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Communication may be defined as the transfer of information from one place to another via a sequence of procedures or it can be defined as the communication of information itself. For communication to be effective, both the sender and the receiver must communicate in the same language. Every living organism on the planet is confronted with the need to continually transmit and receive information from others in the surrounding environment. Throughout history, human beings have made an ongoing effort to increase the quality of communication with other human beings. From prehistoric to contemporary times, the methods and languages used in communication have continued to evolve and satisfy the increasing demands in terms of complexity and the speed of information transmission.Basic elements of communication systemThere are three critical components to every communication system: the transmitter, the channel and the receiver. TransmitterThe transmitter is the electronic component that converts the digital signal from the encoder into an analogue signal that can travel through the wire and be heard by the receiver. The transmitter is sometimes referred to as the modulator. The range or distance that the signal can travel through the wire is limited by the audio properties of the wire. The transmitter also adds additional information to the signal, such as channelization codes, to allow the receiver to identify which Channel it is receiving correctly.ReceiverAn arrangement that extracts the information or message from the input signal through the receiving system and reproduces it in a suitable form as the original input signal is called a receiver.ChannelConstrained problems are often caused by various noise or distortions on the Channel. A distorted signal may have different frequencies compared to the signal being sent. The variation in the frequency can be linear or nonlinear.Process of Communication The information can be sent over a communication system from either a person or a machine. A transmitter is positioned at one location and a receiver is located at another location, with the channel serving as a medium between the two locations. It is the message signal that originates from the source and it is this signal used to feed into the transmitter.The physical media that links the transmitter and receiver (whether wired or wireless) is the channel. It is possible that the broadcast signal may be warped due to its imperfection and that some noise will be added to the transmitted signal as it propagates.An in-depth examination of the components of the communication system, information is the concept or message being given. It is also known as knowledge. The message may consist of a single message or a series of messages. The message might take the form of a symbol, a code, a sequence of words or any other predetermined unit.A transducer, modulator, amplifier and transmitting antenna are transmitter components in radio transmission. Transducers are also known as transmitters.Terms used in a Communication systemIn the electronic communication system, the electric circuits transmit, process and receive the data. The transmission happens through the transmitter. The data processing happens through the medium and gets received by the receiver. The data is transmitted in two forms: digital or analogue form.The Basic terminologies include communication medium, receiver, transmitter, transducer, amplitude, modulation and bandwidth.Communication mediumThe communication medium is the channel used to transmit the signal from transmitter to receiver. An example is copper wire and satellite systems.SignalThe signal is the information or data transmitted and received by the receiver. It is transmitted electronically, in digital format. There are two forms of signals: digital and analogue. In analogue signals, the current and voltage will have continuous variations. An example is a human voice. The variations will have 0 and 1 discrete values in the digital signals. Amplitude The amplitude is the signal height or strength in transmission. The signals should be strong in both transmission and reception. For this, the weak signal is amplified. This phenomenon is called amplification.AttenuationAttenuation is the process in which the amplification of the signal is decreased. It is attenuated when transmitted for long distances.In this electronic communication system, we will discuss the important device, transducers.TransducersThe transducer is the electrical device that transforms the physical quantity into electrical quantity. It consists of two elements: sensing and transduction. For example, the transducer transforms the non-electrical quantity like light and heat into electrical quantity.ConclusionCommunication is the act of transmission of info. Every living creature within the world experiences the necessity to impart or receive information virtually unceasingly with alternatives in the close world. Communication pervades all stages of the lifetime of all living creatures. No matter its nature, each communication system has three essential elements: transmitter, medium/channel and receiver. The essential parts of communication include the transmitter, channel and receiver. A communication system is the backbone of modern society, enabling the transfer of information from one point to another. It consists of various elements, each playing a critical role in ensuring that the message is accurately transmitted, received, and understood. Just like in a conversation between two people, where a clear voice and attentive listening are crucial, the elements of a communication system work together to ensure effective information exchange. In real life, this can be compared to a postal service, where the sender (transmitter) writes a letter, the postal service (medium) delivers it, and the recipient (receiver) reads and understands the message. Similarly, in technology-driven communication systems, the transmitter encodes the message, the channel carries it, and the receiver decodes it, making communication possible across vast distances.Basic elements of a Communication