## UNIT I: ANALOG COMMUNICATION
## PART-A

**1. Define noise and noise figure.**

Noise is defined as any unwanted form of energy, which tends to interfere with proper reception and reproduction of wanted signal.

Noise figure is defined as the ratio between Signal to Noise ratio at the output to the Signal to Noise ratio at the input

**2. What are the types of external noise and internal noise?**

External noise can be classified into Atmospheric noise, Extraterrestrial noises,Man –made noises or industrial noises.Internal noise can be classified into Thermal noise, Shot noise, Transit time noise, Miscellaneous internal noise.

**3. What are the types of extraterrestrial noise and write their origin.**

The two type of extraterrestrial noise are solar noise and cosmic noise Solar noise is the electrical noise emanating from the sun. Cosmic noise is the noise received from the center part of our galaxy, other distant galaxies and other virtual point sources.

**4. Explain thermal noise.**

Thermal noise is the name given to the electrical noise arising from the random motion of electrons in a conductor.

**5. Give the expression for noise voltage in a resistor.**

The mean square value of thermal noise voltage is given by $Vn^2 = 4\ K\ T\ B\ R$ where K – Boltz man constant, R – resistance, T – Absolute temperature, B - Bandwidth

**6. Explain White Noise.**

Many types of noise sources are Gaussian and have flat spectral density over a wide frequency range. Such spectrum has all frequency components in equal portion, and is therefore called white noise. The power spectral density of white noise is independent of the operating frequency.

**7. What is the need for modulation?**

It is extremely difficult to radiate low frequency signals through earth's atmosphere in the form of electromagnetic energy.

At low frequency, the antenna size required becomes impractical.

Information signals often occupy the same frequency band. Signals from two or more sources would interfere if they are not modulated and translated to a different frequency band.

***8.* With reference to AM ,define modulation index (or) depth of modulation.**

It is defined as the ratio of peak amplitude of the message to the carrier signal.

$m = \frac{E_m}{E_c}$ $E_m$ = peak amplitude of modulating signal voltage

$E_c$ = peak amplitude of the unmodulated carrier voltage

**9. A broadcast radio transmitter radiates 5 kW power when the modulation percentage is 60%. How much is the carrier power?**

$Pt = Pc(1+m^2/2) = 5000/(1+0.6^2/2) = 4237.28w$

**10. What is the relationship between total current in AM wave and unmodulated carrier current?**

$It = Ic(1+m^2/2)$

Ic= carrier current

It=total current

m=modulation index

**11. An unmodulated carrier is modulated simultaneously by three modulating signals with coefficients of modulation m1 = 0.2, m2 = 0.4, m3 = 0.5. Determine the total coefficient of modulation.**

$mt = \sqrt{m_1^2+m_2^2+m_3^2} = \sqrt{0.2^2+0.4^2+0.5^2} = 0.67$

**12. Define amplitude Modulation.(Dec'13)**

Amplitude Modulation is the process of changing the amplitude of a relatively high frequency carrier signal in proportion with the instantaneous value of the modulating signal.

**13. Define Modulation index and percent modulation for an AM wave.**

Modulation index is a term used to describe the amount of amplitude change present in an AM waveform .It is also called as coefficient of modulation. Mathematically modulation index is

$m = Em/Ec$

Where m = Modulation coefficient, Em = Peak change in the amplitude of the output waveform voltage, Ec = Peak amplitude of the unmodulated carrier voltage, Percent modulation gives the percentage change in the amplitude of the output, wave when the carrier is acted on by a modulating signal.

**14. What is meant by Frequency modulation and Phase modulation?**
Frequency of carrier is varied in accordance with amplitude of modulating signal.
Phase of carrier is varied in accordance with the amplitude of modulating signal.

**15. What is Bandwidth of AM wave?**
Band width is difference between highest upper side frequency and lowest lower side frequency.
B.W = 2fm(max).

**16. What is over,under,critical modulation?**
If m >1, has severe distortion.This condition is Over modulation. If m=1, has greatest output and condition is Critical modulation. If m< 1 ,has no distortion and condition is Under modulation**.**

**17. Define deviation ratio.**
It is the worst-case modulation index which is the ratio of maximum permitted frequency deviation and maximum modulating signal frequency.
Deviation ratio = $\Delta f_{(max)} / f_{m(max)}$

**18.State Carson's rule for determining approximate Band Width of FM signal.**
Carson rule states that the bandwidth required to transmit an angle modulated wave as twice the sum of the peak frequency deviation and the highest modulating signal frequency**.**
Band Width = 2 [ $\Delta f + f_{m(max)}$ ] Hz
**$\Delta f$ = frequency deviation in Hz $f_{m(max)}$ = highest modulating signal frequency in Hz**

