**Advanced Computer Networks**

**Assignment no. 2**

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1. **A non-periodic composite signal contains frequencies from 10 to 30 KHz. The peak amplitude is 10 V for the lowest and the highest signals and is 30 V for the 20-KHz signal. Assuming that the amplitudes change gradually from the minimum to the maximum, draw the frequency spectrum.**

**10 kHz**

**30 kHz**

**20 kHz**

**10 V**

**10 V**

**30 V**

amplitude

Frequency

1. **A TV channel has a bandwidth of 6 MHz. If we send a digital signal using one channel, what are the data rates if we use one harmonic, three harmonic, and five harmonics?**

**Solution:**

Using data rate and bandwidth relations **of Table 3.2** (Data Communication and Networking by Behrouz A. Forouzan) the data rate can be find as

* Data rate if only first harmonic is used = 2\*N = 2\*6 = **12Mbps**
* Data rate if only first three harmonics are used = 2xN/ 3 = 2x 6/3 = **4Mpbs**
* Data rate if only first five harmonics are used = 2xN/ 5 = 2x 6/5 = **2.4Mbps**

1. **We have sampled a low-pass signal with a bandwidth of 200 KHz using 1024 levels of quantization.**

**a. Calculate the bit rate of the digitized signal.**

**b. Calculate the SNRdB for this signal.**

**c. Calculate the PCM bandwidth of this signal.**

**Solution:**

1. In a low pass signal, the minimum frequency is 0. Therefore, we can say

fmax= 0 + 200 = 200 KHz → fs = 2 × 200,000 =**400,000 samples/s**

 The number of bits per sample and the bit rate are

nb = log21024 = 10 bits/sample N = 400 KHz × 10 =**4 Mbps**

**b**. The value of nb = 10.

We can easily calculate the value of SNRdB

 SNRdB = 6.02 × nb+ 1.76 =**61.96**

1. The value of nb = 10. The minimum bandwidth can be calculated as

BPCM = nb × Banalog = 10 × 200 KHz = 2**MHz**

1. **What is the Nyquist sampling rate for each of the following signals?**

**a. A low-pass signal with bandwidth of 200 KHz?**

**b. A band-pass signal with bandwidth of 200 KHz if the lowest frequency is 100 KHz?**

**Solution:**

According to Nyquist theorem, the sampling rate must be twice of the highest frequency in a signal (s)

1. Since **bandwidth is 200khz** which is also the highest frequency in low pass signal so the sampling rate is 2x200 kHz = **400K samples/ second**
2. In bandpass signal since the lowest frequency is 100kHz so to maintain a bandwidth of 200kHz the highest frequency must be 300kHz thus

Sampling rate = 2 x 300kHz =**600K samples/second**