SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

B.E/B.Tech- Internal Assessment -II

Academic Year 2023-2024 (Odd Semester)

Fifth Semester

Electronics & Communication Engineering

19ECB301 Analog and Digital Communication

ANSWER KEY IAE-2

Part A

1. Inspect the use of RF amplifier in FM receiver.

RF amplifiers are used to amplify the low input radio frequency signals. We need to amplify because the RF signals are usually at low voltages. Because of low voltage they are prone to external disturbances. Boosting the signals usually means increasing the voltage and decreasing the current and vice versa.

2. Define Automatic Gain Control.

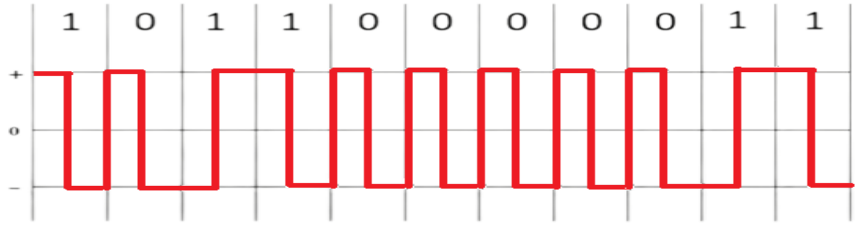
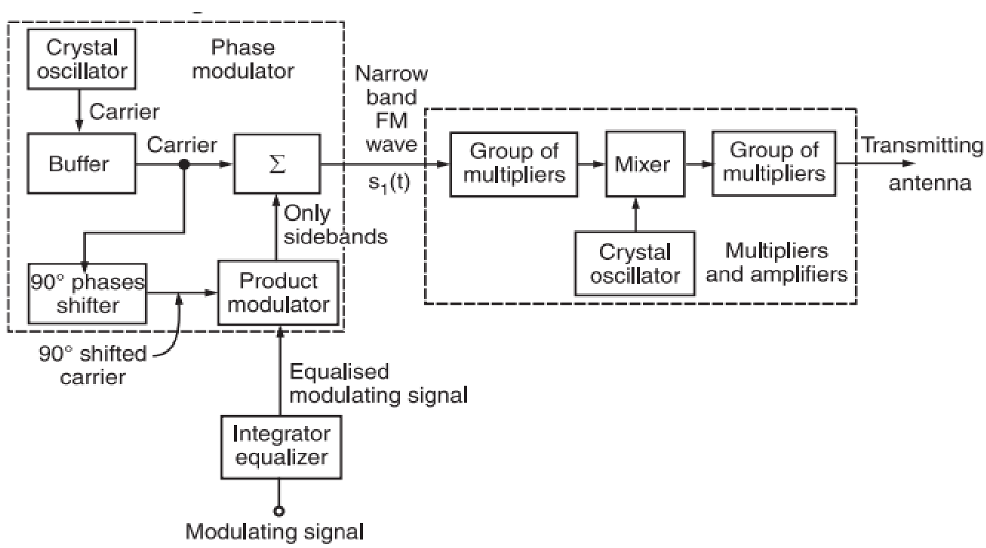
Automatic gain control (AGC) is a closed-loop feedback circuit present in radio receivers which helps to maintain a constant output, irrespective of the input variations. In communication systems, the inclusion of AGC regulates the system output to a constant value, even if the input voltage decreases or increases.

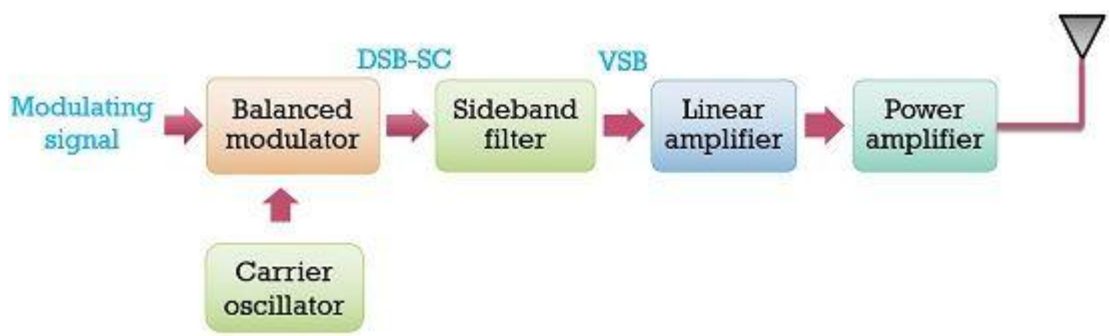
3. Summarize aliasing.