**19.A carrier is frequency is frequency modulated with a sinusoidal signal of 2 KHz resulting in a maximum frequency deviation of 5 KHz. Find the approximate band width of the modulated signal.**
$\Delta f$ = frequency deviation in Hz = 5 KHz
$f_{m(max)}$ = highest modulating signal frequency in Hz = 2 KHz
Band Width = 2 [ $\Delta f + f_{m(max)}$ ] Hz = 14 KHz

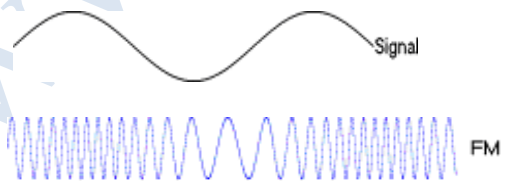
**20. Distinguish between narrow band FM and wide band FM.(Dec'13)**

| **Narrow band FM** | **Wide band FM** |
|---|---|
| Frequency deviation in carrier frequency is very small | Frequency deviation in carrier frequency is large |
| Band width is twice the highest modulating frequency | Band width is calculated as per Carson's rule |

**21. What are the advantages of FM over AM?**
i)The amplitude of FM is constant. Hence transmitter power remains constant in FM where as it varies in AM. ii)Since amplitude of FM is constant, the noise interference is minimum in FM. iii)Any noise superimposing on modulated carrier can be removed with the help of amplitude limiter. iv)The depth of modulation have limitation in AM. But in FM, the depth of modulation can be increased to any value. v)Since guard bands are provided in FM, there is less possibility of adjacent channel interference.vi)Since space waves are used for FM, the radius of propagation is limited to line of sight( LOS ) . Hence it is possible to operate several independent transmitters on same frequency with minimum interference. vii)Since FM uses UHF and VHF ranges, the noise interference is minimum compared to AM which uses MF and HF ranges.

**23. What is the advantage and disadvantage of Angle modulation?**
Advantages: 1. Noise Reduction 2. Improved system fidelity 3. More effective use of power
Disadvantage: 1. Require more Bandwidth 2. Use more complex circuits in both transmitter and receiver

**23. Draw the FM waveform? (June'13)**




**24. Determine the modulation depth of FM system with a maximum frequency deviation of 75 KHz and the maximum modulating frequency of 10 KHz**
$m_f = \Delta f / f_m = 75 \times 10^3 / 10 \times 10^3 = 7.5$

**25.Define instantaneous frequency deviation.**
The instantaneous frequency deviation is the instantaneous change in the frequency of the carrier and is defined as the first derivative of the instantaneous phase deviation.

**PART B:**

1. Obtain AM wave equation and explain each term with the help of frequency spectrum and also obtain an expression for its power?

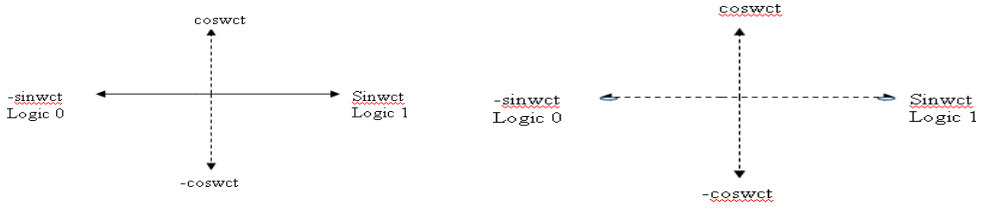
**2.** i)What is the need for modulation? ii) Explain with necessary diagram any one method for generation of AM waves. **(June' 13).**
**3.** Explain with block diagram of a Fm transmitter using direct modulation. ii) Discuss about spectral characteristics of FM signal. **(June' 13).**
4. Draw the block diagram of AM superhetrodyne receiver and explain function of each block. **(Dec'13)**
5. An AM modulator has a carrier of 400 KHz with amplitude of 20v; modulating signal of 8 KHz with amplitude of 8.5v is applied. Determine
   (a) Upper and lower side frequencies.
   (b) Modulation coefficient and percent modulation
   (c) Peak amplitude of the modulated carrier and upper and lower side frequency voltages.
   (d) Maximum and minimum amplitude of the envelope.
   (e) Expression of modulated wave.
   (f) Sketch the output spectrum and envelope.
6. Write down the expression for FM and PM waves and draw their frequency spectrum and explain. **(Nov'14)**
7.Obtain the mathematical expressions for AM & FM modulated waves & draw the necessary waveforms in both cases.
8. Compare AM, FM and PM systems.
9. Expalin the phase deviation and Modulation index of angle modulated wave
**10.** Write short notes on (i)Shot noise (ii) Thermal noise. (iii) Internal Noise **(Nov'14)**

