6.003 12/7/2011

December	M	W	F
	5	7 Today	9
		14	
		$\boxed{19}$ Final	

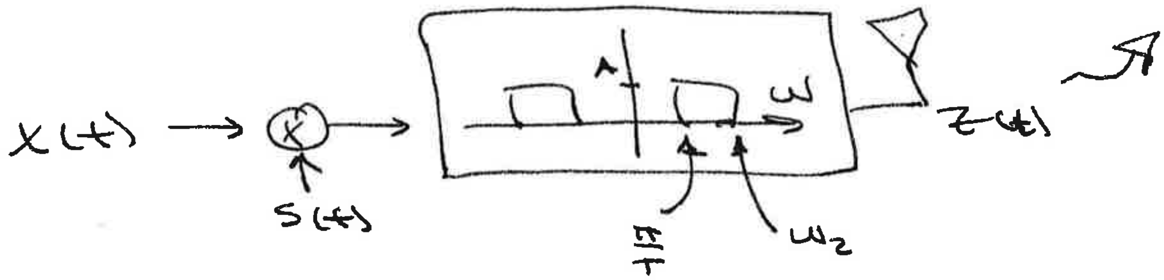
Recitation 20

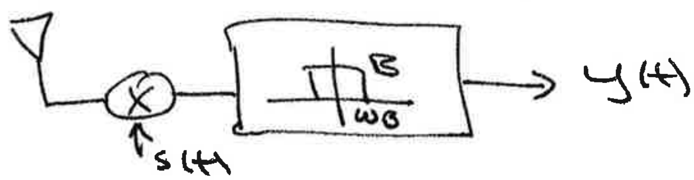
Today

- Non-sinusoidal modulation
- Modulation w/o multiplier
- Super heterodyne modul.
- Reduced BW: SSB

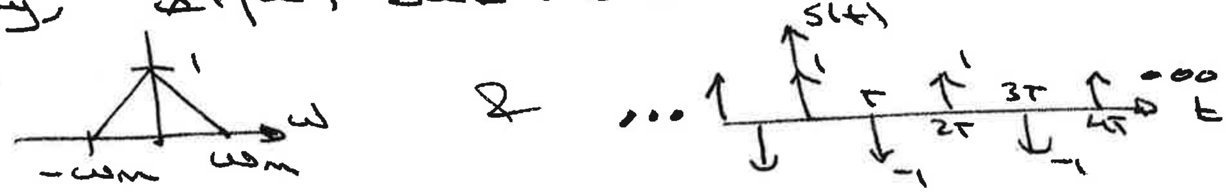
Ex:

Don't have to modulate w/ sin:





say, $X(j\omega)$ bandlimited

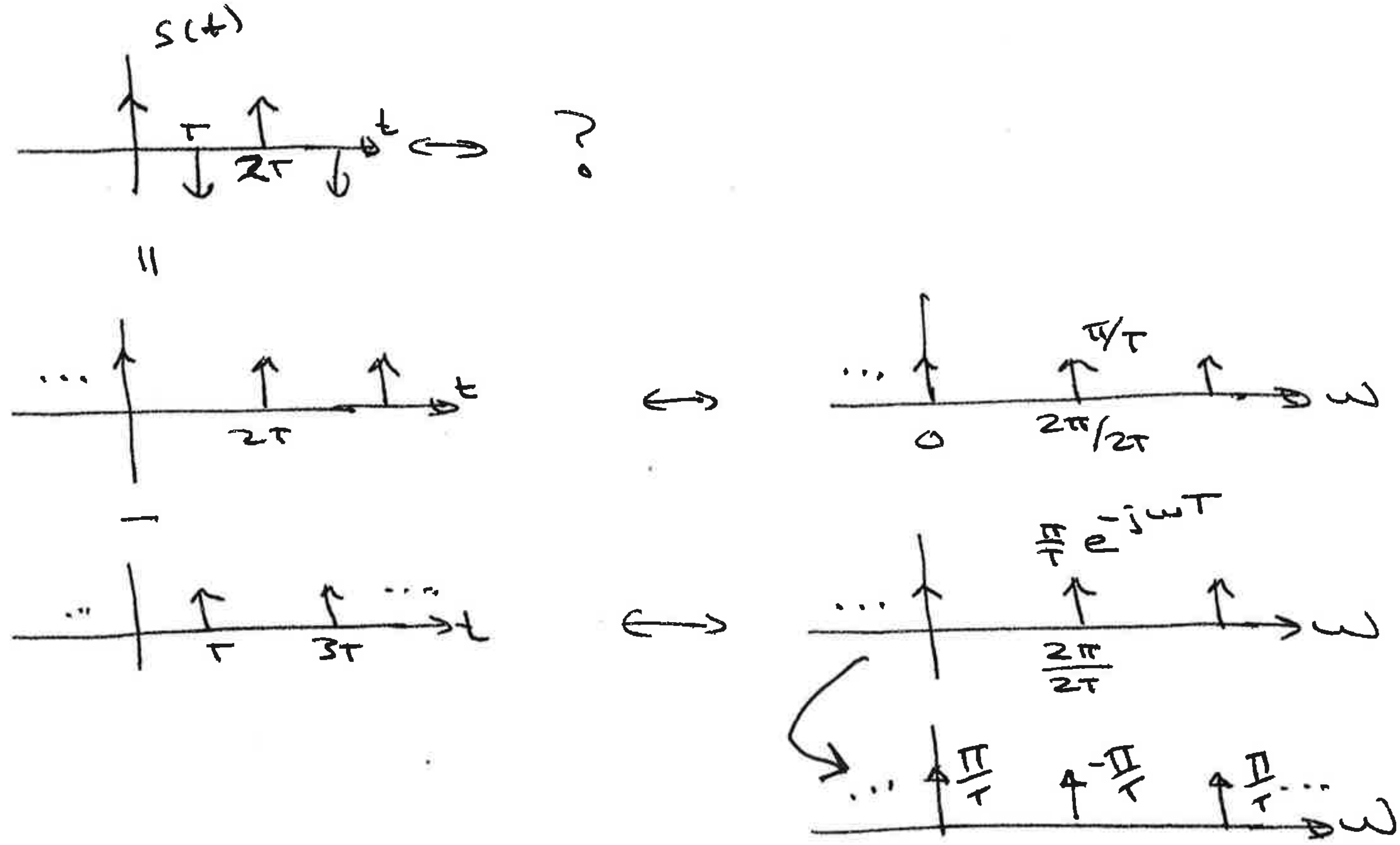


To get $y(t) = x(t)$

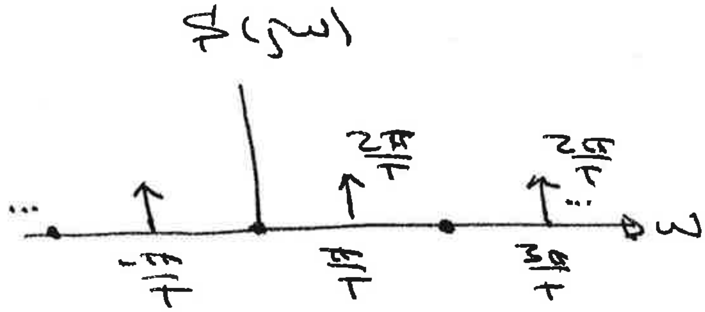
T/F

1. ω_m can be as large as $\frac{2\pi}{T}$
2. ω_2 should be $\frac{2\pi}{T}$
3. ω_2 — — $\frac{3\pi}{T}$

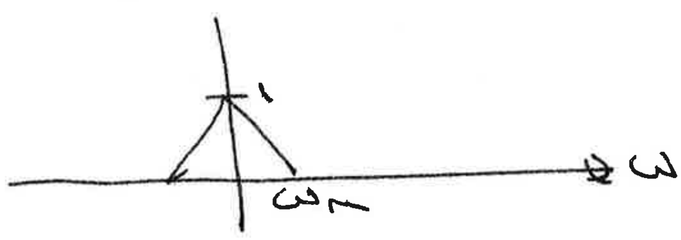
First, what's the transform of $s(t)$?



