

4a) With a sampling frequency (say) 1/2

$$\Omega_s = \frac{2\pi}{T_s} = 2\pi(20.000)$$

the discrete frequency  $\omega$  is related to the analog frequency  $\Omega$  by

$$\omega = \Omega T_s \text{ or } \omega = \frac{\Omega}{20.000}$$

With an  $N$ -point DFT, the Discrete-Time Fourier Transform (DTFT) is sampled at the  $N$  frequencies

$$\omega_k = \frac{2\pi}{N} \cdot k, \quad k = 0, 1, \dots, N-1$$

Therefore,  $X[k]$  corresponds to an analog frequency of

$$\Omega_k = 20.000 \omega_k = \frac{2\pi}{N} \cdot 20.000 \cdot k$$

$$\text{or } f_k = 20.000 \cdot \frac{k}{N}$$