03/12/2020

EHB 351
Analog Haberleşme

Uygulama (2)

1) a) $x(t) = e^{-3|t|}$ işaretinin Fourier dönüşümünü bulunuz

b) a'daki sonuçtan ve Fourier dönüşüm teoremlerinden yararlanarak.

I) $s_1(t) = \frac{6}{t^2+9}$ II) $s_2(t) = \frac{6}{4t^2+9}$

III) $s_3(t) = \frac{1}{t^2+1}$ IV) $s_4(t) = \frac{\cos w_0 t}{t^2+1}$

$(w_0 = 2\pi f_0)$

işaretlerinin Fourier dönüşümlerini bulunuz.

Cevaplar: a) $X(f) = \int_{-\infty}^{\infty} x(t) e^{-j2\pi ft} dt$

$$X(f) = \int_{-\infty}^{\infty} e^{-3|t|} e^{-j2\pi ft} dt = \int_{-\infty}^{0} e^{+3t} e^{-j2\pi ft} dt + \int_{0}^{\infty} e^{-3t} e^{-j2\pi ft} dt$$

$$X(f) = \frac{e^{(3-j2\pi f)t}}{3-j2\pi f}\Bigg|_{-\infty}^{0} + \frac{e^{-(3+j2\pi f)t}}{-(3+j2\pi f)}\Bigg|_{0}^{\infty}$$

$$X(f) = \frac{1}{3-j2\pi f} + \frac{1}{3+j2\pi f} = \frac{6}{4\pi^2 f^2 + 9}$$

$(3+j2\pi f)$ $(3-j2\pi f)$

$$e^{-3|t|} \xrightarrow{F} \frac{6}{4\pi^2 f^2 + 9}$$

b) Dualite Özelliği $x(t) \xrightarrow{\mathcal{F}} X(f)$

$X(t) \xrightarrow{\mathcal{F}} x(-f)$

Ölçekleme Özelliği $y(t) \xrightarrow{\mathcal{F}} Y(f)$

$y(at) \xrightarrow{\mathcal{F}} \frac{1}{|a|} Y\left(\frac{f}{a}\right)$

$$y(t) = \frac{6}{4\pi^2 t^2 + 9} \xrightarrow{\mathcal{F}} Y(f) = e^{-3|-f|} = e^{-3|f|}$$

i) $s_1(t) = y\left(\frac{t}{2\pi}\right) \xrightarrow{\mathcal{F}} S_1(f) = 2\pi\, Y(2\pi f) = 2\pi e^{-3|2\pi f|}$

$$S_1(f) = 2\pi e^{-6\pi|f|}$$

II) $s_2(t) = s_1(2t)$

$$S_2(f) = \frac{1}{2} S_1\left(\frac{f}{2}\right) = \frac{1}{2} 2\pi e^{-6\pi\left|\frac{f}{2}\right|} = \pi e^{-3\pi|f|}$$

III) $s_3(t) = \frac{3}{2} s_1(3t)$

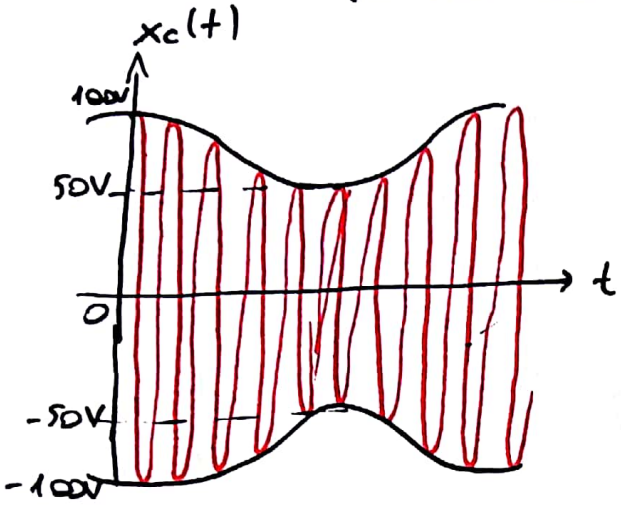
$$S_3(f) = \frac{3}{2}\frac{1}{3} S_1\left(\frac{f}{3}\right) = \frac{1}{2} 2\pi e^{-6\pi\left|\frac{f}{3}\right|} = \pi e^{-2\pi|f|}$$

