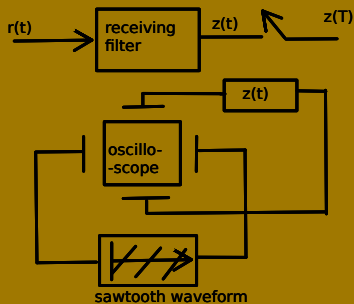


- Lecture 18 recap:
- ▶ Nyquist Pulse shaping equation:  $\sum_{n \in \mathbb{Z}} P(f - nR) = T$ .
- ▶ Examples: Raised Cosine family of pulses with Bandwidth  $\bar{R}$ , and roll-off factor  $r = \frac{\bar{R} - R/2}{R/2}$ . Bandwidth  $\bar{R} = \frac{R}{2}(1 + r)$ ,  $0 \leq r \leq 1$ .
- ▶ Bandpass modulation bandwidth?
- ▶ Assuming  $H_c(f) \equiv 1$ ,  $|H_t(f)| = |H_r(f)|$ , gives  $H_t(f) = \sqrt{|H_{rc}(f)|}$ , called the *root-raised cosine* pulse.

# Eye Diagram

- What will you see in the oscilloscope below?





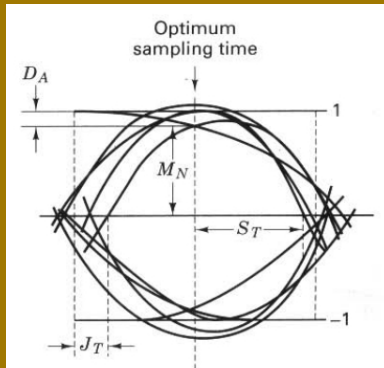


Figure: Eye diagram in the presence of ISI and AWGN

# Channel effects

- Channel frequency response:  $H_c(f) = |H_c(f)| \exp(j\theta_c(f))$ .
- ▶ IF  $|H_c(f)| \neq 1$ , amplitude distortion.