8. What is the difference between TDM and FDM?

The two techniques of multiplexing are TDM -

Time Division Multiplexing and FDM - Frequency Division Multiplexing. The primary difference between TDM and FDM is that TDM shares the timescale for the various signals while FDM uses the frequency scale for the various signals. TDM is used with Digital signals. FDM is used with Analog signals.TDM is in low dispute while FDM has high conflict. In TDM, synchronization pulse is necessary. While in it Guard band is necessary.TDM is efficient ,while  FDM is inefficient. TDM cabling or chiping is easier while FDM is complex.FDM cost is high comparatively TDM is low.TDM is more efficient than FDM system**.** TDM can be used for transmission of both Analog as well as Digital signals. While FDM is mostly employed for analog signal. TDM is protected against crosstalk when compared to FDM system.

7. What is the difference between AF and RF amplifier? Why both of them are used in transmitter or receiver?

AF amplifiers are audio frequency amplifiers. AF is a periodic pulse whose frequency is audible in the band to the average person, the range of person ears. It's the sound quality that defines pitch most. They are increasing the amplitude of sounds we can hear. Around 20kHz to 20Hz. These are widely used in speakers, microphones, earphones, etc. RF amplifiers are radio frequency amplifiers. RF is any of the frequencies of electromagnetic waves that lie within the range from which it extends. Around 20kHz to 300Hz. These are found in satellites, cell phone towers and in dish antennas.

A transmitter or receiver is an electronic system used in communications to generate radio waves such that data can be sent or received using an antenna**.**

In electronic networking and television, and in recording devices of all sorts, amplifiers are used to increase the power of a signal.

A RF power amplifier is a type of electronic amplifier that transforms a low-power radiofrequency signal into a higher-power signal. The RF power amplifiers normally drive a transmitter antenna.

Radio frequency amplifiers (AF amplifiers), used to boost signals from 20Hz-20kHz in the human hearing range, while some Hi-Fi AF (radio amplifiers) extend this spectrum up to about 100kHz, while some audio amplifiers can monitor the high frequency level to 15kHz or less.

And we should phrase it that way. AF and RF amplifiers are used to better extract the information inside the human constraint

4. Give a single advantage of digital communication over analog communication and explain it in your own word.

Since signals such as digital circuits are digitized, they are easier to design and cheaper than analog circuits. Over analog communication it's more reliable.

Digital is cheaper than analog in many ways. The designs are reusable which means the cost of designing is not repeated. Power savings and compact designs lead to inexpensive solutions. Digital signals unlike analog signals, can be encoded into self-correcting codes and transmitted over long distances with no fear of garbling, saving costs. By contrast, analog signals would get completely battered out of shape and useless to the far end which increases costs.

5. Explain the operation of PCM. What are the advantages and disadvantages of taking too many number of bits to represent each sample?

Pulse Code Modulation (PCM) is a standardized method that is used in the telephone network to change an analog signal to a digital one for transmission through the digital telecommunications network. PCM produces a sequence of numbers or digits, rather than a pulse train. In binary code, each of these digits represents the approximate amplitude of the sample signal at that instant. In PCM, a sequence of coded pulses represents the message signal. This message signal is achieved by representing both the time and the amplitude of the signal in discrete form. PCM used, digital audio recording, digitized video special effect, digital video, voice mail.

There are three steps for PCM

1.Sampling .2 Quantization. 3. Encoding. In PCM an analog signal or information is converted into a binary sequence 1 and 0. The output of a PCM resembles a binary sequence. Sampling is the operation in which an analog signal is sampled according to the sampling theorem resulting in a discrete-time signal. The quantizing and encoding operations normally take place in the same circuit known as an analog to digital converter.

Another is Nyquist theorem .The sampling frequency *fs  is higher than two times the highest frequency* component of the analog signal W, that is *fs* >2W.

What are the advantages and disadvantages of taking too many number of bits to represent each sample**?**

Take many samples to make reproducing the signal easy. But we are taking a lot of samples, our bit rate is high, or a high frequency. Every sample, every bit. That's not healthy. Within a small distance, taking more samples is higher sampling frequency. Taking less sample value or original value in the quantization presents some issue for the signal. Loss information, making signal noise and error.

Take more rates or values, and less variation of transmitted signal versus original signals. That's perfect for signalling. Modulation of the pulse code is the most common modulation for the time division. There are several times the sampling rate, or number of samples per second. There is no greater noise buildup or distortion at these.