SystemInformation: The idea or message that is to be conveyed is known as information. The message may be an individual one or a set of messages.Signal: A single-valued function of time (that conveys the information). Transmitter: A device which makes an incoming message signal suitable for transmission through a channel and subsequent reception.Transducer: A device that converts one form of energy into another. Repeater: It is used to extend the range of the signal. Combination of the receiver and a transmitter.Amplifier: It boosts the power of modulated signal.Antenna: The signal is radiated in the space with the help of an antenna.Noise: An unwanted signal that tends to disturb the transmission and processing of the message signal. The source of noise may be located within or outside the system.Receiver: The device which extracts the desired message signal from the received signal at the channel output.Amplification: It is the process of increasing the amplitude of a signal using an electronic circuit called the amplifier. Amplification is necessary to compensate for the attenuation of the signal in communication systems. The energy needed for additional signal strength is obtained from a DC power source. Amplification is done at a place between the source and the destination wherever signal strength becomes weaker than the required strength.Attenuation: The loss of strength of a signal while propagating through a medium is known as attenuation.Modulation: It is the process carried out at the transmitter in which the low-frequency message signal is superimposed on a high-frequency carrier signal.Demodulation: The process of retrieval of information from the carrier wave at the receiver. Reverse process of modulation.Bandwidth of SignalsThe bandwidth of a signal is defined as the difference between the upper and lower frequencies of a signal generated. As seen from the representation below, the Bandwidth (B) of the signal is equal to the difference between the higher or upper frequency (fH) and the lower frequency (fL). It is measured in terms of Hertz(Hz) i.e. the unit of frequency.For example, Whenever we tune into a radio we find various stations at varying particular frequencies. The bandwidth of FM radio is 200 KHz from 88.1 MHz to 101.1 MHz for most places. As you tune, the radio you find various stations at various frequencies.For speech signals, a frequency range of 300 Hz to 3100 Hz is considered adequate. Therefore speech signal requires a bandwidth of 2800 Hz (3100 Hz – 300 Hz) for commercial telephonic communication. To transmit music, an approximate bandwidth of 20 kHz is required because of the high frequencies produced by the musical instruments. The audible range of frequencies extends from 20 Hz to 20 kHz. Video signals for the transmission of pictures require about 4.2 MHz of bandwidth. A TV signal contains both voice and picture and is usually allocated 6 MHz of bandwidth for transmission.Bandwidth of Transmission MediumA transmission medium is a material substance (solid, liquid, gas, or plasma) that can propagate energy waves. For example, the transmission medium for sounds is usually air, but solids and liquids may also act as transmission media for sound. The absence of a material medium in a vacuum may also constitute a transmission medium for electromagnetic waves such as light and radio waves. While material substance is not required for electromagnetic waves to propagate, such waves are usually affected by the transmission media they pass through, for instance by absorption or by reflection or refraction at the interfaces between media.Coaxial cable is a widely used wire medium, which offers a bandwidth of approximately 750 MHz. Such cables are normally operated below 18 GHz. Communication through free space using radio waves takes place over a very wide range of frequencies: from a few hundred kHz to a few GHzSpectrum AllocationsA spectrum is a large bandwidth of frequencies. Cellular or digital methods use this bandwidth for communication. These allocations have arrived with the help of international plans and policies. Often they require an upgrade of existing systems and technologies.For example: 4G communication is for cellular devices accessible. The upcoming years will see the introduction of the 5G spectrum as well. With such huge bandwidths, easy, reliable and ultra-fast data transmissions are possible regularly.Recommended Topic VideoSolved Examples Based On Elements Of Communication SystemExample 1: In a radio communication system, a transmitter consists of 1)oscillator to generate a carrier wave 2)modulator 3)Amplifier 4)All of the above Solution:A device that makes an incoming message signal suitable for transmission through a channel and subsequent reception.An oscillator is used to generate a carrier wave which carries the information during transmission This carrier wave is modulated with the information during transmission Furthermore, an amplifier is used to increase the power of the modulated signal so that it can transmit to long-range The oscillator modulator and amplifier all are housed in the transmitter itself Example 2: The physical size of the transmitter and receiver antenna in a communication system are : 1)Independent of both carrier and modulation frequency 2) Inversely proportional to carrier frequency3)Inversely proportional to the modulation frequency 4) proportional to the carrier frequency Solution:Transmitter A device which makes an incoming message signal suitable for transmission through a channel and subsequent reception.Receiver The device extracts the desired message signal from the received signal at the channel output.Example 3: In a radio communication system, a receiver consists of 1)Filter 2)Amplifier 3)Demodulator 4)All of the above Solution:Receiver The device extracts the desired message signal from the received signal at the channel output.In a receiver, an electronic filter is housed which filters out the unwanted frequency signals and allows the specific frequency signals for further processingThe amplifier is used to increase the intensities of received signals and later these amplified signals are fed into the demodulator unit In the demodulator, the carrier wave is removed and the desired information signal is sent to the transducer where it is converted into the desired form of energy. Hence all of the above is present in a radio receiver Example 4: What are the advantages of analogue communication systems over digital communication systems? 