|  |  |  |  |
| --- | --- | --- | --- |
| **Course Name:** | **Analogue Digital Systems** | **Semester:** | **IV** |
| **Date of Performance:** | **20 / 02 / 2024** | **Batch no.:** | **A - 2** |
| **Faculty Name:** | **Prof. Amrita Naiksatam** | **Roll no.:** | **16014022050** |
| **Faculty Sign & Date:** |  | **Grade / Marks:** | **\_\_\_ / 25** |

**Experiment no.: 6**

**Title: To generate and analyse Time Division Multiplexing of PCM signal**

|  |
| --- |
| **Aim and Objective of the Experiment:** |
| * To generate Pulse Code Modulated Signals and multiplexing those using ‘Time Division multiplexing’ scheme. |

|  |
| --- |
| **COs to be achieved:** |
| CO1: Apply knowledge of mathematics, science, and engineering such as concept of Basic electrical and Electronics to analyze communication system.CO3: Analyze and interpret data of modulation and demodulation techniques. |

|  |
| --- |
| **Theory (Pulse Amplitude Modulation (PAM)):** |
| Multiplexing is a process of simultaneously transmitting two or more Individual signals over a signal communication channel. Multiplexing has the effect of increasing the number of communication channels so that more information can be transmitted. PCM signal is generated by using sampling. Sampling is process of Looking at an analog signal for brief instant of time. During this very short Interval of time, the amplitude of analog signal is sampled at a periodic rate and resulting signal will be a series of samples or pulses that vary in Amplitude according to variations of analog signal.  Pulse code modulation (PCM) is a [digital](http://searchcio-midmarket.techtarget.com/sDefinition/0,,sid183_gci211948,00.html) scheme for transmitting [analog](http://searchcio-midmarket.techtarget.com/sDefinition/0,,sid183_gci211561,00.html) data. The signals in PCM are binary; that is, there are only two possible states, represented by logic 1 (high) and logic0 (low). This is true no matter how complex the analog waveform happens to be. Using PCM, it is possible to digitize all forms of analog data, including full-motion video, voices, music, telemetry, and virtual reality (VR). To obtain PCM from an analog waveform at the source (transmitter end) of a communications circuit, the analog signal amplitude is sampled (measured) at regular time intervals. The sampling rate, or number of samples per second, is several times the maximum frequency of the analog waveform in cycles per second or [hertz](http://searchmobilecomputing.techtarget.com/sDefinition/0,,sid40_gci212244,00.html). The instantaneous amplitude of the analog signal at each sampling is rounded off to the nearest of several specific, predetermined levels. This process is called quantization.  The number of levels is always a power of 2 -- for example, 8, 16, 32, or 64. These numbers can be represented by three, four, five, or six binary digits (bits) respectively. The output of a pulse code modulator is thus a series of binary numbers, each represented by some power of 2bits.At the destination (receiver end) of the communications circuit, a pulse code demodulator converts the binary numbers back into pulses having the same quantum levels as those in the modulator. *These pulses are further processed to restore the original analog waveform. The time division multiplexing of PAM can be accomplished by a circuit called Multiplexer (MUX). The multiplexer is a signal pole, multiple position mechanical or electronics switch that sequentially samples the multiple analog inputs at a high rate of speed.*  At transmitter end the multiple channel signals are selected by various sampled circuits. On Time sharing basis they are all combined in time slot. This is parallel to serial conversion. At the receiver end the serial data is converted into parallel lines for each Channel. |

