**List 3: DFT and FFT**

**Sample solution**

**Exercise 1** *Discrete Fourier Transformation (DFT)*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Spek-trum** | **time function** | **Why do these functions match each other?** | **N** | **Ts**  **[s]** | **Fs**  **[Hz]** | **fstep frequency step**  **[Hz]** | **N.Ts**  **time window**  **[s]** |
| Xa | x3 | Only function with N=8 | 8 | 0,125 | 8 | 1 | 1 |
| Xb | x2 | N.Ts = 2 and  smaller amplitude than x1 | 16 | 0,125 | 8 | 0,5 | 2 |
| Xc | x5 | Only function with Ts=0,0625 and N.Ts=1 | 16 | 0,0625 | 16 | 1 | 1 |
| Xd | x1 | N.Ts = 2 and  larger amplitude than x1 | 16 | 0,125 | 8 | 0,5 | 2 |
| Xe | x4 | Only function with  N.Ts=4s | 16 | 0,25 | 4 | 0,25 | 4 |

**Exercise 2** *FFT and Sampling*

(a) Time window : 

(b) The sampling frequency must be larger than 4Hz, because the signal x(t) has a fmax = 2 Hz.



**Exercise 3** *Discrete Fourier Transformation*

(a) Fs = 400 Hz => „end frequency” on the DFT-plot (more precisely one fstep after last point).

(b) N.Ts = 1/10 = 0,1 s => because N.Ts = (fstep)-1

(c) T0 = 1/10 = 0,1 s => because T0 = (f0)-1

(d) tau = T0/4 => because 4th harmonics = 0