



## S-38.110 Telecommunication Switching Technology I, Exercise 1

Brax/Ilvesmäki 27.1.2000

**The answers are to be returned before the exercise begins either to the exercise assistant (in person or via email to lynx@tct.hut.fi) or to a box underneath the lab's noticeboard.**

*Task 1*

Following the Nyquist sampling theorem, what should be the sampling rate for the following systems:  
a 4-kHz voice channel,  
a 7,5-kHz channel,  
a 4,2-MHz video channel.

*Task 2*

Which voltage levels do the following A-law PCM Coded numbers correspond to, if the maximum amplitude is 1,0 V.

1 000 0011

1 001 0011

1 111 0011

0 000 0011

0 001 0011

0 111 0011

*Task 3*

It is usually taken for granted that the relation of the average power of quantization distortion to the average signal power is known to be  $20 \cdot \log_2 n$ , where  $n$  is the amount of sample bits. Show that this is actually the case. The quantization step  $q=2$  and the average of quantization distortion is assumed to be zero. You may want to know that the average power is calculated according to

$$I_{power} = \sqrt{\frac{1}{T} \int_0^T i(t)^2 dt} .$$

*Task 4*

Determine the S/N -ratio for a sinewave signal of p-to-p amplitude of 2V quantised into L levels. Use the results from the previous task. Assume linear quantization.

