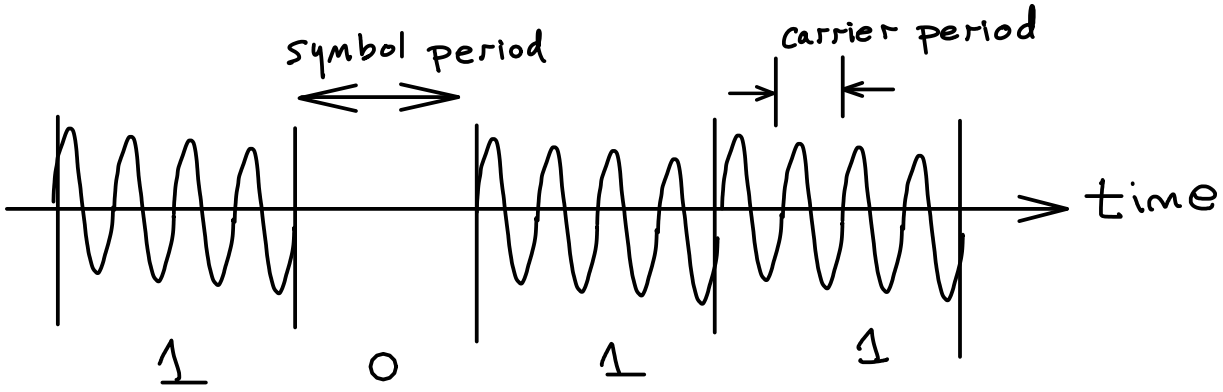
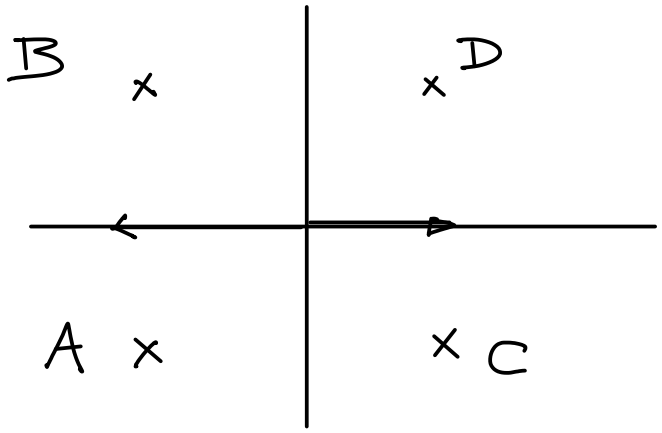
Lecture 11 - Modulation

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



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



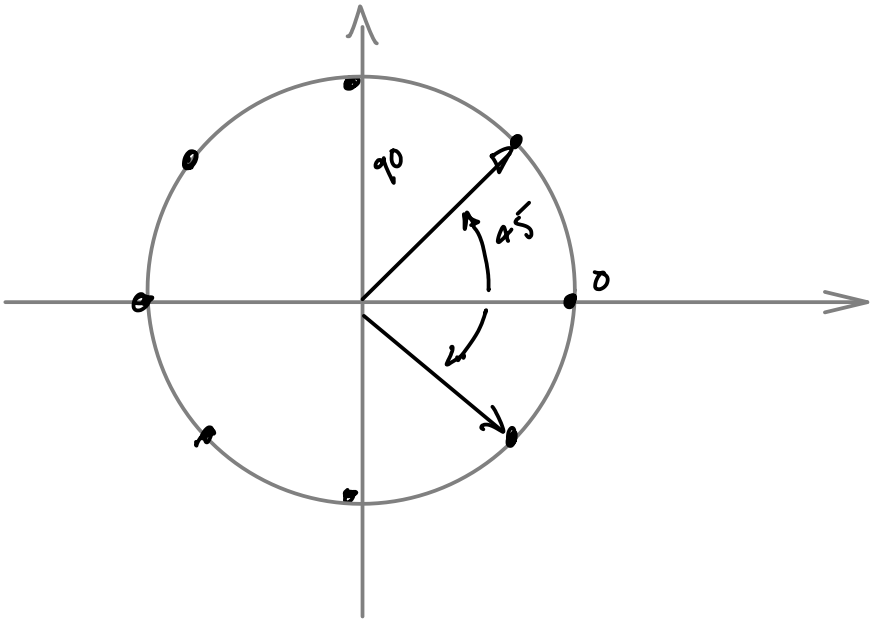
A $-\cos(\omega_c t) - \sin(\omega_c t)$

