ASSAINMENT OF

Digital Electronics and Pulse Technique

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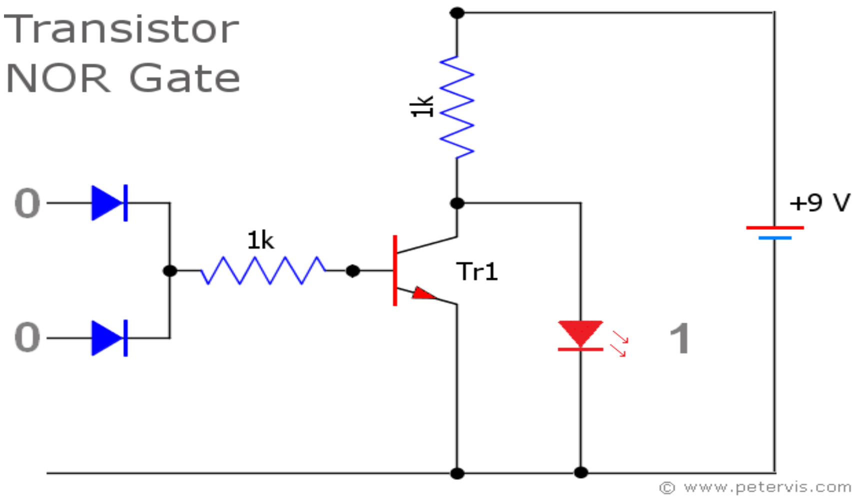
TOPIC-1: LOGIC GATES DIODE:

Q-1: What is diode? Implement NOR gate by diode

Answer:

Diode:
A diode is an electronic device that allows current to flow in one direction but blocks it from flowing in the opposite direction. It is made by joining two different types of semiconducting materials, typically a p-type and an n-type material. When a voltage is applied to a diode in the forward direction (anode positive and cathode negative), the diode conducts electricity easily and has very little resistance.

Implement NOR gate using diode:



Q-2: Show that Transistor acts as a switch.

Answer:

Answer: The switching action of a transistor can be explained by the output characteristics of a CE circuit. The load line is drawn for the load R_C and collector supply V_{CC}. It can be explained by off region, on region and by active region.

1. **Off region:** When the input voltage is zero or negative then the transistor is said to be in the off condition. In this condition I_B=0 and collector current is equal to the collector leakage current I_{CEO}.

   ∴ Power loss = Output current × Output voltage

   = $V_{CC} \times I_{CEO}$

   Since I_{CEO} is very small and it is negligible, the power loss is very low i.e. the transistor has a high efficiency as a switch in the off condition.

2. **On region:** In on condition, the input voltage is positive. In this condition the saturation collector current is

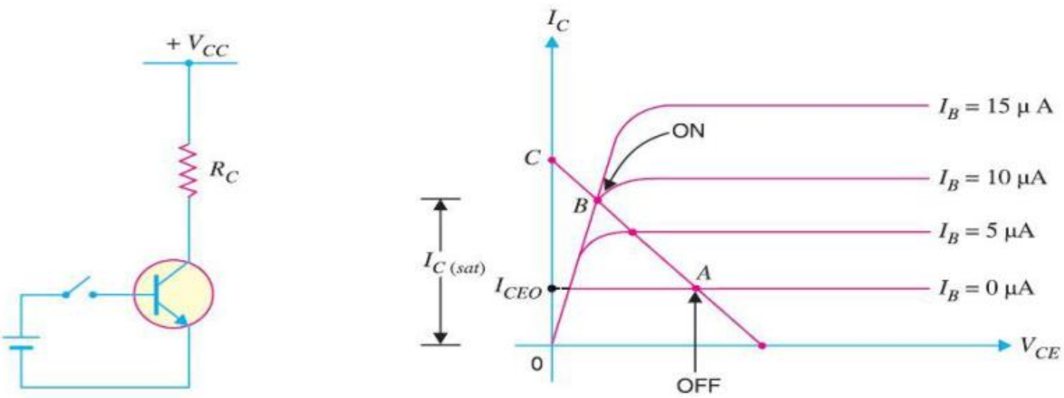
   $I_{C(sat)} = (V_{CC}-V_{knee})/R_C$

   Power loss = Output voltage × Output current

   Output voltage is equal to knee voltage.

   ∴ Power loss = $V_{knee} \times I_{C(sat)}$

   Again the efficiency as a switch in on condition is high.



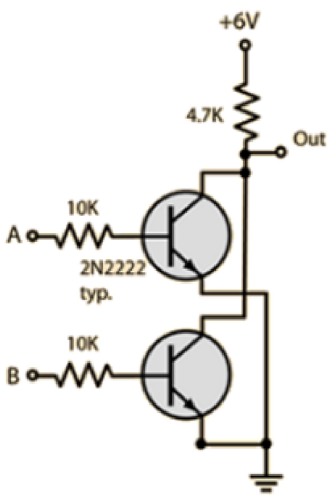
3. **By active region:** It is the region that lies between off and on condition. In this region the transistor operates as a linear amplifier where small changes in input current causes relatively large changes in output current.

Q-3: Describe Exclusive NOR gate by transistor.

Answer:

Transistor NOR Gate

☐	AND Gate
☐	OR Gate
☐	NAND Gate
☑	NOR Gate Double Transistor
☐	NOR Gate Single Transistor

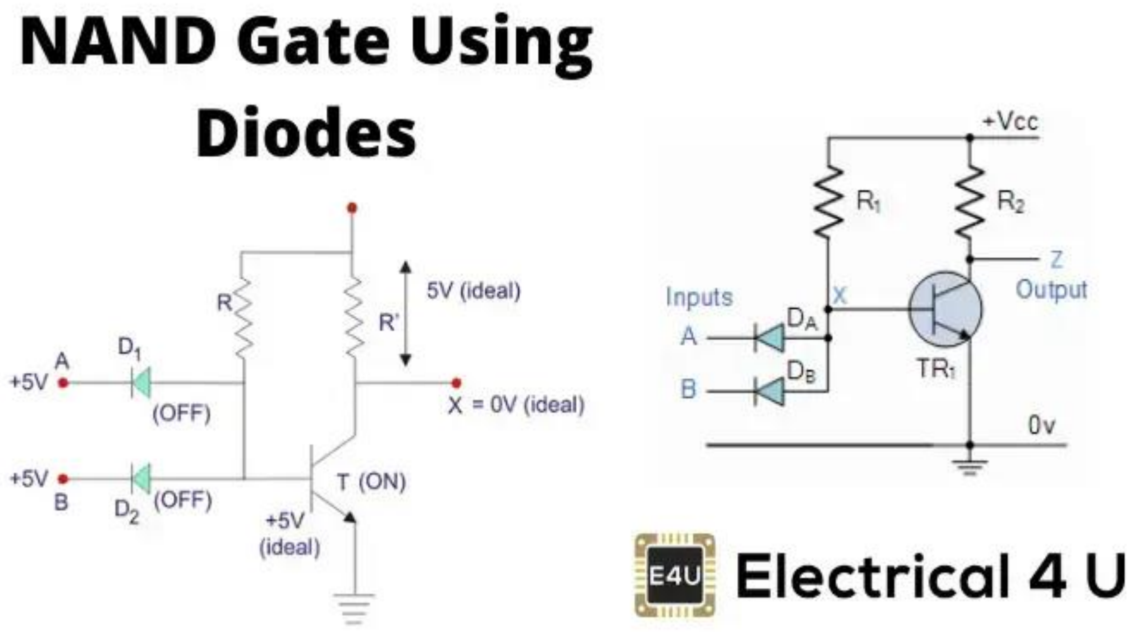


For the NOR logic, the transistors are in parallel with the output above them so that if either or both of the inputs are high, the output is driven low.

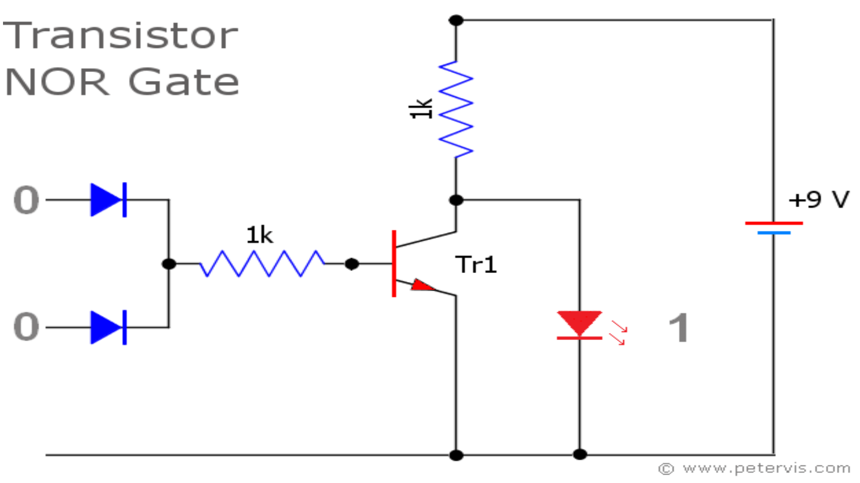
Q-4: What is Switch? Draw a two-input NAND and NOR gate circuit using diode.

Answer:
A switch is an electronic component or device that is used to control the flow of electric current in a circuit. It acts as a mechanical or electronic mechanism to make or break the electrical connection between two or more points in a circuit. Switches are widely used in various applications to control the operation of devices, appliances, and systems.

Below Draw a two-input NAND gate circuit using diode:



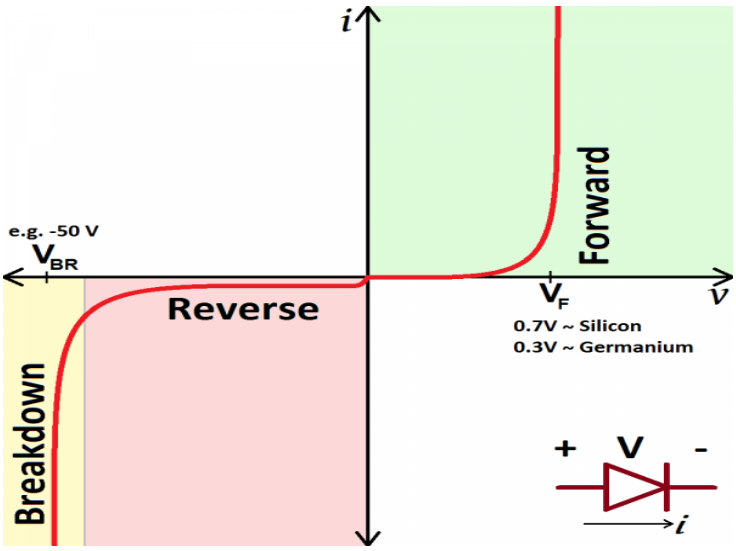
Draw a two-input NOR gate circuit using diode:



Q-5: Define Transistor. "Diode can be used as a switch"- show graphically with characteristic curve.