1)Less bandwidth communication 2)less power communication 3)less noise communication 4)All of the above Analog Communication Which make use of analogue signals.wheree.g. Telegraphy, television broadcast, Radar etc. Analogue communications system consumes more power to transmit the media as compared to digital communication systems. Analog communication systems also suffer from poor signal-to-noise ratio (SNR) which means they are prone to more noise disturbance. However, the bandwidth consumption for transmissions of media/information is less as compared to the digital communication system Example 5: A signal $\mathbf{s}(\mathbf{t})=\frac{A_0}{2} \sin w t$ is fed to an amplifier. What may be the possible output of the amplifier from among the following waveforms? 1)2)3)4)SolutionAmplifiers are used in communication systems to increase the amplitude of signals. They don't change the frequency or phase of a signal. Hence the correct option is (1)SummaryA communication system contains different essential sections, which cooperate expeditiously to send the message. The master is the transmitter, the signal is the one who converts data into a suitable form for transmitting, and the message signal is the progenitor or alternatively, the information to be communicated. The transmission medium, that is, the channels through which the signals are transmitted, can be wired or wireless, and there lay the cable somewhere in between. The receiver is the one, which first records the given signal and, then, translates it into a comprehensible form for the users. Noise is an interference that can cause distortions in the signal because it occurs during its way of delivering the issues. Written By Umesh_K Last Modified 22-06-2023 Elements of Communication System: Communication is the art of transmitting, processing and receiving information by electronic means. For the communication to be successful, the sender and the receiver should understand the common language. Human beings have constantly made endeavours to improve the quality of communication with other human beings. Methods and Languages used in communication have kept evolving from prehistoric to modern times to meet the growing demands in terms of complexity and speed of information. The message signal can be a voice signal, computer data or picture. The signals have a different range of frequencies. The type of communication system needed for a particular signal depends on the band of frequencies considered essential for the communication process. This article investigates the basic elements of communication system, its types, and the bandwidth of a signal. Any communication system has three important elements. They are the transmitter, channel, and receiver. The block diagram of a general form of communication system is as shown. In a communication system, the source of information can be a human being or a machine. A transmitter is located at one place and the receiver at another with the channel as a medium. The signal from the source is called a message signal, and these signals are fed into the transmitter. The main purpose of the transmitter is to convert the message signal produced by the source of information into a suitable form for transmission through the channel. These signals are called transmitted signals. If the message signal from the source of information is the nonelectrical signal is converted into an electrical signal by a transducer The channel (wired or wireless) is the physical medium that connects the transmitter and receiver. When the transmitted signal propagates, it may be distorted due to its imperfection, and some noise is added to the transmitted signal. Information: The idea or message that is to be conveyed is information. The message may be single or a set of messages. The message can be a symbol, code, group of words, or any pre-decided unit. Transmitter: The transmitter consists of a transducer, modulator, amplifier, and transmitting antenna in radio transmission. Note: A transducer converts sound signals into electric signals.The modulator performs the mixing of the electric audio signal with the high-frequency radio wave.The amplifier boosts the power of the modulated signal.The signal is radiated in space with the aid of an antenna. Communication channel: The duty of the communication channel is to carry the modulated signal from transmitter to receiver. The communication channel is also called a transmission link or medium. The term channel refers to the frequency range allocated to a particular transmission or service. Table: Different channels Type of communicationChannels or linksRadio communication (The basic elements of radio communication system are a transmitter and a receiver) spaceTelephony and Telegraphy communicationTransmission lineOptical communicationOptical fibre Receiver: The receiver consists of: Pickup antenna: To pick the signalDemodulator: To separate the audio signal from the modulated signalAmplifier: To boost up the weak audio signalTransducer: converts back audio signal in the form of electrical pulses into sound waves. Communication systems are classified according to the nature of information, mode of transmission, or types of the transmission channel. According to the nature of the information source, there are three types of communication systems-(i) Speech transmission(ii) Picture transmission(iii) Facsimile transmission (FAX): This involves the exact reproduction of a document or picture which are static. According to the mode of transmission of information, there are two types of communication systems-(i) Analogue communication: The communication system, which uses analogue signals, is called an analogue communication system. Table: Few analogue communication systems SystemSpecificationTelegraphCode messages are sent.Television broadcastBoth sounds, as well as pictures, are sent.TelephonyIt