PES1UG20EC136

Section-C

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Date

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1. $f_i(t) = 10^8 - 10^5 \cos(10^4 \pi t)$

(a) $= f_c + k_f m(t)$

(b) $= f_c$

$k_f m(t) = -10^5 \cos 10^4 \pi t$

$\Delta f = k_f A_m = 10^5$

Band width.

$BW = 2(\Delta f + f_m)$

$BW = 2\left(10^5 + \frac{10^4}{2}\right)$

$BW = 210\ KHz$.

(a)(b) $s(t) = \cos\left[2\pi \times 10^8 t - 20 \sin 10^4 \pi t\right]$

$=$

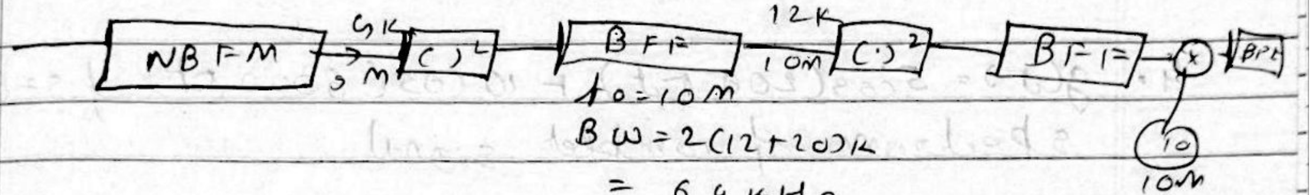
(d) $f_i(t) = f_c + \frac{K_p}{2\pi} \frac{d\,m(t)}{dt} = f_c - K_p A_m f_m \sin 2\pi f_m t$

$K_p A_m f_m = 10^5$

$K_P = \frac{10^5}{\frac{10 \times 10^4}{2}} = 2 \quad K_p = 2$

2. $m(t)$ - $BW = 20K$ $f_c = 5M$, $\Delta f = 6\ KHz$ NBFM
WBFM $f_c = 30M$, $\Delta f = 24\ KHz$.

sol) multiplication factor $= 4 \Rightarrow 2$ doublers.



$BW = 2(12+20)K$
$= 64\ KHz$.

$BW = 2(\Delta f + B)$

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3. carrier $c(t) = \cos 10^8 \pi t$ $A_c = 1$ $f_c = 10^8/2$
message $m(t) = 2\cos 10^3 \pi t$ $A_m = 2$ $f_m = \frac{10^3}{2}$
$k_f =$

(a) modulation index (β), maximum freq deviation (Δf) maximum phase deviation ($\Delta f/f_m$), BW, FM expression

(b) same $m(t)$ and $c(t)$ for P(M) and same Δf, k_p

sol) $\beta = \frac{k_f A_m}{f_m} = \frac{1K \times 2}{\frac{1K}{2}} = 4 \Rightarrow \beta = 4$

$\Delta f = k_f A_m = 1K \times 2 \Rightarrow \Delta f = 2KHz$.
$\Delta f / f_m = \beta = 4 \Rightarrow \Delta f / f_m = 4$
$BW = 2(\beta + 1) f_m = 2 \times 5 \times \frac{1}{2} = 5K \Rightarrow BW = 5KHz$.

$S(t) = A_c \cos(2\pi f_c t + \beta \sin 2\pi f_m t)$

$S(t) = \cos(10^8 \pi t + 4 \sin 10^3 \pi t)$

b) $\Delta f = 2K \cdot KP = ?$

$\Delta f = KP\, A_m f_m$

$KP = \frac{2K}{2 \times 1/2} = 2$

$\therefore KP = 2$

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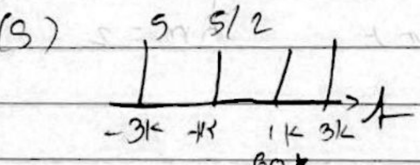
4. $g(t) = 5\cos(200\pi t) + 10\cos(6000\pi t)$ $f_s = 600$

spectrum of samplet signal.

