Gate Assignment 4

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Download all python codes from

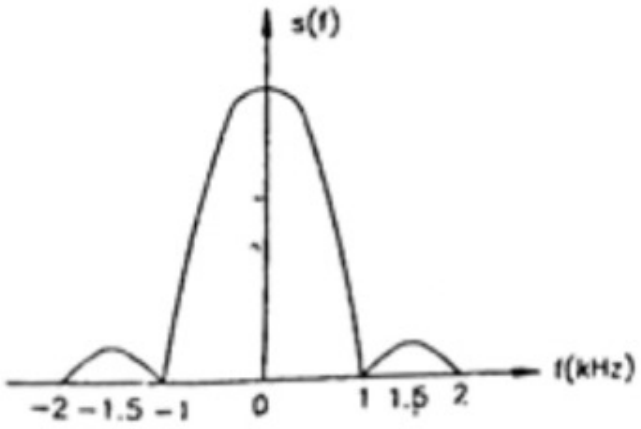
https://github.com/YashasTadikamalla/EE3900/blob/main/GateAssignment4/codes

and latex-tikz codes from

https://github.com/YashasTadikamalla/EE3900/blob/main/GateAssignment4/GateAssignment4.tex

1 Problem (EC-1997 Q1.10)

A deterministic signal has the power spectrum given in the figure. The minimum sampling rate needed to completely represent this signal is



1) $1KHz$
2) $2KHz$
3) $3KHz$
4) None

2 Solution

Definition 2.1 (Normalised sinc function)**.** *A normalised sinc function is defined as*

$$sinc(x) = \begin{cases} 1, & x = 0 \\ \dfrac{sin(\pi x)}{\pi x}, & x \neq 0 \end{cases} \tag{2.0.1}$$

Definition 2.2 (Power spectrum)**.** *Power Spectral density, or simply, Power spectrum, denoted by $s(f)$ is defined as*

$$s(f) = |X(f)|^2 \tag{2.0.2}$$

Theorem 2.1 (Sampling Theorem)**.** *If a signal contains no frequency components above W Hz, then the sampling rate at which the continuous time signal needs to be sampled uniformly, so as to completely recover the original signal is given by*

$$f_s \geq 2W \tag{2.0.3}$$

Definition 2.3 (Nyquist rate)**.** *Minimum sampling rate is also called as Nyquist rate. It is given by*

$$f_s = 2W \tag{2.0.4}$$

Given, power spectrum of a deterministic signal. From (2.2), Fourier transform of the given band limited signal is **truncated normalised sinc pulse**. As no frequency component exceeds $2KHz$,

$$W = 2KHz \tag{2.0.5}$$

From (2.0.4),

$$f_s = 2W = 4KHz \tag{2.0.6}$$

Hence, option 4 is the correct answer.

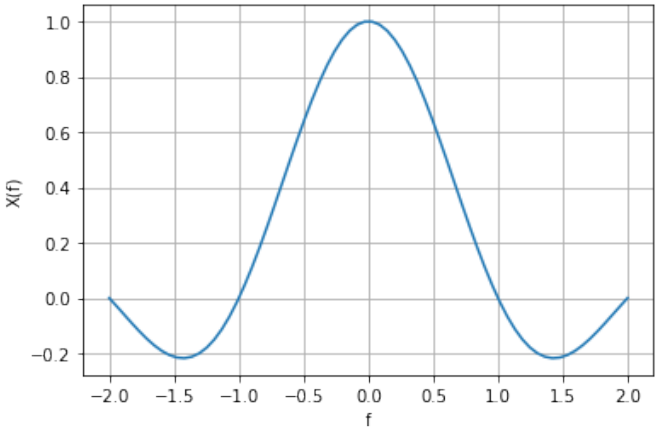


Fig. 4: Plot of X(f)