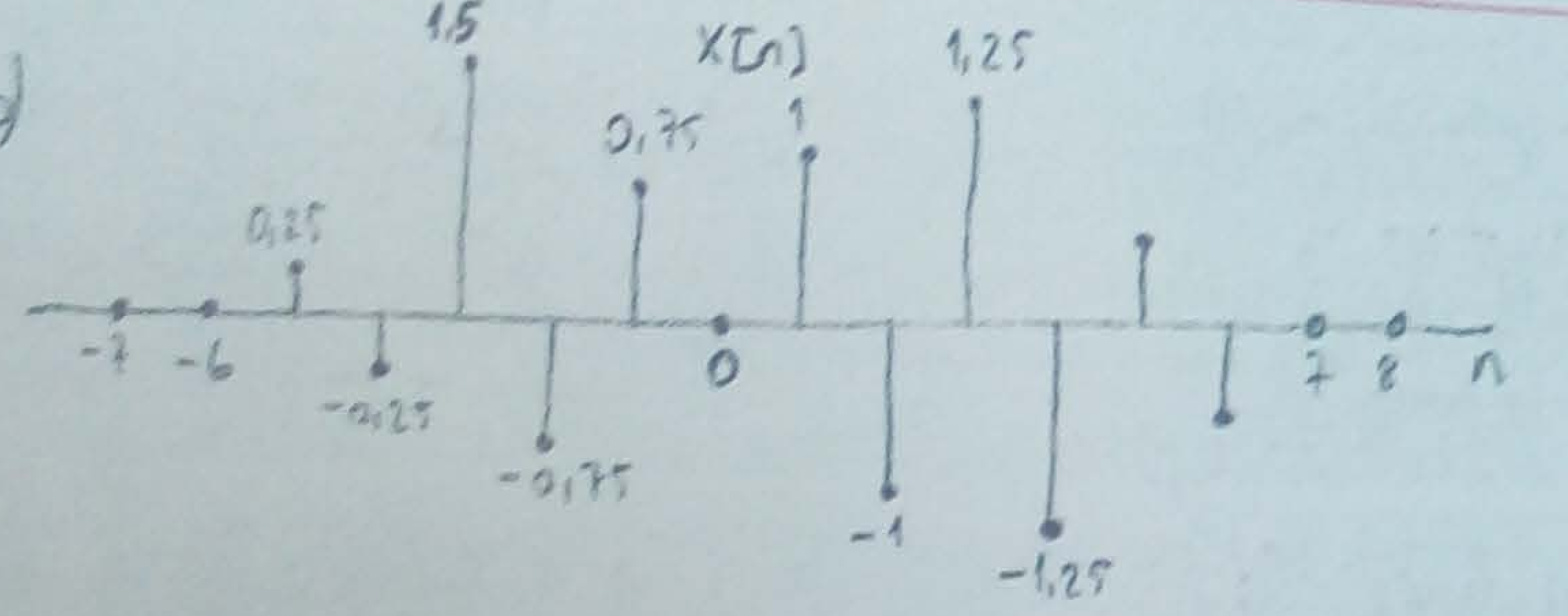


1,5p



2p

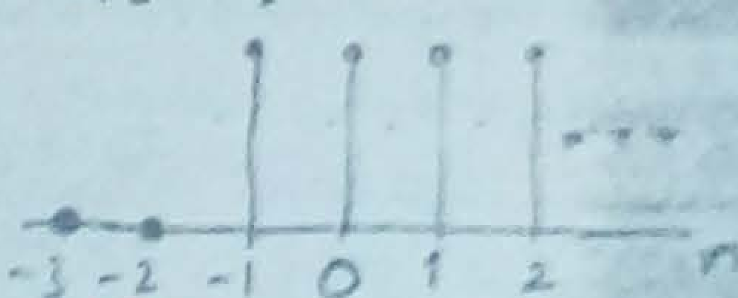
b)



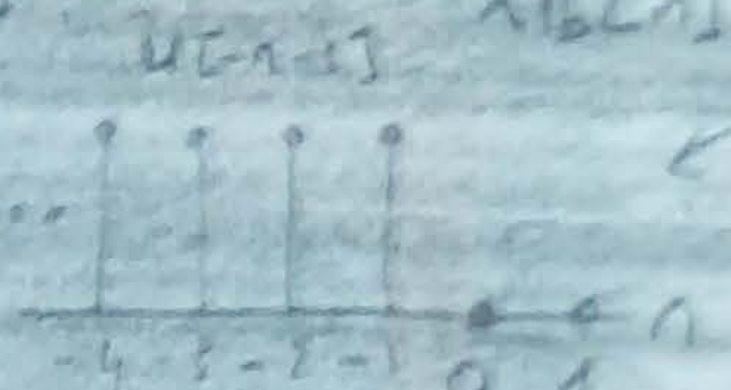
6

6,5

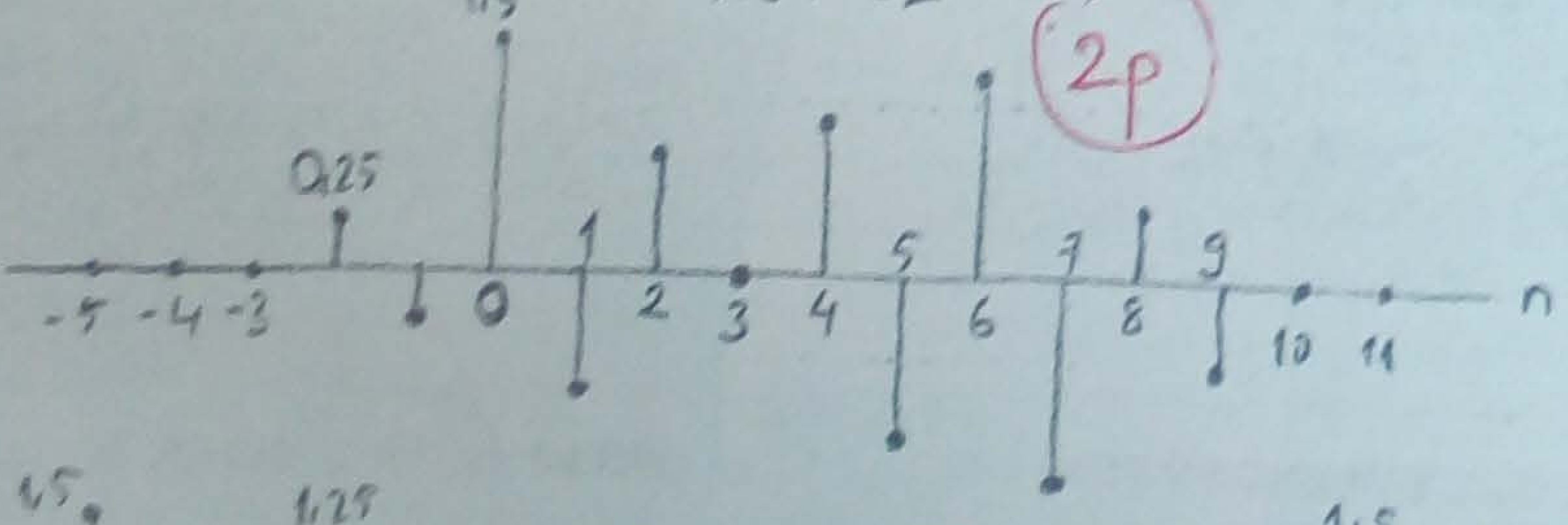
$x_1[n] = \underbrace{x[2n-3]\,u[n+1]}_{x_{1a}[n]} + \underbrace{x[-3n-3]\,u[-n-1]}_{x_{1b}[n]}$



