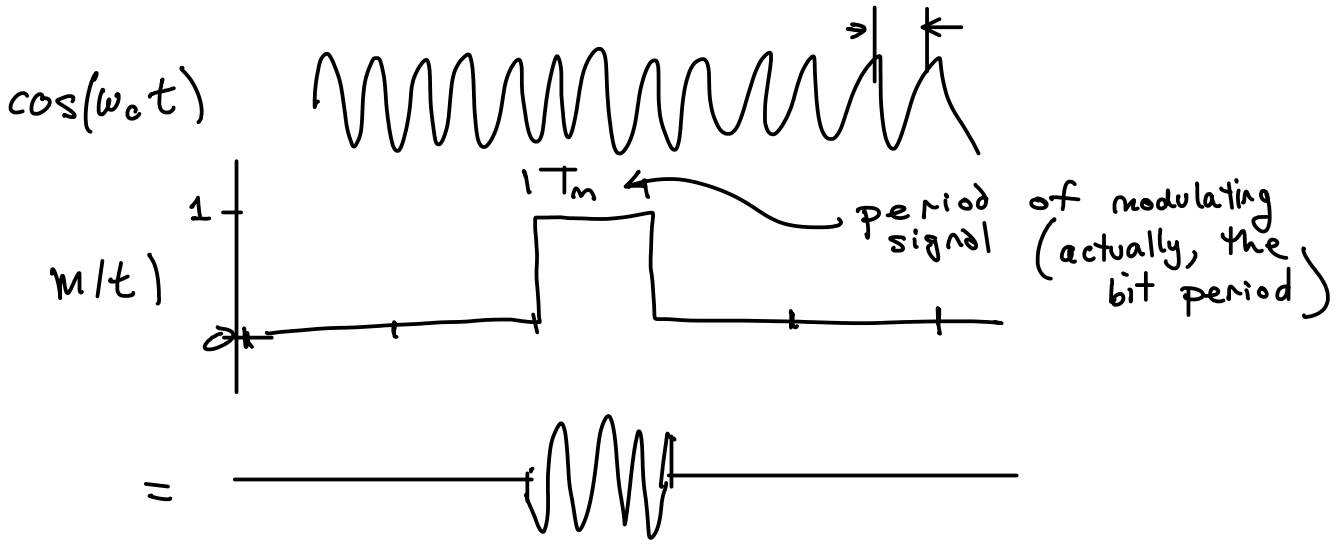
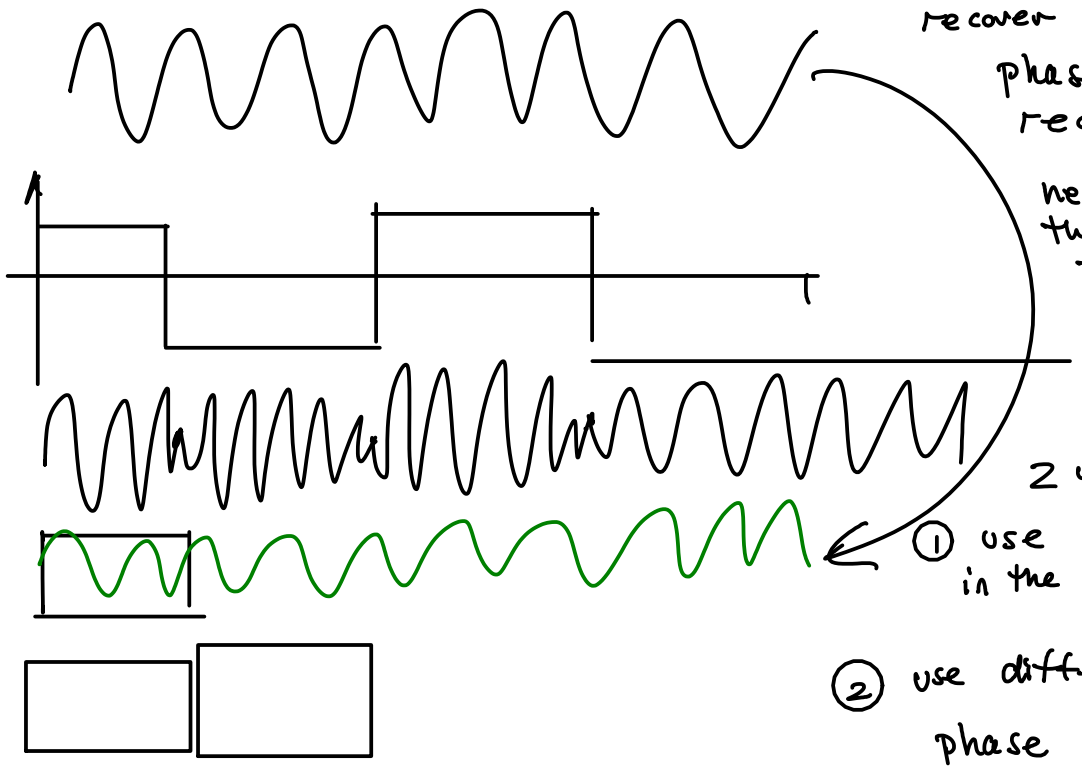
Lecture 14 - Modulation