Answer:
Definition of Transistor:
A transistor is a three-terminal electronic device that is widely used in modern electronics for amplification, switching, and signal processing. It is a fundamental building block in integrated circuits and serves as a key component in various electronic systems and devices.

Here is a graph of the current-voltage characteristic curve for a diode. The horizontal axis represents the voltage across the diode, and the vertical axis represents the current flowing through the diode.



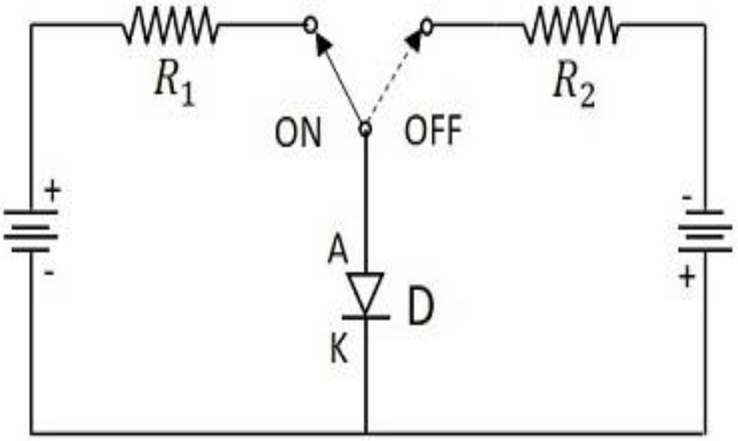
characteristic curve

As you can see, the diode has two distinct regions: the forward-biased region and the reverse-biased region. In the forward-biased region, the diode allows current to flow freely. In the reverse-biased region, the diode blocks current flow.

The forward-biased region is the region where the diode is used as a switch. When a small positive voltage is applied to the diode, the diode will switch to the forward-biased region and allow current to flow. When the voltage is removed, the diode will switch back to the reverse-biased region and block current flow.

This property of diodes makes them ideal for use in electronic circuits. Diodes can be used to create simple switches, as well as more complex circuits such as amplifiers and oscillators.

Here is an example of how a diode can be used as a switch in a simple circuit. In this circuit, the diode is used to control the flow of current to a light bulb. When the switch is closed, the diode is forward-biased and current flows through the light bulb, causing it to light up. When the switch is open, the diode is reverse-biased and no current flows through the light bulb, causing it to turn off.

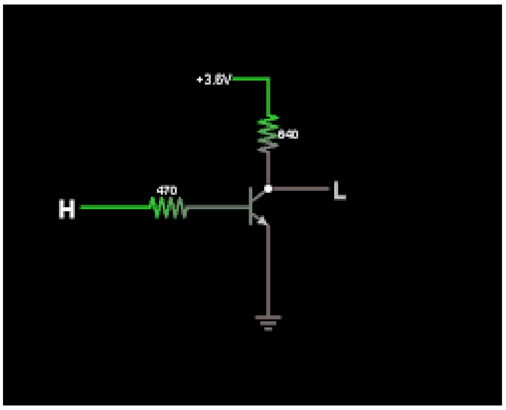


Switching circuit using Diode

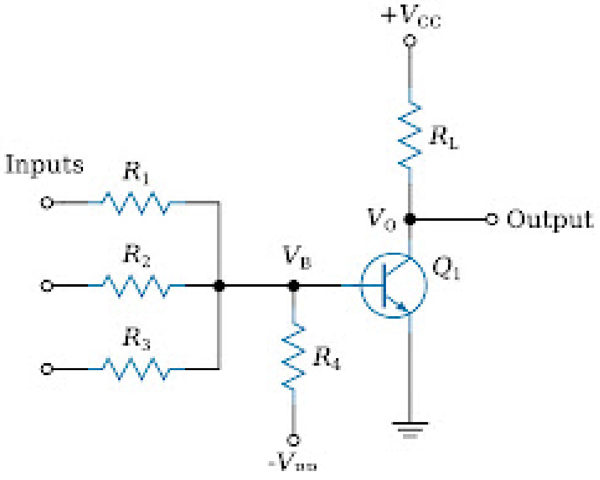
Diode switch circuit

Q-6: Explain RTL basic circuits.

Answer:
RTL inverter: The simplest RTL gate is the inverter, which has one input and one output. The input is connected to the base of a transistor, and the output is taken from the collector. When the input is high, the transistor turns on and the output is low. When the input is low, the transistor turns off and the output is high.



RTL NOR gate: The NOR gate is a two-input gate that produces a high output when either or both of its inputs are low. The circuit consists of two RTL inverters connected in parallel, with their outputs connected to the input of a third inverter. When either input is low, the corresponding inverter turns on and its output is high. This high output is then fed to the third inverter, which turns on and produces a high output at the output of the NOR gate.

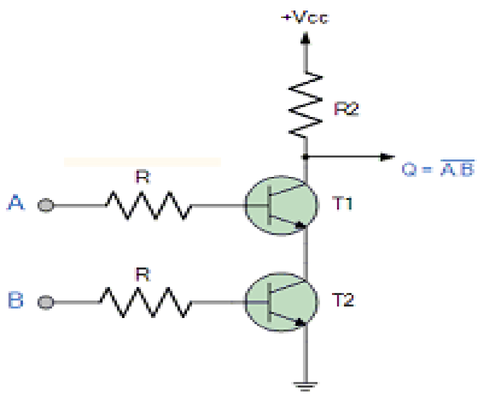


RTL circuits are characterized by their high speed and low power consumption. However, they also have a low fan-out, which means that they can only drive a limited number of other gates. Additionally, RTL circuits are sensitive to noise, which can cause them to malfunction.

Despite these limitations, RTL circuits were the first type of transistorized logic circuit to be widely used. They were used in early computers and other digital devices. RTL circuits were eventually replaced by other logic families, such as DTL and TTL, which offered higher speed, fan-out, and noise immunity.

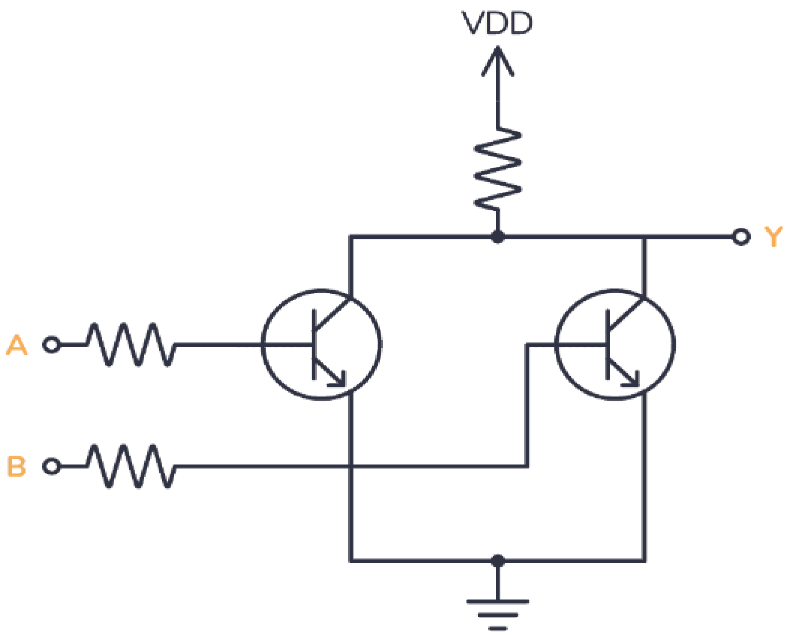
Q-7: Implement NAND & NOR gate using RTL.

Answer:



RTL NAND gate

<u>For NOR gate:</u>

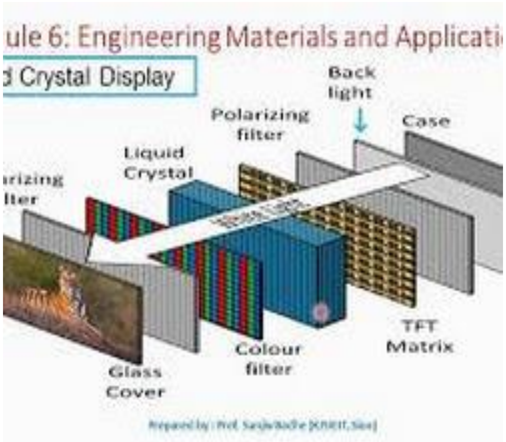


TOPIC-2: LOGIC FAMILIES

Q-1: What do mean by LED and LCD.

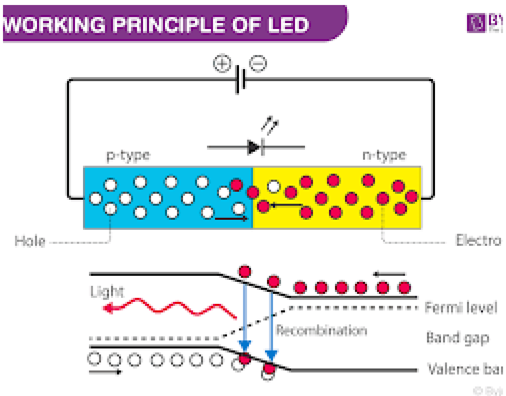
Answer:
LED stands for Light Emitting Diode and LCD stands for Liquid Crystal Display. Both are types of display technologies commonly used in electronic devices such as televisions, computer monitors, and mobile phones.

LED displays use an array of small light emitting diodes to create the image on screen. They offer high contrast ratios, fast response times, and low power consumption. LED displays are commonly used in outdoor billboards, large screens at stadiums, and traffic lights.



LCD display working principle

LCD displays use a layer of liquid crystals that are illuminated by a backlight to create the image on screen. They offer bright and clear images with wide viewing angles and consume less power than traditional CRT displays. LCD displays are commonly used in computer monitors, televisions, and mobile phones.



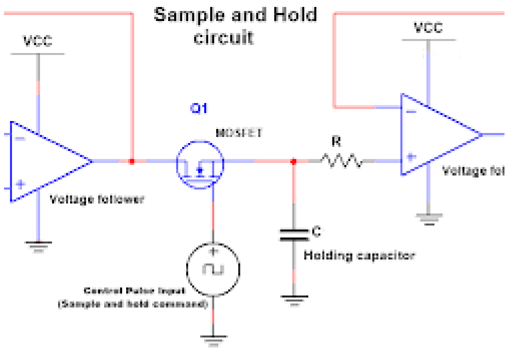
LED display working principle

Q-2: Explain Sample and Hold (S/H) circuit by using Operational Amplifier.