## Unit III : DIGITAL COMMUNICATION
## PART-A

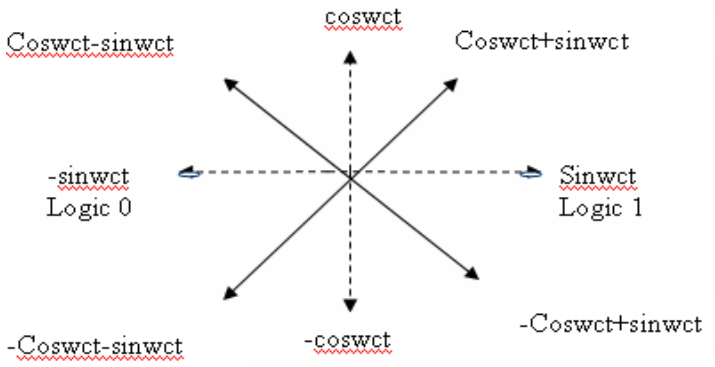
**1. Define ASK and FSK. (Dec'13)**
ASK: A binary information signal directly modulates the amplitude of an analog carrier.
FSK: The frequency of a sinusoidal carrier is shifted between two discrete values**.**
**2. Define bit time and baud rate.**
Bit time: It is the reciprocal of the bit rate
Baud rate: The rate of change of a signal on the transmission medium after encoding and modulation have occurred. Baud = 1/ts
**3. Define DPSK and QPSK.**
DPSK is an alternative form of digital modulation where the binary input information is contained in the difference between two successive signaling elements rather than absolute phase .It combines two basic operations namely ,differential encoding and phase shift keying. .
QPSK: The two successive bits in a bit stream ar combined together to form a message and each message is represented by a distinct value of phase shift of the carrier. Each symbol or message contains two bits so the symbol duration Ts =2Tb.
These symbols are transmitted by the same carrier at four different phase shifts as shown below.

| Symbol | Phase |
|---|---|
| 00 | -135 |
| 01 | -45 |
| 10 | 135 |
| 11 | 45 |

**4.What is a constellation diagram? Draw the constellation diagram and phasor diagram for BPSK.**
Constellation diagram is used to show the relative positions of the peaks of the phasors.
Phasor diagram: constellation diagram




**5.Draw the phasor diagram of QPSK signal.(June'13)**




**6. What is the primary advantage of DBPSK and what is its disadvantage?**
Advantage: simple implementation. No carrier recovery circuit needed for detection.
Disadvantage: It requires between 1 dB and 3 dB more signal to noise ratio to achieve the same BER as that of standard absolute PSK

**7. What are the advantages of M-ary signaling schemes?**
M-ary signaling schemes transmit multiple bits at a time.
Bandwidth requirement of M-ary signaling schemes is reduced.

**8. Compare binary PSK with QPSK.**

| **BPSK**<br>Binary Phase Shift Keying | **QPSK**<br>Quadrature Phase Shift Keying |
|---|---|
| One bit form a symbol | Two bits form a symbol |
| Two possible symbols | Four possible symbols |
| Minimum bandwidth required = $f_b$<br>where $f_b$ is bit rate | Minimum bandwidth required = $f_b / 2$<br>where $f_b$ is bit rate |

**9. What are the advantages of QPSK as compared to BPSK?**
For the same bit rate, the bandwidth required by QPSK is reduced to half as compared to BPSK.
Because of reduced bandwidth, the information transmission rate of QPSK is higher.

**10.What happens to the probability of error in M-ary PSK as the value of M increases?**
As the value of M increases, the Euclidean distance between the symbols reduces. Hence the symbols are closer to each other. This increases the probability of error in M-ary systems.

**11.What is the minimum bandwidth required for BPSK, QPSK, 8-PSK, 8-QAM and16-QAM systems if the bit rate is 10 MBPS?**

| **System** | **Minimum band width required**<br>if $f_b$ = bit rate | **Minimum band width required**<br>if $f_b$ = 10 Mbps |
|---|---|---|
| BPSK | $f_b$ | 10 MHz |
| QPSK | $f_b / 2$ | 5 MHz |
| 8 – PSK | $f_b / 3$ | 3.33 MHz |
| 8- QAM | $f_b / 3$ | 3.33 MHz |
| 16 – QAM | $f_b / 4$ | 2.5 MHz |

**12. What is difference between coherent and non coherent detection?**

| **Coherent detection** | **Non- Coherent detection** |
|---|---|
| Carrier which is in perfect coherence with that used in transmitter is used for demodulation.<br>Carrier recovery circuit is needed for detection | No carrier recovery circuit needed for detection. |
| Relatively complex | Simple implementation |