|  |
| --- |
| **Step-Wise Procedure:** |
| 1. Set up the following initial conditions on Trainer kit: Scientech 2153:    1. Mode Switch: Set to 320 KHz (FAST mode) position.    2. DC signal (I) & DC signal (II) Controls: Turn fully clockwise in function generator block.    3. ~ 2 KHz and ~4 KHz control levels: Adjusted to give 10Vpp.    4. Pseudo-random sync code generator: Switch off (position: OFF).    5. Error check code generator switch A & B: Set to A=0 & B=0 position (OFF Mode).    6. Switched faults: All off. 2. First, connect only the 2 KHz output to CH I. 3. Turn ON the power. Verify the presence of the PAM output of 2 KHz sine wave at the sample and hold input of the trainer kit 2153. 4. Connect CH1(Y) of the oscilloscope to the ‘CH I sampling signal’ output of the Demultiplexer block, and CH2(X) of the oscilloscope to the input of the sample and hold block. Observe the timing & phase relation between the CH I sampling signal & the sampled waveform at the input of the Sample & hold block. 5. Turn OFF the power supply. Now, also connect the 4 KHz supply to CH II. 6. Connect CH1(Y) of the oscilloscope to the ‘CH II sampling signal’ output of the Demultiplexer block, and CH2(X) of the oscilloscope to the input of the sample and hold block. 7. Observe & explain the timing relation between the signals at:    1. CH I sampling signal,    2. 2 KHz Sine wave of Function Generator,    3. 4 KHz Sine wave of Function Generator,    4. CH II sampling signal,    5. Multiplexed output at the input of the Sample and hold block. |

|  |
| --- |
| **Circuit Diagram:** |
|  |

|  |
| --- |
| **Observation Table:** |
| Part 1: To obtain PCM Codewords w.r.t. different D.C. voltage levels   |  |  |  | | --- | --- | --- | | **Sr. No.** | **DC Voltage (Volts)** | **PCM Codeword** | | 1 | -6 | 0 | | 2 | -4 | 0 | | 3 | -2 | 0 | | 4 | 2 | 1 | | 5 | 4 | 1 | | 6 | 6 | 1 |   Part 2: To verify ‘Time division multiplexing & demultiplexing’ w.r.t. two D.C. voltages applied at two different channels.  Note: Draw corresponding waveforms on graph paper. |

|  |
| --- |
| **Post Lab Subjective / Objective type Questions:** |
| 1. **Define types of multiplexing techniques used in communication.**   Multiplexing techniques are methods used to combine multiple signals into one signal for transmission over a shared medium. Here are the main types:   1. Time Division Multiplexing (TDM): In TDM, multiple signals are interleaved in time. Each signal is allocated a specific time slot within a frame, and the frames are transmitted sequentially. TDM is commonly used in telephone systems and digital communication networks. 2. Frequency Division Multiplexing (FDM): FDM divides the available bandwidth into multiple frequency bands. Each signal is assigned a different frequency band, allowing multiple signals to be transmitted simultaneously without interfering with each other. FDM is often used in radio and television broadcasting. 3. Wavelength Division Multiplexing (WDM): WDM is similar to FDM but is used in optical communication systems. It divides the optical spectrum into different wavelengths, with each signal assigned a unique wavelength. WDM enables high-capacity data transmission over fiber optic networks. 4. Code Division Multiplexing (CDM): CDM assigns a unique code to each signal, allowing multiple signals to occupy the same frequency band simultaneously. This technique is common in spread spectrum communication systems and is used in technologies like CDMA (Code Division Multiple Access). 5. **Write application of TDM.**   One of the primary applications of TDM is in telecommunications, where it is used to transmit multiple voice or data signals over a single communication channel. Here's a specific application scenario:  Telephony Systems: TDM is extensively used in traditional telephony systems. In a TDM-based telephony system, multiple voice signals from different callers are sampled and digitized. These digitized voice signals are then interleaved into time slots within a frame. Each time slot corresponds to a fraction of time during which a particular voice signal is transmitted. By sharing the transmission medium in this manner, TDM allows multiple phone calls to be carried over the same physical communication channel simultaneously. This enables efficient use of resources and reduces infrastructure costs in telecommunication networks.  In modern digital telephone networks, TDM is also used in conjunction with other multiplexing techniques to handle various types of traffic efficiently, including voice, data, and multimedia services. |

|  |
| --- |
| **Conclusion:** |
| In conclusion, the experiment successfully demonstrated the generation of Pulse Code Modulated Signals followed by their multiplexing using the Time Division Multiplexing scheme. Through this process, we effectively combined multiple signals into a single transmission channel, showcasing the practical application and effectiveness of TDM in communication systems. |

|  |
| --- |
| **Signature of faculty in-charge with date:** |