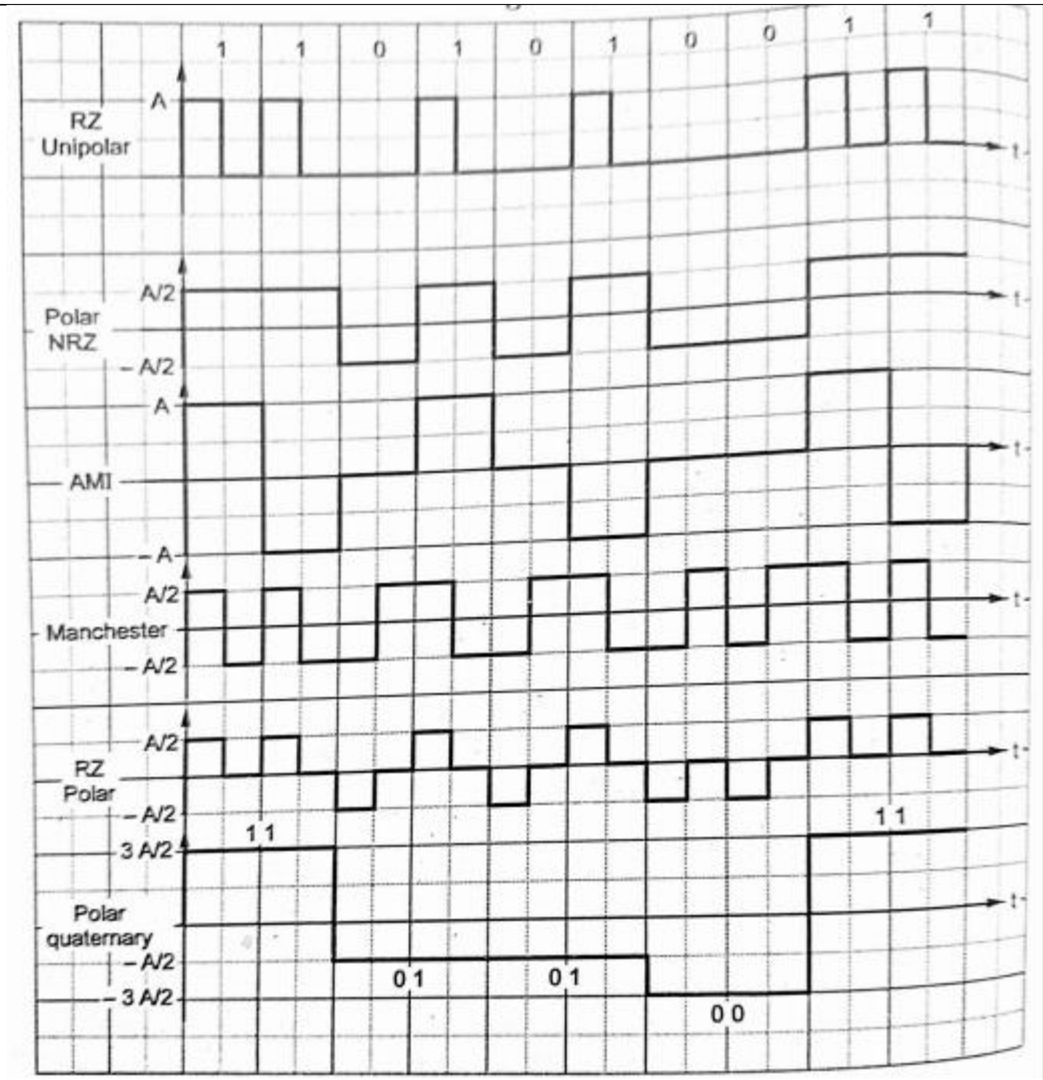
In signal processing and related disciplines, aliasing is the overlapping of frequency components resulting from a sample rate below the Nyquist rate.

4. Differentiate sampling and quantization.

Sampling	Quantization
Digitization of co-ordinate values.	Digitization of amplitude values.
x-axis(time) – discretized.	x-axis(time) – continuous.
y-axis(amplitude) – continuous.	y-axis(amplitude) – discretized.
Sampling is done prior to the quantization process.	Quantizatin is done after the sampling process.
It determines the spatial resolution of the digitized images.	It determines the number of grey levels in the digitized images.
It reduces c.c. to a series of tent poles over a time.	It reduces c.c. to a continuous series of stair steps.

