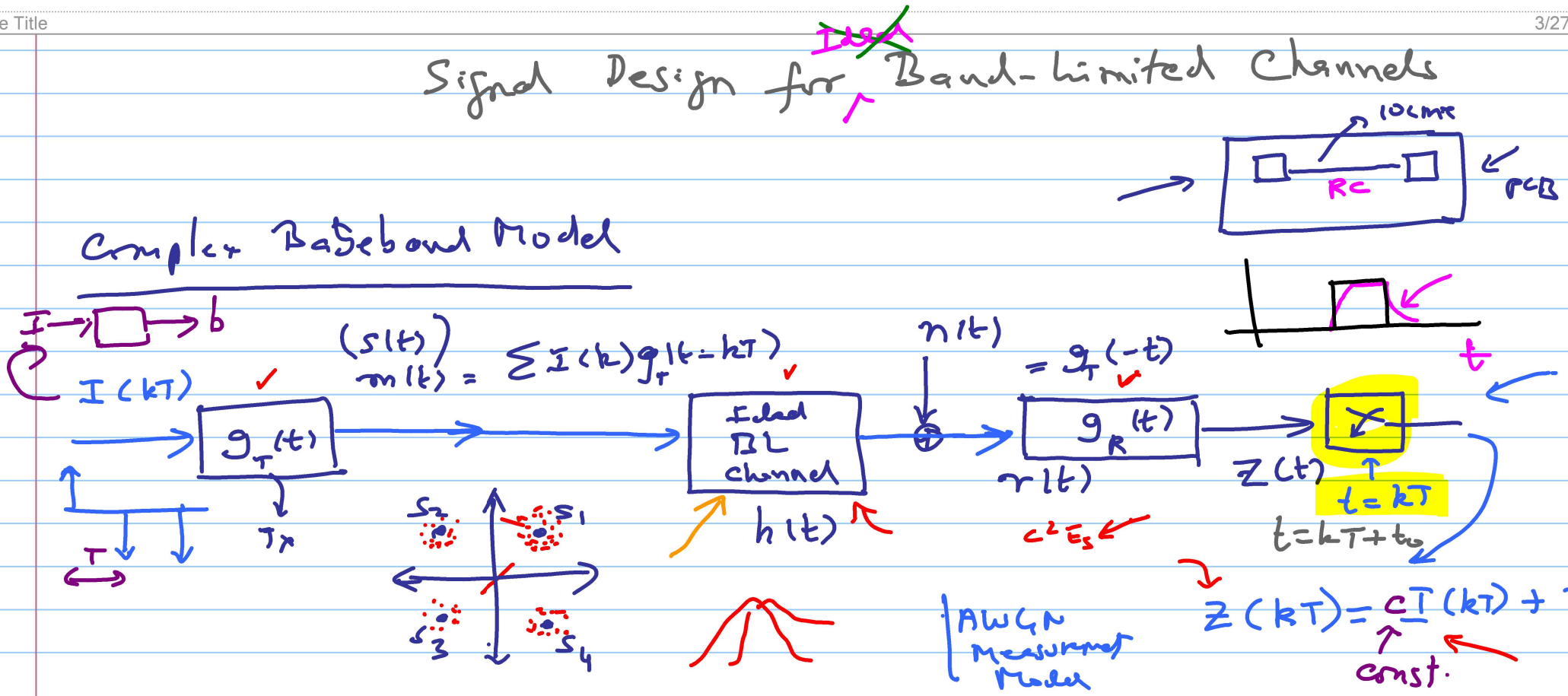
EE4140 **Class # 18** - October 30, 2020