**13. Define Bandwidth efficiency. What is the bandwidth efficiency of BPSK and 8-PSK system?**
It is the ratio of the transmission bit rate to the minimum bandwidth required for a particular modulation scheme.
For BPSK, transmission rate = $f_b$ and minimum bandwidth = $f_b$, Band width efficiency = 1
For 8-PSK, transmission rate = $f_b$ and minimum bandwidth = $f_b/3$ Band width efficiency = 3

**14. What is the difference between probability of error P(e) and bit error rate BER?**

P(e) Probability of error is a theoretical (mathematical) expectation of the bit error rate for a given system.BER is an empirical record of a system's actual bit error performance. For Example, if a system has a P(e) of $10^{-5}$, this mean that, you can expect one bit error in every 100,000 bits transmitted. If a system has a BER of $10^{-5}$, this mean that, there was one bit error for every 100,000 bits transmitted. BER is measured and then compared to the expected probability of error to evaluate the system's performance.

**15. Define ( $E_b / N_0$ ) Energy per bit to Noise power density ratio.**

Energy per bit to noise power ratio is used to compare two or more digital modulation systems that uses different bit rates and modulation schemes.

It is the product of carrier to noise power ratio and the noise band width to bit rate ratio. This is equivalent to signal to noise ratio.

**16. List out the advantages and disadvantages of QPSK.**

Advantages: low error probability, good noise immunity, baud rate is half of the bit rate

Disadvantages: very complex to generate and detect the signal

**17. Define carrier recovery.**

It is the process of extracting a phase coherent reference carrier from a received signal.

**18. Draw the block diagram of BFSK transmitter. (Dec'12)**


**19. Compare QAM and QPSK.**

| Parameter | QPSK | QAM |
|---|---|---|
| Type of modulation | Quadrature phase modulation | Quadrature amplitude and phase modulation |
| Noise immunity | Better than QASK | Poorer than QPSK |
| Probabilty of error | Less than QASK | More than QPSK |
| Type of demodulation | Synchronous | Synchronous |
| Complexity | Less complex than QASK | More complex than QPSK |

**20. Why QAM is preferred when compared to other digital to analog modulation technique ?**

In all PSK methods, one symbol is distinguished from the other in phase. But all the symbols transmitted are of same amplitude. Noise immunity will improve if the signal vectors differ not only in phase, but also in amplitude. Here, the direct modulation of carriers in quadrature is involved therefore the system is called QAM.

**21. List out merits and demerits of ASK.**

Merits: Simple technique ,Easy to generate and detect.

Demerits: very sensitive to noise, Used at very low bit rates upto 100 bits/sec.

**22. Define frequency deviation.**

It is the half difference between mark and space frequencies.

$$\Delta f = \frac{fm - fs}{2}$$

Where Δf—frequency deviation (hz), fm-fs—absolute difference between mark and space frequencies.

**PART B:**

1. Explain BPSK Transmitter and receiver with a neat diagram.**(Dec'13)**
2. Explain BFSK Transmitter and receiver with a neat diagram.
3. Explain QPSK Transmitter and receiver with a neat diagram.**(Nov'14)**
4. Explain DPSK Transmitter and receiver with a neat diagram. What are the advantages of DPSK over PSK **(June'13)**.
5. With relevant diagram explain the method of synchronous detection of FSK signal. What should be the relationship between bit rate and frequency shift for better performance. **(June'13)**
6. Explain 8 QAM transmitter and receiver diagrams.**(Dec'13)**
7. Write short notes on the Carrier Recovery of the following (i)Costas loop, (ii) Squaring loop.
8. For an QPSK modulator with an input data rate (Fb)equal to 20mbps and a carrier freq of 70Mhz determine the minimum double sided Nyquist bandwidth (fn) and baud.
9. Compare and contrast the various Digital Communication Systems **(Nov'14)**
10. Explain the operation of the following (a) 8-PSK (b)QAM.

## UNIT II : DATA AND PULSE COMMUNICATION
## PART-A

**1. What are the error detection techniques?**
Redundancy checking ----- VRC, LRC, CRC, Checksum
Parity coding, Exact count encoding, Echoplex

**2. What is redundancy checking?**
Redundancy checking is defined as the process of adding extra bits for detecting errors at the destination.

**3. What is meant by CRC?**
CRC is a systematic code, where instead of adding bits together to achieve a desired parity ,a sequence of redundant bits called CRC or CRC remainder is added to the end of the data to be transmitted. It can be written as (n,k) cyclic codes.