5.	**Find the Manchester code for 10110001?**  Differential Manchester encoding for 10110000011		
		Part B	
6.	(a)	**Analyze and discuss the working of wideband FM Armstrong multiplier**. In the direct methods of generation of FM, LC oscillators are to be used. The crystal oscillator cannot be used. The LC oscillators are not stable enough for the communication or broadcast purpose. Thus, the direct methods cannot be used for the broadcast applications. The alternative method is to use the indirect method called as the Armstrong method of FM generation. In this method, the FM is obtained through phase modulation. A crystal oscillator can be used hence the frequency stability is very high and this method is widely used in practice.  The crystal oscillator produces a stable unmodulated carrier which is applied to the 90° phase shifter as well as the combining network through a buffer. The 90° phase shifter produces a 90° phase shifted carrier. It is applied to the balanced modulator along with the modulating signal. Thus, the carrier used for modulation is 90° shifted with respect to the original carrier. At the output of the product modulator, we get DSB SC signal i.e., AM signal without carrier. This signal consists of only two sidebands with their resultant in phase with the 90° shifted carrier. The two sidebands and	13

		the original carrier without any phase shift are applied to a combining network (∑).	
		(or)	
	(b)	**Explain the generation of Vestigial Side Band Signal using product modulator method with necessary block diagram and its applications.** Vestigial Sideband (VSB) modulation is a modulation technique which allows transmission of one sideband in addition with a part or vestige of the other. It is basically a compromise between DSB-SC and SSB modulation. VSB technique was introduced to overcome the drawbacks of SSB modulation. As SSB modulation requires accurate frequency response of the filter to transmit only one sideband completely. Thus by using VSB modulation one can simplify the design of the filter to a great extent. Also, the SSB modulation does not allow transmission of extremely low-frequency signal accurately. Hence VSB technique is used. Usually, VSB technique is used in TV transmission as television signal are extremely low-frequency signals.  VSB signal generation and transmission Electronics Coach Here, from the above figure, it is clear that a VSB signal is generated at the output of the sideband filter employed in the circuit. However, further amplification of the signal is needed in order to transmit it to longer distances. The balanced modulator used here produces the DSB-SC signal which is fed to the sideband filter. The filter is designed such that it transmits one sideband including vestige (some part) of the other. Thus producing a VSB signal.	13
7.	(a)	A binary data **1 1 0 1 0 1 0 0 1 1** is transmitted; Calculate a) Unipolar NRZ code b) polar NRZ code c) Unipolar RZ code d) Bipolar RZ code e) Manchester Code.	13

			
		(or)	
	(b)	Explain the operation of low pass Sampling theorem with its individual blocks. A continuous signal or an analog signal can be represented in the digital version in the form of samples. Here, these samples are also called as discrete points. In sampling theorem, the input signal is in an analog form of signal and the second input signal is a sampling signal, which is a pulse train signal and each pulse is equidistance with a period of “Ts”. This sampling signal frequency should be more than twice of the input analog signal frequency. If this condition satisfies, analog signal perfectly represented in discrete form else analog signal may be losing its amplitude values for certain time intervals. How many times the sampling frequency is more than the input analog signal frequency, in the same way, the sampled signal is going to be a perfect discrete form of signal. And these	13

types of discrete signals are well performed in the reconstruction process for recovering the original signal.

Sampling Theorem. If the highest frequency contained in an analog signal $x_a(t)$ is $F_{max} = B$ and the signal is sampled at a rate $F_s > 2F_{max} \equiv 2B$, then $x_a(t)$ can be exactly recovered from its sample values using the interpolation function

$$g(t) = \frac{\sin 2\pi Bt}{2\pi Bt} \qquad (1.4.22)$$

Thus $x_a(t)$ may be expressed as

$$x_a(t) = \sum_{n=-\infty}^{\infty} x_a\left(\frac{n}{F_s}\right) g\left(t - \frac{n}{F_s}\right) \qquad (1.4.23)$$

where $x_a(n/F_s) = x_a(nT) \equiv x(n)$ are the samples of $x_a(t)$.

