

4. Problem Sheet

Out	Due	Discussion
10.05.17	16.05.17	19.05.17 - 23.05.17

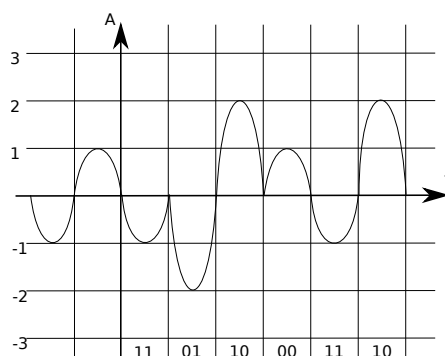
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Please solve the problems in groups with two people and submit your solutions before the lecture. The discussion of the problem sheet is in the exercise course after the submission.

Problem 4.1: Modulation 1

4 points

Consider the following modulation diagram.



The signal has already been sampled and demodulated. The symbols are depicted in the modulation diagram. Specify the (de-)modulation table for the applied (de-)modulation scheme. Sketch the corresponding constellation diagram.

Problem 4.2: Modulation 2

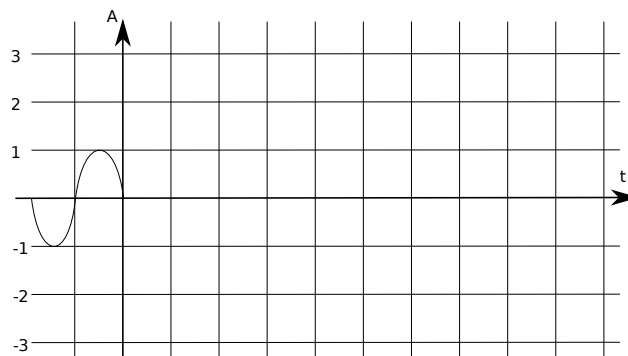
4+4 = 8 points

- Consider a sender transmits the bit sequence 000110010011. A combination of amplitude shift keying (ASK) and differential phase shift keying (Differential PSK) is applied¹. The base frequency is f and, for simplicity, each symbol is sent for $\frac{1}{2}T$. The following modulation table is used:

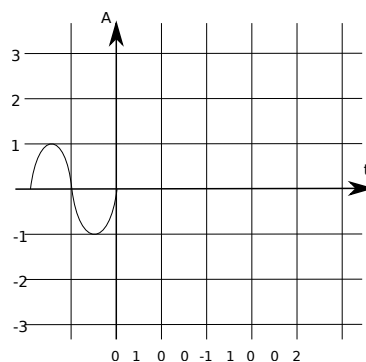
Symbol	Amplitude	Phase Shift
00	1	0
01	2	0
10	1	π
11	2	π

In the following diagram, a sine wave carrier $s(t) = \sin(2\pi ft)$ is depicted for $\frac{1}{f}$ seconds. Modulate the bit sequence on the carrier.

¹Differential phase shift keying means that the signal is shifted by the given phase relative to the current value.



2. A receiver has sampled the amplitudes 0, 1, 0, 0, -1, 1, 0, 0, 2 at the times depicted in the following diagram.



Consider every 3-tupel of bits was encoded as follows:

Symbol	Amplitude	Phase Shift
000	1	0
001	2	0
010	1	$\frac{\pi}{2}$
011	2	$\frac{\pi}{2}$
100	1	π
101	2	π
110	1	$\frac{3\pi}{2}$
111	2	$\frac{3\pi}{2}$

Sketch the wave carrier based on the sampled values. Specify the bit sequence that was transmitted.

Problem 4.3: Baud + Coding

$1+1+1 = 3$ points

Two computer are connected over a medium. One of them want to transmit the bits 1011100100 to the second. Assuming there are four signal levels $+1V, +0,5V, -0,5V, -1V$ for a transmission.

1. Which bit rate can be achieved with a baud rate of 4800?
2. How many different codings are possible? Define one.
3. Make a diagram with the defined coding.

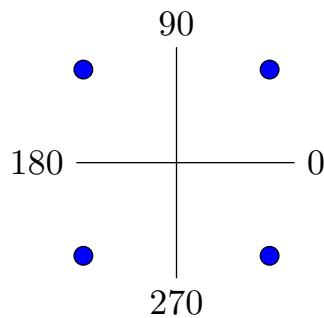
Problem 4.4: Dropping support for analog telephone and ISDN

2 points

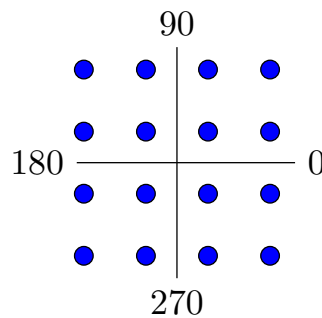
The telephone company “Magenta” is phasing out support for analog communications and ISDN and instead deploying VoIP (voice over IP). What is the motivation for this? Why might this actually be a good thing for most of their customers?

Problem 4.5: Modem bit rates

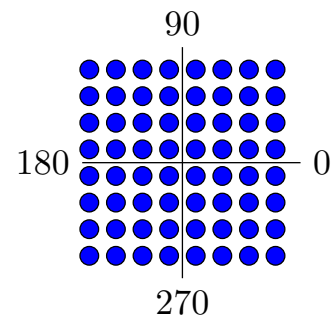
$1+1+1 = 3$ points



QPSK



QAM-16



QAM-64

Calculate the resulting bitrate of the modulation schemes depicted above when a symbol rate of 600 baud is used.

a total of 20 points