Answer: A sample and hold (S/H) circuit is an electronic circuit that takes samples of an analog signal and holds them for a period of time. This is done by using an operational amplifier (op-amp) and a capacitor. The op-amp is configured as a unity-gain buffer, which means that the voltage at its output is equal to the voltage at its input. The capacitor is connected between the op-amp's output and ground.

When the S/H circuit is in the "sample" mode, the switch is closed. This allows the input signal to charge the capacitor. The op-amp's output will be equal to the input signal, so the capacitor will be charged to the same voltage as the input signal.

When the S/H circuit is in the "hold" mode, the switch is opened. This disconnects the input signal from the capacitor. The capacitor will then discharge slowly through the op-amp's input resistance. The op-amp will maintain the voltage on its output at the same level as it was when the switch was closed. This means that the S/H circuit will hold the last sample of the input signal until the next time the switch is closed



The op-amp in this circuit is configured as a unity-gain buffer
When the switch is closed, the input signal is applied to the capacitor. The op-amp will maintain the voltage on its output at the same level as the input signal, so the capacitor will be charged to the same voltage as the input signal.

When the switch is opened, the input signal is disconnected from the capacitor. The capacitor will then discharge slowly through the op-amp's input resistance. The op-amp will maintain the voltage on its output at the same level as it was when the switch was closed. This means that the S/H circuit will hold the last sample of the input signal until the next time the switch is closed.

Ex: Q-1: Define of S&H. Discuss Advantages of S&H. Discuss application of S&H. Draw the Block & circuit diagram of S & H

Answer:

A Sample and Hold Circuit, sometimes represented as S/H Circuit or S & H Circuit, is usually used with an Analog to Digital Converter to sample the input analog signal and hold the sampled signal.

Advantages of S&H.

- The main and important advantage of a typical SH Circuit is to aid an Analog to Digital Conversion process by holding the sampled analog input voltage.
- In multichannel ADCs, where synchronization between different channels is important, an SH circuit can help by sampling analog signals from all the channels at the same time.
- In multiplexed circuits, the crosstalk can be reduced with an SH circuit.
- SH circuits can help increase the conversion rate of an ADC by holding the input voltage level long enough for the ADC to complete the conversion process.
- SH circuits can improve the SNR of ADCs by reducing the noise introduced during the conversion process.

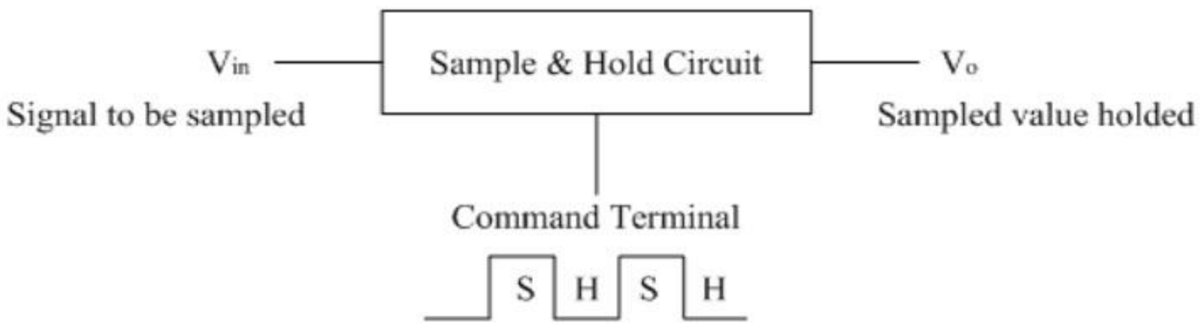
Applications of Sample and Hold Circuit:

- Analog to Digital Converter Circuits (ADC):
  Sample and Hold circuits are a crucial component in ADCs. They are used to sample and hold the analog input signal at a specific instant, ensuring that the voltage remains constant during the conversion process.
- Digital Interface Circuits:
  Sample and Hold circuits are used in digital interface circuits to maintain the integrity of analog signals during their conversion into digital format.
- Operational Amplifiers:
  Sample and Hold circuits can be implemented using operational amplifiers (op-amps). Op-amps are used to sample and hold the input voltage, providing a stable and accurate output.
- Analog De-multiplexers:
  Sample and Hold circuits are employed in analog de-multiplexers, which are used to select and distribute analog signals to different channels.
- Storage of Outputs of Multiplexers:

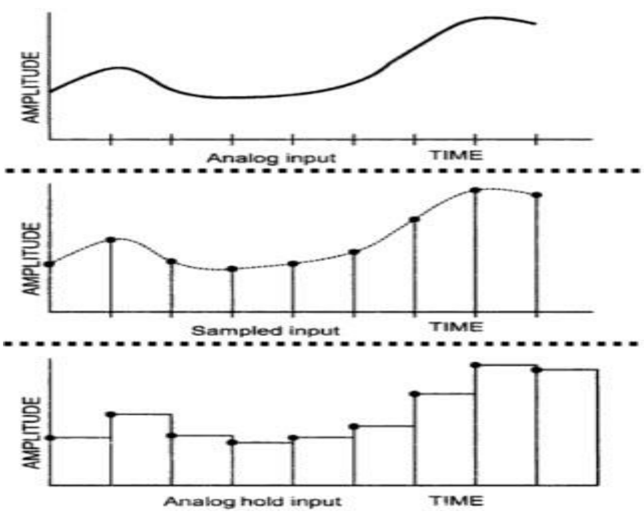
Multiplexers are used to select one input from multiple sources and route it to a single output.

- Data Distribution Systems:
  In data distribution systems, Sample and Hold circuits can be utilized to store and distribute analog signals to multiple destinations.
- Pulse Modulation Systems:
  Sample and Hold circuits play a vital role in pulse modulation systems such as pulse amplitude modulation (PAM) and pulse width modulation (PWM).

Draw the Block & circuit diagram of S & H:



circuit diagram:



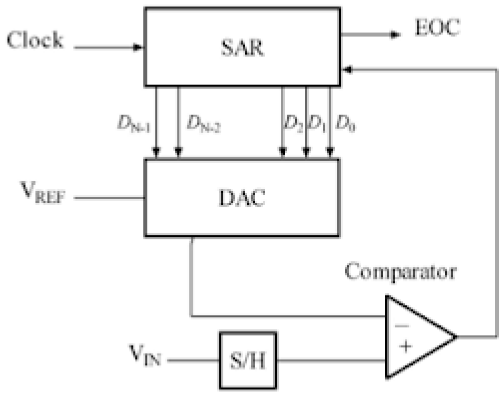
Q-3: Describe Analog to digital Converter circuit.

Answer:
An analog to digital converter (ADC) is a device that converts an analog signal into a digital signal. An analog signal is a continuous signal, meaning that it can take on any value within a certain range. A digital signal, on the other hand, is a discrete signal, meaning that it can only take on certain values.

The most common type of ADC is the successive approximation ADC. This type of ADC works by first sampling the analog signal at a certain rate. The sampled signal is then compared to a reference voltage. If the sampled signal is higher than the reference voltage, the ADC will output a 1. If the sampled signal is lower than the reference voltage, the ADC will output a 0.

The sampled signal is then divided into a number of smaller intervals. The ADC will then continue to sample the analog signal and compare it to the reference voltage, bit by bit. The more bits that are used, the more accurate the digital signal will be.

Here is a picture of a successive approximation ADC circuit:



ADCs are used in a wide variety of applications, including digital cameras, audio recording devices, and medical equipment.

Q-4: What is PLA? Explain block diagram of PLA circuit. Describe PLA's working principles.

Answer:
PLA stands for "Programmable Logic Array." It is a type of digital circuit that can be programmed to implement any Boolean logic function.

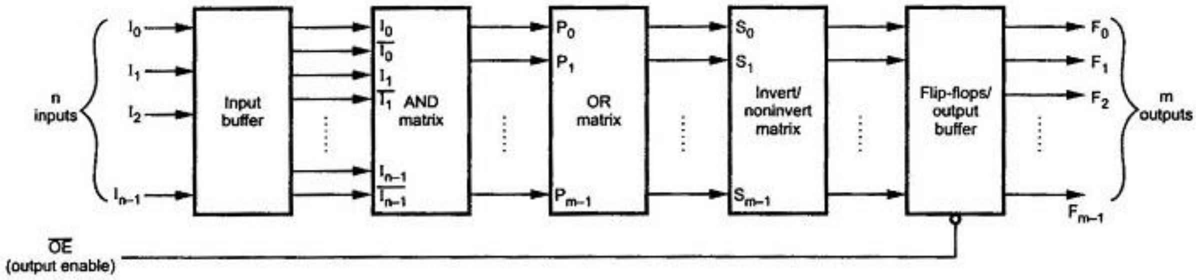


Fig. 3.88 Block diagram of a PLA

The block diagram of a PLA circuit typically consists of two main sections: the AND array and the OR array. The AND array is made up of a set of input lines, which are connected to a set of product terms. Each product term is composed of a combination of the input variables and their complements. The output from each product term is then fed into the OR array.

The OR array is made up of a set of sum terms, which are connected to the outputs of the product terms in the AND array. Each sum term is also composed of a combination of the input variables and their complements. The final output from the PLA is determined by the logical "OR" of all the sum terms.

In essence, the PLA allows for a flexible mapping of input variables to output values through a programmable matrix of AND and OR gates, where the programmer can selectively enable or disable certain combinations of inputs. This flexibility makes it a useful tool for implementing complex logic functions in a relatively compact and efficient manner.

PLA's working principles:
The working principles of a PLA are as follows:

- The input values are applied to the AND array.
- The AND array generates a set of product terms.
- The product terms are applied to the OR array.
- The OR array produces the final output.

PLAs are a versatile and powerful tool for implementing digital logic. They are often used in applications where the logic function needs to be changed frequently, such as in programmable logic controllers (PLCs).

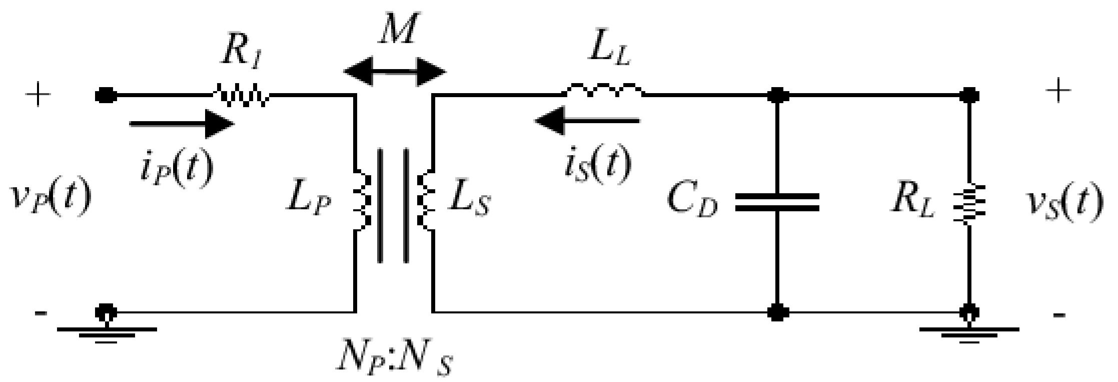
Q-5: Describe the pulse transformer circuit and its equivalent circuit.