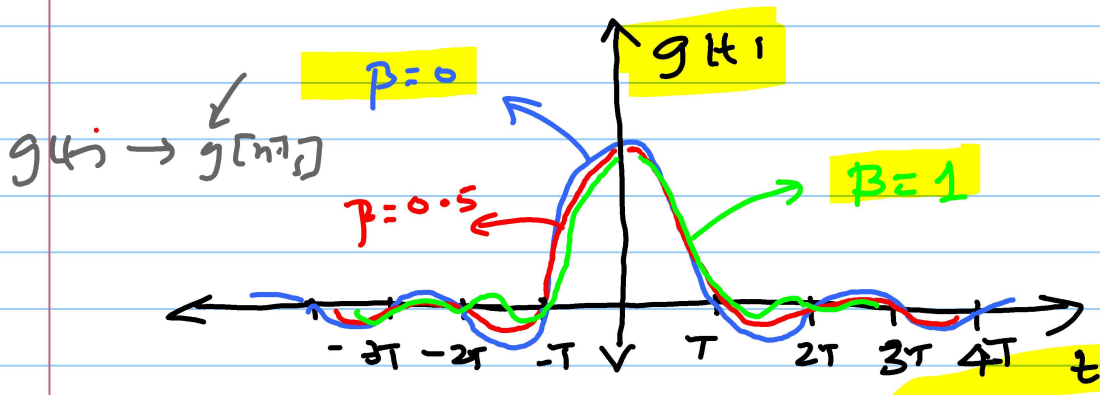
Note Title 3/27/2020

Signal Design for Band-limited Channels

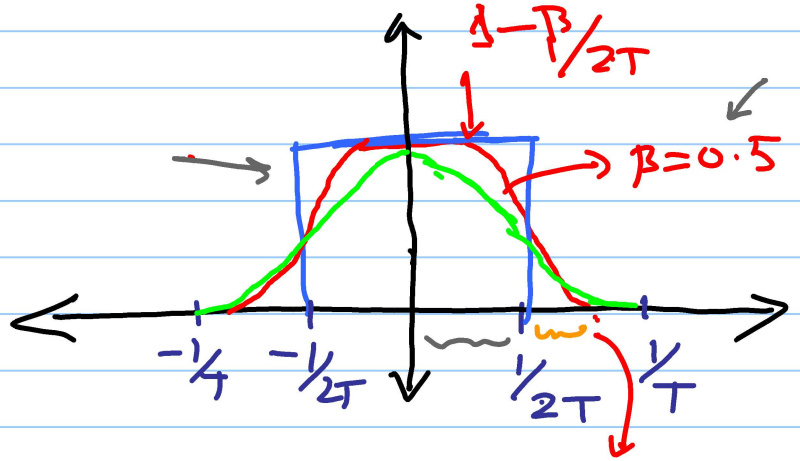
Complex Baseband Model



Assume the use of Nyquist Pulse Shape → Sinc, Raised-Cosine



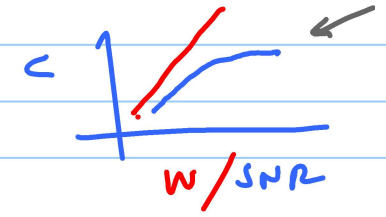
$g(t) \rightarrow g[n]$

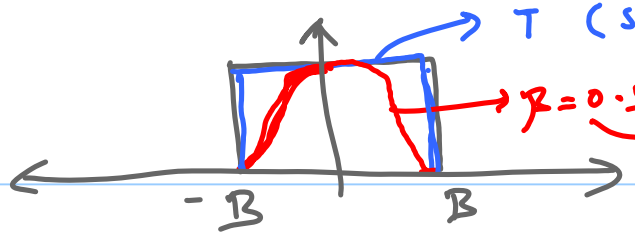


$$g(t) = \text{sinc}\left(\pi \tfrac{t}{T}\right) \frac{\cos\left(\pi \beta \tfrac{t}{T}\right)}{\left(1 - 4\beta^2 \tfrac{t^2}{T^2}\right)}$$

β → excess BW factor

$$\rightarrow \quad C = W \log_2(1 + SNR)$$





$B = \frac{1}{2T}$

$\frac{1+\beta}{2T'} = B$ Hz symbols/sec

$B \rightarrow$ fixed,

- $\beta = 0$, $\frac{1}{2T} = B$
- $\beta > 0$, $\frac{(1+\beta)}{2T'} = B$

Zero-ISI model

$z(k) = I(k) + n(k)$

Practical design easier

(*) Timing error (due to incorrect sampling instant) is less

(*) Rate loss since $T' > T$

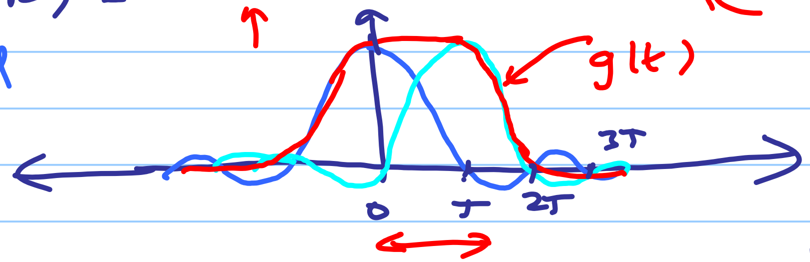
Q: Is it possible to not use excess BW & lose rate, and yet have realizable filter?

A: Yes → by introducing controlled ISI

eg: Duo-Binary Signal

$$z(k) = I(k) + I(k-1) + n(k)$$

$3 \quad kT \quad (k-1)T$



$$z(k) - \hat{I}(k-1) \approx y(k) = I(k) + n(k)$$

→ Precoding ✓

noiseless values

controlled ISI