sends a voice signal from one place to another utilizing wire.RadarIt is an acronym for 'radio detection and ranging'. It is used for determining the distance and direction of objects using a microwave.Tele-printingMessage can be typed and telegraphed to distant receivers (ii) Digital communication: In this system, digital signals are used. Table: Few digital communication systems SystemSpecificationFacsimile transmission (FAX)It involves the exact reproduction of a document or picture which are static.Mobile phoneSuch telephones are also called cellular phones because they operate within a network of radio cells.E-mailThe message sent via a computer network is called e-mail.TeleconferencingIt is a system in which persons are sitting at coloured television screens. They see and talk to each other via a computer communication network.Communication satelliteIt is used to relay radio and television programmers.Global positioning system (GPS)It is a navigation system based on a network of earth-orbiting satellites. According to the transmission channel, there are two types of communication systems-(i) Line communication (ii) Space communication According to the type of modulation, there are six types of communication systems-(i) Amplitude modulation (AM)(ii) Frequency modulation (FM)(iii) Phase modulation (PM)(iv) Pulse amplitude modulation (PAM)(v) Pulse time modulation (PTM)(vi) Pulse code modulation (PCM) In the communication system, a signal means a time-varying electrical signal containing information. Analogue signals: It is a continuous waveform that changes smoothly and continuously over time.(i) Analogue signals can be easily generated from the information source by using a suitable transducer, e.g. pressure variations of sound waves can be converted into corresponding current or voltage pulses by a microphone(mic). (ii) An analogue signal is represented by a sine wave. (iii) The frequency of analogue signals(speech or music) varies in audible range i.e. \(20\;{\rm{Hz}}\) to \(20\;{\rm{kHz}}\).(iv) Bandwidth is the range over which the frequencies of a signal vary. (v) The term baseband designates the band of frequencies representing the signal supplied by the source of information.(vi) A signal consisting of two or more waves of different frequencies is a complex analogue signal. Digital signals: It is a discontinuous function of time. It has only two voltage levels, i.e. either low \((0)\) or high \((1)\). Either \(0\) and \(1\) is known as bit. A group of bits is called a byte. A byte comprising \(2\) bits can give on the four code combinations, i.e. \(00, 01, 10\) and \(11\). The number of code combinations increases with the number of bits in a byte by \(N = {2^x}\), where \(x=\) the number of bits. Bits or the number of binary digits per second is called bits per rate. It describes a digital signal and is expressed in bits per second (bps). Digital and analogue signals are of low frequency and hence cannot be transmitted to long distances. These signals require some carrier. These carriers are known as carrier waves or high-frequency signals. The placement of a low frequency (LF) signal over the high frequency (HF) signal is known as modulation. Need for modulation: The sound wave (\(20\;{\rm{Hz}}\) to \(20\;{\rm{kHz}}\)) cannot be transmitted directly from one place to another because- (i) Height of antenna: For efficient radiation and reception, the height of transmitting and receiving antennas should be comparable to a quarter of the wavelength of the frequency used. For \(15\;{\rm{kHz}}\), it is \(5000\;{\rm{m}}\) (too large), and for \(1\;{\rm{MHz}}\), it is \(75\;{\rm{m}}\).The energy radiated from an antenna is practically zero when the signal frequency to be transmitted is below \(15\;{\rm{Hz}}\). (ii) Detecting signals: All audible signals are in the range of \(20\;{\rm{Hz}}\) to \(20\;{\rm{kHz}}\), so the signals from all sources remain heavily mixed up in the air. It won't be easy to differentiate or detect the broadcast signal at the receiving station.Thus modulation is necessary for a low-frequency signal when it is sent to a distant place so that the information may not die out in the way itself and for the proper identification of a signal and keeping the height of the antenna small. Amplitude modulation (AM) is the process in which the amplitude of the modulated wave is varied in accordance with the amplitude of modulating wave. In AM, the frequency of the carrier wave is unchanged. Modulation index: It isthe ratio of change of amplitude of carrier wave to the amplitude of original carrier wave. It is also called the modulation factor or degree of modulation\(\left({{m_a}} \right)\).\({m_a} = \frac{{{\rm{ Changen\, amplitudef\, carrier\, wae }}}}{{{\rm{ Amplitudef\, originatarrier\, wae }}}} = \frac{{k{E_m}}}{{{E_c}}}\) Where \(k=\) is a factor determining the maximum change in the amplitude for a given amplitude \({E_m}\) of the modulating signal. If \(k=1\) then \({m_a} = \frac{{{E_m}}}{{{E_c}}} = \frac{{{E_{\max }} - {E_{\min }}}}{{{E_{\max }} + {E_{\min }}}}\) If several sine waves modulate a carrier wave, the total modulated index \({m_t}\) is given by \({m_t} = \sqrt {m_1^2 + m_2^2 + m_3^2 + \ldots \ldots } \) Voltage equation for AM wave: Let us consider the voltage equations for carrier wave and modulating wave is- \({e_c} = {E_c}\cos {\omega _c}t\) and \({e_m} = {E_m}\sin {\omega _m}t = m{E_c}\sin {\omega _m}t\) where \({e_c} = \) Instantaneous voltage of carrier wave, \({E_c} = \) Amplitude of carrier wave, \({\omega _C} = 2\pi {f_c} = \) Angular velocity at the carrier frequency \({f_c},{e_m} = \) Instantaneous voltage of modulating, \({E_m} = \) Amplitude of modulating wave, \({\omega _m} = 2\pi {f_m} = \) Angular velocity of modulating frequency \({f_m}\) The voltage equation for AM wave is \(e = E\sin {\omega _c}t = \left({{E_c} + {e_m}} \right)\sin {\omega _c}t = \left({{E_c} + {e_m}\sin {\omega _m}t} \right)\sin {\omega _c}t\) \(= {E_c}\sin {\omega _c}t + \frac{{{m_a}{E_c}}}{2}\cos \left({{\omega _c} - {\omega _m}} \right)t - \frac{{{m_a}{E_c}}}{2}\cos \left({{\omega _c} + {\omega _m}} \right)t\) The above AM wave indicates that the AM wave is equivalent to the summation