Answer:

A pulse transformer is a type of transformer that is designed to transmit electrical pulses with minimal distortion. It consists of two coils of wire, the primary coil and the secondary coil, wound around a common magnetic core. The primary coil is connected to a source of input pulses, while the secondary coil is connected to a load.

The equivalent circuit of a pulse transformer can be represented as an ideal transformer with an inductance Lp for the primary coil and an inductance Ls for the secondary coil. The winding resistances of the coils are represented by Rp and Rs respectively. In addition, there is also a leakage inductance Lm, which represents the amount of magnetic flux that does not link the two coils.

When a pulse is applied to the primary coil, it generates a changing magnetic field that induces a voltage across the secondary coil. The voltage induced in the secondary coil is directly proportional to the number of turns in the secondary coil and the rate of change of the magnetic field. Therefore, by controlling the number of turns in the secondary coil and the shape of the pulse applied to the primary coil, it is possible to transmit a high-quality pulse signal to the load. This makes pulse transformers useful in applications where a high-speed, high-quality pulse signal is required, such as in digital communication circuits or high-voltage power supplies.



Equivalent circuit of the pulse transformer

Q-6: Explain pulse transmission with input and output waveforms in different media.

Answer:
Pulse transmission is a method of sending digital signals through a communication channel. The input waveform is typically a series of pulses, where each pulse represents a bit of information. The output waveform will depend on the medium used to transmit the signal.

In the case of a wire or cable, the input waveform will be transmitted as a voltage signal. The pulse shapes may be distorted due to impedance mismatches or other factors, resulting in a noisy output waveform. Here's an example of an input waveform and its corresponding output waveform when transmitted through a wire:

Input waveform:

```
      _________       _________       __
 ____|         |____|         |____|  |_____
```

Output waveform:

```
      _________       ___________       _
 ____|         |_____|           |____|    ____
```

In the case of wireless communication, the input waveform is typically a radio frequency signal, which is then transmitted through the air as an electromagnetic wave. The output waveform will depend on the modulation scheme used, such as amplitude modulation (AM), frequency modulation (FM), or phase modulation (PM). Here's an example of an input waveform and its corresponding output waveform when transmitted wirelessly using frequency modulation:

Input waveform:

```
      _________       _________       __
 ____|         |____|         |____|  |_____
```

Output waveform:

```
          /\                          /\
         /  \                        /  \
        /    \                      /    \
       /      \                    /      \
  ____/        \__________________/        \__
```

As you can see, the output waveform has a different shape than the input waveform due to the process of modulation and the characteristics of the medium used for transmission.

Q-7: What do you mean by flip flops? Explain operating principle of J-K flip flop.

Answer:

A flip-flop is a digital circuit that has two stable states and can be used to store one bit of information. It is a sequential circuit, which means that its output depends on its previous state as well as its current input. Flip-flops are used in a wide variety of digital devices, including computers, calculators, and digital watches.

A J-K flip-flop is a type of flip-flop that has two inputs, J and K. The J input is used to set the output to 1, and the K input is used to reset the output to 0. When both J and K are 1, the output toggles, or changes state.

The operating principle of a J-K flip-flop is as follows:

- The J and K inputs are fed into a pair of exclusive-OR gates.
- The outputs of the exclusive-OR gates are fed into a pair of D flip-flops.
- The outputs of the D flip-flops are the Q and Q' outputs of the J-K flip-flop.
- When the clock input is high, the outputs of the D flip-flops are updated to the values of the J and K inputs.

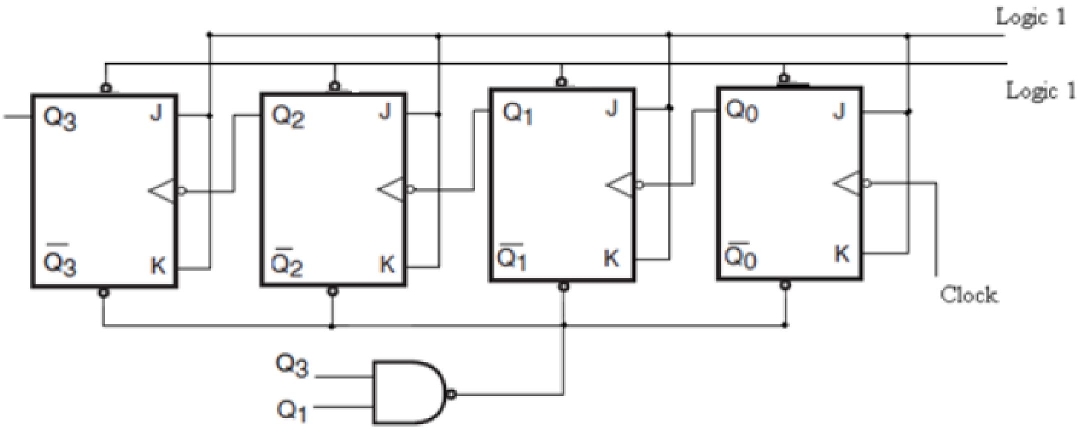
The following table shows the truth table for a J-K flip-flop:

```
Input | Output
-------|--------
J=0, K=0 | Q=0, Q'=0
J=0, K=1 | Q=1, Q'=0
J=1, K=0 | Q=0, Q'=1
J=1, K=1 | Toggle
```

The J-K flip-flop can be used to implement a variety of digital logic functions, such as counters, shift registers, and latches.

Q-8: Draw & explain BCD ripple counter.

Answer:



A BCD (Binary Coded Decimal) ripple counter is a type of counter circuit that counts in decimal digits, using binary-coded decimal notation. This means that each digit is represented by four bits, which can take on the values 0000 to 1001 in binary. The counter advances by one count for each clock pulse applied to its input, and when it reaches the maximum count value of 9 (in binary, 1001), it resets to zero and the next higher-order digit is incremented.

The BCD ripple counter gets its name from the fact that the carry output from each digit "ripples" or carries over to the next higher-order digit when it reaches its maximum count value. For example, when the rightmost digit of the counter reaches 9 and then resets to 0, it causes a carry signal to be generated which increments the next digit to the left by one count.

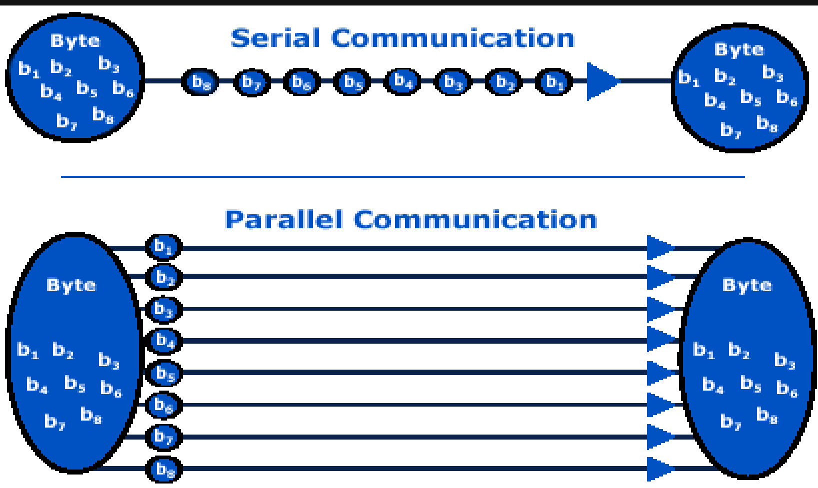
A basic BCD ripple counter can be constructed using four D flip-flops, where the Q output of each flip-flop drives the clock input of the next flip-flop in the chain. The inputs to the first flip-flop are connected to the clock and reset signals, while the outputs of the other three flip-flops are combined to form the BCD output.

Overall, a BCD ripple counter is a simple yet effective way to count in decimal digits using binary-coded decimal notation, and is commonly used in digital circuits such as time-keeping devices and electronic counters.

Q-9: What is the difference between a serial and parallel transfer?

Answer:

Feature	Serial Transfer	Parallel Transfer
Data transfer rate	Slow	Fast
Number of data lines required	One	Multiple
Distance	Suitable for long distances	Suitable for short distances
Cost	Lower cost	Higher cost
Complexity	Simpler	More complex
Interference	More susceptible to interference	Less susceptible to interference



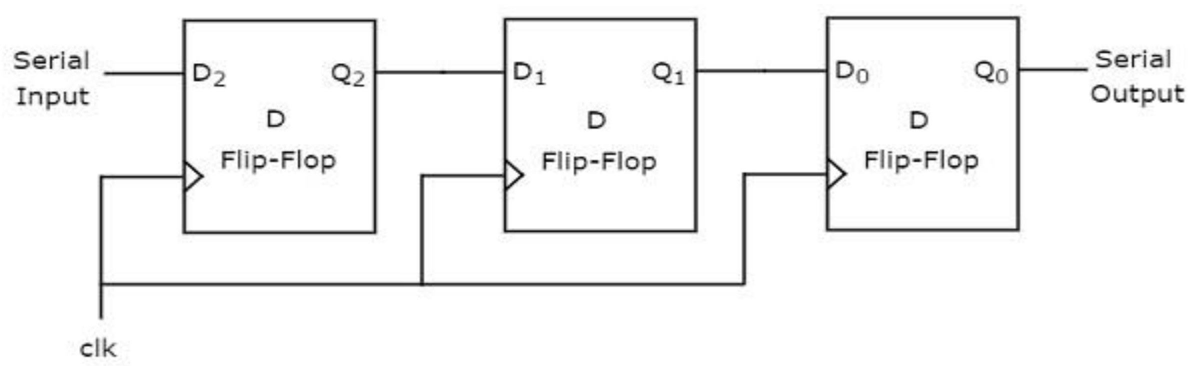
Q-10: Explain operating principle of 3-bit register.

Answer:

A 3-bit register is a digital circuit that can store three binary digits (bits) of information. The operating principle of a 3-bit register involves storing and retrieving binary data using three flip-flops, which are basic building blocks of digital circuits.

The operating principle of a 3-bit register is as follows:

- The data is applied to the input of the first flip-flop.
- On the rising edge of the clock signal, the data is transferred to the second flip-flop.
- On the next rising edge of the clock signal, the data is transferred to the third flip-flop.
- The process repeats, with the data being shifted from one flip-flop to the next on each rising edge of the clock signal.



