Study Group

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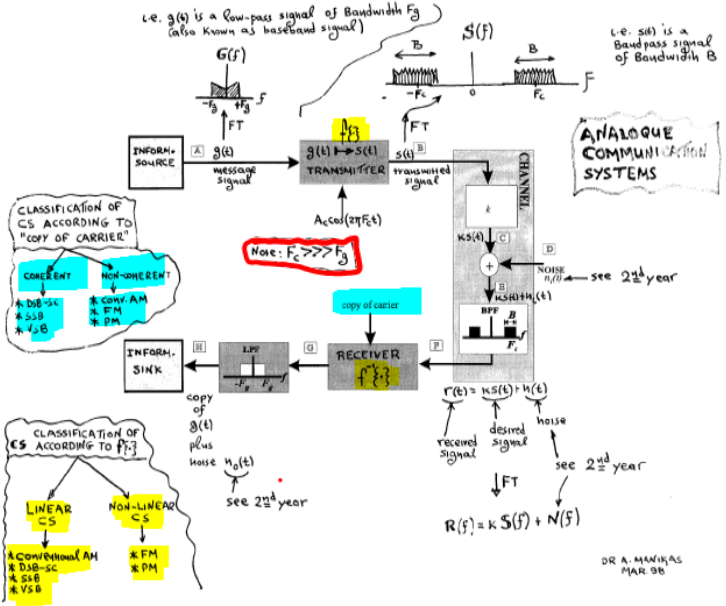
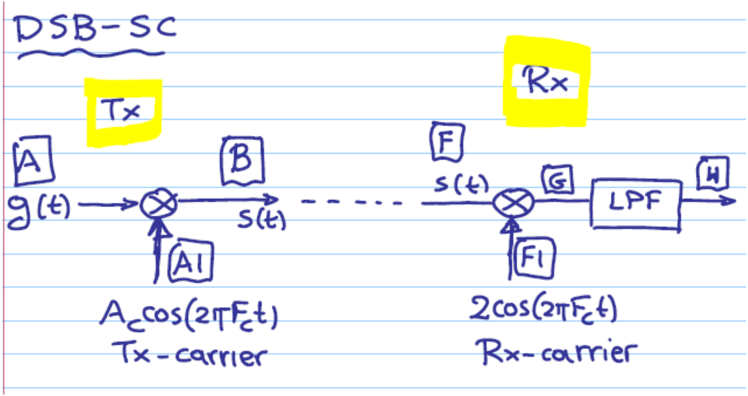
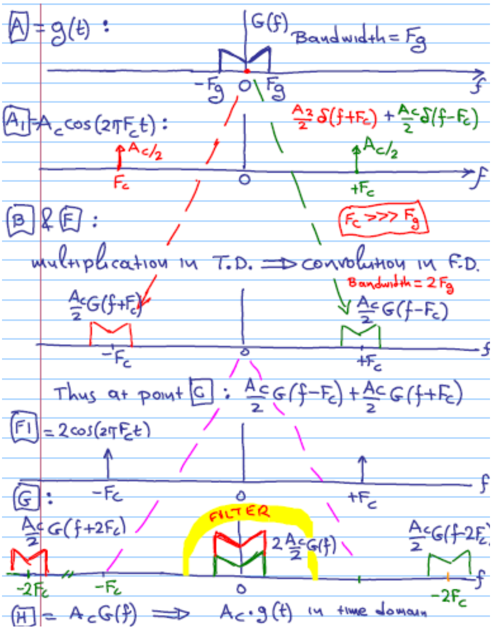
Comms-1

