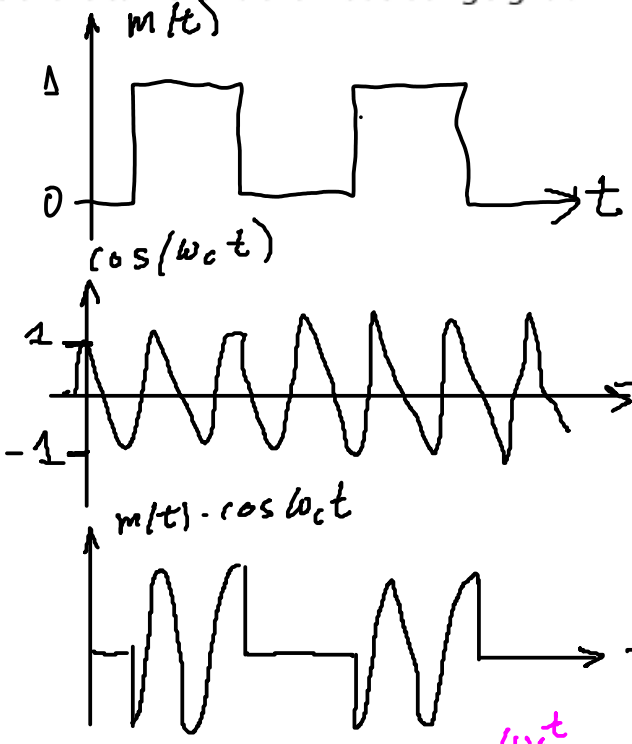
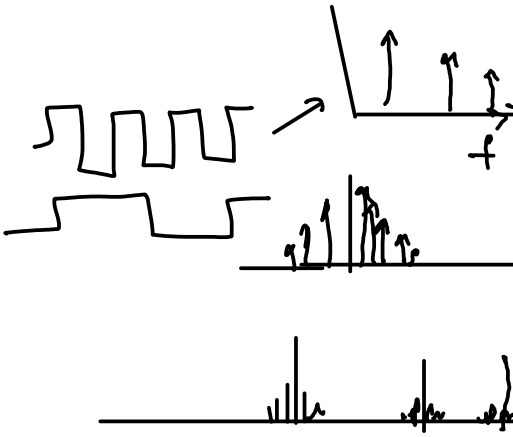
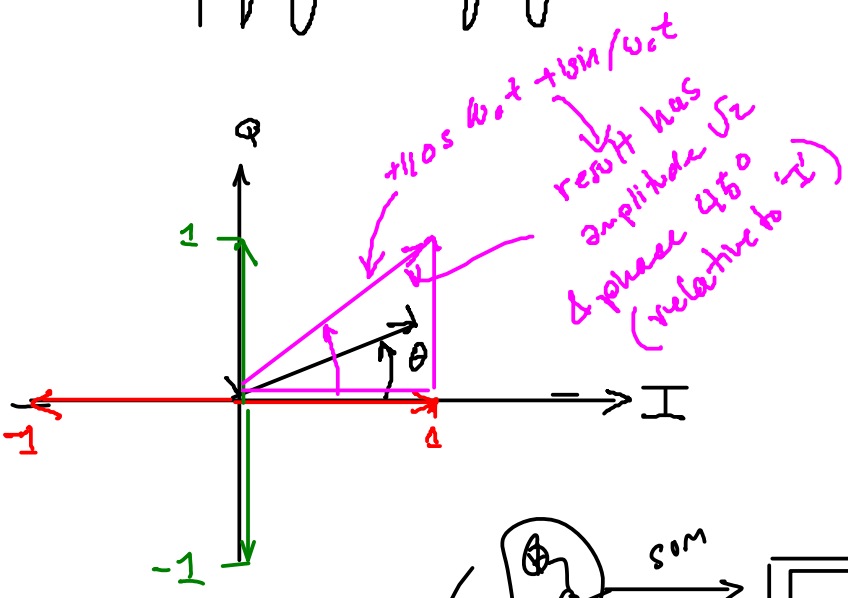
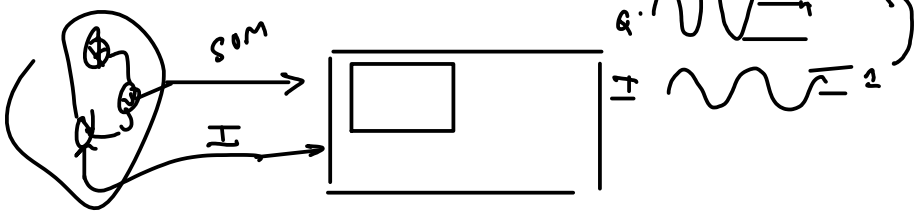
Exercise 1: Draw the waveform of an OOK (ASK) signal. Show the periods of the carrier and the modulating signal.