The three D flip-flops in the register are labeled D1, D2, and D3. The input of the register is labeled SI, and the output of the register is labeled SO. The clock signal is labeled Clk.

Q-11: What do you mean by A/D & D/A converters? Write down a comparison between A/D & D/A converters

Answer:

A/D and D/A converters are electronic devices used in digital signal processing applications. A/D stands for Analog-to-Digital converter, while D/A stands for Digital-to-Analog converter.

An A/D converter is a device that transforms an analog signal, such as sound or temperature, into a digital signal that can be processed by a computer or other digital system. The process of converting the analog signal to a digital one involves sampling and quantization. Sampling is the process of measuring the amplitude of the analog signal at fixed intervals, while quantization is the process of assigning a numerical value to each sample.

On the other hand, a D/A converter is a device that takes a digital signal and converts it back into an analog signal. This is useful when the output of a digital system, such as a computer, needs to be converted back to an analog format, for example, to play music on speakers or to control an analog device like a motor. The process of converting the digital signal to an analog one involves reconstructing a waveform from the digital data points using a process called interpolation.

<u>**Comparison between A/D & D/A converters:**</u>

- Input and output signals: The input of an ADC is an analog signal, while the output is a digital stream of numbers. The input of a DAC is a digital stream of numbers, while the output is an analog signal.

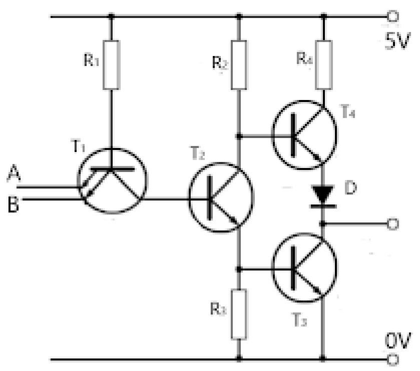
- Sampling rate: The sampling rate is the number of times per second that a signal is measured or reproduced. ADCs typically have a higher sampling rate than DACs because it's easier to convert an analog signal into a digital signal than vice versa.
- Resolution: The resolution of an ADC or DAC refers to the number of bits used to represent each sample. Higher resolution means more detailed representation of the signal. Typically, ADCs have higher resolution than DACs because it's easier to add precision to a digital signal than an analog one.
- Accuracy: Both ADCs and DACs have errors associated with their conversion process, which can affect the accuracy of the signal. The most common sources of error include quantization error, non-linear distortion, and noise.
- Applications: ADCs are commonly used in applications such as data acquisition, instrumentation, and audio recording. DACs are often used in applications such as audio playback, motor control, and waveform generation.

Shortcut:

Feature	A/D Converter	D/A Converter
Converts	Analog signal to digital signal	Digital signal to analog signal
Uses	Sampling and quantization	Reconstruction
Accuracy	Depends on the number of bits	Depends on the resolution and the size of the output buffer
Speed	Varies depending on the type of A/D converter	Varies depending on the type of D/A converter
Applications	Audio, video, data acquisition, medical imaging	Audio, video, control systems, telecommunications

Q-12: Draw the Transistor Transistor Logic (TTL) circuit and explain working procedure.

Answer:



The TTL circuit consists of two transistors, an input transistor and an output transistor. The input transistor is used to amplify the input signal, and the output transistor is used to drive the output load.

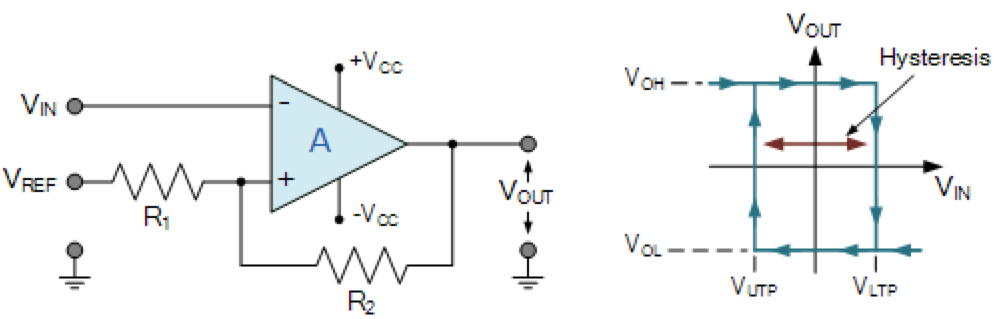
The working procedure of the TTL circuit is as follows:

- When the input signal is LOW, the input transistor is turned off. This causes the base of the output transistor to be pulled LOW, which turns off the output transistor.
- When the input signal is HIGH, the input transistor is turned on. This causes the base of the output transistor to be pulled HIGH, which turns on the output transistor.

The output of the TTL circuit is the opposite of the input signal. When the input signal is LOW, the output signal is HIGH. When the input signal is HIGH, the output signal is LOW.

Q-13-: Explain operating principle of comparator circuit

Answer:



Comparator circuit diagram

A comparator is an electronic circuit that compares two input voltages and produces an output signal that indicates which input voltage is higher.

<u>The operating principle of a comparator circuit can be explained as follows:</u>

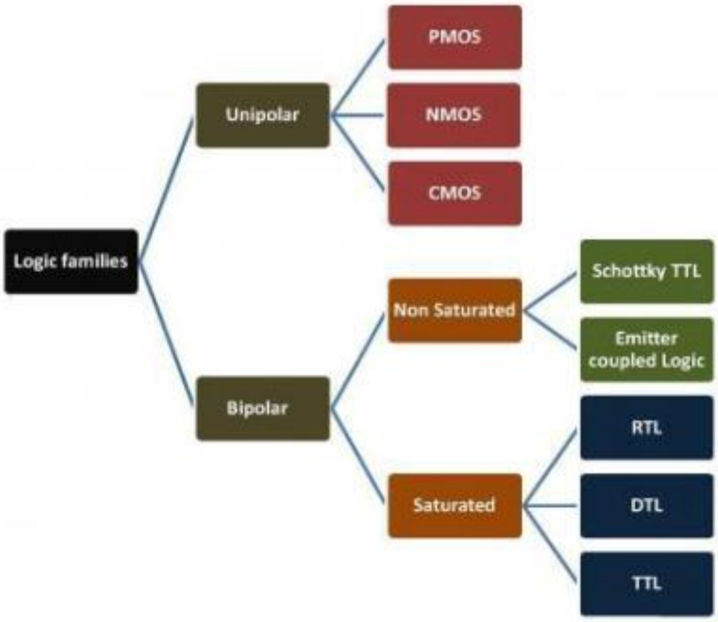
- The two input voltages, V+ and V-, are applied to the non-inverting and inverting inputs of an operational amplifier (op-amp), respectively.
- The op-amp amplifies the voltage difference between the inputs and produces an output voltage that is proportional to this difference.
- If V+ is greater than V-, the output voltage of the op-amp will be positive and close to the supply voltage level. Conversely, if V- is greater than V+, the output voltage of the op-amp will be negative and close to the negative supply voltage level.
- A voltage reference or threshold voltage is then compared with the output voltage of the op-amp using a voltage divider network or other circuitry. If the output voltage is higher than the threshold voltage, the output of the comparator will be high. If the output voltage is lower than the threshold voltage, the output of the comparator will be low.
- The output of the comparator can be used to drive other circuits, such as switches, relays, or digital logic gates, depending on the application.

Overall, the operating principle of a comparator circuit relies on the ability of an op-amp to amplify the voltage difference between two inputs and produce an output voltage that can be compared with a threshold voltage to generate a binary output signal.

Q-14: Explain classification of logic family.

Answer:

A logic family is a collection of different integrated circuit chips that have similar input, output, and internal circuit characteristics, but they perform different logic gate functions such as AND, OR, NOT, etc.



Q-15: What is pulse transformer? Write the functions of pulse transformer.

Answer:

A pulse transformer is a type of transformer that is designed to transmit electrical pulses with high efficiency and minimal distortion. It is used in electronic circuits to isolate and transfer signals between different stages or components.

The main function of a pulse transformer is to provide galvanic isolation between input and output circuits. This means that the input and output circuits are not electrically connected, which can be important for safety reasons or to prevent interference between different parts of a circuit. Pulse transformers also serve to match impedance between the input and output circuits, ensuring maximum power transfer and signal fidelity.

Another function of pulse transformers is to reduce the rise time of signals transmitted through them. By reducing the rise time, pulse transformers help to minimize distortion and improve the quality of the transmitted signal. They are often used in applications such as high-speed data transmission, switching power supplies, and pulse generators.

The main functions of a pulse transformer are to:

- Convert voltage from one level to another.
- Provide isolation between input and output.
- Provide distributed power factor correction (PFC)

Q-16: Draw the block diagram of a D/A converter and explain its operation.

Answer:

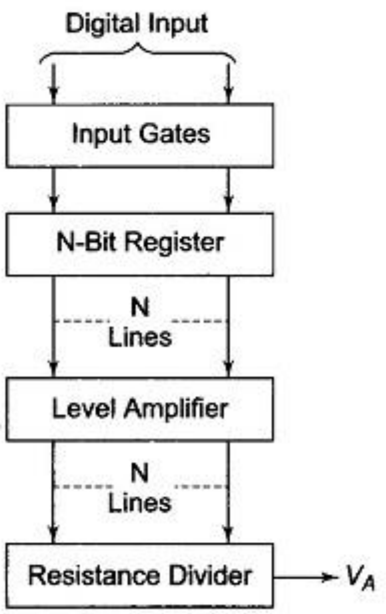
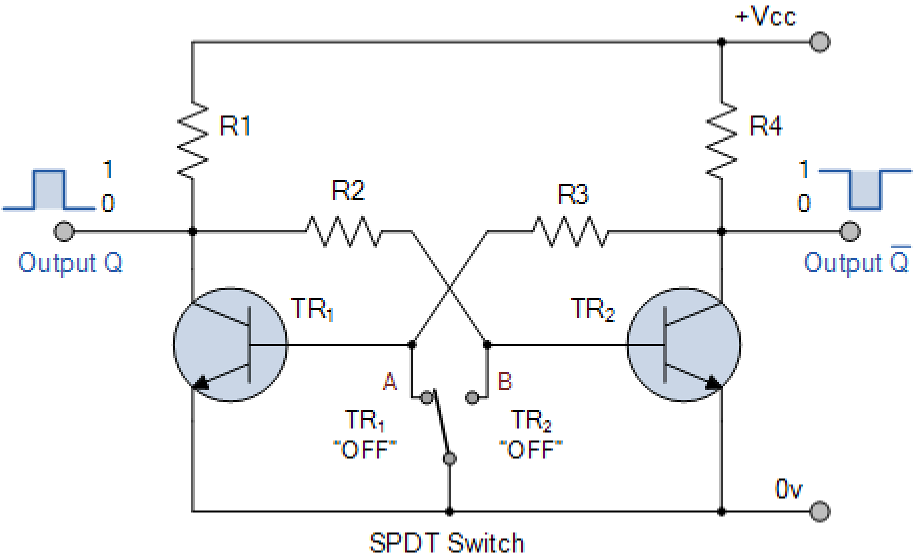


Fig. 17.20 Block Diagram of a D/A Converter

The operation of a D/A converter can be explained as follows:

- The digital input is converted into a series of pulses by the DAC. The amplitude of each pulse is proportional to the value of the corresponding bit in the digital input.
- The pulses are then passed through the R-2R ladder network. The R-2R ladder network is a weighted resistor network, which means that the resistance of each resistor is proportional to the weight of the corresponding bit in the digital input.
- The pulses are multiplied by the resistances of the R-2R ladder network. The products are then summed to produce an analog voltage.
- The analog voltage is then output from the DAC.

