

SIGNAL PROCESSING TUTORIAL QUESTIONS

1. How does the Fourier transform modify the information in a signal?
2. Consider $x_a(t) = \cos(100t)$, determine the minimum sampling rate to avoid aliasing and write down an expression for $x[n]$ if a sampling frequency of 75 Hz is used.
3. Find an expression for the d.c. gain of the first order lowpass filter
4. Which filter structure, FIR or IIR has feedback and can therefore be unstable if the coefficients are inappropriately chosen?
5. Find the magnitude spectrum of the sequence given by $\{1; 1; 2; 3; 3\}$ without using a Matlab software tools on a computer.
6. What information is needed in order to compute the output of a discrete-time LTI system?
7. What is the order of the system function with a FIR filter is given by $H(z) = \sum_{k=0}^{N-1} b_k z^{-k}$
8. Consider a complex discrete-time signal $x[n]$ with N samples with discrete Fourier transform (DFT) $X[k]$. State the expression for $X[k]$ in terms of $x[n]$ and the number of real multiply operations to compute $X[k]$.
9. Find the Discrete Fourier Series coefficients for the sequence $x_p[n] = 10 \sin(2\pi n/3)$ and calculate $x_p[n]$ at $n \leq 2$
10. Given the continuous signal as $f(t) = 5\sin(t)$ with $-\pi \leq t \leq \pi$, find the corresponding Fourier transform of the signal.
11. Briefly explain the consequences of extending the order of the filter during filter designing for signal processing
12. Determine the Fourier transform of the function below

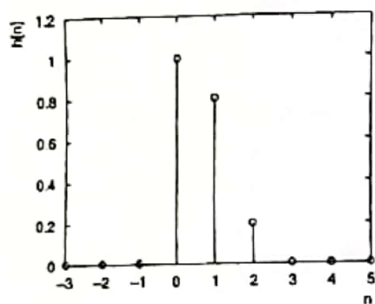
$$\begin{aligned} x(t) &= e^{-\alpha t} & \text{f o r } t &\geq 0 \\ &= 0 & \text{f o r } t < 0 \end{aligned}$$

13. Give reasons why do we process signal.?

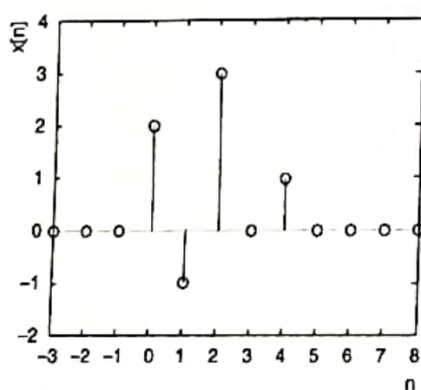
14. Briefly explain the two common ways through which the edge of a binary image can be detected.

15. A filter has a difference equation $y[n] = 0.5y[n-1] + x[n]$. If the input $x[n]$ is $u[n]$, find first 4 samples of the output $y[n]$ and sketch the result.

16. Write the expression for the signal whose impulse response is shown in the figure.



17. Use the plotted signal bellow to find the DTFT of the given signal.



18. Implement question 20,22, 12, 14,17,2 and 5 using MatLab.

19. A Digital Filter has frequency response $H(\omega)$ such that

$$\begin{aligned} 0.95 \leq |H(\omega)| \leq 1.05 & \quad \text{for } 0 \leq \omega \leq 0.3\pi \\ 0 \leq |H(\omega)| \leq 0.005 & \quad \text{for } 0.4\pi \leq \omega \leq \pi \end{aligned}$$

and the sampling frequency is given as $F_s = 8\text{kHz}$. Determine the Passband and Stopband frequencies in kHz, the Passband ripple and the Stopband attenuation in dB.

20. Design a BPF to provide an amplification of 2 within the band of frequencies 100 and 10000Hz using $0.2\mu\text{F}$ capacitors.
21. Why FFT is more preferable in signal processing than DFT?
22. State how to read and write image using Matlab?
23. An image is usually interpreted as being one of: intensity, binary, indexed or RGB. State what does each term mean?
24. MATLAB provides functions for changing images from one type to another. What is the syntax for this task?