**4. Define FCS.**
The group of characters forming a message is called as block or frame of data. Hence, the bit sequence for the LRC is called as block check sequence or frame check sequence(FCS).

**5. Name the two error correction method. (Nov'14)**
Retransmission and forward error correction.

**6. What is Forward Error Correction?**
It is the type of error correction scheme, where the errors are detected and corrected without retransmission but by adding the redundant bit to the message before transmission.

**7. Define DTE and DCE.**
DTE is a binary digital device where the information originates or terminates. It contains the hardware and software necessary to establish and control communications between end points within a data communication systems. DCE is used to interfaces data terminal equipment to a transmission channel.

**8. Define parallel interface.**
Parallel interface allows the user to transfer data between two devices with eight or more bits at a same time or simultaneously. It is also called as serial by word transmission.

**9. Define UART and USRT.**
UART:Universal asyncronous receiver/transmitter is used for asynchronous transmission of data between DTE and DCE. Asyncronous transmission means that an asynchronous data format is used and there is no clocking information transferred between DTE and DCE.
USRT:Universal synchronous receiver/transmitter is used for synchronous data transmission between DTE and DCE .It means that there is clocking information transferred between USRT and modem .

**10. What is meant by RS 232 interface?**
RS 232 interface specifies a 25 wire cable with DB25P compatible connector .It is simply a cable and two connectors, the standard also specifies limitations on the voltage levels that the DTE and DCE can output onto or receive from the cable.

**11.What is meant by centronics parallel interface?**
Centronics parallel interface was originally designed to be used for transferring data between a microcomputer and a printer. Centronics was one of the original companies to design printers especially for desktop computers.

**12.Give the primary functions of UART.**
*To perform serial to parallel and parallel to serial conversion of data.
* To perform error detection by inserting and checking parity bits.
*To insert and detect start and stop bits.

**13.State sampling Theorem.**
If a finite energy signal g(t) contains no frequency component higher than W Hz, it is completely determined by specifying its ordinates at a separation of points spaced 1/ 2W seconds apart.

**14.What is Aliasing or Foldover?**
When the continuous time signal g(t) is sampled at the rate less than Nyquist rate, frequencies higher than W takes on the identity of the low frequencies in sampled signal spectrum . This is called aliasing. The use of a low pass reconstruction filter, with its pass band extending from –W to W will not yield an undistorted version of the original signal. Aliasing can be reduced by sampling at a rate higher than Nyquist rate.In other words, Aliasing occurs when the signal is sampled at a rate less than Nyguist rate(2W samples/ sec). It is prevented by using Guard Bands Pre-alias Filter

**15. Define Nyquist rate and Nyquist interval.**

According to sampling theorem, a continuous time signal can be completely represented in its samples and recovered back if the sampling frequency is $f_S \geq 2W$. Here $f_S$ is sampling frequency and W is the highest frequency component of the signal.
Nyquist rate: The minimum sampling rate of 2W samples per second is called Nyquist rate.
i.e., $f_S = 2W \rightarrow$ Nyquist rate
Nyquist interval: Reciprocal of 2W is called the Nyquist interval.
Nyquist interval = 1/2W

**16. Define aliasing error. Give the upper bound for the aliasing error.**

Let $\{g(n/f_S)\}$ denote the sequence obtained by sampling an arbitrary signal g(t) at the rate $f_S$ samples per second. Let $g_i(t)$ denote the signal reconstructed from this sequence by interpolation;
That is, $g_i(t)=\sum g( ) \text{ sinc } ( f_S t - n)$
The absolute error $\varepsilon = | g(t) – gi(t) |$ is called the aliasing error.
The aliasing error is bounded as

$$\varepsilon \leq 2 \quad | G(f) | df$$

**17. What is Inter symbol Interference (ISI) ?**

ISI arises because of imperfections in the overall frequency response of the system.
When a short pulse of duration $\mathbf{T_b}$ seconds is transmitted through a band limited system, the frequency components constituting the input pulse are differentially attenuated and, more significantly, differentially delayed by the system. Consequently the pulse appearing at the output of the system is dispersed over an interval longer than $T_b$ seconds.Thus when a sequence of short pulses are transmitted through the system, one pulse every $T_b$ seconds, the dispersed responses originating from different symbol intervals will interfere with each other, there by resulting in ISI.

**18. What are the types of pulse modulation systems and define them?**

PAM is a process in which amplitudes of regularly spaced pulses are varied in proportion to the corresponding sample values of continuous message signal.
PPM is the process in which the position of a pulse relative to its unmodulated time of occurrence is varied in accordance with message signals.
PWM is the process in which the samples of message signal are used to vary the duration of individual pulses in the carrier.