Q-17: Mention the process of triggering of a bistable multivibrator with proper diagram.
Answer:



<u>Mention the process of triggering of a bistable multivibrator:</u>

The bistable multivibrator consists of two transistors, Q1 and Q2, and two resistors, R1 and R2. The transistors are connected in a configuration called a common collector circuit. The resistors are connected between the bases of the transistors and the power supply.

When the circuit is first turned on, the transistors are both in the OFF state. This is because the base voltage of each transistor is below the threshold voltage for turning it on.

When a trigger pulse is applied to the circuit, it causes one of the transistors to turn ON. The transistor that turns ON is determined by the polarity of the trigger pulse. If the trigger pulse is positive, then Q1 turns ON. If the trigger pulse is negative, then Q2 turns ON.

When one of the transistors turns ON, it pulls the base voltage of the other transistor below the threshold voltage, turning it OFF. This causes the output of the bistable multivibrator to switch states.

Q-18: What is Cache Memory? Differentiate between primary and secondary memory
Answer:

Cache memory is a type of high-speed memory that stores frequently accessed data or instructions closer to the processor for faster access. It acts as a buffer between the processor and the main memory, which can be much slower in comparison.

Feature	Primary Memory	Secondary Memory
Speed	Faster	Slower
Cost	More expensive	Less expensive
Capacity	Smaller	Larger
Accessibility	Directly accessible by the CPU	Not directly accessible by the CPU
Volatile	Yes	No

PRIMARY MEMORY
VERSUS
SECONDARY MEMORY

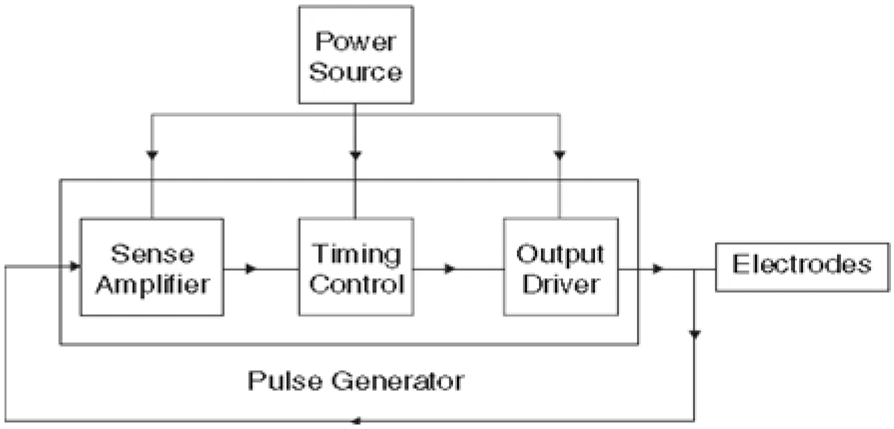
PRIMARY MEMORY	SECONDARY MEMORY
It is the main memory where the data and information are stored temporarily.	It refers to the external memory where data is stored permanently.
Data is directly accessed by the processing unit.	Data cannot be accessed directly by the processor.
It's a volatile memory meaning data cannot be retained in case of power failure.	It's a non-volatile memory so data can be retained even after power failure.
Memory is stored in semiconductor chips which are relatively expensive.	Memory is stored in external storage devices such as hard disks, flash drives, etc.
It can be categorized into cache memory and random access memory (RAM).	They are permanent storage devices such as CD, DVD, HDD, floppy disk, etc.
It's relatively faster than secondary memory because of its volatile nature.	They are usually slower than primary memory. It's like a backup memory.
It holds data or information that is currently being used by the processing unit.	It stores substantial amount of data and information, ranging from gigabytes to terabytes.

DifferenceBetween.net

Q-19: Explain pulse generator block diagram with equivalent circuit.

Answer:

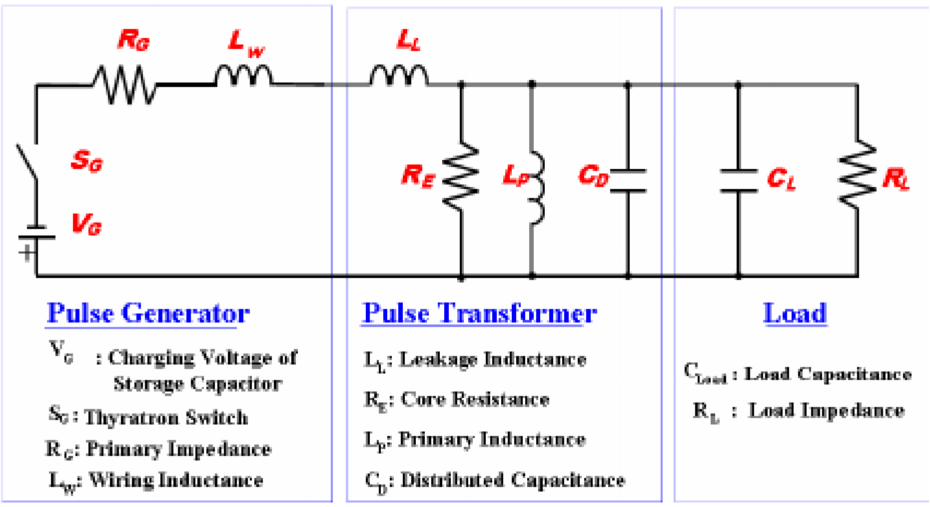
A pulse generator is an electronic device that produces a series of pulses with a desired frequency, pulse width, and amplitude. The block diagram of a pulse generator is shown below.



The main components of a pulse generator are:

- Oscillator: The oscillator generates a continuous train of pulses. The frequency of the oscillator is controlled by a variable resistor or potentiometer.
- Ramp generator: The ramp generator produces a linear voltage ramp. The slope of the ramp is controlled by a variable resistor or potentiometer.
- Schmitt trigger: The Schmitt trigger converts the linear voltage ramp from the ramp generator into a series of square pulses. The threshold levels of the Schmitt trigger are controlled by two variable resistors or potentiometers.
- Pulse output: The pulse output provides the output pulses from the pulse generator. The pulse output can be either a single pulse or a series of pulses.

The equivalent circuit of a pulse generator is shown below.



The equivalent circuit of a pulse generator is similar to the block diagram, with the following components:

- Oscillator: The oscillator is represented by an AC source.
- Ramp generator: The ramp generator is represented by a capacitor.
- Schmitt trigger: The Schmitt trigger is represented by a transistor and two resistors.
- Pulse output: The pulse output is represented by a resistor and a diode.

Q-20: What is OP-AMP. Why OP-AMP is a differential, voltage amplifier with high gain?

Answer:

An operational amplifier (OP-AMP) is an electronic circuit component that amplifies the difference between two input voltages. It has a high gain and a differential input configuration, which makes it particularly useful in many analog applications.

The reason why OP-AMPs are differential voltage amplifiers with high gain is due to their internal circuitry. They consist of several transistors and resistors arranged in such a way as to amplify the difference between the two input signals applied to its inputs. The gain of an OP-AMP is usually very high, often on the order of thousands or even millions, which means that even a small difference between the input signals can be amplified to a large output signal.

In addition, OP-AMPs are designed to operate with negative feedback, which helps to stabilize the amplifier's output and improve its performance. Negative feedback is achieved by sending some of the output signal back to the input through a feedback network, which reduces the gain of the amplifier and makes it more stable.

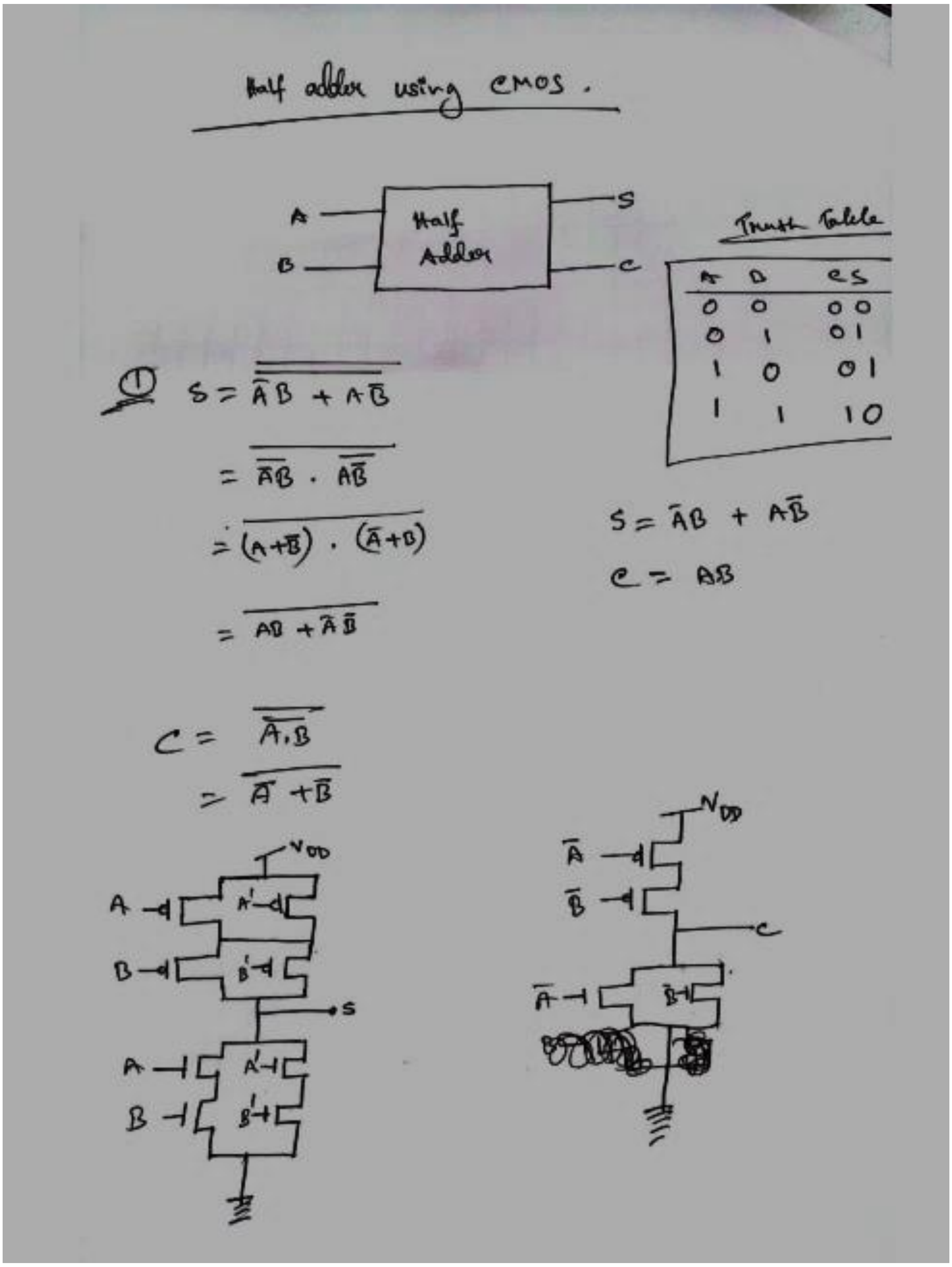
Overall, the combination of high gain and differential input configuration makes OP-AMPs a versatile and widely used component in analog circuits, including instrumentation, audio processing, and control systems.