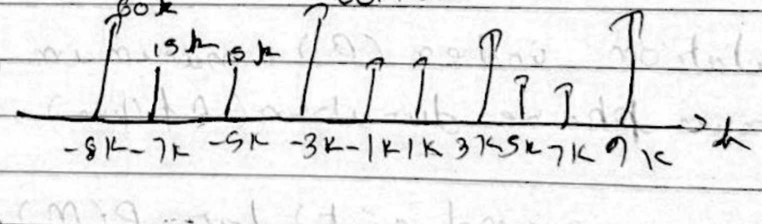
Sol) $G_s(f) = f_s \sum_{k=-\infty}^{\infty} G(f - kf_s)$

$= 6000 \sum_{k=-\infty}^{\infty} G(f - 6000k)$

$G(f)$



$G_s(f)$



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5. $g_1(t)$ and $g_2(t)$ are transmitted over common channel by means of TDM. Highest freq. of $g_1(t)$ = 1K and g_2 = 1.5KHz. Min value of sampling rate.

Sol. min sampling rate = 2(Max freq of all samples)

$= 2(1.5K)$

$= 3KHz$

6. (a) Six independent message signal of BW, ω, ω, 2ω, 2ω, and 3ω Hz transmitted on a TDM basis

(a) Scheme for accomplishing this with each message sampled at Nyquist rate.

(b) Min transmission BW.

Sol (a) Highest BW = 3ω

Nyquist Rate = 6ω sample/sec

Max freq of commutator = 3ω rev/sec

(b) BW = $\frac{\text{Tot no of sample sent}}{2}$

$= \frac{2\omega + 2\omega + 4\omega + 4\omega + 6\omega + 6\omega}{2}$

BW = 12ω Hz

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7 $g(t) = 10\cos 50\pi t$ $f_s = 75Hz$.

(a) $g(n)$

(b) $g'(t) \to$ result using $g(n)$ with $f_s = 75Hz$. Name Phenomenon.

(c) Find diff $g(t)$ results using $g(n)$ with $f_s = 75Hz$.

Sol (a) $g(n) = g(t)\Big|_{t=nT_s}$ $T_s = \frac{1}{f_s} = \frac{1}{75}$

$g(n) = 10\cos \frac{50\pi n}{75}$

$g(n) = 10\cos \frac{2\pi n}{3}$

(d) $g'(t) = 10\cos(50\pi t \times 4)$

$g'(t) = 10\cos(200\pi t)$

$g'(n) = 10\cos\left(\frac{200\pi n}{75}\right) = 10\cos\left(\frac{8\pi n}{3}\right)$

$= 10\cos\left(\left(2\pi + \frac{2\pi}{3}\right)n\right)$

$g'(n) = 10\cos\frac{2\pi n}{3} = g(n)$ but results on aliasing $\because 100 > 25$.

$g'(t) = 10\cos(200\pi t)$

(c) $g(t) = 10\cos(2\pi f_0 t)$ where $f_0 = 25, 50, 100, 125,$ [illegible] 200

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(8) $g(t) = A\cos 2\pi f_0 t$ sampled at f_s Hz to get $g(n)$
Find general expression for $g'(t)$ to get $g(n)$ at f_s

Sol $g(n) = A\cos 2\pi f_0 n T_s$

$= A\cos\left(2\pi \frac{f_0}{f_s} n\right)$

$g'(t) = A\cos\left(\left(2\pi k + 2\pi \frac{f_0}{f_s}\right)n\right)$ $k = 0, 1, 2$

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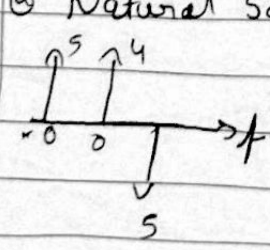
(9) $g(t) = 10\sin(20\pi t) + 4$ $f_s = 50$ Hz $T_s = 10$ ms.
What freq are present b/w 0 and 200

(a) Natural Sampling

(b) Flat top sampling

Sol



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ⓐ $S(f) = Tf_s \sum_{k=-\infty}^{\infty} \sin(kTf_s)\, G(f - kf_s)$

ⓑ $S(f)\ \frac{1}{2} \sum_{k=\infty}^{\infty} \sin(\frac{k}{2})\, G(f - 50k)$