**19. What do you mean by Aperture Effect?**

It is nothing but amplitude distortion occurring at PAM due to the sinc function. It is overcome by using a Equalizer whose transfer function is

$$| H(f)| = T^{-1} \text{sinc}(fT)$$

**20. What is Quantization and sampling?**

Quantization :It is the process in which the analog sample of the original signal is converted into a digital form.
Sampling :It is the process in which the original analog signal is converted into a discrete time and continuous amplitude signal

**21. What is Quantization Noise?**

The difference between the output analog sample and the discrete output quantized signal gives raise to an error called Quantization Noise.

**22. What are the advantages of digital transmission?**

The advantage of digital transmission over analog transmission is noise immunity. Digital pulses are less susceptible than analog signals to variations caused by noise.
Digital signals are better suited to processing and multiplexing than analog signals.
Digital transmission systems are more noise resistant than the analog transmission systems.
Digital systems are better suited to evaluate error performance.

**23. What are the disadvantages of digital transmission?**

The transmission of digitally encoded analog signals requires significantly more bandwidth than simply transmitting the original analog signal. Analog signal must be converted to digital codes prior to transmission and converted back to analog form at the receiver, thus necessitating additional encoding and decoding circuitry.

**24. Define pulse code modulation.**

In pulse code modulation, analog signal is sampled and converted to fixed length, serial binary number for transmission. The binary number varies according to the amplitude of the analog signal.

**25. Define companding Nyquist sampling rate**

Companding is the process of compressing, then expanding. With companded systems, the higher amplitude analog signals are compressed prior to transmission, then expanded at the receiver.
Nyquist sampling rate: Nyquist sampling rate states that, the minimum sampling rate is equal to twice the highest audio input frequency.

## PART B

1. Explain about centronics parallel interface
2. Explain in detail about line control unit in data communication hardware.
3. Write in detail about Pulse Amplitude Modulation.
4. Define and explain ASCII code and Bar codes.
5. Explain the operation of PPM & PWM.
6. State and explain the various Error Detection methods and Error correction Methods
7. Explain the procedure of PCM generation and detection with its block diagram. **(June'13), (Nov'14)**
8. Explain in detail about DCE and DTE. **(Nov'14)**
9. Give a detailed note on (i)Retransmission (ii) Forward error control
10. Explain about the standards organizations for data communications in detail. **(Nov'14)**

## UNIT IV SOURCE AND ERROR CONTROL CODING

## PART A

**1. Give the factors which influence reliable transmission?**

Transmitted signal power. channel bandwidth.

**2. List out the advantages of error control coding.**

Reduces the required transmitted power, Reduces the size of antennas, Reduces the hardware cost.

**3. What are the disadvantages of error control coding?**

Increases the transmission bandwidth, Increases the complexity of decoder.

**4. Give the types of error control codes. (June'13)**

Block codes , Convolutional codes.

**5. List the types of block codes.**

Linear block codes, Cyclic codes.

**6. Define block codes.**

The codes which consists of (n-k) parity bits for every k bit message block are known as block codes

**7. Define linear block codes.**

Block code is the code in which every 'k-bit' message block (n-k) parity bits are appended to produce 'n' bit codeword. If the parity bits are the linear combination of 'k' message bits then the code is referred as linear block codes.

**8. What are the systematic codes?**

Block codes in which the message bits are transmitted in unaltered form are called systematic codes.

**9. Define generator matrix.**

Generator matrix Gkxn is used in the encoding operation and its k rows are linearly independent the encoding operation and its k rows are linearly independent

$G_{kxn}=[P_{kx(n-k)} \mid I\ kxk]$ ;

Where, P-parity matrix, I-identity matrix

**10. Explain Shannon-Fano coding. (June'13)**

An efficient code can be obtained by the following simple procedure, known as Shannon- Fano algorithm. List the source symbols in order of decreasing probability. Partition the set into two sets that are as close to equiprobable as possible, and sign 0 to the upper set and 1 to the lower set. Continue this process, each time partitioning the sets with as nearly equal probabilities as possible until further partitioning is not possible.

**11. Define information rate.**

If the time rate at which source X emits symbols is r symbols per second. The information rate R of the source is given by R=r H(X) bits/second, H(X)- entropy of the source

**12. What is data compaction?**

For efficient signal transmission the redundant information must be removed from the signal prior to transmission .This information with no loss of information is ordinarily performed on a signal in digital form and is referred to as data compaction or lossless data compression.

**13. Define mutual information and channel capacity.**

Mutual information I(X,Y) of a channel is defined by I(X,Y)=H(X)-H(X/Y) bits/symbol

H(X)- entropy of the source, H(X/Y)- conditional entropy of Y.