<u>Here are some additional details about op-amps:</u>

- Input impedance: Op-amps have very high input impedance, meaning that they draw very little current from the input signals. This is important because it prevents the op-amp from loading the input signals.
- Output impedance: Op-amps have low output impedance, meaning that they can source or sink a large amount of current. This is important because it allows the op-amp to drive a wide variety of loads.
- Bandwidth: Op-amps have a limited bandwidth, meaning that they can only amplify signals up to a certain frequency. This is important because it limits the amount of noise that is amplified by the op-amp.
- Common-mode rejection ratio (CMRR): CMRR is a measure of how well an op-amp rejects common-mode signals. A high CMRR is important because it prevents the op-amp from amplifying noise and other unwanted signals.
- Op-amps are versatile and useful devices that can be used in a wide variety of applications. They are commonly used in audio amplifiers, filters, and control systems.

Q-3: Describe the Implementation process of half-adder with CMOS.

Answer:



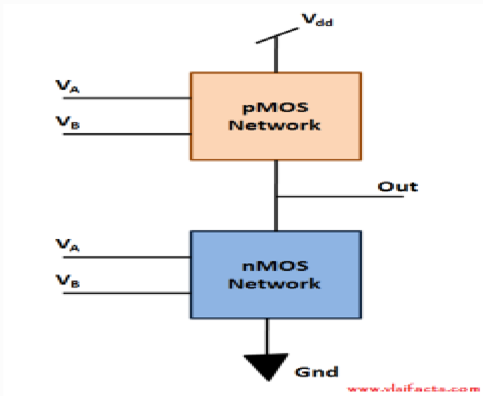
A	B	Sum	Carry
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

Q-4: Describe the Implementation process of:
NAND gate using CMOS
NOR gate using CMOS technology.

Answer:

NAND gate using CMOS Technology:

Block Diagram:



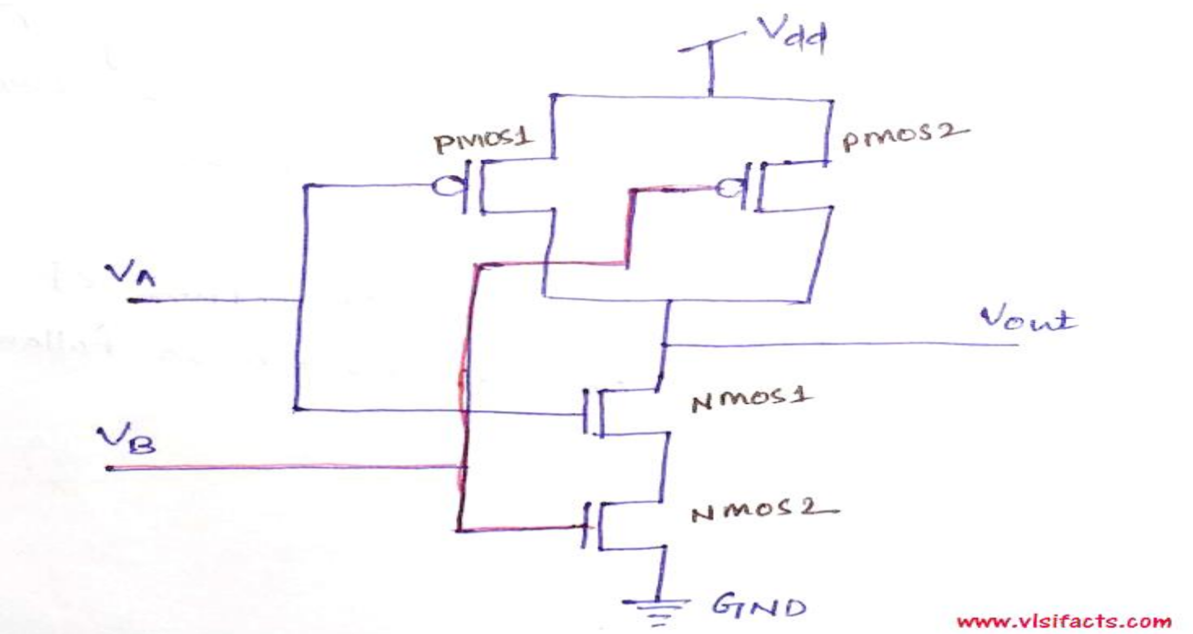
2 Input NAND Gate

TRUTH TABLE

V_A	V_B	V_{out}
Low	Low	High
Low	High	High
High	Low	High
High	High	Low

CIRCUIT

Implementation 😊 (follow case from sir pdf)



NOR gate using CMOS technology.

Block Diagram:

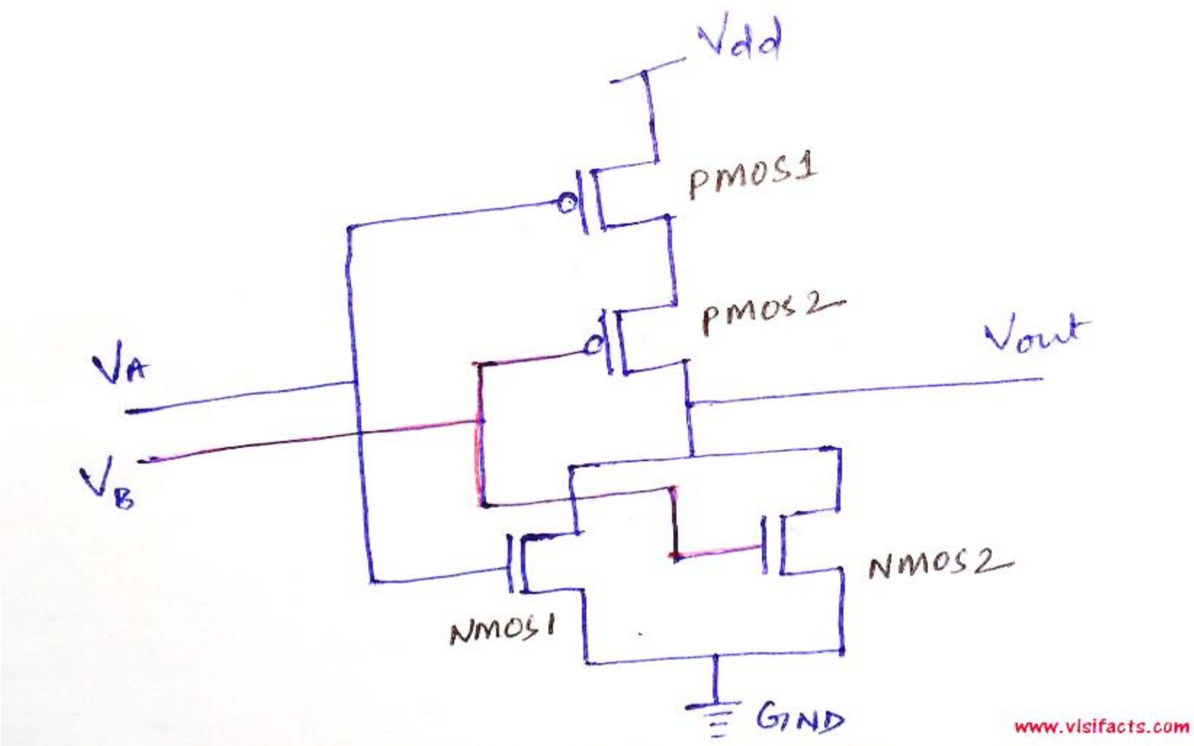
2 Input NOR Gate

TRUTH TABLE

V_A	V_B	V_{out}
Low	Low	High
Low	High	Low
High	Low	Low
High	High	Low

CIRCUIT

Implementation:



Q-5: Describe Bipolar logic family; Explain NOR gate using TTL

Answer:

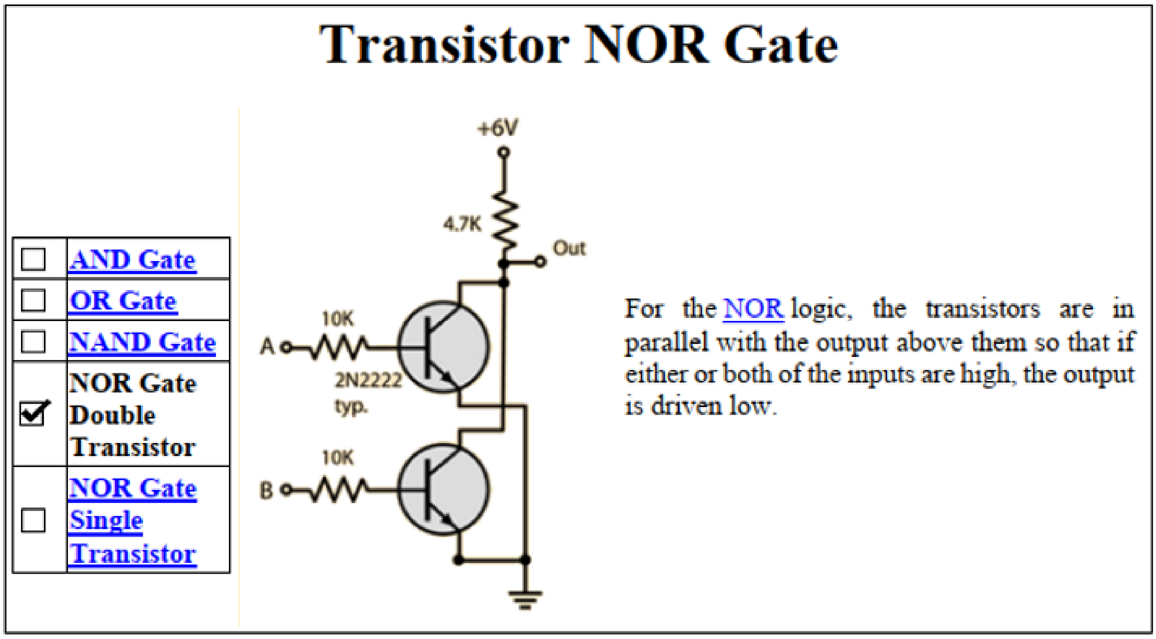
BIPOLAR LOGIC FAMILY

There are two kinds of operations in bipolar integrated circuits: Saturated Bipolar Logic family and Non-saturated Bipolar Logic family.