of three sinusoidal waves, one having amplitude \({E_c}\) and the other two having amplitude \(\frac{{{m_a}{E_c}}}{2}\). Side-band frequencies: The AM wave contains three frequencies \({f_c},\left({{f_c} + {f_m}} \right)\) and \(\left({{f_c} - {f_m}} \right)\). Here \({f_c}\) is called carrier frequency, \(\left({{f_c} + {f_m}} \right)\) and \(\left({{f_c} - {f_m}} \right)\) are called sideband frequencies. \(\left({{f_c} + {f_m}} \right)\): Upper sideband (USB) frequency \(\left({{f_c} - {f_m}} \right)\): Lower sideband (LSB) frequency Side-band frequencies are generally close to the carrier frequency. Bandwidth: The two sidebands lie on either side of the carrier frequency at equal frequency intervals \({f_m}\). So, bandwidth \(= \left({{f_c} + {f_m}} \right) - \left({{f_c} - {f_m}} \right) = 2{f_m}\) Power in AM waves: Power dissipated in any circuit \(P = \frac{{V_{rms}^2}}{R}\). Hence (i) Carrier power \({P_c} = \frac{{{{\left({\frac{{E_c}}{{\sqrt 2 }}} \right)}^2}}}{R} = \frac{{E_c^2}}{{2R}}\) (ii) Total power of sidebands \({P_{sb}} = \frac{{{{\left({\frac{{{m_a}{E_c}}}{{2\sqrt 2 }}} \right)}^2}}}{R} + \frac{{\left({\frac{{{m_a}{E_c}}}{{2\sqrt 2 }}} \right)}}{R} = \frac{{m_a^2E_c^2}}{{4R}}\) (iii) Total power of AM wave \({P_{\rm{Total }}} = {P_C} + {P_{sb}} = \frac{{E_c^2}}{{2R}}\left({1 + \frac{{m_a^2}}{2}} \right)\) (iv) \(\frac{{{P_t}}}{{{P_c}}} = \left({1 + \frac{{m_a^2}}{2}} \right)\) and \(\frac{{{P_{sb}}}}{{{P_t}}} = \frac{{m_a^2/2}}{{\left({1 + \frac{{m_a^2}}{2}} \right)}}\) (v) Maximum power in the AM (without distortion) will occur when \({m_a} = 1\) i.e. \({P_t} = 1.5P = 3{P_{sb}}\) (vi) If \(I_{c = }\) Unmodulated current and \(I_{t = }\) total or modulated current \ \Rightarrow \frac{{{P_t}}}{{{P_c}}} = \frac{{I_t^2}}{{I_c^2}} \Rightarrow \frac{{{I_t}}}{{{I_c}}} = \sqrt {\left({1 + \frac{{m_a^2}}{2}} \right)} \). (i) Noisy reception(ii) Low efficiency(iii) Small operating range(iv) Poor audio quality It is the process of changing the frequency of a carrier wave in accordance with the audio frequency signal. It is known as frequency modulation. The audio quality of AM transmission is poor. Amplitude-sensitive noise has to be eliminated by removing amplitude variation. (I.e. a need to keep the amplitude of the carrier constant). In FM, the overall amplitude of the FM wave remains constant at all times. In FM, the total transmitted power remains constant. Frequency deviation: Frequency deviation isthe maximum change in frequency from the mean value \({f_c}\). It is also the change or shift either above or below the frequency \({f_c}\) and called frequency deviation. \(\therefore \quad \delta = \left({{f_{\max }} - {f_c}} \right) = {f_c} - {f_{\min }} = {k_f} \cdot \frac{{{E_m}}}{{2\pi }}\) \({k_f} = \) Constant of proportionality. It determines the maximum variation in the frequency of the modulated wave for a given modulating signal. Carrier swing (CS): Carrier swing is the total variation in frequency from the lowest to the highest. i.e. \(CS = 2 \times \Delta f\) Frequency modulation index \(\left({{m_f}} \right)\): The ratio of maximum frequency deviation to the modulating frequency is called modulation index. \({m_f} = \frac{\delta }{{{f_m}}} = \frac{{{f_{\max }} - {f_c}}}{{{f_m}}} = \frac{{{f_c} - {f_{\min }}}}{{{f_m}}} = \frac{{{k_f}{E_m}}}{{{f_m}}}\) Frequency spectrum: FM sideband modulated signal consist of an infinite number of sidebands whose frequencies are \(\left({{f_c} \pm {f_m}} \right),\left({{f_c} \pm 2{f_m}} \right),\left({{f_c} \pm 3{f_m}} \right) \ldots \ldots \) The number of sidebands depends on the modulation index \({m_f}\). In the FM signal, the information (audio signal) is contained in the sidebands. Since the sidebands are separated from each other by the frequency of modulating signal \({f_m}\) soBandwidth \(= 2n \times {f_m}\); where \(n=\) number of significant sideband pairs Deviation ratio: The ratio of the maximum permitted frequency deviation to the maximum permitted audio frequency is the deviation ratio. Thus, the deviation ratio \(= \frac{{{{\left({\Delta f} \right}_{\max }}}}{{{{\left({\Delta f} \right}_{\max }}}}\). Percentage modulation: It is the ratio of actual frequency deviation to the maximum allowed frequency deviation. Thus, percent modulation, \(m = \frac{{{{\left({\Delta f} \right}_{\rm{actual }}}}}{{{{\left({\Delta f} \right}_{\max }}}}\) Table: Range of frequency allotted for FM radio/TV broadcast Type of broadcastFrequency bandFM radio\(88\) to \(108\,{\rm{MHz}}\)UHF TV\(47\) to \(230\,{\rm{MHz}}\)UHF TV\(470\) to \(960\,{\rm{MHz}}\) Pulse Modulation(PM) is a process in which the carrier wave is in the form of pulses. (1) Pulse amplitude modulation (PAM): The pulse amplitude varies in accordance to the modulating signal(message signal). (2) Pulse width modulation (PWM): The pulse duration varies in accordance with the modulating signal. (3) Pulse position modulation (PPM): In PPM, the position of the pulses of the carrier wave train varies according to the instantaneous value of the modulating signal. Demodulation is the process of extracting the audio signal(message signal) from the modulated wave(modulated signal). The wireless signals consist of radiofrequency (high frequency) carrier waves modulated by audio baseband frequency(low frequency). The diaphragm membrane of a telephone receiver or a loudspeaker cannot vibrate with high frequency. Therefore, it is necessary to separate the audio frequencies from the radio frequency carrier wave. Simple demodulator circuit: A diode can detect or demodulate an amplitude modulated (AM) wave. A diode acts as a rectifier, i.e. it reduces the modulated carrier wave into a positive envelope only. The AM wave input is shown in the figure. It appears at the output of the diode across PQ as a rectified wave (since a diode conducts only in the positive half cycle). After passing through the RC network, this rectified wave does not contain the radio frequency carrier component. Instead, it has only the envelope of the modulated wave. In the actual circuit, the value of \(RC\) is chosen such that \(\frac{1}{{{f_c}}} < RC\); where \({f_c = }\) carrier signal frequency. The modulation factor determines