B $-\cos(\omega_c t) + \sin(\omega_c t)$

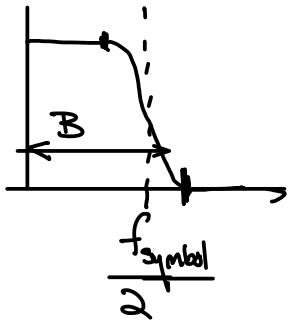
C $+\cos(\omega_c t) - \sin(\omega_c t)$

D $+\cos(\omega_c t) + \sin(\omega_c t)$

Exercise 3: Draw the constellation for 8-PSK.



Exercise 4: What is the bandwidth of a baseband signal with a symbol rate of 1 MHz that has been passed through a filter meeting the Nyquist conditions with an excess bandwidth (α) of 1? If two of these signals are used as the I and Q modulating signals for a 16-QAM modulator, what is the RF bandwidth? 2 MHz
What are the symbol and bit rates of the baseband (I, Q) and RF signals?

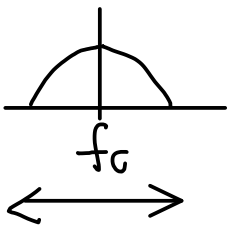


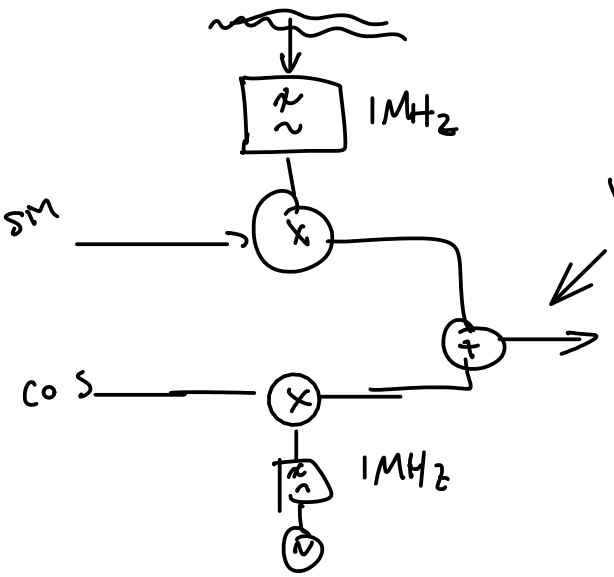
minimum baseband bandwidth

$\frac{f_{symbol}}{2}$ = 500 kHz. $\alpha = 1$ = 100%

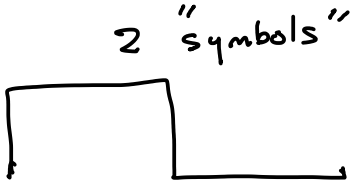
if $\alpha = 1$ what is B?

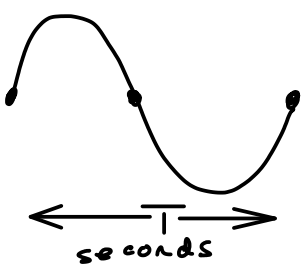
for $\alpha = 1$ need filter w/ B/W = 1 MHz. B = 1 MHz





bandwidth?





16-QAM = $\log_2 16 = 4$ bits/symbol

1 MS/s × 4 bits/symbol = 4×10^6 bits/s

Exercise 5: An MSK signal uses a carrier frequency of 100 MHz to transmit a 0 and a higher frequency to transmit a '1'. If the bit rate is 50 kHz, what is the other frequency?

for [G]MSK frequency deviation is half of the bit rate: $\frac{50\text{kHz}}{2} = 25\text{kHz}$.

∴ The second frequency is 100.025 MHz.

Exercise 6: Assign gray-coded values to the 8-PSK constellation.

100
101
111
110
010
011
001
000