

EHB 351
ANALOG HABERLEŞME
(Araştırma 2 Çözümleri)

10.12.2015

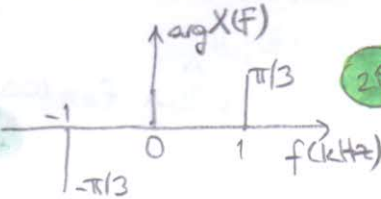
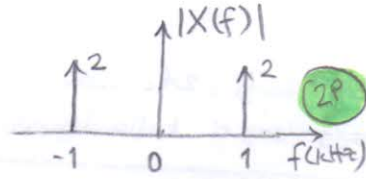
43P (1)

$$x(t) = 4 \cos(2\pi 10^3 t + \theta), \theta = \pi/3 \Rightarrow x(t) = 4 \cos(2\pi 10^3 t + \pi/3)$$

$$a) x(t) = 2e^{j\pi/3} e^{j2\pi 10^3 t} + 2e^{-j\pi/3} e^{-j2\pi 10^3 t}$$

$$X(f) = 2e^{j\pi/3} \delta(f - 10^3) + 2e^{-j\pi/3} \delta(f + 10^3) \quad (4P)$$

$\theta = 0$ alanlar için
 θ 'ya bağlı kısımlar $\times \frac{2}{3}$



$$X(f) = |X(f)| e^{j \arg X(f)}$$

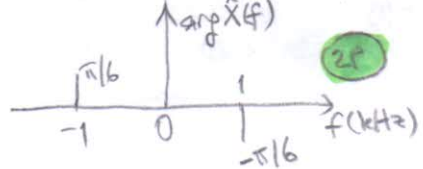
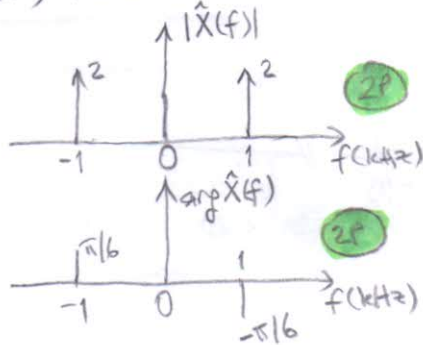
$$b) \hat{x}(t) = 4 \cos(2\pi 10^3 t + \pi/3 - \pi/2) = 4 \cos(2\pi 10^3 t - \pi/6) = 4 \sin(2\pi 10^3 t + \pi/3) \quad (4P)$$

$$\hat{X}(f) = -j \operatorname{sgn}(f) X(f)$$

$$= -2j e^{j\pi/3} \underbrace{\operatorname{sgn}(10^3)}_1 \delta(f - 10^3) - 2j e^{-j\pi/3} \underbrace{\operatorname{sgn}(-10^3)}_{-1} \delta(f + 10^3)$$

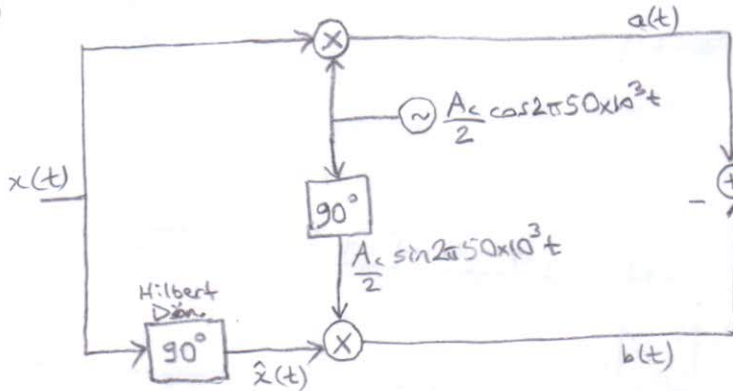
$$= -2j e^{j\pi/3} \delta(f - 10^3) + 2j e^{-j\pi/3} \delta(f + 10^3)$$

$$= 2e^{-j\pi/6} \delta(f - 10^3) + 2e^{j\pi/6} \delta(f + 10^3) \quad (4P)$$



$$\hat{X}(f) = |\hat{X}(f)| e^{j \arg \hat{X}(f)}$$

c)



$$x_c(t) = \frac{A_c}{2} [x(t) \cos(2\pi 50 \times 10^3 t) - \hat{x}(t) \sin(2\pi 50 \times 10^3 t)] \quad (6P)$$