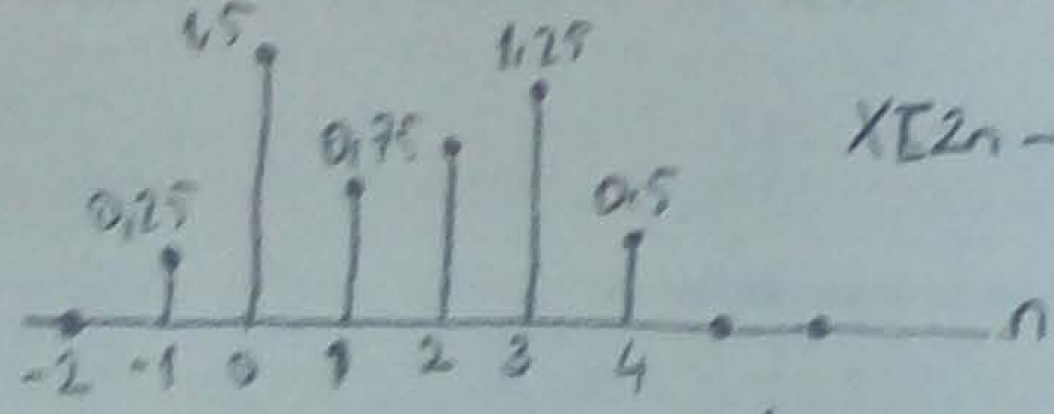
1p



$x_{1a}[n]$ - - .



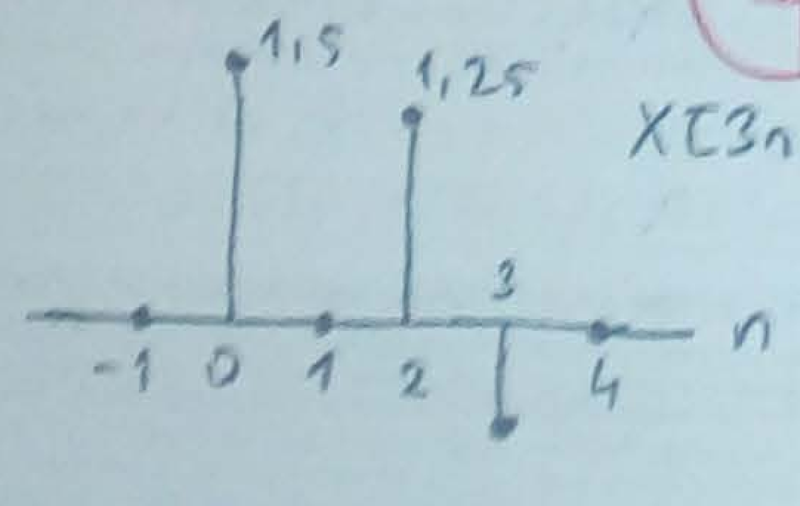
2p



x[2n-3]

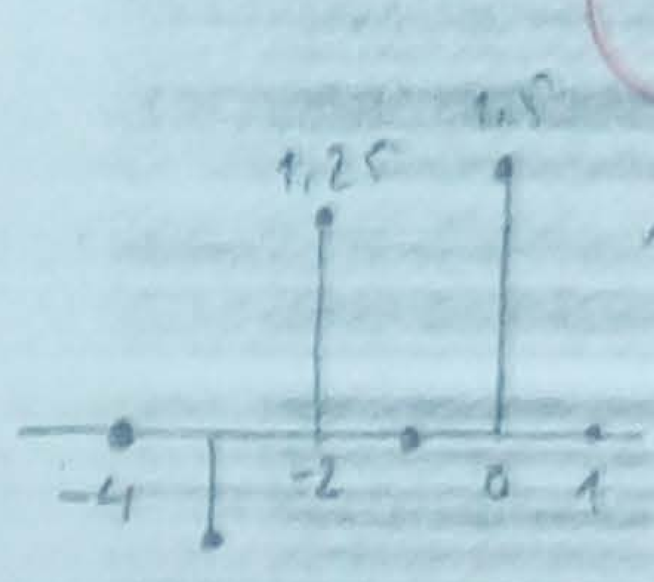
3p

$x[2n-3] \cdot u[n+1] = x_{1a}[n]$



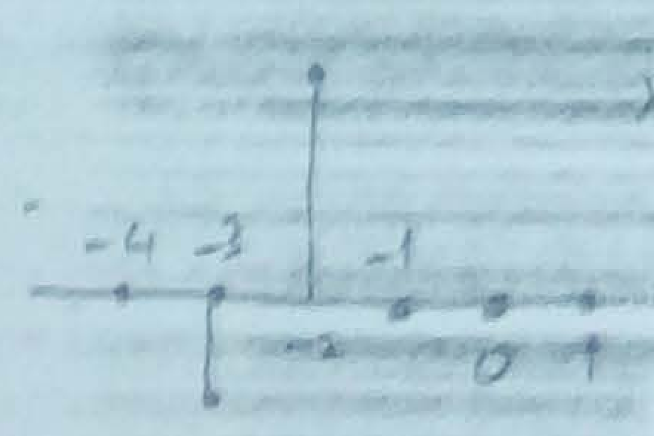
x[3n-3]