IV) Frekansta Öteleme $e^{j\omega_0 t} x(t) \xrightarrow{\mathcal{F}} X(f - f_0)$

$s_4(t) = s_3(t)\cos\omega_0 t$

$$S_4(f) = \frac{S_3(f-f_0) + S_3(f+f_0)}{2} = \frac{1}{2}\pi e^{-2\pi|f-f_0|} + \frac{1}{2}\pi e^{-2\pi|f+f_0|}$$

2) $x_1(t) = 25\cos(\omega_m t)$ bilgi işareti bir taşıyıcı yardımıyla şekilde görülen GM'lu işarete dönüştürülüyor.



a) Modülasyon indisini bulunuz.

b) GM'lu işaretin ifadesini yazınız.

c) GM'lu işaretin frekans spektrumunu çiziniz.

d) $\frac{P_{YB}}{P_c}$ oranını bulunuz.

a) $m = \frac{C_{max} - C_{min}}{C_{max} + C_{min}} = \frac{100 - 50}{100 + 50} = \frac{50}{150} = \frac{1}{3}$

b) $x_c(t) = A_1(1 + k x_1(t))\cos\omega_c t = A_c[1 + m x(t)]\cos\omega_c t$

$x_1(t) = a + b x(t)$

$a = \langle x_1(t) \rangle$ $\qquad b = \underset{t}{maks}\,|x_1(t) - a|$

$x_1(t) = 25\cos\omega_m t$ ise $a = 0$, $b = 25$, $x(t) = \cos\omega_m t$

$C_{maks} = 100 = A_c(1+m) = A_c\left(1 + \frac{1}{3}\right) = 100$

$A_c = \frac{300}{4} = 75\,V$

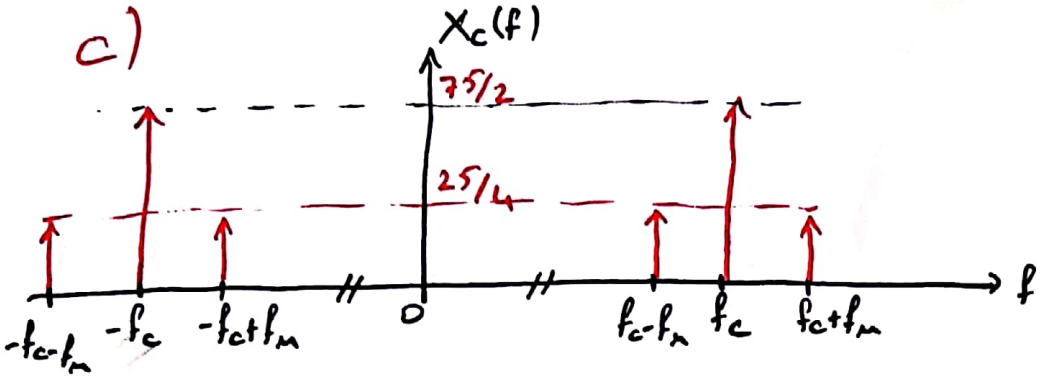
GM lu işaretin ifadesi

$x_c(t) = A_c(1 + m x(t))\cos\omega_c t$

$= 75\left(1 + \frac{1}{3}x(t)\right)\cos\omega_c t = 75\left(1 + \frac{1}{3}\cos\omega_m t\right)\cos\omega_c t$

$$x_c(t) = 75\cos\omega_c t + \frac{25}{2}\cos(\omega_c+\omega_m)t + \frac{25}{2}\cos(\omega_c-\omega_m)t$$

c)



d) $\frac{P_{YB}}{P_c} = ?$ $\quad 2P_{YB} = \frac{m^2 A_c^2 \langle x^2(t)\rangle}{2}$

$$\langle x^2(t)\rangle = 1/2$$

$$2P_{YB} = \frac{(1/3)^2 75^2}{4} = \left(\frac{75}{6}\right)^2 = 156,25\,w = \left(\frac{25}{2}\right)^2$$

$$P_c = \frac{A_c^2}{2} = \frac{75^2}{2} = 2812,5\ w$$

Buradan $\frac{25^2/8}{75^2/2} = \frac{1}{36}$ bulunur.