A digital signal reflection of analog signals, taking samples at regular intervals of the analog signal amplitude. Natural audio signals are clustered more close to zeros. At small values, the human ear is more sensitive to errors in quantization.

3. What is FM? What is the purpose of Bessel function regarding FM? What is the benefit of Carson's rule against general equation for bandwidth of FM?

Frequency modulation (FM) is a method used to represent the data on a digital or analog alternating signal. The method involves varying the frequency of the carrier wave which imposes or impresses useful information on. Example : FM radio. FM radio makes use of frequency modulation. For FM radio the frequency range is roughly 88 to 108 MHz.

Modulation index may determine the total bandwidth of an FM signal. The number and amplitudes of significant sidebands are determined from the modulation index by solving basic equation of an FM signal.

If we want to understand that signal in terms of cosines without any modulation of frequency. The result turns out to be a series of cosines weighted by Bessel's β functions.

The bandwidth of an FM signal is not as easy to measure as that of an AM signal. Carson's rule is regarded as a very useful thumb rule used by many engineers to evaluate the bandwidth of an FM signal for radio broadcasting and radio communication systems. This rule states that within a bandwidth equal to the frequency of deviation 98 percent of the signal power is stored, plus the frequency of modulation doubled.

Also, the rule is very useful when evaluating the bandwidth of radio communication systems in several two ways. These use narrow band FM, and it is particularly important that the

sidebands do not cause interference to adjacent channels that other users

can occupy.

2. What is the difference between AM and ASK? Which types of signal are used to be modulated by them? What is SSB? Why is it okay to send sideband instead of the whole modulated signal?

AM: Modulation of amplitude (AM) is a modulation technique used in electronic communication most commonly used to transmit information via a radio carrier wave.

Through this the message signal is amplified by a high frequency carrier(RF). In doing so the carrier amplitude is adjusted according to the low frequency message signal voltage. And the message signal modulates the carrier in amplitude.

ASK: Amplitude Shift Keying (ASK) is a digitalmodulation scheme while Amplitude Modulation (AM) is referred to as an analoguemodulation method.

In this we transmit a high frequency carrier wave(RF) when the binary digit is 1 and if the binary signal is 0, no signal. But a much less amplitude signal is still transmitted for practical purposes for the distinguishing of the transmitted 1 and 0. Here the modulating signal is a digital signal which is varied according to a carrier signal's amplitude.

Single sideband modulation for two-way radio communication is widely used in the HF portion, or short wave portion of the radio spectrum. Single-sideband modulation has many users. Single sideband modulation is derived from amplitude modulation, and a number of disadvantages of AM are overcome by SSB modulation.

Single sideband modulation is usually used for voice processing, although it can also be used for many other uses where analog signals are used for two-way radio communication. When an audio signal is moduled to a steady state carrier. Spectra are used above and below the carrier as moduled into the carrier.

Although signals using single sideband modulation are more powerful and more effective than ordinary AM for two-way radio communication. We may need an elevated level of receiver difficulty. As the carrier has been deleted from the SSB modulation, this has to be re-introduced in the receiver so that the original audio can be regenerated.

SSB -single-sideband modulation (SSB) is a type of modulation used to transmit information, such as an audio signal, by radio waves. SSB 's advantage is its limited bandwidth and higher power output compared with other voice modes.

SSB takes advantage of the fact that in each of these sidebands the entire original signal is encoded. Both sidebands plus the carrier need not be transmitted, as a suitable receiver can extract the entire original signal from either the upper or lower sideband.

1. (a) What is the difference between band reject filter and notch filter? (b) What is roll off of a filter? Should it be faster or slower? why?

A band-rejection filter is a filter in signal processing that passes most frequencies unaltered, but attenuates those at very low levels within a limited range. That is the opposite of a band-pass filter.

A notch filter is a kind of band-rejection filter with a narrow [stopband](https://en.wikipedia.org/wiki/Stopband" \o "Stopband) and high [Q factor](https://en.wikipedia.org/wiki/Q_factor).

Roll-off is the steepness of a frequency transfer function, particularly in the analysis of electrical networks and most notably in the transition between a passband and a stopband in connection with filter circuits.

This is the slope of the filter response between the pass-band and the stop-band within the transition field. Rolloff is given in dB / octave or dB / decade . If the frequency response shifts rapidly the rolloff is called steep.

Roll-off is the magnitude of the amplitude shift with a filter frequency. The faster the roll-off, or the higher the attenuation rate, the more selective the filter example the better it is able to distinguish between two signals are spaced closely, one desired and the other not. So my point of view it should be faster .