Assignment of Digital Logic Design



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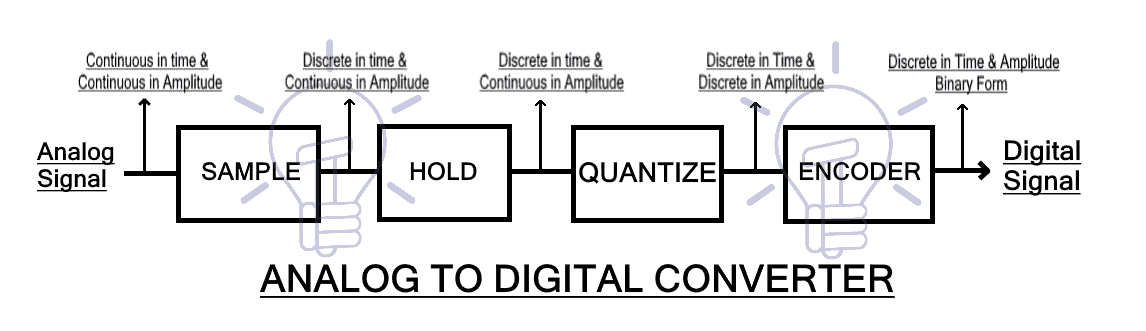
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**Q1:** **Briefly describe and give the block diagram, how to convert analog signal into digital signal?**

**Ans:** Converting an analog signal into a digital signal involves two main processes: sampling and quantization. Here's a brief description and a block diagram of the typical steps involved in analog-to-digital conversion:

1. **Sampling:**
   * In this step, the continuous analog signal is sampled at regular intervals.
   * The purpose of sampling is to capture the amplitude of the analog signal at discrete points in time.
   * The rate at which the signal is sampled is known as the sampling rate or frequency.
2. **Quantization:**
   * After sampling, the continuous amplitude values obtained are then quantized into discrete levels.
   * Quantization involves assigning a digital code (binary representation) to each sampled amplitude.
   * The number of quantization levels determines the resolution of the digital signal. More levels result in higher resolution but also require more bits for representation.
3. **Encoding:**
   * The quantized values are then encoded into a binary format.
   * Each binary code represents the amplitude value of the signal at a specific sampling point.
4. **Digital Transmission:**
   * The digital signal, now represented as a sequence of binary codes, can be transmitted, processed, or stored digitally.

Here's a simplified block diagram:



* **Analog Signal:** The continuous, varying signal that needs to be converted.
* **Sampling:** The process of discretizing the analog signal at regular intervals.
* **Quantization:** The process of assigning discrete digital values to the sampled amplitudes.
* **Encoding:** The representation of quantized values in binary format.
* **Digital Signal:** The discrete, digital representation of the original analog signal.

The quality of the digital representation depends on the sampling rate, the number of quantization levels, and the encoding scheme used. Higher sampling rates and more quantization levels generally result in a more accurate representation of the original analog signal, but also require more data storage and processing resources.

**Q2:** **What are the advantage and disadvantage of analog and digital system?**

**Ans:** **Analog System:**

**Advantages:**

1. **Smooth Representation:** Analog signals can represent information in a continuous and smooth manner, which is useful for representing physical quantities like sound and light.
2. **Simple Processing:** Analog systems often require simpler and less expensive processing equipment.
3. **Natural Transitions:** Analog signals can smoothly represent gradual transitions, making them suitable for certain types of data.

**Disadvantages:**

1. **Susceptibility to Noise:** Analog signals can be susceptible to noise and interference during transmission, which may degrade signal quality.
2. **Limited Precision:** Analog systems may have limited precision in representing values due to the continuous nature of signals.
3. **Signal Loss:** Analog signals can experience signal loss over long distances.

**Digital System:**

**Advantages:**

1. **Precision and Accuracy:** Digital signals can represent information with high precision and accuracy due to discrete values.
2. **Noise Immunity:** Digital signals are less susceptible to noise during transmission, providing better signal integrity.
3. **Easy Storage and Processing:** Digital data can be easily stored, processed, and manipulated using digital systems, allowing for efficient information handling.

**Disadvantages:**

1. **Complex Processing:** Digital systems may require more complex and expensive processing equipment compared to analog systems.
2. **Sampling Limitations:** In certain cases, digital systems may face challenges in accurately representing rapid changes or continuous variations.
3. **Quantization Error:** When converting analog signals to digital, there can be errors introduced due to quantization, affecting signal quality.

In summary, analog systems excel in representing continuous information but may face challenges with noise and precision, while digital systems provide high precision, are less susceptible to noise, but may require more sophisticated equipment and can face limitations in representing continuous variations. The choice between analog and digital often depends on the specific requirements of the application.

