

Tutorial 1

Digital Signal Processing

1. Using an appropriate block diagram describe a typical digital signal processing system. Indicate the function of each block in the system.
2. What effects will occur if there is no anti-aliasing filter in a DSP system that takes an analogue input?
3. What are the different parameters that require to be determined before the final choice of analogue to digital converter can be made?
4. What is Shannon's sampling theorem?
5. Using a suitable sketch show the effect that not sampling at a high enough frequency can have.
6. With the aid of a suitable sketch show how quantisation noise arises and how its effects can be minimised.

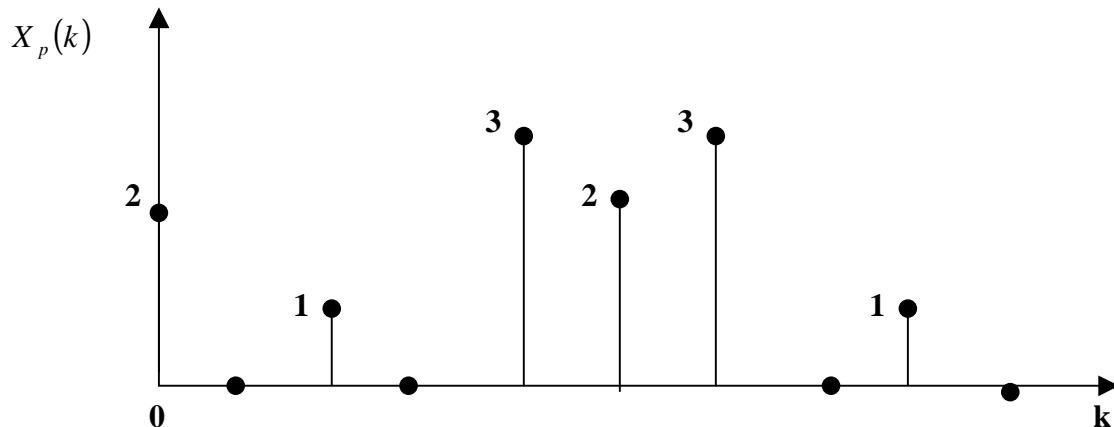
7. A periodic analogue signal is given by:

$$x_p(t) = \cos(200\pi t)$$

This analogue signal is sampled with sampling rate f_s to yield the periodic sequence

$$x_p(n) = \cos\left(200\frac{n\pi}{f_s}\right)$$

- a. Find the period of the sequence and the DFS coefficients for $f_s = 250\text{Hz}$ and for $f_s = 450\text{Hz}$. Comment on the relationship between the two sets of DFS coefficients.
 - b. Sketch the DFS coefficients as functions of k and label the frequency axis with analogue frequencies for the sampling frequencies in part (a). Assume that in both cases the record length is such that the samples in the record constitute one period of the sequence.
8. A periodic analogue signal is sampled at a frequency of 200 Hz. The resulting periodic sequence has a period of 10 and its Discrete Fourier Series coefficients are shown below.



- a. Show the analogue frequency scale on the abscissa of the DFS plot. Assume the record length is 0.05s.
- b. Without using the inverse Fourier equation write down the sequence as a sum of cosines (hint think about what each coefficient represents).