When the sampling of $x_a(t)$ is performed at the minimum sampling rate $F_s = 2B$, the reconstruction formula in (1.4.23) becomes

$$x_a(t) = \sum_{n=-\infty}^{\infty} x_a\left(\frac{n}{2B}\right) \frac{\sin 2\pi B(t - n/2B)}{2\pi B(t - n/2B)} \qquad (1.4.24)$$

The sampling rate $F_N = 2B = 2F_{max}$ is called the *Nyquist rate*. Figure 1.19 illustrates the ideal D/A conversion process using the interpolation function in (1.4.22).

As can be observed from either (1.4.23) or (1.4.24), the reconstruction of $x_a(t)$ from the sequence $x(n)$ is a complicated process, involving a weighted sum of the interpolation function $g(t)$ and its time-shifted versions $g(t - nT)$ for $-\infty < n < \infty$, where the weighting factors are the samples $x(n)$. Because of the complexity and the infinite number of samples required in (1.4.23) or (1.4.24), these reconstruction

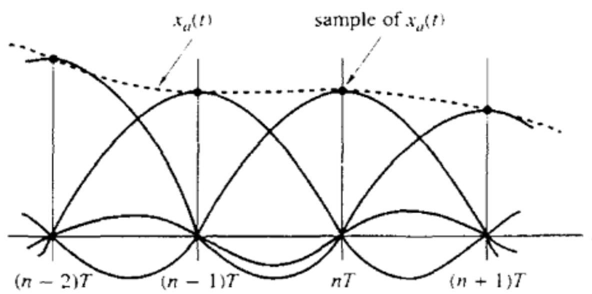


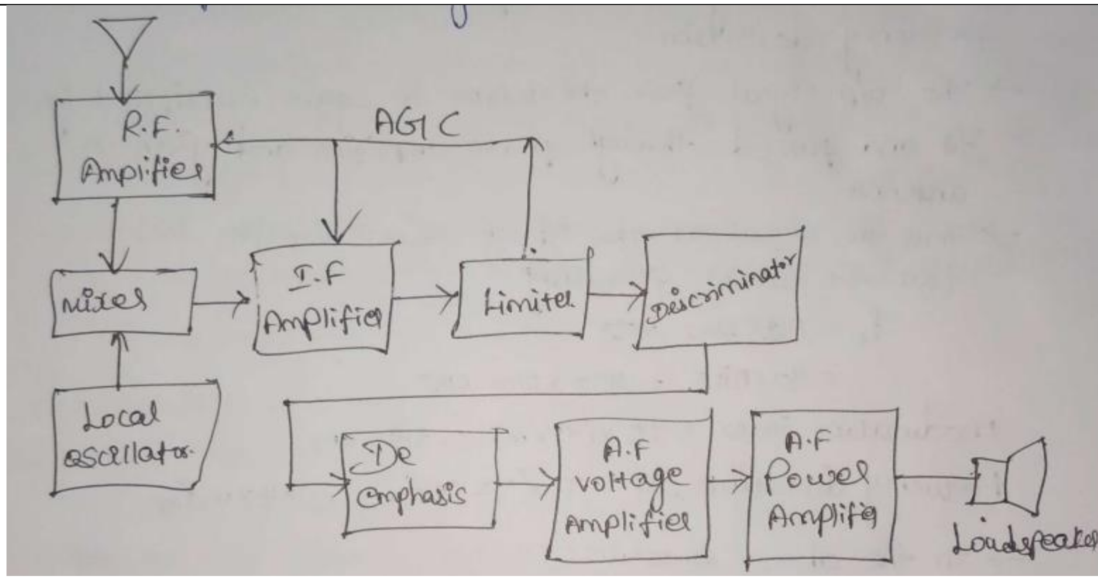
Figure 1.19 Ideal D/A conversion (interpolation).

formulas are primarily of theoretical interest. Practical interpolation methods are given in Chapter 9.

8. (a) Derive the expression of SNR input , post detection , pre detection of FM receiver. — 14

Signal-to-Noise Ratio (SNR) is the ratio of the signal power to noise power. The higher the value of SNR, the greater will be the quality of the received output.

Signal-to-Noise Ratio at different points can be calculated using the following formulas.



Relationship between i/p, Predetection & Postdetection signal to noise Ratio:

When the detection takes place in FM Receiver, the signal to noise ratio is improved.

→ this improved SNR is also called FM Improvement.

→ The FM improvement, SNRs at the i/p of the receiver and at the o/p of receiver are related as

$$\left(\frac{S}{N}\right)_{Improvement} = \left(\frac{S}{N}\right)_{Postdetection} - \left(\frac{S}{N}\right)_{Predetection} \rightarrow (1)$$

All the values must be in dB.

