

Homework Assignment #7 – do not submit
[revised 10:15 pm 12/16/25 and 3:15 pm 12/17/25]

Ungraded Problems:

The following problems will not be graded, but you should attempt to solve them on your own and then check the solution.

1. Sketch the pulse progression for RZ bipolar signaling for the binary stream 101000111100.
2. **[text in boldface added to Part c 12/16/25]** Draw the constellation for the following digital carrier schemes:
 - a. 8-ary ASK
 - b. 16-ary PSK
 - c. 64-ary QAM (**assume a square constellation**)
3. **[text in boldface added 12/17/25]** Find the minimum channel spacing for 16-ary FSK for a **symbol** rate of $R_b = 1.0 \text{ Msymbols/s}$. Also find the total bandwidth used by the system, assuming that the bandwidth of a single channel is the same as the channel spacing.
4. **[text in boldface added 12/16/25]** Sketch the **Fourier transform** of the raised cosine pulse (for good performance with regard to Nyquist's first criterion for zero ISI) obtained for a roll-off factor of $r = 0.25$ and a bit rate of $R_b = 10 \text{ Mbits/s}$.
5. **[figure clarified 12/16/25]** A simple model of multipath propagation is characterized by the elliptical area shown below, where the transmitter and receiver are at the foci of the ellipse. All paths that originate at the transmitter, reflect at a point along the ellipse, and progress to the receiver, like the one indicated in the diagram, have the same length (7.5 km total distance) no matter where on the ellipse the reflection occurs. Those paths have the longest time delays. Of course, reflections from objects within the ellipse have shorter delays. The minimum delay is the direct path between the transmitter and the receiver (1.0 km distance). Find the delay spread of a wireless communication link with a direct distance of 1.0 km between the transmitter and receiver if significant multipath (i.e., above the ambient noise level) occurs only within the elliptical area shown below. Consider only single reflections; ignore the possibility of multiple reflections.

