Gate Assignment 4

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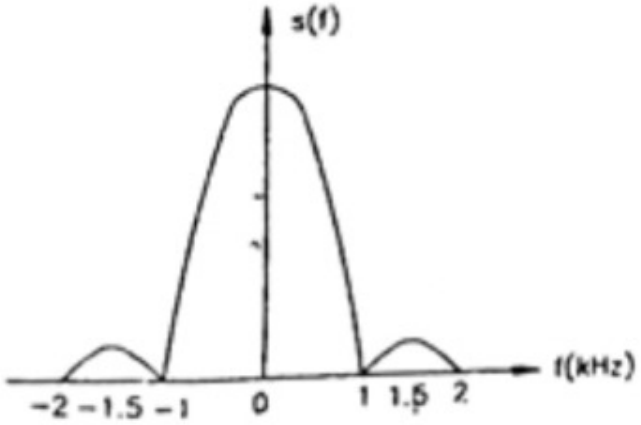
Download latex-tikz codes from

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 (Power spectrum)**.** *Power Spectral density, or simply, Power spectrum, denoted by $s(f)$ is defined as square of magnitude of Fourier transform of a signal.*

$$s(f) = |X(f)|^2 \tag{2.0.1}$$

Theorem 2.1 (Sampling Theorem)**.** *If a continuous time signal contains no frequency components higher than 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*

$$f_s \geq 2W \tag{2.0.2}$$

Definition 2.2 (Nyquist rate)**.** *The minimum sampling rate is also called as Nyquist rate. It is given by*

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

Given, power spectrum of a deterministic signal. From (2.1), we can observe that no frequency component exceeds $2KHz$. Hence,

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

From (2.0.3),

$$f_s = 2W \tag{2.0.5}$$
$$= 2(2) = 4KHz \tag{2.0.6}$$

Hence, option 4 is the correct answer.