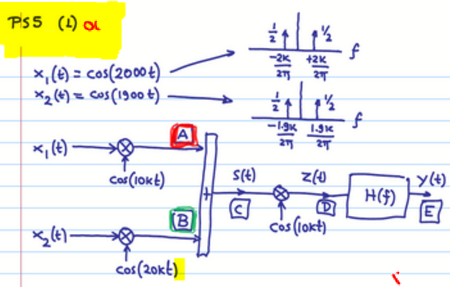
DSB-SC

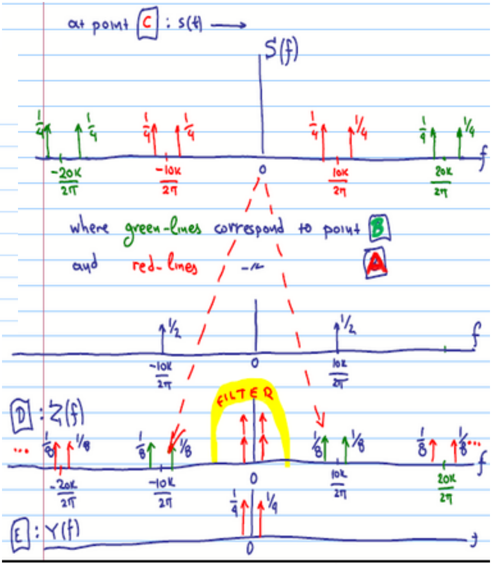

i.e. g(t) is a low-pass signal of Bandwidth Fg (also known as baseband signal)
G(f)
S(f)
i.e. s(t) is a Band pass signal of Bandwidth B
B
B
-Fc
0
Fc
FT
FT
ANALOGUE COMMUNICATION SYSTEMS
INFORM. SOURCE
g(t)
message signal
g(t) ↦ s(t)
TRANSMITTER
s(t)
transmitted signal
CHANNEL
Ac cos(2πFct)
CLASSIFICATION OF CS ACCORDING TO "COPY OF CARRIER"
COHERENT
NON-COHERENT
* DSB-SC
* SSB
* VSB
* CONV. AM
* FM
* PM
Note: Fc >>> Fg
NOISE
see 2nd year
copy of carrier
BPF
LPF
RECEIVER
INFORM. SINK
copy of g(t) plus noise n0(t)
see 2nd year
r(t) = ks(t) + n(t)
received signal
desired signal
noise
see 2nd year
FT
R(f) = k S(f) + N(f)
CLASSIFICATION OF CS ACCORDING TO f{·}
LINEAR CS
NON-LINEAR CS
* Conventional AM
* DSB-SC
* SSB
* VSB
* FM
* PM
DR A. MANIKAS
MAR. 98


DSB-SC
Tx
Rx
A
B
F
G
H
g(t)
s(t)
s(t)
LPF
A1
F1
A_c cos(2πF_c t)
Tx-carrier
2cos(2πF_c t)
Rx-carrier

DSB-SC in the Frequ. Domain




PS5 (1) a
$x_1(t) = \cos(2000t)$
$x_2(t) = \cos(1900t)$
$x_1(t)$
$x_2(t)$
cos(10kt)
cos(20kt)
A
B
s(t)
z(t)
C
D
cos(10kt)
H(f)
y(t)
E


at point C : s(t) →
S(f)
where green-lines correspond to point B
and red-lines -/- A
FILTER
D : Z(f)
E : Y(f)

PS.5 [2] a, b

$$m_1(t) = \frac{2}{\pi}\,\text{sinc}(2t) = \frac{2}{\pi}\,\text{sinc}\left(\frac{t}{0.5}\right)$$

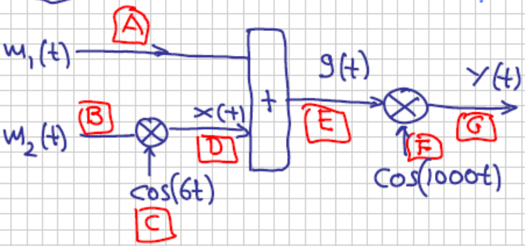
$$m_2(t) = \frac{4}{\pi^2}\,\text{sinc}^2(2t) = \frac{4}{\pi^2}\,\text{sinc}^2\left(\frac{t}{0.5}\right)$$

(0.5: scaling factor s)

$$y(t) = \underbrace{(m_1(t) + x(t))}_{\text{message } g(t)} \cos(1000t)$$

$$x(t) = m_2(t)\cos(6t)$$

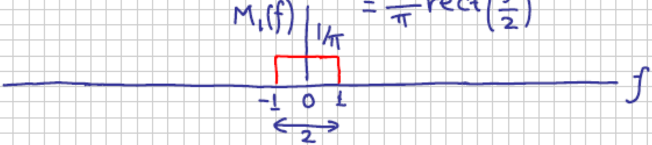
SYSTEM



at point A $= m_1(t) = \frac{2}{\pi}\,\text{sinc}(2t) = \frac{2}{\pi}\,\text{sinc}\left(\frac{t}{0.5}\right)$ ← scaling factor

↓ FT

$$M_1(f) = \frac{2}{\pi}(0.5)\,\text{rect}(f\,0.5) = \frac{1}{\pi}\,\text{rect}(0.5f) = \frac{1}{\pi}\,\text{rect}\left(\frac{f}{2}\right)$$



The above uses $\text{sinc}(t) \triangleq \frac{\sin \pi t}{\pi t}$ ← standard definition of sinc.

However in the lectures the definition of a sinc is:

$$\text{sinc}(\pi t) \triangleq \frac{\sin \pi t}{\pi t}$$

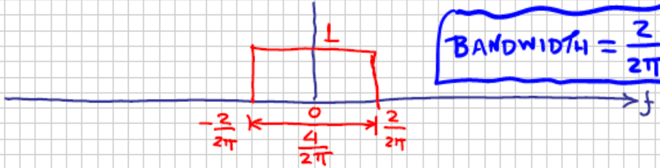
This definition will be used here.

$$m_1(t) = \frac{2}{\pi}\,\text{sinc}(2t) = \frac{2}{\pi}\,\text{sinc}\left(\pi \frac{2}{\pi} t\right) = \frac{2}{\pi}\,\text{sinc}\left(\pi \frac{t}{0.5\pi}\right)$$

scaling factor

$\downarrow$ FT

$$M_1(f) = \frac{2}{\pi}\,0.5\pi\,\text{rect}(f\,0.5\pi) = \text{rect}\left\{\frac{f}{4/2\pi}\right\}$$