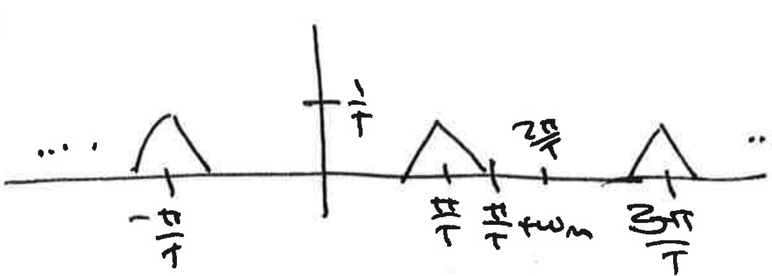
i.e.



&



so $\frac{1}{2\pi} X * S\ (j\omega)$



clearly, need

$2\omega_m < \frac{2\pi}{T}$

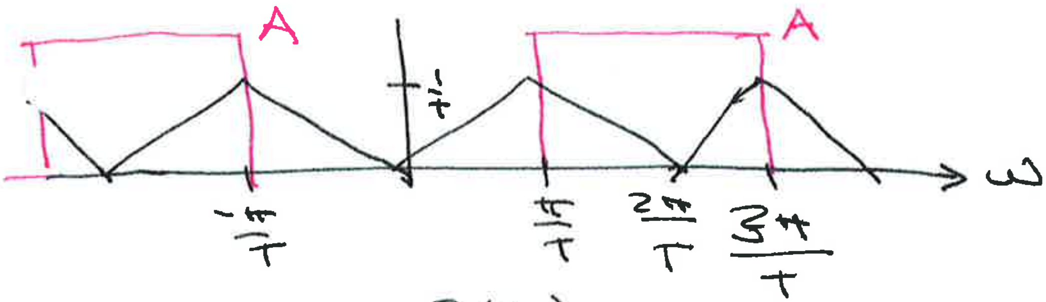
i.e.

$\omega_m < \frac{\pi}{T}$

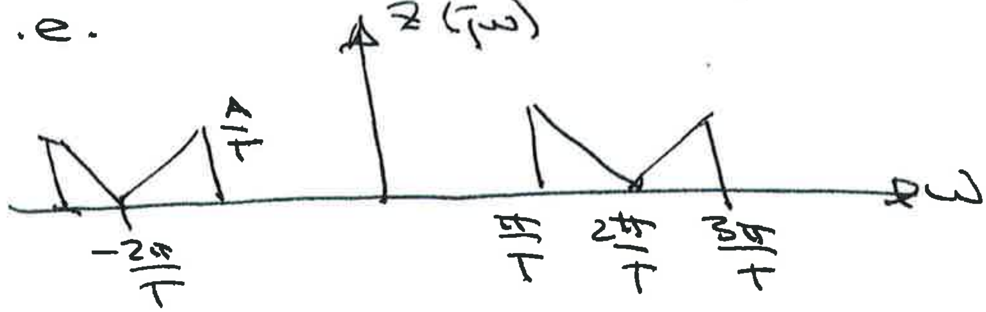
to prevent aliasing.