the strength and quality of the transmitted signal.A straight conductor of the length \(l = \frac{\lambda }{2}\) of radio signals transmitted or received is called a Hertz antenna. The Marconi antenna is a straight conductor of length \(l = \frac{\lambda }{4}\).In a digital signal, information is carried by the pattern of pulses and not by the shape of pulses.The three important elements in a communication system are Transmitter, Channel, and Receiver.The transmitter converts the message signal produced by the source of information into a suitable form for transmission. Q.1. What are the essential elements of a communication system?Ans: The basic components of a communication system are information source, input transducer, transmitter, communication channel, receiver, and destination. Q.2. What are the parts of a communication system?Ans: Primarily communication system consists of three main parts:(i) transmitter,(ii) communication channel(iii) receiverThe transmitter and the receiver are erected at different places. At the same time, the channel is the physical medium that connects them. Q.3. What is the function of a repeater used in a communication system?Ans: The function of a repeater in a communication system is to extend the range of communication. Q.4. What is the function of a transducer used in a communication system?Ans: Any device that converts one form of energy into another is called a transducer. Q.5. How does the effective power radiate from a linear antenna depend on the signal's wavelength?Ans: Effective power radiated decreases with an increase in wavelength, i.e. \(P \propto \frac{1}{{{\lambda ^2}}}\). Q.6. Give one example each for point-to-point communication mode and broadcast mode of communication.Ans: Telephone is an example for point-to-point communication, and television is an example for the broadcast mode of communication. Communication means sending, receiving and processing of information between two or more devices. A collection of elements (devices) which works together to establish a communication between the sender and receiver is called a communication system. Some examples of communication system include radio broadcasting, television broadcasting, radio telegraphy, mobile communication, computer communication etc. Two or more people communicating with each other by using sound signals is also known as the communication system. Block Diagram of Communication system The basic components of a communication system are information source, input transducer, transmitter, communication channel, receiver, output transducer, and destination. Information Source As we know that the communication system establishes the communication bridge between the sender (transmitter) and receiver. To establish this communication bridge between the sender and receiver, first, we need an information to send. This information originates in the information source. The information generated by the source may be in the form of sound (human speech), picture (image source), words (plain text in some particular language such as English, French, German etc.) For example, if you are talking with your friend on a phone, you are considered as the information source who generates information in the form of sound. For beginners to analog communication, it's important to understand the difference between message and information. The message is the part of a communication which involves sending information from source to destination. Information is a meaningful data that the receiver consumes. Input Transducer If you want to talk (communicate) with your friend who is sitting beside you, then you can directly talk with him by using voice signals (sound signals). But if the same friend is farther away from you, then you can't directly communicate with him by using voice signals (sound signals) because sound signals cannot travel larger distances. So in order to overcome this problem and transmit information to larger distances, first we need to convert this sound signal into another form of signal (electrical signal or light signal) which travel larger distances. The device which is used to convert this sound signal into another form of signal is called transducer. A transducer is a device which converts one form of energy or signal into another form of energy or signal. The transducer is present at the input side and output side of the communication system. The transducer that is present at the input side of the communication system is called input transducer. Generally, the input transducer converts the non-electrical signal (sound signal or light signal) into an electrical signal. The best example of an input transducer is the microphone which is placed between the information source and the transmitter section. A microphone is a device which converts your voice signals (sound signals) into electrical signals. Transmitter The transmitter is a device which converts the signal produced by the source into a form that is suitable for transmission over a given channel or medium. Transmitters use a technique called modulation to convert the electrical signal into a form that is suitable for transmission over a given channel or medium. Modulation is the main function of a transmitter. When we send the signal to larger distances, it undergoes various circumstances which makes the signal weak. In order to send the signals to larger distances, without the effect of any external interferences or noise addition and without getting faded away, it has to undergo a process called modulation. Modulation increases the strength of a signal without changing the parameters of the original signal. Thus the resulted signal overcomes the various effects which make it to become weak. Communication Channel The communication channel is a medium through which the signal travels. or The communication channel is a wired or wireless medium through which the signal (information) travels from source (transmitter) to destination (receiver). or The communication channel is a wired or wireless medium that is used to send the signal from the source (transmitter) to the destination (receiver). or The communication channel is a wired or wireless