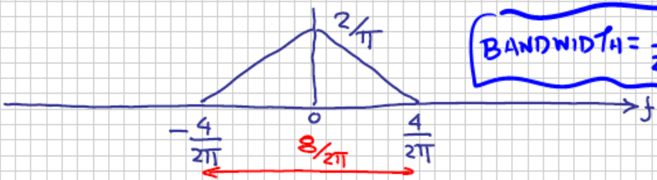
BANDWIDTH $= \frac{2}{2\pi}$

at point $\boxed{B} = m_2(t) = \frac{4}{\pi^2}\text{sinc}^2(2t) = \frac{4}{\pi^2}\text{sinc}^2\left(\pi\frac{2}{\pi}t\right) = \frac{4}{\pi^2}\text{sinc}^2\left(\pi\frac{t}{0.5\pi}\right)$

$\downarrow$ FT

$$M_2(f) = \frac{4}{\pi^2}\,0.5\pi\,\Lambda\{f\,0.5\pi\} = \frac{2}{\pi}\Lambda\left\{\frac{f}{4/2\pi}\right\}$$

Scaling factor



BANDWIDTH $= \frac{4}{2\pi}$

at point $\boxed{C} = \cos(6t) \longrightarrow F_1 = \frac{6}{2\pi}$

$\downarrow$ FT

at point $\boxed{D}$ = [point $\boxed{B}$] $*$ [point $\boxed{C}$] $= x(t)$

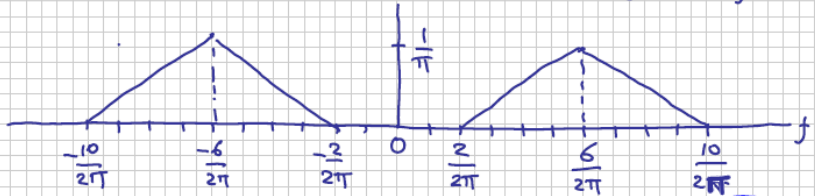
($*$ ↑ conv)

$$X(f) = \frac{1}{2} M_2\left(f+\frac{6}{2\pi}\right) + \frac{1}{2} M_2\left(f-\frac{6}{2\pi}\right)$$

$$= \frac{1}{2}\,\frac{2}{\pi}\,\Lambda\left\{\frac{f+\frac{6}{2\pi}}{\frac{4}{2\pi}}\right\} + \frac{1}{2}\,\frac{2}{\pi}\,\Lambda\left\{\frac{f-\frac{6}{2\pi}}{\frac{4}{2\pi}}\right\}$$

$$= \frac{1}{\pi}\,\Lambda\{\ldots\ldots\} + \frac{1}{\pi}\,\Lambda\{\ldots\}$$

=



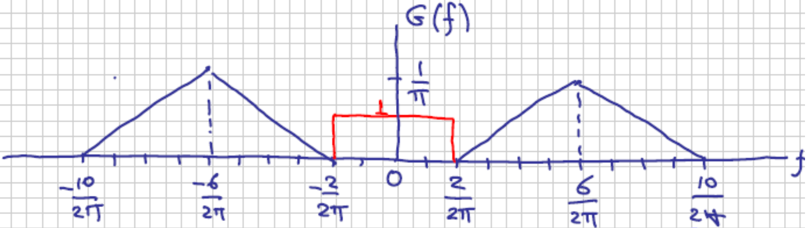
$$\boxed{\text{BANDWIDTH} = \frac{4}{\pi}}$$

at point [E] = point [A] + point [D] = message = $g(t)$

$$g(t) = m_1(t) + x(t)$$

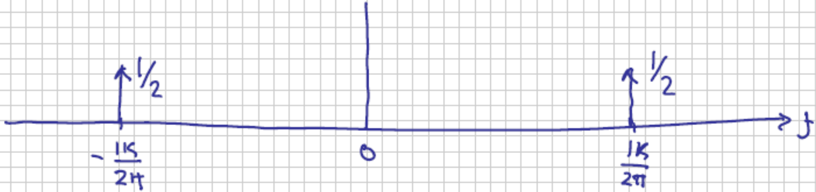
$\downarrow$ FT

$$\therefore \quad G(f) = M_1(f) + X(f)$$



$$\text{BANDWIDTH} = \frac{5}{\pi}$$

at point (F) $= \cos(\underbrace{1000}_{2\pi F_c}t) \Rightarrow F_c = \frac{1000}{2\pi}$



at point (G) $= \frac{1}{2}G\left(f+\frac{1K}{2\pi}\right) + \frac{1}{2}G\left(f-\frac{1K}{2\pi}\right)$

BANDWIDTH $= \frac{10}{\pi}$