$$a(t) = x(t) \frac{A_c}{2} \cos(2\pi 50 \times 10^3 t) = 2A_c \cos(2\pi 10^3 t + \pi/3) \cos(2\pi 50 \times 10^3 t)$$

$$= A_c \cos(2\pi 51 \times 10^3 t + \pi/3) + A_c \cos(2\pi 49 \times 10^3 t + \pi/3) \quad (4P)$$

$$b(t) = \hat{x}(t) \frac{A_c}{2} \sin(2\pi 50 \times 10^3 t) = 2A_c \sin(2\pi 10^3 t + \pi/3) \sin(2\pi 50 \times 10^3 t)$$

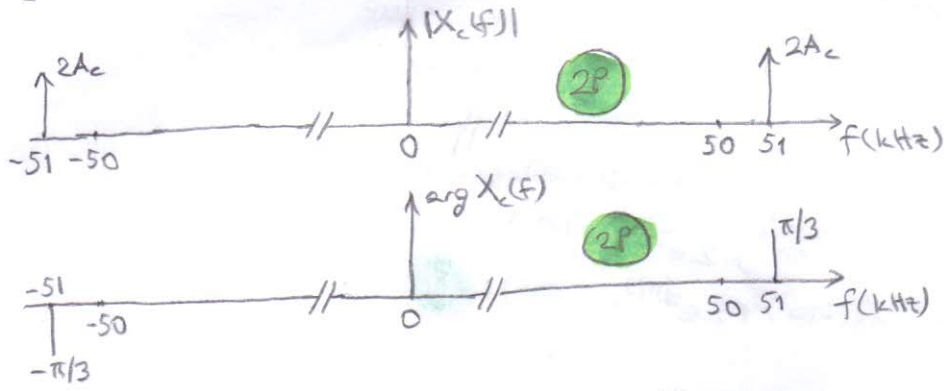
$$= A_c \cos(2\pi 49 \times 10^3 t + \pi/3) - A_c \cos(2\pi 51 \times 10^3 t + \pi/3)$$

$$\Rightarrow x_c(t) = a(t) - b(t) = 2A_c \cos(2\pi 51 \times 10^3 t + \pi/3) \quad (4P)$$

→

$$X_c(f) = 2A_c e^{j\pi/3} \delta(f - 51 \times 10^3) + 2A_c e^{-j\pi/3} \delta(f + 51 \times 10^3)$$

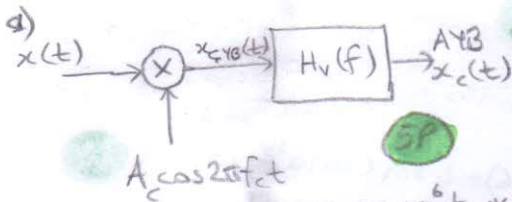
$$X_c(f) = |X_c(f)| e^{j\arg X_c(f)}$$



d) $x_c(t) = 2A_c \cos(2\pi 51 \times 10^3 t + \pi/3)$ ifaretinin zarfı: $2A_c$ (Sabit)

Zarfta $x(t)$ yer almadığı için zarf seçici kullanılmaz. (5P)

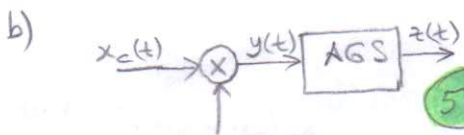
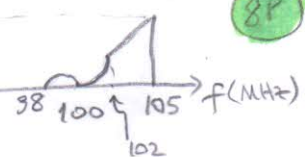
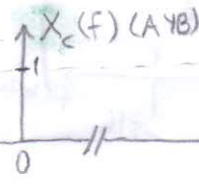
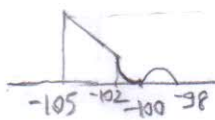
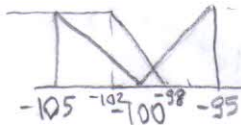
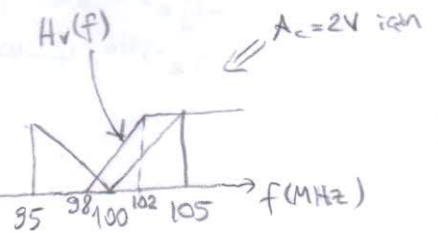
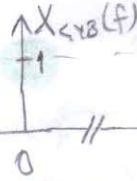
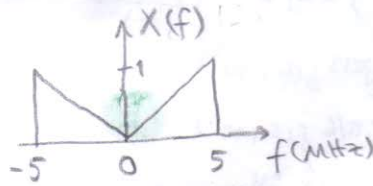
57P (2)



