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* FCS Tutorial Assignment (Unit 1) *

1. We send a voice signal from a microphone to a recorder. Is this baseband / lowpass or broadband / bandpass transmission?

→ When we send a voice signal from a microphone to a recorder, here no modulation is involved. As low band transfer means sending a digital signal over a channel without converting the digital in to the analog signal there. Hence this transmission is baseband / lowpass.

2. We send a digital signal from one station on a LAN to another station. Is this baseband or broadband transmission?

→ A digital signal transmitted from one station on a LAN to another station does not required any change or modulation. Hence it is a baseband transmission.

3. Can we say if signal is periodic or non periodic by just looking at its frequency domain plot? Why?

→ The given signal may be periodic if its frequency spectrum having the fundamental time periodic repeats at regular intervals of time. The given signal is non periodic when the signals frequency is random & it is not defined in sine wave or cosine wave.

4. We modulate several voice signals and send them through the air. Is this baseband or broadband transmission?

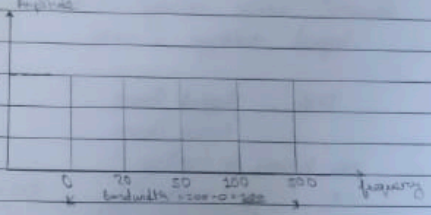
→ This is broadband transmission because it involves modulation i.e., it composite signals travel through the medium.

5 What does the shannon capacity have to do with communica-tions?

→ Shannon information capacity C has long been used as a measure of the goodness of electronic communication channels. It specifies the maximum rate at which data can be transmitted within, even if an appropriate code is used.

6 What is the bandwidth of a signal that can be decomposed into 5 sine waves with frequency at 0, 20, 50, 100 & 200 Hz? All peak amplitudes are the same. Draw the bandwidth.

→ $B = f_h - f_l = 200 - 0 = 200\text{Hz}$



7 Which signal has a wider bandwidth, a sine wave with a frequency of 200 Hz or a sine wave with a frequency of 200Hz

→ Each signal is a simple in this case. The bandwidth of a simple signal is 0 so, the bandwidth of both signals will be same.

8 A signal has a wavelength of 1m in air. How far can the front wave travel during 1000 periods?

→ Wavelength of signal = 1m
Time period = T = 1000
Wavelength of = propagation speed
frequency of signal

$$\text{Speed} = \frac{\text{Wavelength}}{\text{Period}} = \frac{1}{1000} = 10^{-3}\,m$$

9. If the peak voltage value of a signal is 20 times the peak voltage value of the noise, what is the SNR? What is the SNR dB?

→ Assume noise voltage = Vs
Signal voltage = 20Vs

$$SNR = \frac{\text{Signal Power}}{\text{Noise Power}}$$

as power $\propto$ (voltage)^2

i.e, $\frac{[(\text{Signal voltage})^2]}{[(\text{Noise voltage})^2]}$ - SNR (Signal to Noise Ratio).

$$= \left(\frac{\text{Signal voltage}}{\text{Noise voltage}}\right)^2$$

$$= \left(\frac{20 \times Vs}{Vs}\right)^2$$

= 400 microwatts.

formula for calculating SNR in dB is

$$SNR = 20 \times \log\left(\frac{\text{Signal}}{\text{Noise}}\right)$$

$$= 20 \log 400$$

$$= 52.04\ dB$$

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10. We need to upgrade a channel to a higher bandwidth. Answer the following questions.

(a) How is the rate improved if we double the bandwidth.

→ By doubling the bandwidth (2B), capacity will be doubled. [illegible] bandwidth is directly proportional to the number of bits sent or to the rate. Hence channel will increased [$C_2 = 2 * BW_1 \times \log_2($[illegible] The rate is doubled [illegible] $[C_2 = 2 * C_1]$]

(b) How is the rate improved if we double the SNR?

→ $C_2 = BW_1 \times \log_2 (1 + 2 \times SNR)$

$= BW_1 \times \log_2 (2 \times SNR)$

$= BW_1 \times \log_2 (2) + BW_1 \times \log_2 (SNR)$

$= BW_1 + C_1$