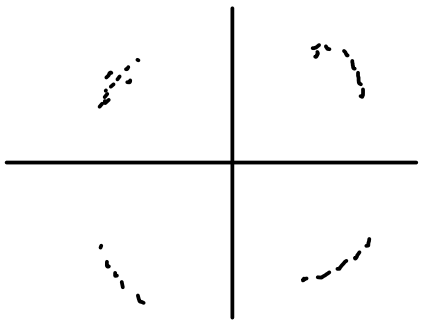
← OOK (or ASK) modulated signal

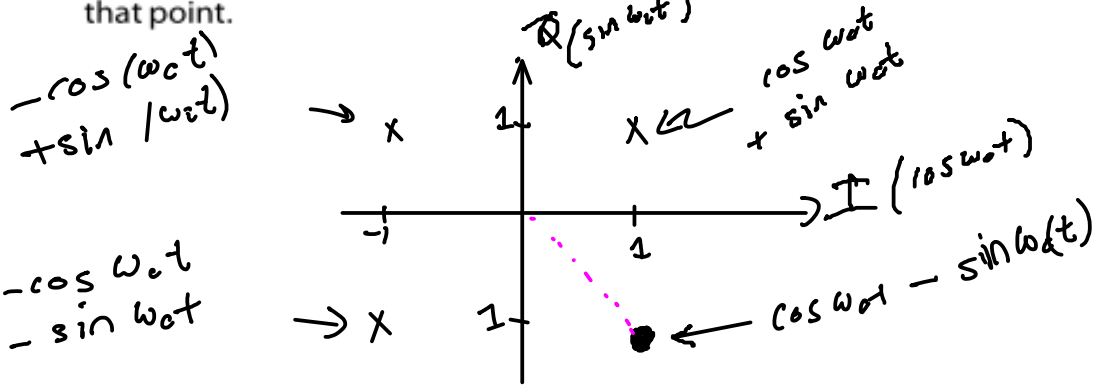




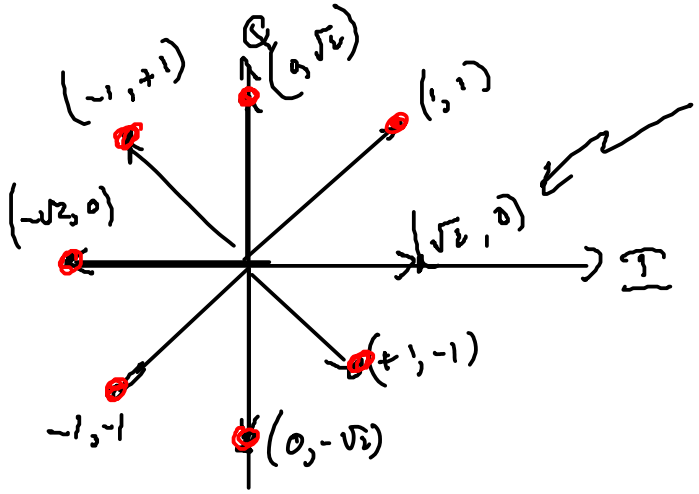


Exercise 2: Label the other three points in the constellation diagram with the equation of the signal that corresponds to that point.