medium that connects the transmitter and receiver for sending the signal. Communication channels are divided into two categories: wired and wireless. Some examples of wired channels include co-axial cables, fiber optic cables, and twisted pair telephone lines. Examples of wireless channels are air, water, and vacuum. Although channel provides a way for communication, it has one drawback. The communication channel reduces the signal strength (attenuates the signal) that carries the information. This reduction in signal strength is mainly caused by the addition of external noise, physical surroundings, and travel distance. Thus the signal received by the receiver is very weak. To compensate this signal loss, amplifiers (the device that amplifies the signal strength) are used at both the transmitter and the receiver side. Noise Noise is an unwanted signal that enters the communication system via the communication channel and interferes with the transmitted signal. The noise signal (unwanted signal) degrades the transmitted signal (signal containing information). Receiver The receiver is a device that receives the signal (electrical signal) from the channel and converts the signal (electrical signal) back to its original form (light and sound) which is understandable by humans at the destination. TV set is a good example of a receiver. TV set receives the signals sent by the TV transmitting stations and converts the signal into a form which is easily understandable by the humans who are watching TV. Output Transducer The transducer that is present at the output side of the communication system is called output transducer. Generally, the output transducer converts the electrical signal into a non-electrical signal (sound signal, light signal, or both sound and light signal). The best example of an output transducer is the loudspeaker which is placed between the receiver section and the destination. The loudspeaker converts the electrical signals into sound signals which are easily understandable by the humans at the destination. Destination The destination is the final stage in the communication system. Generally, humans at some place are considered as the destination. A destination is a place where humans consume the information. For example, if you are watching TV, you are considered as the destination. Whenever you've had a conversation, texted a friend, or given a business presentation, you have engaged in communication. Any time two or more people get together to exchange messages, they are engaging in this basic process. Although it seems simple, communication is actually quite complex and has several components. The basic elements of communication include the sender, receiver, and message, as well as the medium and potential feedback. The term communication process refers to the exchange of information (a message) between two or more people. For communication to succeed, both parties must be able to exchange information and understand each other. If the flow of information is blocked for some reason or the parties cannot make themselves understood, then communication fails. The communication process begins with the sender, who is also called the communicator or source. The sender has some kind of information—a command, request, question, or idea—that he or she wants to present to others. For that message to be received, the sender must first encode the message in a form that can be understood, such as by the use of a common language or industry jargon, and then transmit it. The person to whom a message is directed is called the receiver or the interpreter. To comprehend the information from the sender, the receiver must first be able to receive the sender's information and then decode or interpret it. The message or content is the information that the sender wants to relay to the receiver. Additional subtext can be conveyed through body language and tone of voice. Put all three elements together—the sender, receiver, and message—and you have the communication process at its most basic level. Also called the channel, the medium is the means by which a message is transmitted. Text messages, for example, are transmitted through the medium of cell phones. Other common mediums of communication include television broadcasts, radio waves, internet platforms, and face-to-face interactions. The communication process reaches its final point when the message has been successfully transmitted, received, and understood. The receiver, in turn, responds to the sender, indicating comprehension. Feedback may be direct, such as a written or verbal response, or it may take the form of an act or deed in response (indirect). The communication process isn't always so simple or smooth, of course. These elements can affect how information is transmitted, received, and interpreted: Noise: This can be any sort of interference that affects the message being sent, received, or understood. It can be as literal as static over a phone line or radio or as esoteric as misinterpreting a local custom. Context: This is the setting and situation in which communication takes place. Like noise, context can have an impact on the successful exchange of information. It may have a physical, social, or cultural aspect to it. In a private conversation with a trusted friend, you would share more personal information or details about your weekend or vacation, for example, than in a conversation with a work colleague or in a meeting. Brenda wants to remind her husband, Roberto, to stop by the store after work and buy milk for dinner. She forgot to ask him in the morning, so Brenda texted a reminder to Roberto. He texts back with a photo of the milk and then shows up at home with the gallon of milk under his arm. But something's amiss: Roberto bought chocolate milk when Brenda wanted regular milk. In this example, the sender is Brenda. The receiver is Roberto. The medium is a text message. The code is the English language they're using. And the message itself is "Remember the milk!" In this case, the feedback is both direct and indirect. Roberto texts a photo of milk at the store (direct) and then comes home with it (indirect). However, Brenda did not see the