Exercise 1: Draw the waveform of an OOK (ASK) signal. Show the periods of the carrier and the modulating signal.

$\frac{1}{f_c} = T_c$ – period of carrier





Question: how to recover the signal phase at the receiver?

need to regenerate the carrier at the receiver

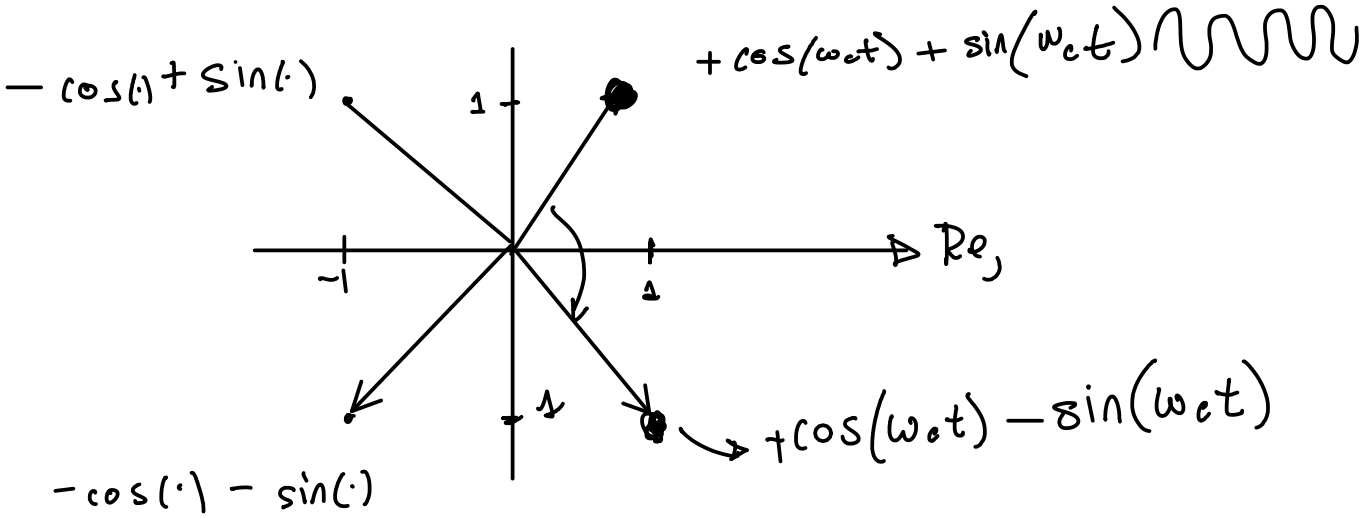
2 ways:

① use a reference in the preamble

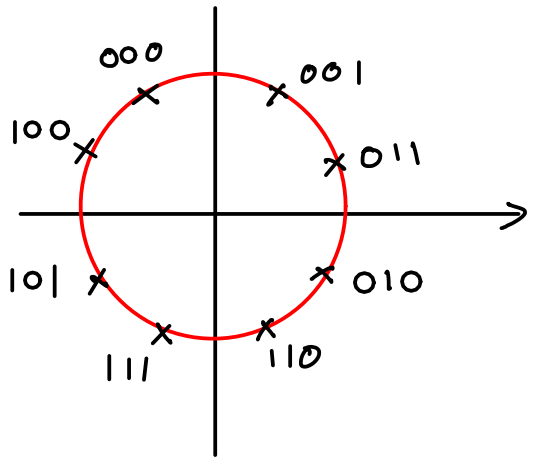
② use differential phase modulation

(e.g.: change the phase for a '1', keep the same for a '0')

Exercise 2: Label the other three points in the constellation diagram with the equation of the signal that corresponds to that point.



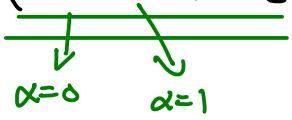
Exercise 3: Draw the constellation for 8-PSK.



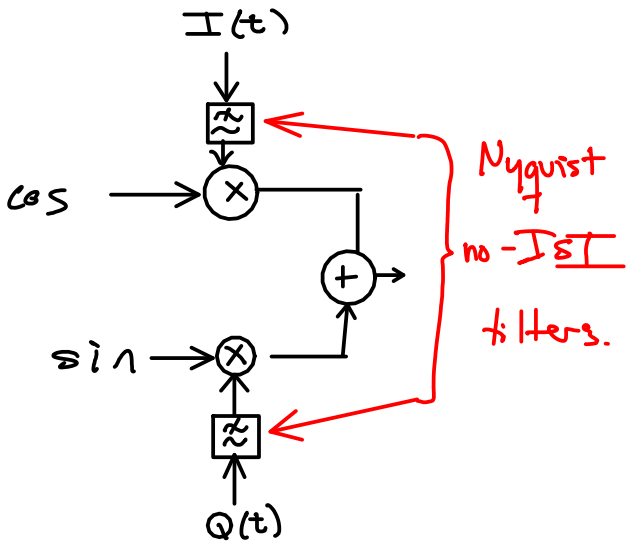
Exercise 4: If the I and Q modulating signals have symbol rates of 2 MHz, what is the minimum bandwidth of the I and Q channels so that there is no ISI? What would be the bandwidth of the modulated (RF) signal? What are the spectral efficiencies (symbols/second/Hz) of the baseband and of the modulated signals?

if symbol rate is 2MHz

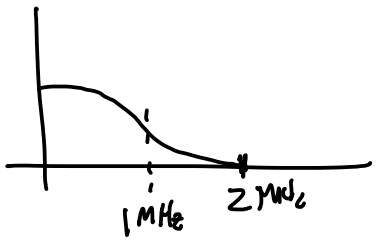
need between 1-2 MHz



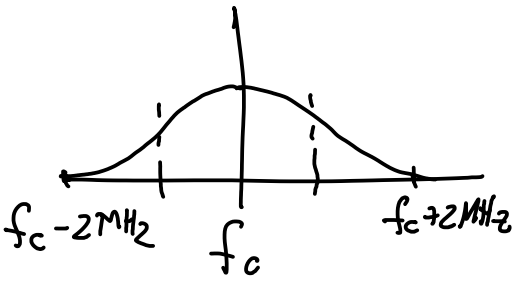
of band width for I & Q



examples below for $\alpha=1$



BW = 2 MHz



BW = 4MHz

spectral efficiency 1 b/s/Hz

SAME spectral efficiency

1 b/s/Hz

(2 Ms/s I + 2 Ms/s Q)

Exercise 5: Assign gray-coded values to the 8-PSK constellation.

See Exercise 3 above