3p



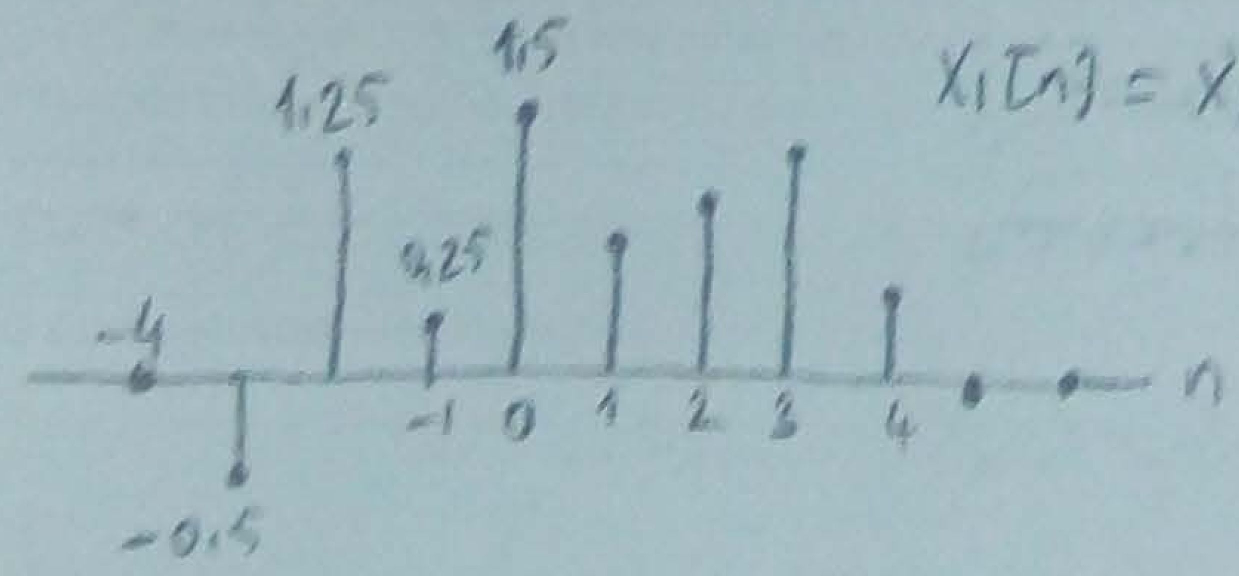
x[-3n-3]

2p



$x[-3n-3]\,u[-n-1]$
↓
$x_{1b}[n]$

$x_1[n] = x_{1a}[n] + x_{1b}[n]$



1,5p

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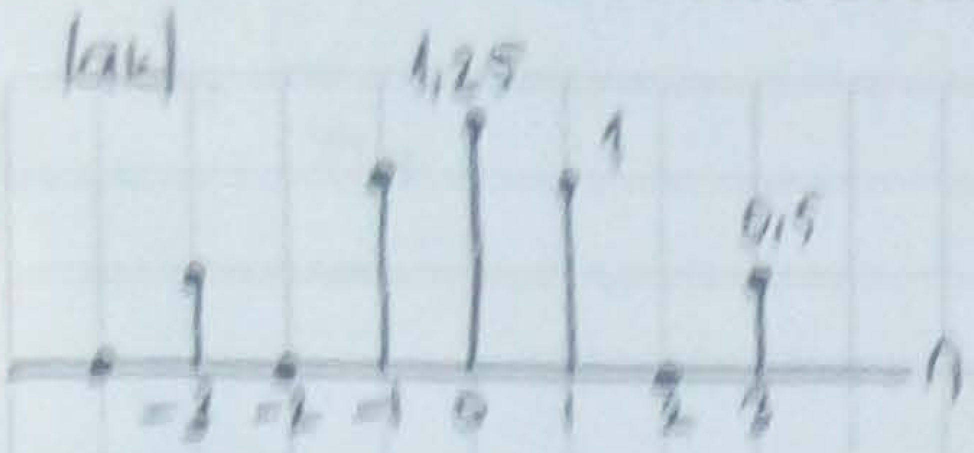
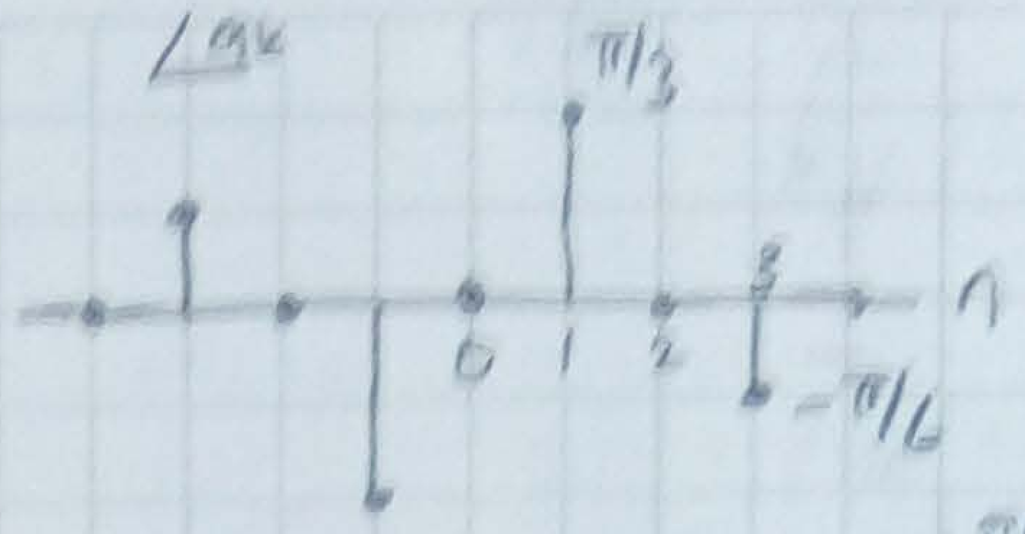
C2 (10p)