photo of the milk because the message didn't transmit (noise), and Roberto didn't think to ask what kind of milk (context). In order to communicate effectively, it's important to consider each element of communication, especially if the message you are trying to convey is particularly important. By carefully assessing each aspect of communication, especially in critical situations, you can enhance clarity and ensure your message resonates with the intended audience. For example, when delivering a presentation to a diverse audience, considering cultural differences and language barriers can significantly impact how your message is received and understood. Similarly, if your message is some sort of business correspondence, you must prepare it beforehand and proofread it to ensure you maintain a professional tone. Effective communication hinges on understanding and leveraging the basic elements of the process: the sender, receiver, message, medium, and feedback.Assessing each aspect of communication, from encoding messages to considering noise and context, is essential for ensuring clarity and resonance, particularly in formal or important exchanges.Considering cultural nuances, language barriers, and professional tone can significantly influence how messages are received and understood, so always provide proper context and consider your audience. A communication system, also known as a communications network, is a collection of individual telecommunications networks, transmission systems, relay stations, tributary stations, and terminal equipment that can be interconnected and interoperated to form an integrated whole. The components of a communications system have a shared goal, are technically compatible, follow standard procedures, respond to controls, and collaborate. The term "telecommunications" refers to a sort of communication (e.g., for sports broadcasting, mass media, journalism, etc.). The act of communicating intentional meanings from one entity or group to another using mutually understood signals and semiotic norms is known as communication. An optical communication system is any type of telecommunication that employs light as a medium of transmission. A transmitter encodes a message into an optical signal, a communication channel delivers the signal to its destination, and a receiver reproduces the message from the received optical signal to make up the equipment. Fibre-optic communication systems send light through an optical fibre to transmit data from one location to another. The light creates a carrier signal, which is modulated to carry data. A radio communication system is made up of several communications subsystems that enable external communication. A radio communication system consists of a transmitting conductor that generates electrical oscillations or currents and is designed to transmit those frequencies or oscillations through the free space of the space from one point to another remote from the transmitter, as well as the receiving conductor at such a distance. modified to accelerate the oscillations or waves transmitted to the transmitter. Power cable communication systems work by transmitting a network signal to a switch over power cables. Depending on the signal transmission characteristics of the power wiring used, different types of powerline communications use different frequency bands. Because the power wiring system was designed to transmit alternating current (AC), the power wire circuits have a limited ability to carry higher frequencies. The propagation problem stymies all types of power line communications. Don't Miss: JEE Main 2025 Paper Analysis (22nd Jan) Shift 1 & Shift 2 | JEE Main 2025 Paper Analysis (23rd Jan) Shift 1 & Shift 2 | JEE Main 2025 Paper Analysis (24th Jan) Shift 1 & Shift 2 | JEE Main 2025 Paper Analysis (28th Jan) Shift 1 & Shift 2 | JEE Main 2025 Paper Analysis (29th Jan) Shift 1 & Shift 2 Basic Elements of Communication System Overview The communication system is a model of a communication exchange between two stations, transmitter and receiver. A channel is used to send signals or information from one location to another. It represents a method by which the signal moves from a source to its destination. To transmit signals in a communication system, they must first be processed, beginning with signal representation and progressing through signal shaping, encoding, and modulation. After the transmitted signal has been prepared, it is routed to the channel's transmission line. As a result of signal crossing this medium, it suffers from a variety of impairments such as noise, attenuation, and distortion. The process of exchanging information between two sites is referred to as communication. The transmitter sends the information, the medium sends the information, and the receiver receives the information on the other end are the main elements required for communication. Communication systems include things like line telephony and telegraphy, radiotelephony and telegraphy, radio broadcasting, point-to-point communication and mobile communication, computer communication, radar communication, television broadcasting, radio telemetry, radio aids to navigation, radio aids to aircraft landing, and so on. Communication, in its most basic form, entails the transmission of information from one point to another via a series of processes, as listed below: The creation of a thought pattern or image in the mind of the creator. A set of oral visual symbols is used to describe that image with a certain degree of precision. The encoding of these symbols in a format suitable for transmission over an interesting physical medium. The delivery of encoded symbols to their intended destination. The process of decoding and reproducing the original symbols. The recreation of the original thought pattern or image in the recipient's mind, with a discernible degradation in quality. Watch Session on Our YT Channel Types Of Communication Systems The communication system is classified as follows based on signal specifications or technology: (1) Analogous Analog technology transmits data in the form of electronic signals with varying frequencies or amplitude. Analog technology is