1. Generate 2-PAM and 4-PAM PRBS waveforms at 50 & 100Gbps with 64 samples per UI. Filter each of the waveforms with first-order low-pass filters having a cut-off frequency of 20, 30, 40, and 50GHz. Plot the eye diagrams.

2. Encode 10000 data payloads from a PRBS sequence with RS KR4 code. In each block of encoded data, randomly introduce burst errors in the following way: the probability of any bit being the first in a burst of errors is 0.0005, and the burst is equally likely to be any length from 1 bit to 20 bits. Then decode each of the errored sequences. Form an estimate of the pre-FEC BER, post-FEC BER and FER (Frame Error Rate). Repeat this for a RS-KP4 code and compare.

3. Generate a channel model for a 50 Ohm coaxial cable of lengths 10cm and 15cm having skin effect constant 87 and dielectric loss coefficient 0.01. Plot the frequency response magnitude from DC to 100Ghz, as well as the impulse and pulse response assuming perfect 50 Ohm matching for source and termination impedance. Now introduce 200fF shunt capacitance at each end of the cable and compare the resulting frequency responses. In each case, plot an eye diagram of a 4-PAM waveform through the channel at 100Gbps.

Diagram of Transmission Line with no capacitors

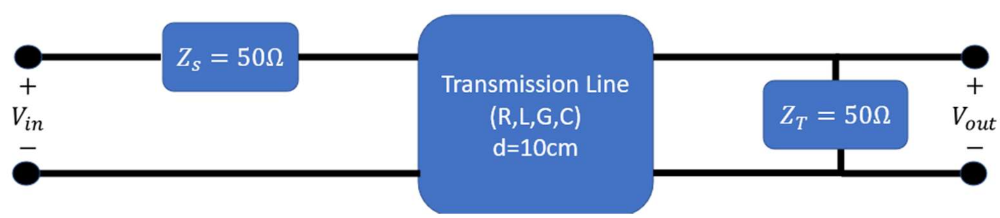
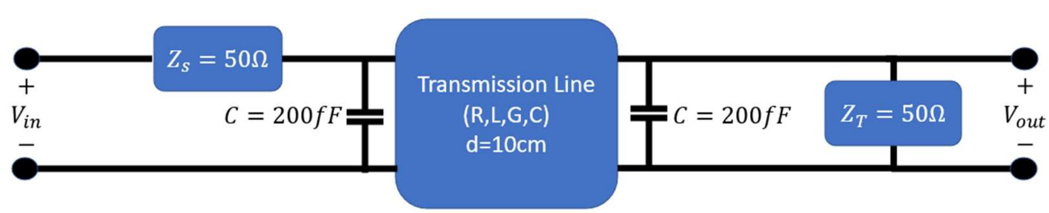


Diagram of Transmission Line with capacitors



4. Using the waveforms from homework #3, filter the channel outputs with a linear CTLE modelled with a zero at $\omega_z = 5 \times 10^{10}\ rad/s$, two poles at $\omega_p = 1.7 \times 10^{11}\ rad/s$ and a DC gain of 1. Using the information from lecture 4 slide 6 on active CTLE design, suggest component values for a typical CTLE circuit that would have such poles and zeros. Assume the bias current is set so that input transistors have g_m = 25 millisiemens. Find the MMSE coefficients of a digital FFE with 2 pre-taps and 5 post-taps, and DFE with 2-taps to finish equalizing the CTLE output. Plot and compare eye diagrams of the signal before CTLE, after CTLE, after FFE, and after DFE.

5. A channel has an equalized sampled response of $1+0.5z^{-1}$. Draw the resulting trellis assuming 4-PAM symbols $\pm 3, \pm 1$. If the channel samples are u(k), find an expression for each of the branch metrics in the trellis. This Homework assignment does not involve coding, only handwritten work.

6. Take the waveform from homework #3 for 10cm channel with no capacitors and introduce receiver jitter with 1ps RMS Gaussian distribution. Compare the resulting eye diagrams to what is observed with 1ps RMS jitter introduced at the transmitter. Why would there be any difference?

7. A particular optical modulator has a nonlinear characteristic so that the light power at its output, P_{out}, is related to the light power at its input, P_{in}, and the driving voltage, V_i, as follows:

$$\frac{P_{out}}{P_{in}} = \sin\left(\frac{\pi V_{in}}{5V}\right)$$

Take one of the waveforms from Homework #1 and pass it through this nonlinearity assuming peak-to-peak voltages of V_i of 2V, 3V, and 4V (biased at 0V). What is the R_{LM} in each case?