**14. Define entropy.**

Entropy is the measure of the average information content per second.

$$\text{Entropy} = -\sum_{i=1}^{n} p_i \log_b(p_i)$$

n = number of different outcomes.

**15. Define syndrome.**
Syndrome contains information about the error pattern 'e ' and may therefore be used for error detection . S is a x (n-k0 vector and is used to decode the vector C from the received vector 'r ' $S = r H^T$ where r = C + e .
**16. Give the properties of syndrome.**
The syndrome depends only on the error pattern and not on the transmitted code word.
All error patterns that differ by a codeword have the same syndrome.
**17. Define: Cyclic codes**
Cyclic codes are a sub-class of linear block codes .It posses a well defined mathematical structure and which provides efficient decoding.
**18.Give any two properties of cyclic codes?**
Linearity, Cyclic property
**19. State cyclic porperty.**
Cyclic property states that any cyclic shift of a code word in the code is also a codeword.
**20. State linearity property.**
Linearity property states that the sum of any 2 code words in the code is also a code.
**21. Give the graphical representation of convolutional encoder?**
Code tree, Trellis, State diagram
**22. What is the need for convolution coding?**
Convolution coding may be the preferred method in applications where the message bits come in serially rather in large blocks in which case the use of buffer may be undesirable.
**23. What is trellis?**
Trellis is a tree like structure with remerging branches. The code branch with an input 'o' is drawn by a solid line and a branch by an input '1' is drawn as a dashed line. each input sequence corresponds to a specific path through the trellis. trellis contains (l+k) levels where l - length the message and k-constraint length level, j- is the depth of the trellis
**24. What is code tree ?**
Each branch of the tree responds an input symbol with the corresponding pair of input binary symbols indicated on the branch the input 'o' specifies the upper branch of the tree and the input '1' specifies the lower branch of the tree. a specific path is traced from left to right in accordance with the input sequence .the corresponding coded symbols on the branches of that path constitute the output sequence.
**25. Distinguish block codes and convolution codes?**

| **Block codes** | **Convolution codes** |
|---|---|
| 1) code the block of k Msg bits. | 1) code each msg bit individually. |
| 2) needs the buffer to store msg block. | 2) does not need the buffer since the bits are arriving in serial fashion. |

**PART -B**

**1.** Five symbols of the alphabet of DMS and their probabilities are given below. S={So,S1,S2,S3,S4} P(S) = {0.1, 0.1, 0.2, 0.2, 0.4}.Code the symbols using Huffman coding. Find the efficiency of the code. **(Nov'14)**
2. Find the Shannon –fanno code for the following seven messages with probabilities indicated. S={S1,S2,S3,S4,S5, S6,S7},P(S)= {0.05,0.15,0.2,0.05,0.15,0.3,0.1}.
3. Construct a convolution encoder whose constraint length is 3 and has 3 modulo- 2 adders and an output multiplexer. The generator sequences of the encoder are $g^{(1)}=(1,0,1),g^{(2)}=(1,1,0),g^{(3)}=(1,1,1)$. Draw the block diagram of the encoder. Find the encoder output produced by the message sequence 10111.
4. Explain coding and decoding process of block codes.
5. Write in detail the procedure of Shannon-fanno coding scheme
6. (i)Derive the channel capacity of Binary symmetric channel. (ii)Derive the channel capacity of Binary erasure channel.
8. Define entropy. Explain the properties of entropy.
**9.** Give brief notes on error detection. **(June'13)**
**10.**Write short notes on (1)Linear Block Codes(2)Viterbi Algorithm **(Nov'14)**

## UNIT V MULTI - USER RADIO COMMUNICATION
## PART-A

**1. What are the different multiple access techniques used in wire less communication?**

TDMA – Time Division Multiple Access, FDMA- Frequency Division Multiple Access, CDMA – Code Division Multiple Access.

**2. Compare FDMA and TDMA.(June'13)**

| FDMA - Frequency Division Multiple Access | TDMA - Time Division Multiple Access |
|---|---|
| All users access the channel by transmitting simultaneously but using disjoint frequency bands | All users occupy the same RF band width of the channel, but they transmit sequentially in time |
| Fixed assignment multiple access technique | Fixed assignment multiple access technique |
| Well suited for analog communication | Well suited for digital communication |

**3. List the merits of CDMA over TDMA**.

CDMA does not require an external synchronization network which is an essential feature of TDMA. CDMA offers a gradual degradation in performance as the number of user is increased. It is there fore relatively easy to add new users to the system. CDMA offers an external interference rejection capability.