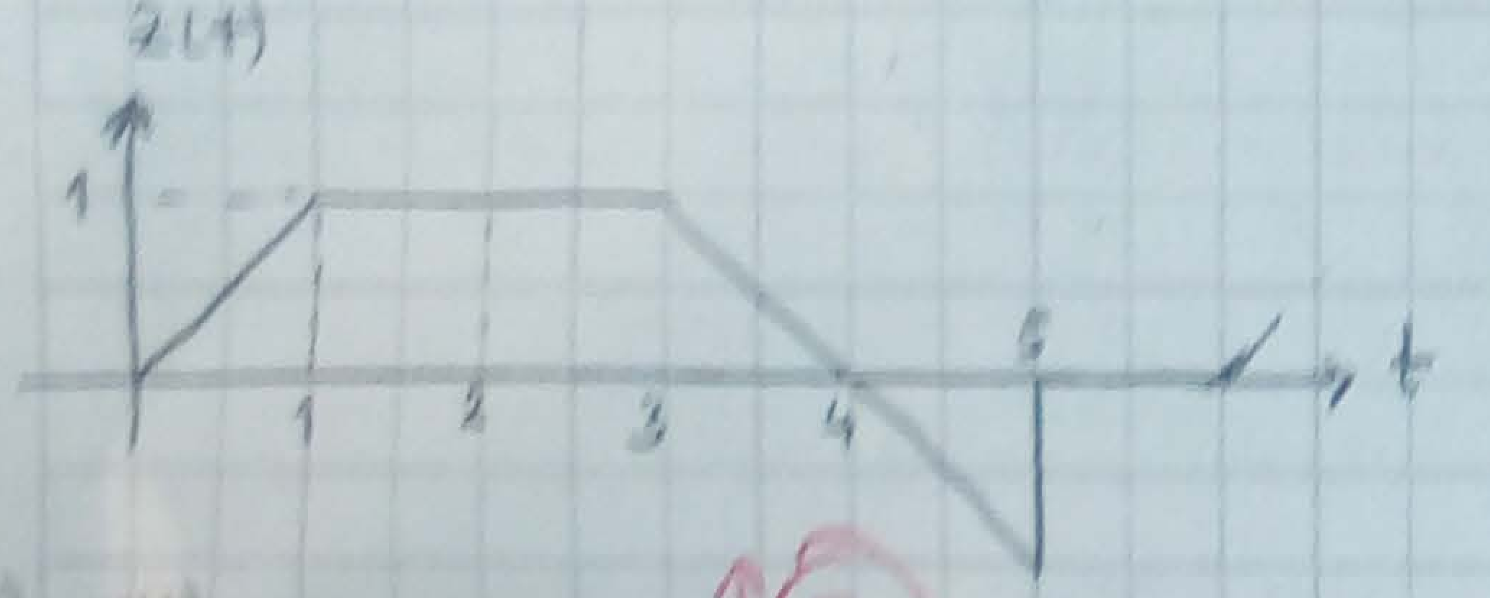
$$x(t)=\sum_{-\infty}^{\infty} a_k e^{jk\omega_0 t} = \frac{1}{2}e^{+j\pi/6}\cdot e^{-j3\omega_0 t} + e^{-j\pi/3}e^{-j\omega_0 t} + 1{,}25 + e^{j\pi/3}e^{j\omega_0 t} + \frac{1}{2}e^{-j\pi/6}\cdot e^{j3\omega_0 t}$$ (7p)

$$2\cdot\frac{e^{j(\omega_0 t+\pi/3)}+e^{-j(\omega_0 t+\pi/3)}}{2}$$

$$\frac{e^{j(3\omega_0 t-\pi/6)}+e^{-j(3\omega_0 t-\pi/6)}}{2}$$

$$x(t)=1{,}25+2\cos(\omega_0 t+\pi/3)+\cos(3\omega_0 t-\pi/6)$$ (3p)

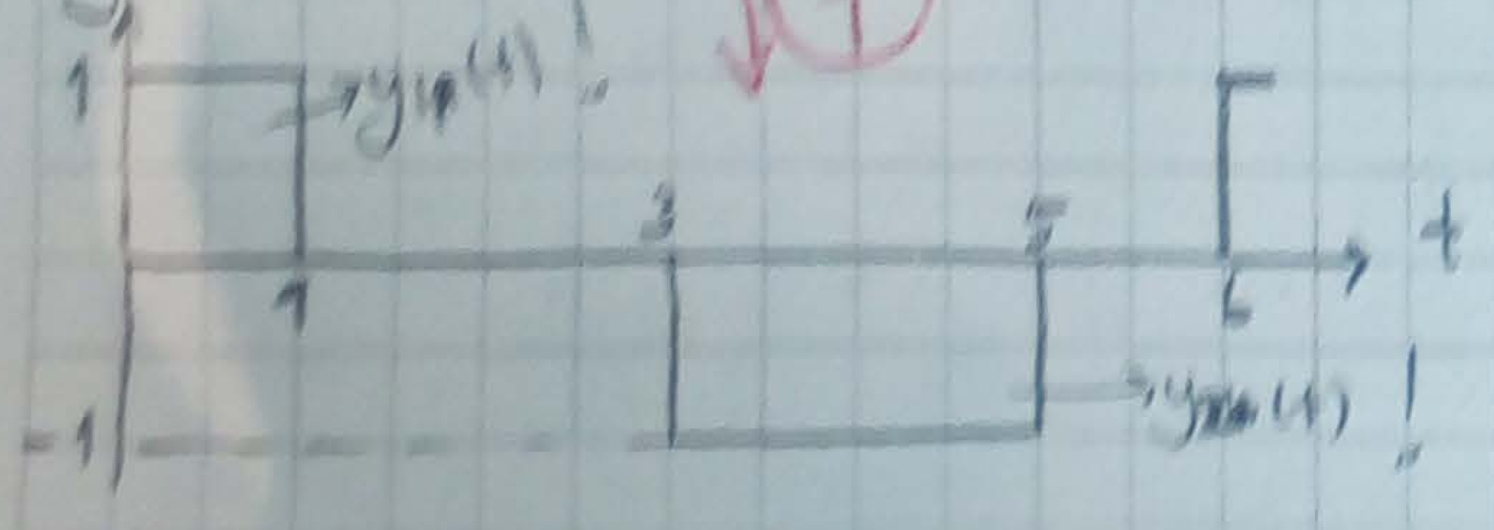
b)



$z(t) \xrightarrow{F.S} b_k \qquad y(t) \xrightarrow{F.S} c_k$

$c_k = jk\omega_0 b_k$

$\frac{dz(t)}{dt}=y(t)$ (5p)



(3p)

$T_1 = 1/2$ ve $T=6$ için

$y_1(t) = x(t-1/2)$

$y_1(t) \xrightarrow{FS} c_{1k} = e^{-jk\omega_0\frac{1}{2}} a_k$

$c_{1k} = e^{-jk\omega_0/2}\cdot \sin(k\,2\pi/6\cdot 1/2)/k\pi$

(3p)