The overall receiver noise figure (F), i/p SNR $\left(\frac{S}{N}\right)_{i/p}$ and predetection SNR $\left(\frac{S}{N}\right)_{predetection}$ are related as

$$\left(\frac{S}{N}\right)_{Input} = \left(\frac{S}{N}\right)_{Predetection} + F \rightarrow (2)$$

The minimum receiver i/p s/g to noise ratio is given as

$$\left(\frac{S}{N}\right)_{i/p,min} = V_{i(min)} - n_{i(max)}$$

- Here $\left(\frac{S}{N}\right)_{i/p,min}$ is minimum receiver i/p SNR,

$V_{i(min)}$ is minimum receiver signal level &

$n_{i(max)}$ is maximum noise level.

(or)

(b) Examine the drawbacks of Inter Symbol Interference and explain the use of Eye pattern with its working. 14

The eye pattern, also referred to as the eye diagram, is produced by the synchronized superposition of (as many as possible) successive symbol intervals of the distorted waveform appearing at the output of the receive filter prior to thresholding. As an illustrative example, consider the distorted, but noise-free, waveform shown. Part b of the figure displays the corresponding synchronized superposition of the waveform’s eight binary symbol intervals. The resulting display is called an “eye pattern” because of its resemblance to a human eye. By the same token, the interior of the eye pattern is called the eye opening

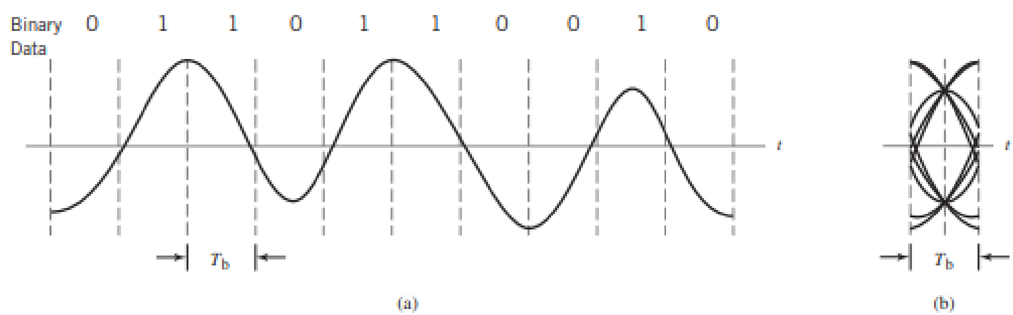


Figure 8.12 (a) Binary data sequence and its waveform. (b) Corresponding eye pattern.

From this diagram, we may infer three timing features pertaining to a binary data transmission system, exemplified by a PAM system:

1. Optimum sampling time. The width of the eye opening defines the time interval over which the distorted binary waveform appearing at the output of the receive filter in the PAM system can be uniformly sampled without decision errors. Clearly, the optimum sampling time is the time at which the eye opening is at its widest.

2. Zero-crossing jitter. In practice, the timing signal (for synchronizing the receiver to the transmitter) is extracted from the zero-crossings of the waveform that appears at the receive-filter output. In such a form of synchronization, there will always be irregularities in the zero-crossings, which, in turn, give rise to jitter and, therefore, nonoptimum sampling times.

3. Timing sensitivity. Another timing-related feature is the sensitivity of the PAM system to timing errors. This sensitivity is determined by the rate at which the eye pattern is closed as the sampling time is varied.

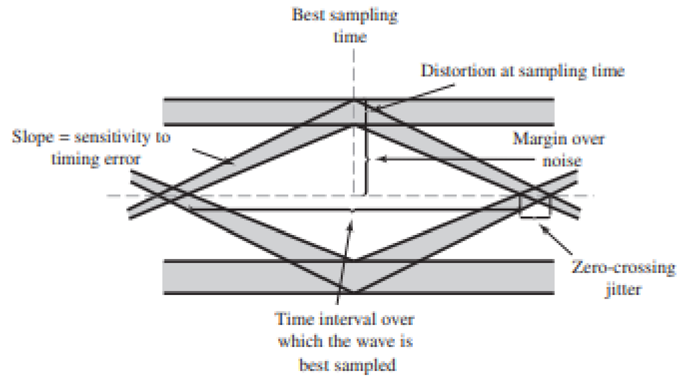


Figure 8.13 Interpretation of the eye pattern for a baseband binary data transmission system.