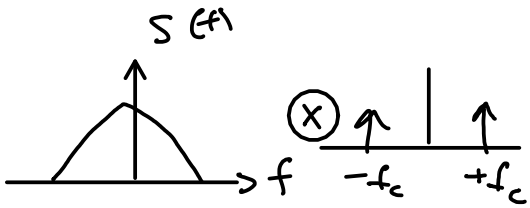


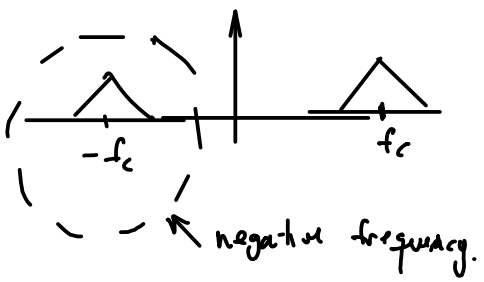


Exercise 3: Draw the constellation for 8-PSK.



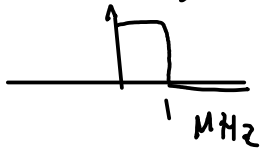
x, y or I, Q values or coordinates



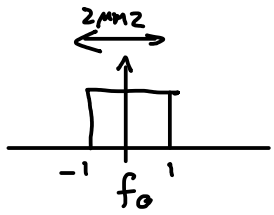


Exercise 4: If the I and Q modulating signals have symbol rates of 2 MHz, what is the minimum bandwidth of the I and Q channels so that there is no ISI? What would be the bandwidth of the modulated (RF) signal? What are the spectral efficiencies (symbols/second/Hz) of the baseband and of the modulated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

— for 2 M symbols/sec there is no ISI
if Nyquist no-ISI criteria are met for each of I & Q.
∴ need minimum of $\frac{1}{2} \cdot 2 = 1$ MHz of bandwidth ($\alpha = 0$)
(or would need 2 MHz for $\alpha = 1$)



— RF bandwidth is 2X the baseband (1-sided) bandwidth
∴ 2 X 1 = 2 MHz



— spectral efficiency is $\frac{\text{symbols/s}}{\text{bandwidth}}$

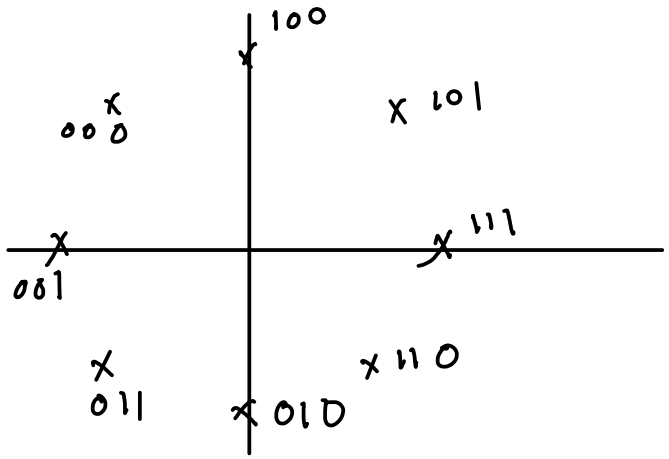
spectral efficiencies

baseband: bandwidth is 1 MHz $\quad \frac{1 \times 2\text{M sym/s}}{1\text{ MHz}} = 2$

RF signal: bandwidth is 2 MHz (but there are two: I & Q)

symbol rate: 2 MHz (2M symbols/sec). $\quad \frac{2 \times 2\text{M sym/sec}}{2\text{ MHz}} = 2$

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



100
101
111
110
010
011
001
000

Spectral Efficiency: $\frac{\text{bits/second}}{\text{bandwidth.}}$

higher is better.

e.g. GSM: $\frac{280\text{ kb/s}}{200\text{ kHz.}} = 1.4\text{ bits/s/Hz}$

tel. modem $\frac{56\text{ kb/s}}{4\text{ kHz}} = 14\text{ bits/s/Hz.}$