**4. What is CDMA?**

CDMA – Code Division Multiple Access. In CDMA , all users transmit simultaneously and occupy the same RF bandwidth. Each user is assigned a **code** which perform the DSSS or FHSS modulation

**5.List out any four features of TDMA.**

TDMA shares a single carrier frequency with several users where each user makes use of non overlapping time slots.Data transmission for users is not continuous,but occurs in burst. Because of discontinuous transmission,handoff process is much simpler for a suscriber unit . TDMA uses different time slots for transmission and reception ,thus duplexers are not required.

**6. What is Satellite?**

An artificial body that is projected from earth to orbit either earth (or) another body of solar systems.Types: Information satellites and Communication Satellites

**7. Define Satellite Communication.**

It is defined as the use of orbiting satellites to receive, amplify andretransmit data to earth stations.

**8. State Kepler's first law.**

It states that the path followed by the satellite around the primary will bean ellipse.An ellipse has two focal points F1 and F2. The center of mass of the twobody system, termed the barycenter is always centered on one of the foci.e = [square root of ( $a^2$-$b^2$)]/a

**9. State Kepler's second law.**

It states that for equal time intervals, the satellite will sweep out equalareas in its orbital plane, focused at the barycenter.

**10. State Kepler's third law.**

It states that the square of the periodic time of orbit is perpendicular to thecube of the mean distance between the two bodies$a^3$= 3 / $n^2$ Where, n = Mean motion of the satellite in rad/sec.3 = Earth's geocentric gravitational constant.With the n in radians per sec. the orbital period in second is given by, P = 27 / n

**11. Define apogee and perigee**

The point farthest from the earth is apogee, The point closest from the earth is perigee.

**12. What is line of apsides?**

The line joining the perigee and apogee through the center of the earth.

**13. Define ascending node and descending node.**

The point where the orbit crosses the equatorial plane going from south to north.
The point where the orbit crosses the equatorial plane going from north to south.

**14. Define Inclination.**

The angle between the orbital plane and the earth's equatorial plane. It is measured at the ascending node from the equator to the orbit going from east to north.

**15.What is declination?**

The angle of tilt is often referred to as the declination which must not be confused with the magnetic declination used in correcting compass readings.

**16.Write short notes on station keeping.**

It is the process of maintenance of satellite's attitude against different factors that can cause drift with time. Satellites need to have their orbits adjusted from time to time, because the satellite is initially placed in the correct orbit,natural forces induce a progressive drift.

**17. What is meant by Pitch angle?**

Movement of a spacecraft about an axis which is perpendicular to its longitudinal axis. It is the degree of elevation or depression.

**18. What is an propellant?**

A solid or liquid substance burnt in a rocket for the purpose of producing thrust.

**19.What is meant by frequency reuse?**

The satellite as a whole to be accessed by earth stations widely separated geographically but transmitting on the same frequency that is known as frequency reuse.

**20.What are the limitations of FDMA-satellite access?**

a. If the traffic in the downlink is much heavier than that in the uplink, then FDMA is relatively inefficient. b. Compared with TDMA, FDMA has less flexibility in reassigning channels. c. Carrier frequency assignments are hardware controlled.

**21. Write about pre-assigned TDMA satellite access.**

Example for pre-assigned TDMA is CSC for the SPADE network. CSC can accommodate upto 49 earth stations in the network and 1 reference station. All bursts are of equal length. Each burst contains 128 bits. The bit rate is 128 Kb/s.

**22. Write about demand assigned TDMA satellite access.**

The burst length may be kept constant and the number of bursts per frame used by the given station is varied when the demand is varied.

**23.Define AMPS.**

AMPS is a first-generation cellular technology that uses separate frequencies for each conversation and it uses the 800 MHz frequency band of the spectrum Utilizes FDMA (Frequency division multiple access) to separate users

**24.What is meant by hand over?**

The term handover or handoff is the process of transferring an ongoing call or data session from one channel connected to another channel. It can be classified into soft and hard hand over.

Is normally performed because the signal level from the current cell is becoming to low, but can also be done for different reasons, such as too much traffic in a cell

**PART -B**

1. Explain in detail about AMPS.
2. Describe the elements in GSM radio access network.
3. Explain the types of Multiple Access techniques.
4. Explain TDMA system with frame structure, frame efficiency and features.
5. Explain CDMA system with its features and list out various problems in CDMA systems.
6. Compare TDMA, FDMA and CDMA
7. State Kepler's three laws of planetary motion.Illustrate in each case their relevance to artificial satellites orbiting the earth.
8. Write short notes on Frequency reuse and Hand over **(Nov'14)**
9. Explain in detail about Bluetooth.
10. Explain about Error correction coding in GSM. **(Nov'14)**