1. The bandwidth of a monotone signal is 8kHz，with PCM transmission, calculate:

(1) Minimum sampling frequency;

(2) After sampling, conduct 16 levels quantification, then the information transmission rate of the PCM system?

(3) If the sampling is quantified at 128 levels, what is the information transmission rate of the PCM system?

solution:

(1).

The minimum sampling frequency is two times of the bandwidth.

The Bandwidth of the signal is: 8k Hz,

The minimum sampling frequency is

fs> 23= 2×81k112=16kHz.

(2). Quantization level is 16 means that the number of bits is ; $\log_2 16 = 4$.

Because the code is in binary.

The translation rate is:

$4 \times 16\,kHz = 64\,kb/s$.

(3) As same as (2), the translation rate is: $\log_2 128 \times 16\,kHz = 112\,kb/s$.

2. Describe the differences between TDM and FDM.

FDM uses frequency to distinguish the signals transmitted simultaneously on the same channel. The signals are separated from each other in frequency, but overlap in time.

TDM is to distinguish the signals transmitted in turn on the same channel in time. The signals are separated from each other in time, but overlap in frequency.

3. Write down the concept (including the full name) and steps of PCM.

· PCM is a method used to digitally represent analog signals. It is widely used in audio, video, and data communications.

step 1: Sampling

step 2: Quantization

step 3: Encoding

4. Briefly describe the purpose of quantization

Map each sampled value to the nearest quantization level. This process can use linear or non-linear quantizers.

5. Write down the Nyquist interval and Nyquist frequency formulas in the sampling theorem.

5.1 The Nyquist frequency f_N is defined as half of the sampling rate.

$$f_N = \frac{f_s}{2}$$

5.2 The Nyquist interval T_N is the reciprocal of twice the maximum frequency present in the signal

$$T_N = \frac{1}{2B}.$$