$T_1 = 1$ ve $T=6$ için

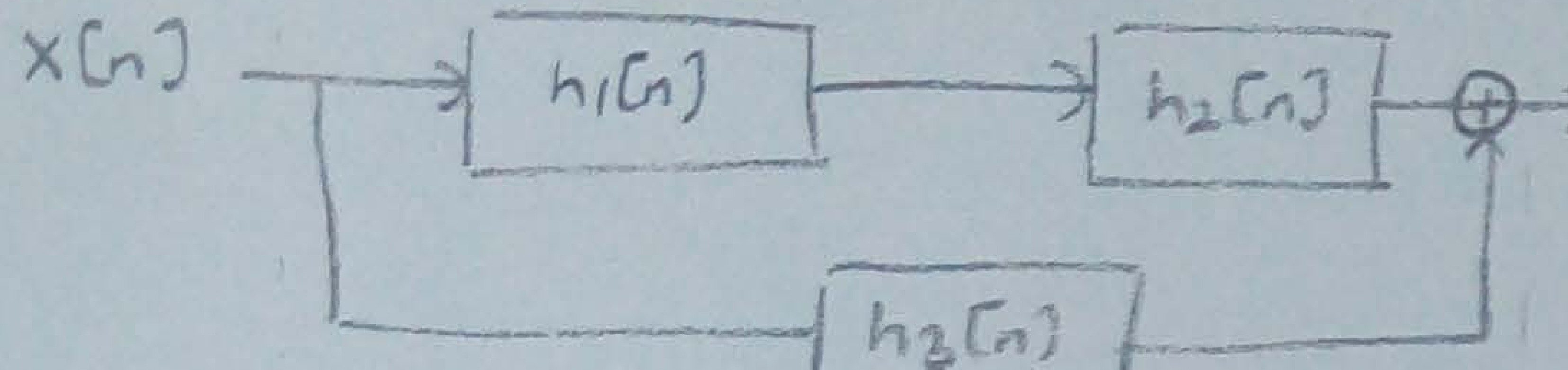
$y_2(t) = -x(t-4) \xrightarrow{F.S} c_{2k} = -e^{-jk\omega_0 4}\cdot a_k = -e^{-jk\omega_0 4}\cdot \sin(k\cdot 2\pi/6\cdot 1)/k\pi$

$c_k = c_{1k}+c_{2k} = e^{-jk\omega_0/2}\cdot \sin(k\cdot\pi/6)/k\pi - e^{-jk\omega_0 4}\sin(k\cdot \pi/3)/k\pi$

$b_k = \frac{c_k}{jk\omega_0} = \frac{3c_k}{jk\pi}$ (2p)

(2p) $b_0 = 2.5/6$ (grafikten) $\left\{ b_0 = \frac{1}{T}\int_T z(t)\,dt \right\}$

25P

3) 

$h_1[n] = \frac{1}{2}\delta[n] - \frac{1}{4}\delta[n-1]$

$h_2[n] = 2 \cdot \delta[n]$

$h_3[n] = \frac{1}{2}\delta[n-1] + 2 \cdot \sum_{k=1}^{3} \delta[n-k]$

a) Yukarıda verilen LTI sistemin eşdeğer impuls cevabını bulunuz.

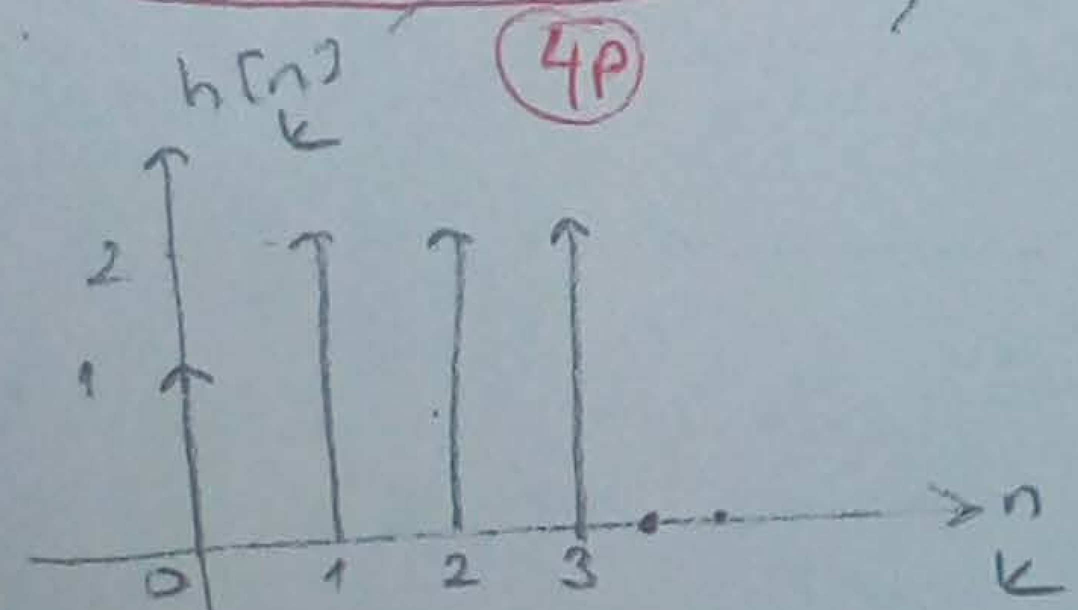
b) $x[n] = \left(\frac{1}{2}\right)^n \left(u[n] - u[n-3]\right)$ girişine cevabını hesaplayınız (işaretleri çiziniz)