∴ 1 X

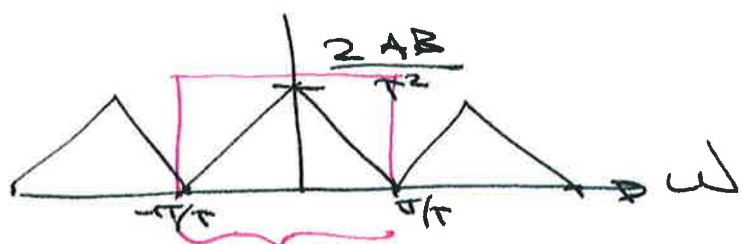
Also, 3:

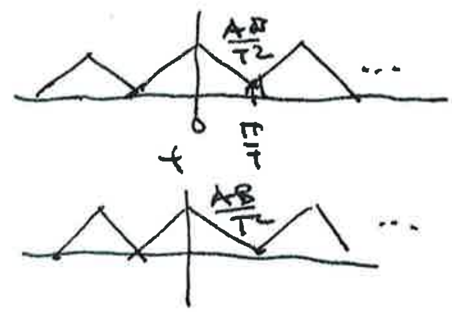


i.e.



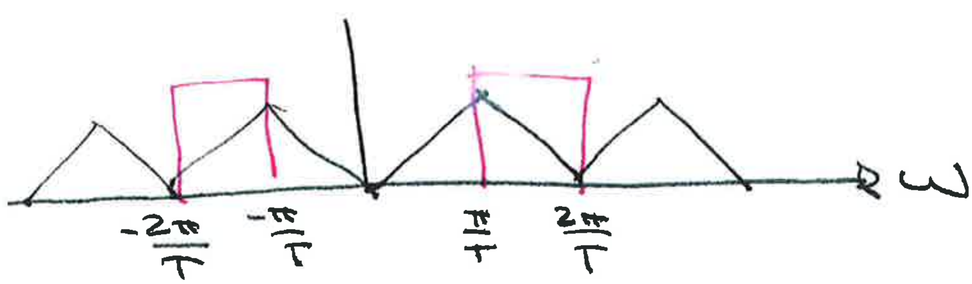
& after demodulation:

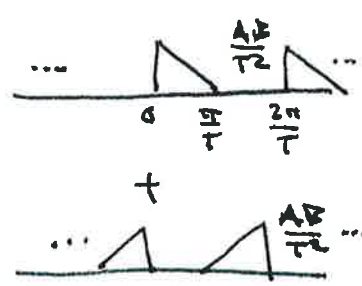




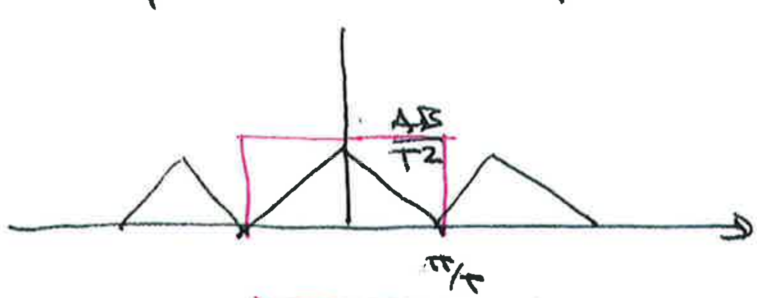
LPF w/ $\omega_B = \frac{\pi}{T}$

Or, for case 2:





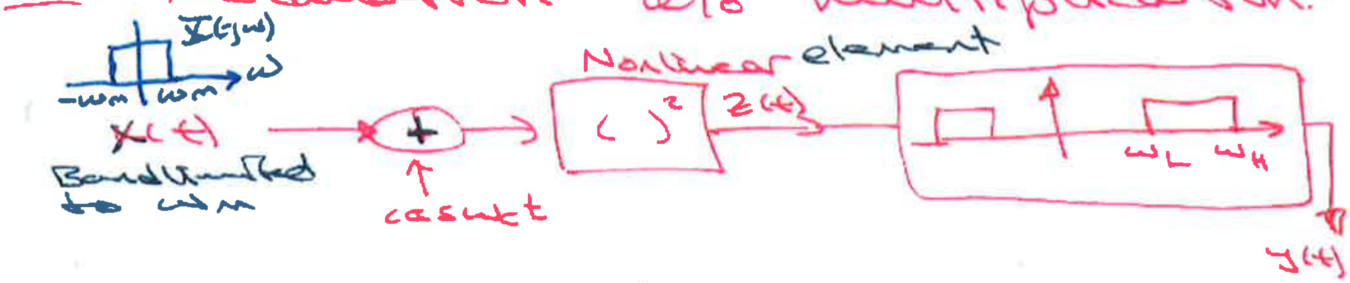
so



LPF w/ $\omega_B = \pi/T$.