Şekilden $f_c = 100$ MHz olduğu görülmektedir. (3P)

$$x_c(t) = A_c x(t) \cos(2\pi 100 \times 10^6 t) * h_v(t)$$

$$X_c(f) = \frac{A_c}{2} [X(f - 100 \times 10^6) + X(f + 100 \times 10^6)] H_v(f)$$

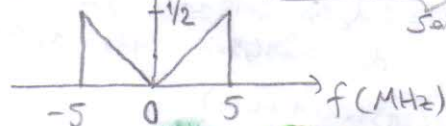


$$y(t) = x_c(t) \cos(2\pi 100 \times 10^6 t)$$

$$Y(f) = \frac{X_c(f - 100 \times 10^6) + X_c(f + 100 \times 10^6)}{2}$$

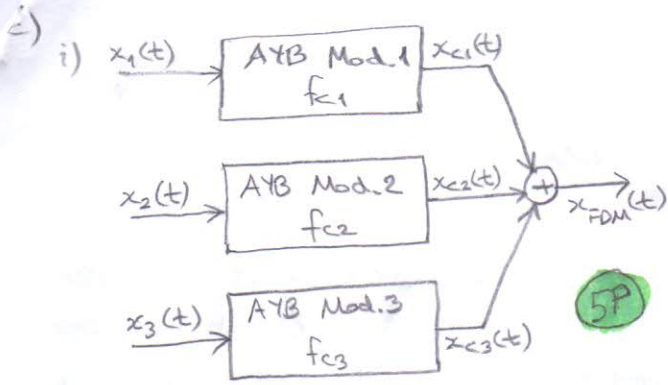


$$Z(f) = \frac{H_v(f - 100 \times 10^6) + H_v(f + 100 \times 10^6)}{2} X(f) = k X(f)$$



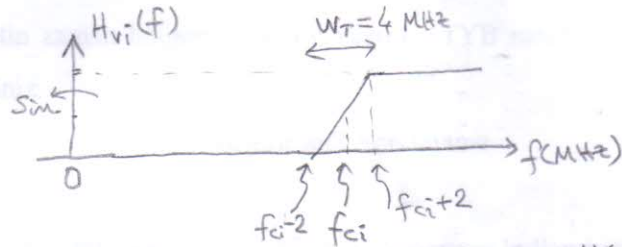
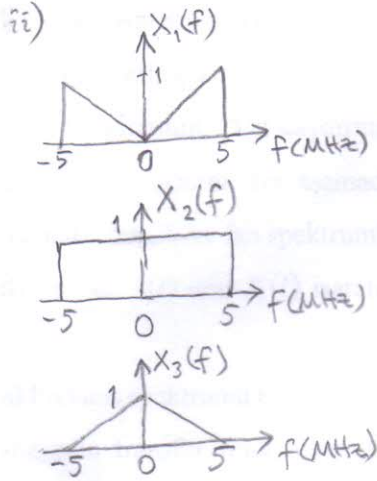
$$\Rightarrow z(t) = k x(t)$$

(6P)

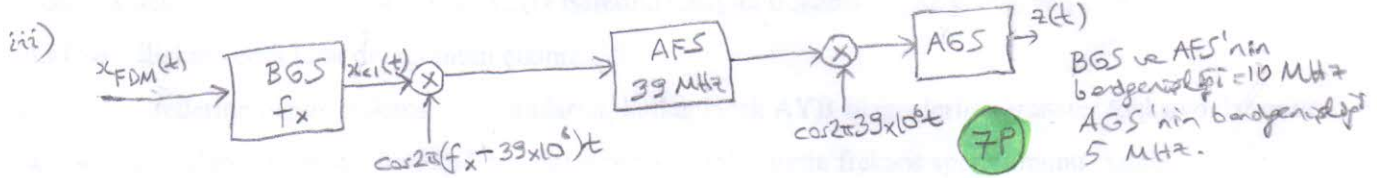
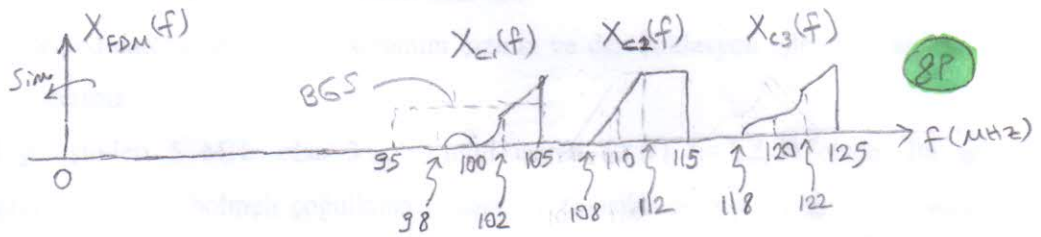