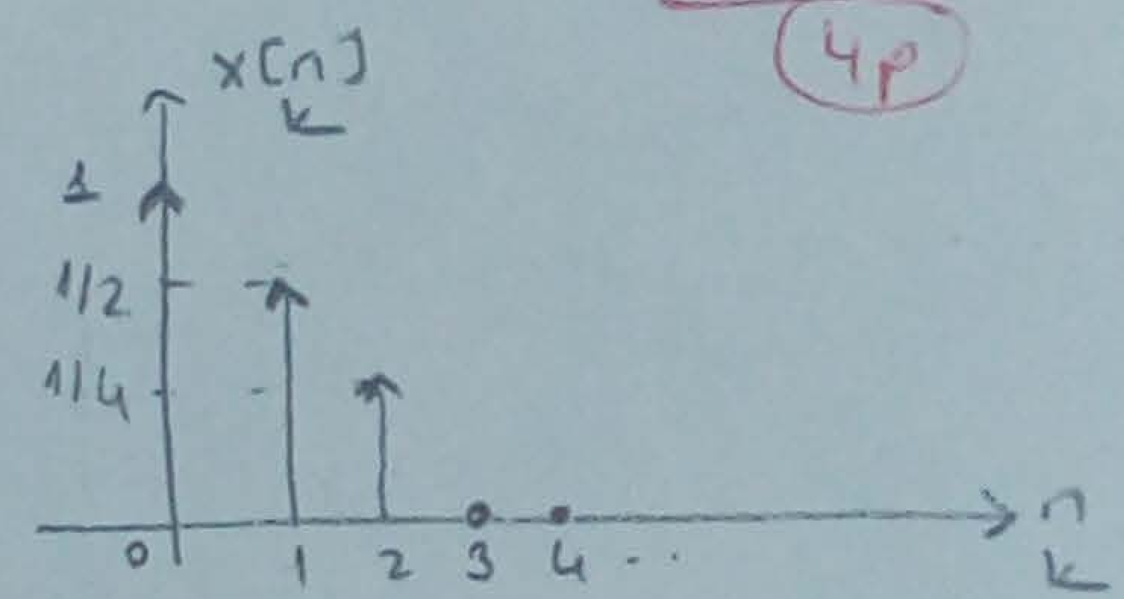
c) sistemin nedensellliğini ve kararlılığını inceleyiniz

Çözüm

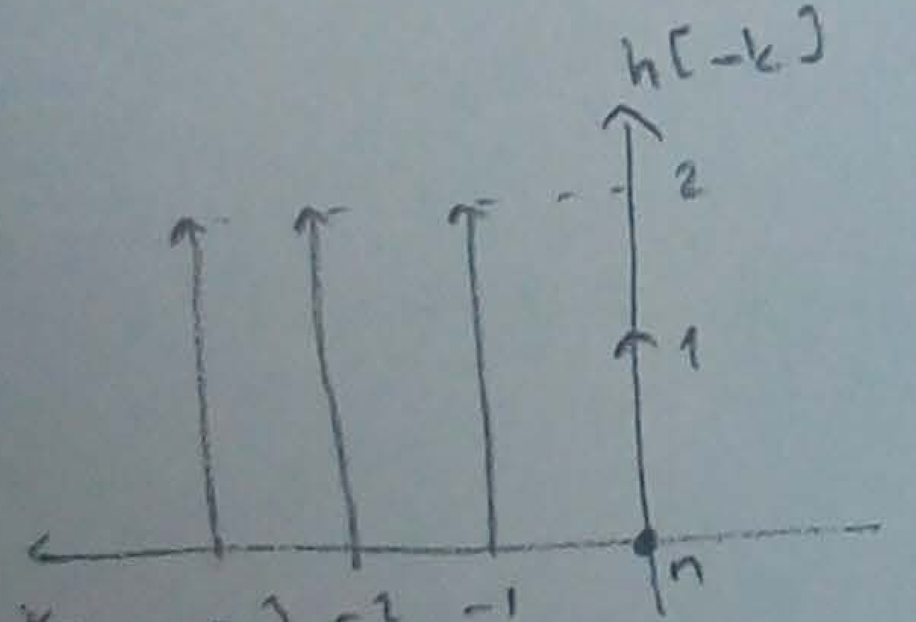
a) $h[n] = \underbrace{(h_1[n] * h_2[n]) + h_3[n]}_{(2p)} = \left[\left(\frac{1}{2}\delta[n] - \frac{1}{4}\delta[n-1]\right) * 2\delta[n]\right] + \frac{1}{2}\delta[n-1] + 2\sum_{k=1}^{3}\delta[n-k]$

$= \underbrace{\delta[n] - \frac{1}{2}\delta[n-1]}_{(4p)} + \frac{1}{2}\delta[n-1] + 2\sum_{k=1}^{3}\delta[n-k] = \underbrace{\delta[n] + 2\sum_{k=1}^{3}\delta[n-k]}_{(4p)} \ldots$ 10P

b) 



$y[n] = \sum_{k=-\infty}^{\infty} x[k] \cdot h[n-k]$



10P

10p

$n < 0 \quad y[n] = 0$

$n = 0 \quad y[n] = (1/2)^0 \cdot 1 = 1$

$n = 1 \quad y[n] = \left(\frac{1}{2}\right)^1 1 + 2\left(\frac{1}{2}\right)^0 = \frac{5}{2}$

$n = 2 \quad y[n] = \left(\frac{1}{2}\right)^2 1 + \left(\frac{1}{2}\right)^1 \cdot 2 + \left(\frac{1}{2}\right)^0 2 = \frac{1}{4} + 1 + 2$

$n = 3 \quad y[n] = \left(\frac{1}{2}\right)^3 \cdot 0 + \left(\frac{1}{2}\right)^2 \cdot 2 + \left(\frac{1}{2}\right)^1 2 \cdot + \left(\frac{1}{2}\right)^0 \cdot 2 = \frac{1}{2} + 1 + 2$

$n = 4 \quad y[n] = \left(\frac{1}{2}\right)^2 2 + \left(\frac{1}{2}\right)^1 \cdot 2$

$n = 5 \quad y[n] = \left(\frac{1}{2}\right)^2 \cdot 2$

$n \geq 6 \quad y[n] = 0.$

$y[n] = \left\{1, \frac{5}{2}, \frac{13}{4}, \frac{7}{2}, \frac{3}{2}, \frac{1}{2}\right\}$

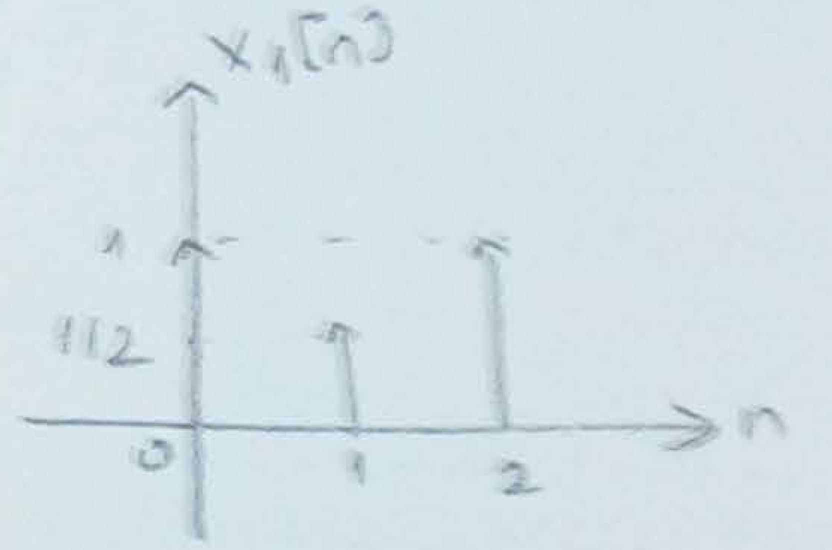
c) $h[n] = \delta[n] + 2\sum_{k=1}^{3}\delta[n-k]$