i.e. 1 ✗
2 ✓
3 ✓

Ex: Modulation w/o multiplication:

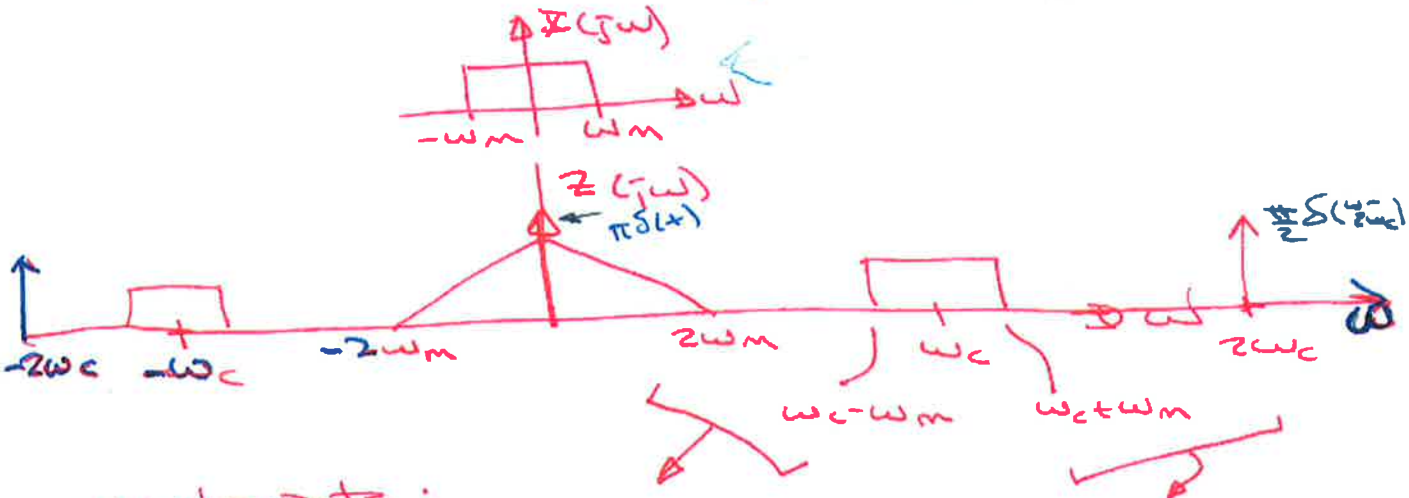


constraints on $\omega_L, \omega_H, \omega_m$? (BW of $x(t)$)

$$z(t) = (x(t) + \cos\omega_c t)^2$$

$$= x^2(t) + 2x(t)\cos\omega_c t + \cos^2\omega_c t$$

$$z(t) = x^2(t) + 2x(t)\cos\omega_c t + \tfrac{1}{2} + \tfrac{1}{2}\cos 2\omega_c t$$



constraints:

$\omega_c - \omega_m > 2\omega_m$ $\qquad$ $\omega_c + \omega_m < 2\omega_c$

$\omega_c > 3\omega_m$ $\qquad$ $\omega_m < \omega_c$

$\omega_m < \frac{1}{3}\omega_c$

If satisfied then OK. $\omega_c > 3\omega_m$

$\Downarrow$

$\boxed{\omega_m < \frac{1}{3}\omega_c.}$

DT systems – Z-transform
Feedback
modes

CT systems – $\mathcal{L}$-transform
Feedback
Modes

E1

Convolution – Impulse Resp – ~~Freq~~ Freq Resp
Bode

Feedback control, root-locus

E2

CTFS

CTFT

DTFT, DTFS

$\mathcal{F}$-relations

E3

Sampling

Modulation

Apps

Final