**Q3:**  **Explain how the clock is synchronized with the digital system.**

**Ans:** In the simplest terms, synchronizing a clock in a digital system means making sure that all the different parts of the system agree on the current time. Just like people need a shared understanding of time to coordinate activities, the components of a digital system need to be synchronized to work together effectively.

Here's an easy way to understand it:

1. **Imagine a Dance Party:**
   * Think of a digital system like a dance party where everyone needs to move in sync to the music.
   * The "clock" in this analogy is like the beat of the music that guides everyone's movements.
2. **The Beat of the Clock:**
   * In a digital system, the clock sends out regular signals, like the beat of the music, to all the components.
   * These signals say, "Okay, everyone, do your next action now!"
3. **Keeping Everyone in Step:**
   * All the digital components (like processors, memory, and other devices) pay attention to these clock signals.
   * When the clock says it's time to do something, they all do it together.
4. **Why Sync Matters:**
   * Imagine if some dancers in our party moved to a different beat. It would be a mess!
   * Similarly, if parts of a digital system aren't synchronized, it can lead to errors or chaos in how information is processed.
5. **Clock Synchronization Methods:**
   * Different systems use methods to ensure that all parts share the same understanding of time.
   * It's like making sure everyone at the dance party is listening to the same music.

In a digital system, precise timing is crucial for tasks like data transfer, processing instructions, and coordinating different functions. Clock synchronization ensures that all the digital "dancers" move in harmony, preventing confusion and errors in the system's performance.

**Q4: Calculate the duty cycle of signal which switches ON for a period 0.25 msec and time period equal to 1.25 msec?**

**Ans:** The duty cycle of a periodic signal is the ratio of the time it is ON to the total time of one complete cycle. It is typically expressed as a percentage.

The duty cycle (�*D*) is calculated using the formula:

�= (ON timeTotal time) ×100*D*= (Total time ON time​) ×100

In your case:

* ON time (ONON) = 0.25 milliseconds
* Total time (Period Period) = 1.25 milliseconds

Now, substitute these values into the formula:

�= (0.25 ms1.25 ms) ×100*D*=(1.25ms0.25ms​) ×100

Simplify the expression:

�=(15)×100*D*= (51​)×100

�=20%*D*=20%

So, the duty cycle of the given signal is 20%. This means that the signal is ON for 20% of the total time period.

**Shift Register and its types**

**Shift Register:**

A shift register is a digital circuit that can store and transfer data. It operates by shifting the binary bits of data along its internal storage elements, typically flip-flops, in a serial manner. Shift registers come in different configurations, but they all share the common feature of moving data sequentially from one stage to the next.

1. **Left Shift Register:**

* In a left shift register, data is shifted from right to left. This means that each bit is moved one position to the left, and a new bit (usually a 0) is shifted in at the rightmost position.
* The shift operation in a left shift register is often represented as "<<".
* Left shift registers are used in applications where a sequence of bits needs to be shifted to the left, such as in certain types of counters or in digital signal processing.

1. **Right Shift Register:**

* In a right shift register, data is shifted from left to right. Each bit is moved one position to the right, and a new bit (usually a 0) is shifted in at the leftmost position.
* The shift operation in a right shift register is often represented as ">>".
* Right shift registers are employed in situations where a sequence of bits needs to be shifted to the right. They are commonly used in various digital systems, including microprocessor architectures and serial data communication.

Both left and right shift registers can be implemented using various types of flip-flops or other storage elements. The choice between left and right shifting depends on the specific requirements of the application.

**Example of Left and Right Shift Operation:**

Let's consider an initial 4-bit binary sequence: (1101)

**Left Shift:**

If we perform a left shift operation, the new sequence will be (1010) with a 0 shifted in at the rightmost position.

**Right Shift:**

If we perform a right shift operation, the new sequence will be (0110) with a 0 shifted in at the leftmost position.

**Types of Shift Register:**

1. **Serial-In Serial-Out (SISO) Shift Register:**

* In a SISO shift register, data is entered bit by bit at one end and shifted out bit by bit at the other end.
* Often used in serial communication and data storage.

1. **Parallel-In Parallel-Out (PIPO) Shift Register:**

* PIPO shift registers allow the simultaneous input and output of multiple bits.
* Useful in applications where data needs to be transferred in parallel, such as interfacing with parallel data buses.

1. **Serial-In, Parallel-Out (SIPO) Shift Register:**

* SIPO shift registers take in data serially and output it in parallel.
* Commonly used in applications where parallel data is needed, but it is more convenient to input the data serially.

1. **Parallel-In, Serial-Out (PISO) Shift Register:**

* PISO shift registers accept parallel input and provide serial output.
* Useful in applications where data is received in parallel but needs to be processed or transmitted serially.

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