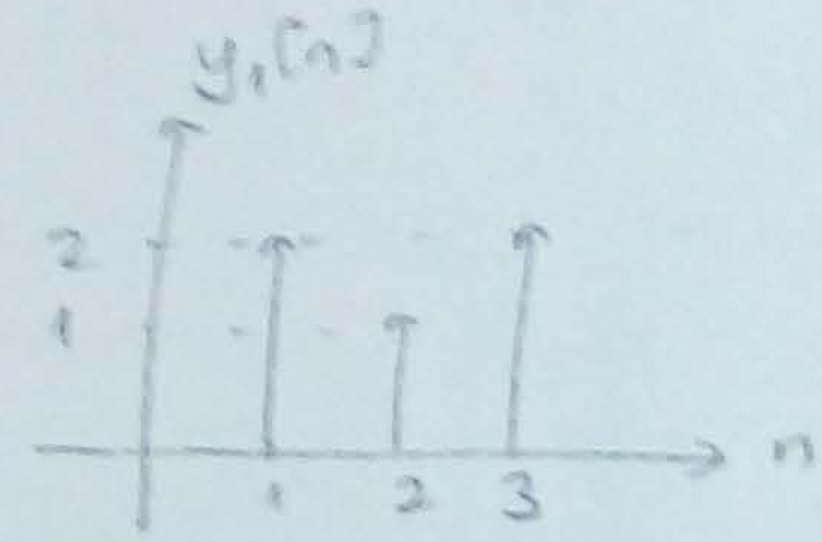
$n < 0, \ h[n] = 0$ olduğundan sistem nedenseldir (2,5p) 5P

$\sum_{n=-\infty}^{\infty} |h[n]| < \infty$ " " kararlıdır (2,5p)

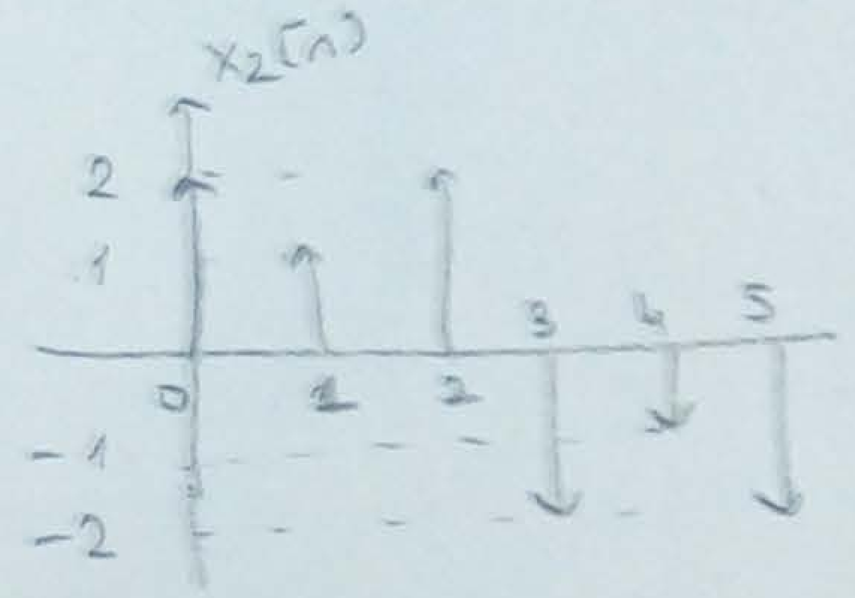
25P

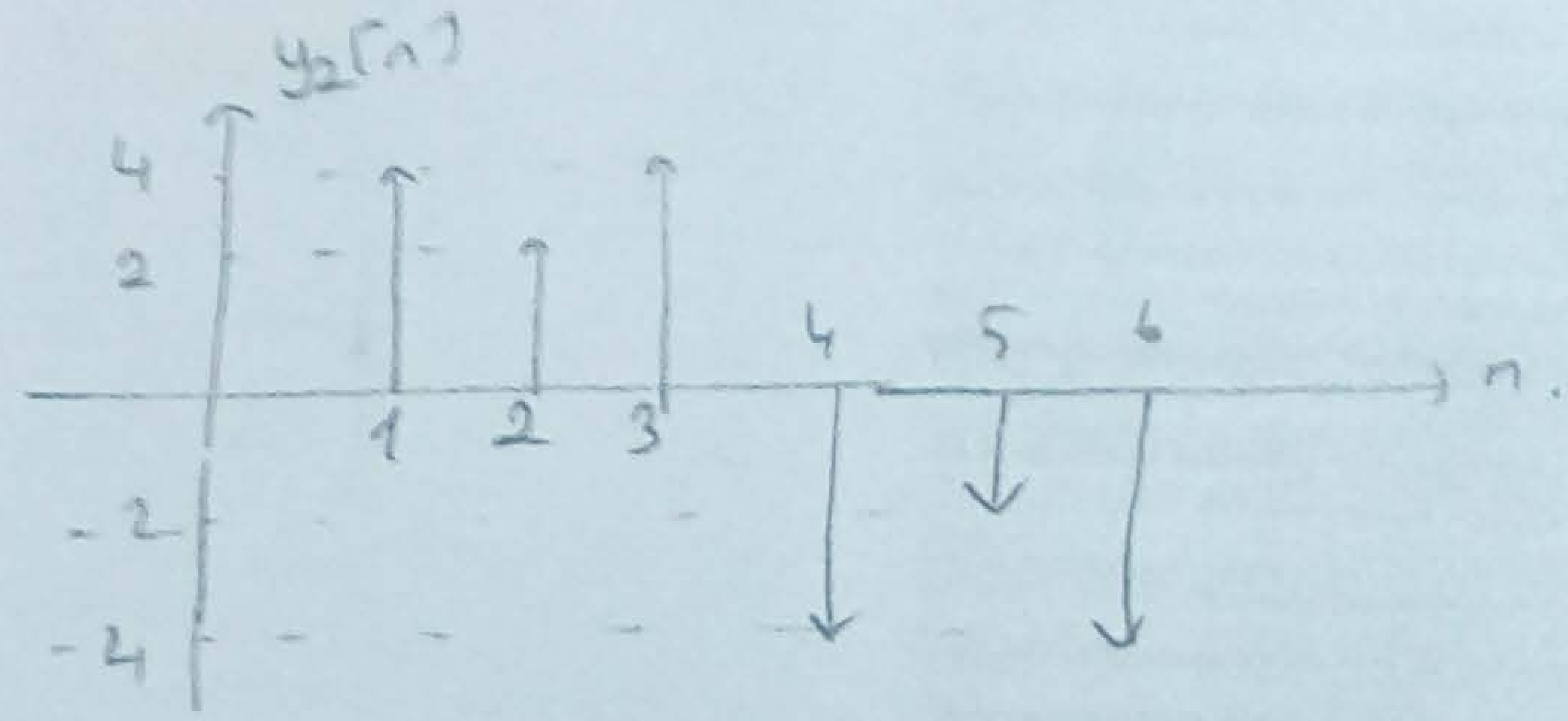
2) a) Ayrık-zaman bir sisteme ait girişler ve sistemin verdiği cevap aşağıda şekil olarak verilmiştir.