$$x_{ci}(t) = A_{ci} x_i(t) \cos 2\pi f_{ci} t * h_{vi}(t)$$

$$x_{FDM}(t) = x_{c1}(t) + x_{c2}(t) + x_{c3}(t)$$



$f_{c1} = 100 \text{ MHz}$, $f_{c2} = 108 \text{ MHz}$, $f_{c3} = 116 \text{ MHz}$ olun.



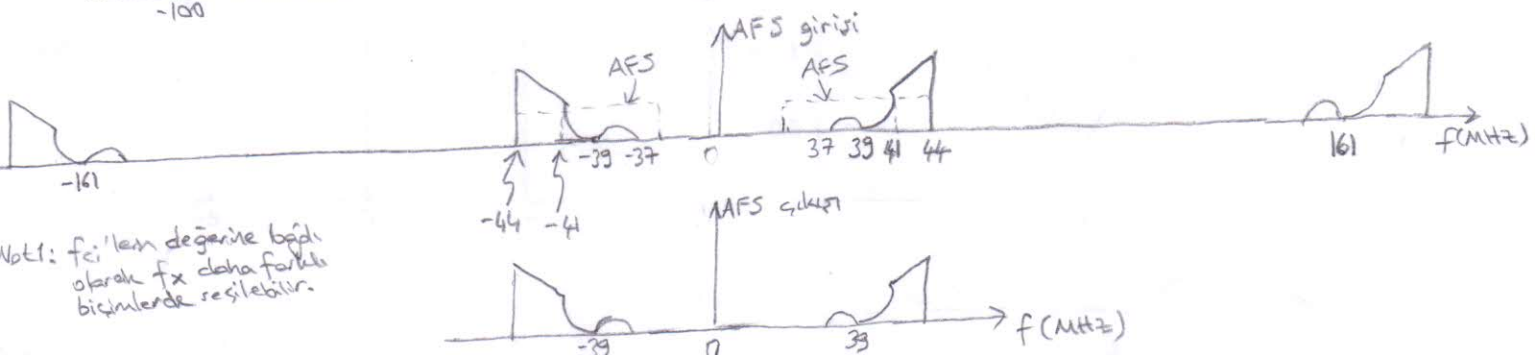
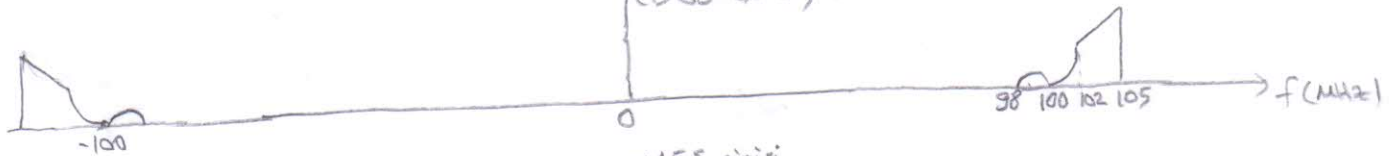
iv) $x_1(t)$ 'nin demodülasyonu:

$$f_x = f_{c1} = 100 \text{ MHz}$$

$$f_x - 39 \times 10^6 = 61 \text{ MHz}$$

$$\frac{A_{c1}}{2} [X_1(f - 100 \times 10^6) + X_1(f + 100 \times 10^6)] H_{v1}(f) = X_{c1}(f)$$

(BGS çıkışı)



Not1: f_{ci} 'lerin değerine bağlı olarak f_x daha farklı biçimlerde seçilebilir.

Bundan sonrası 2-b) şikindaki gibi.

10P