Şekil 1





Şekil 2

Buna göre sistemin doğrusallık, zamanla değişmezlik, nedensellik, hafızasızlık ve kararlılık özelliklerini açıklayarak inceleyiniz. 15P

b) Giriş-çıkış ilişkileri aşağıda verilen LTI sistemlerin blok diyagram gösterilimlerini mümkün en az eleman ile çiziniz.

$$y[n] = -\frac{1}{8}y[n-2] + \frac{3}{4}y[n-1] + 2x[n-1]. \quad 5P$$

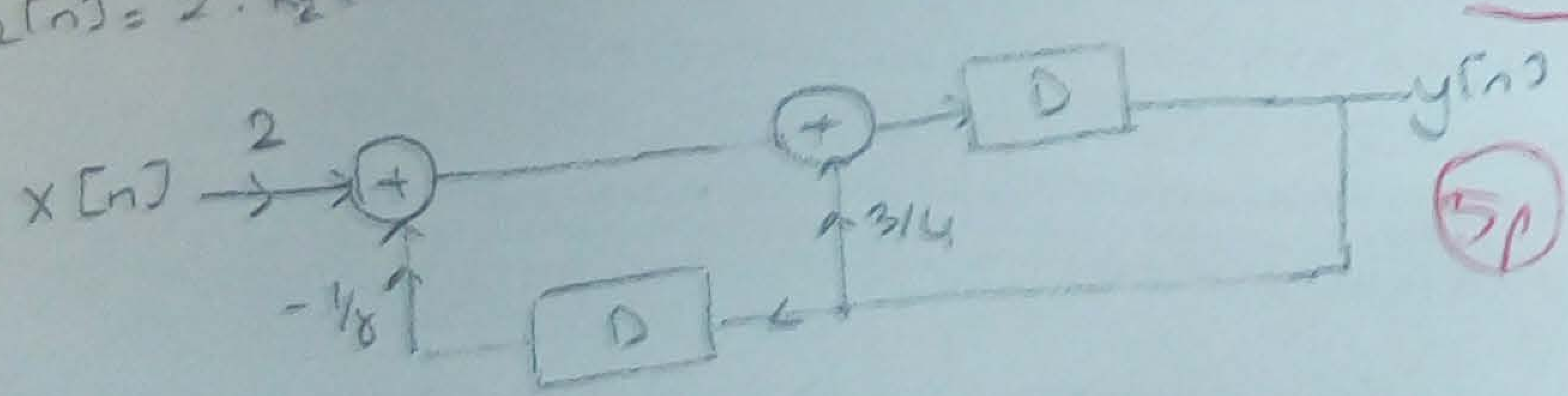
$$y(t) = -\frac{1}{2}\frac{dy(t)}{dt} + 4\cdot\frac{dx(t)}{dt} + x(t). \quad 5P$$

Çözüm

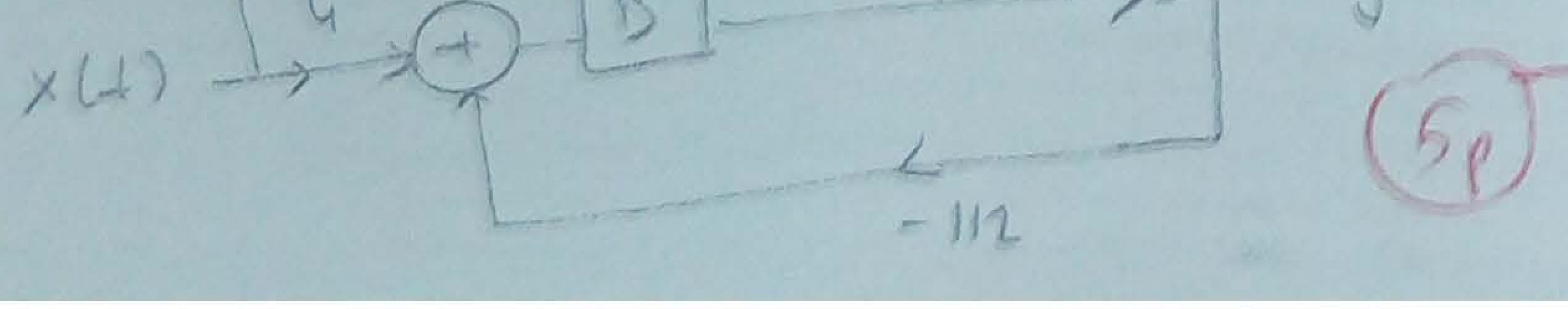
İlk şekile göre $y[n] = 2\cdot x_1[n-1]$ olduğu açıkça görülmektedir. Şekil 2 sistem ölçeklendiğinde girişteki bir katsayı ile çarpma ve süperpozisyon sağlandığında da sistem ölçeklendiğinde çıkış da aynı oranda ölçeklendiğinden sistem zamanla değişmezdir. Giriş ölçeklendiğinde doğrusaldır.

$y_1[n] = 2x_1[n-1]$
$y_2[n] = 2\cdot x_2[n-1]$) bakılacak sistem nedensel, hafızalı, kararlıdır.

$3\times5 = 15p$



5p



5p — int. olabilir