Saturated Bipolar Logic Families are:

1. Diode logic (DL)
2. Resistor Transistor Logic (RTL)
3. Diode Transistor Logic (DTL)
4. Integrated Injection Logic (IIL or I2L)
5. Transistor Transistor Logic (TTL)

NOR gate using TTL:



Q-6: Describe Unipolar logic family & Design OR gate using CMOS [Image only]

Answer:

Unipolar logic family consists of Metal Oxide Semiconductor (MOS) logic families. They are:

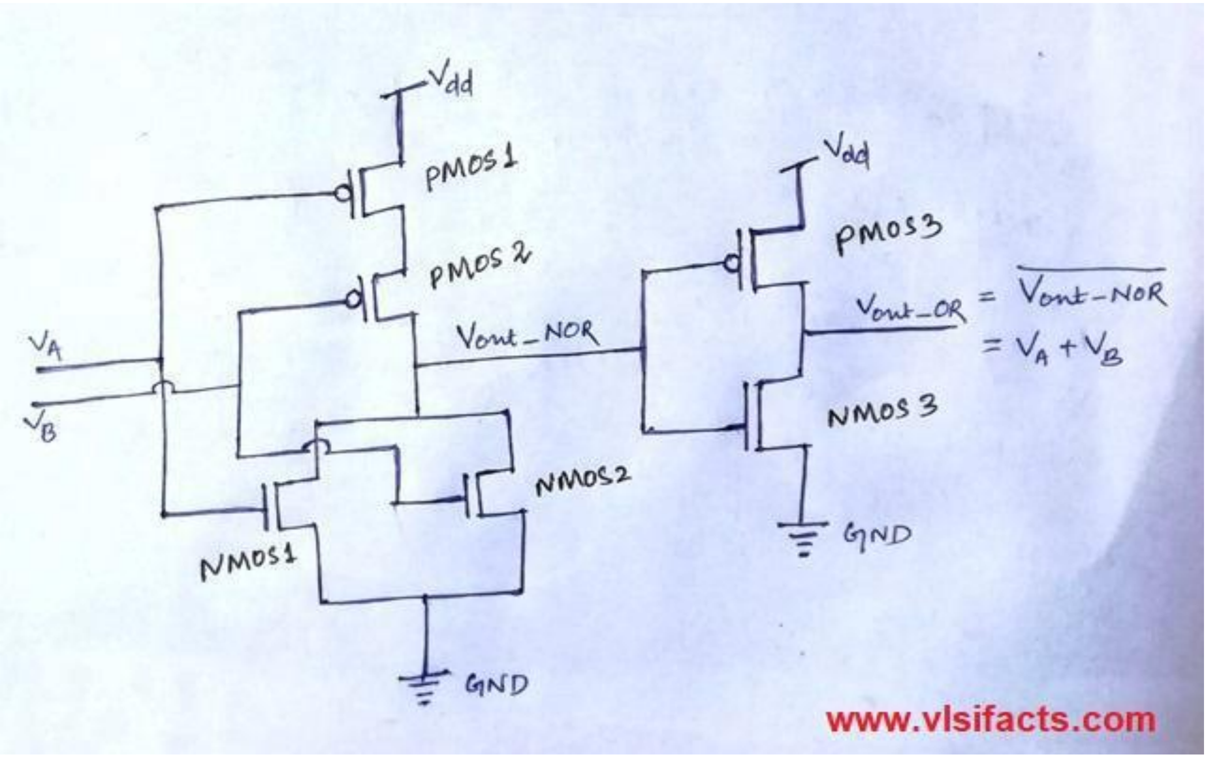
1. P-type MOS (PMOS) Logic
2. N-type MOS (NMOS) logic
3. Complementary MOS (CMOS) logic
4. Bipolar MOS (BiMOS) logic
5. Bipolar CMOS (BiCMOS) logic

OR gate using CMOS:

TRUTH TABLE:

V_A	V_B	V_{out_NOR}	$V_{out\_OR} = \overline{V_{out\_NOR}}$
Low	Low	High	Low
Low	High	Low	High
High	Low	Low	High
High	High	Low	High

CIRCUIT:



Q-7: Define S/H write down the advantages and applications of S/H

Answer:

Answer:

A Sample and Hold Circuit, sometimes represented as S/H Circuit or S & H Circuit, is usually used with an Analog to Digital Converter to sample the input analog signal and hold the sampled signal.

Advantages of S&H.

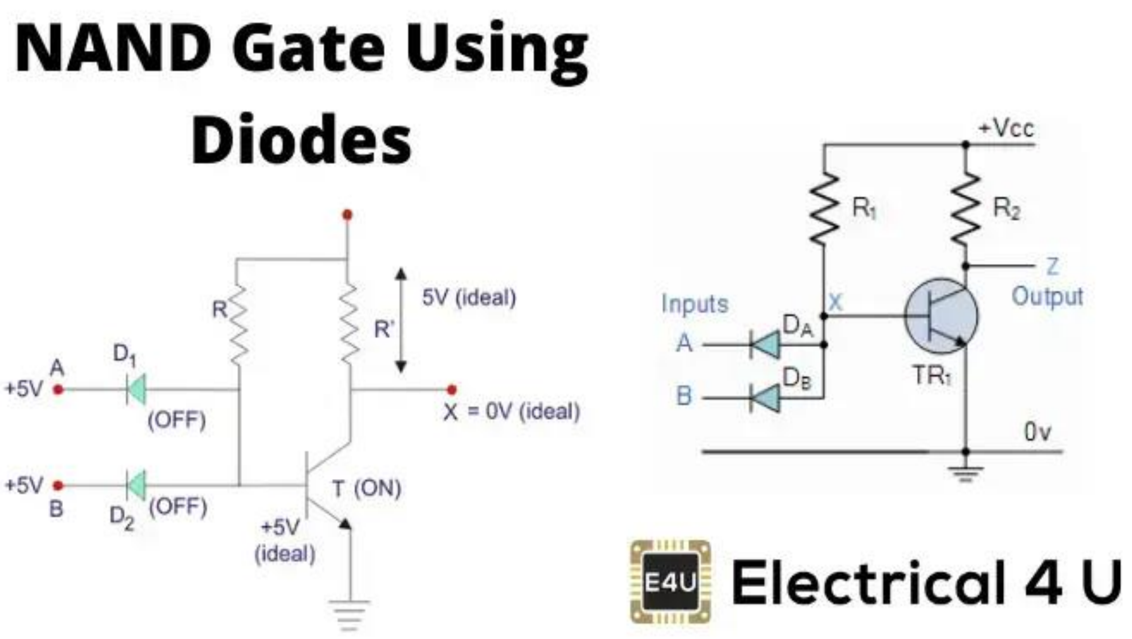
- The main and important advantage of a typical SH Circuit is to aid an Analog to Digital Conversion process by holding the sampled analog input voltage.
- In multichannel ADCs, where synchronization between different channels is important, an SH circuit can help by sampling analog signals from all the channels at the same time.
- In multiplexed circuits, the crosstalk can be reduced with an SH circuit.
- SH circuits can help increase the conversion rate of an ADC by holding the input voltage level long enough for the ADC to complete the conversion process.
- SH circuits can improve the SNR of ADCs by reducing the noise introduced during the conversion process.

Applications of Sample and Hold Circuit:

- Analog to Digital Converter Circuits (ADC)
- Digital Interface Circuits:
- Operational Amplifiers:
- Analog De-multiplexers:
- Storage of Outputs of Multiplexers:
- Data Distribution Systems:
- Pulse Modulation Systems:

Q-8: Define DTL; Describe the implementation of NAND gate using DTL.
Answer:
Define DTL:
DTL stands for Diode-Transistor Logic. It is a type of digital logic that uses diodes and transistors to implement logic gates. DTL gates are relatively simple to implement, but they have a high-power consumption.

Implementation of NAND gate using DTL.

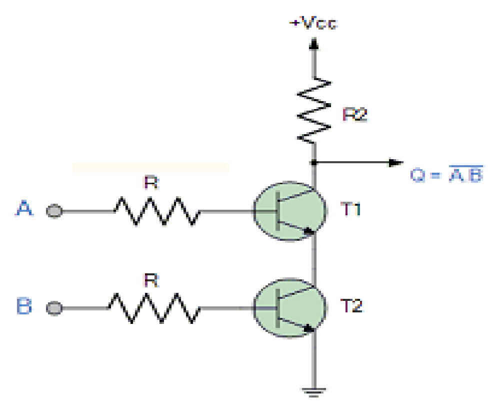


The NAND gate is implemented using two diodes and two transistors. The diodes are connected in series with the transistors, and the transistors are connected in parallel.

The output of the NAND gate is low if both inputs are high, and high if either input is low.

Q-9: Define Digital IC; Describe the Implementation of NAND gate using RTL
Answer:
Define Digital IC:
A digital integrated circuit (IC) is a semiconductor device that implements a logical function, such as a logic gate or a flip-flop. Digital ICs are used in a wide variety of electronic devices, such as computers, smartphones, and digital cameras.
Describe the Implementation of NAND gate using RTL:
RTL stands for Resistor-Transistor Logic. It is a type of digital logic that uses resistors and transistors to implement logic gates. RTL gates are relatively simple to implement, but they have a higher power consumption than other types of logic gates, such as CMOS logic.

The following diagram shows the implementation of a NAND gate using RTL:



RTL NAND gate

The NAND gate is implemented using two resistors and two transistors. The resistors are connected in series with the transistors, and the transistors are connected in parallel. The output of the NAND gate is low if both inputs are high, and high if either input is low.

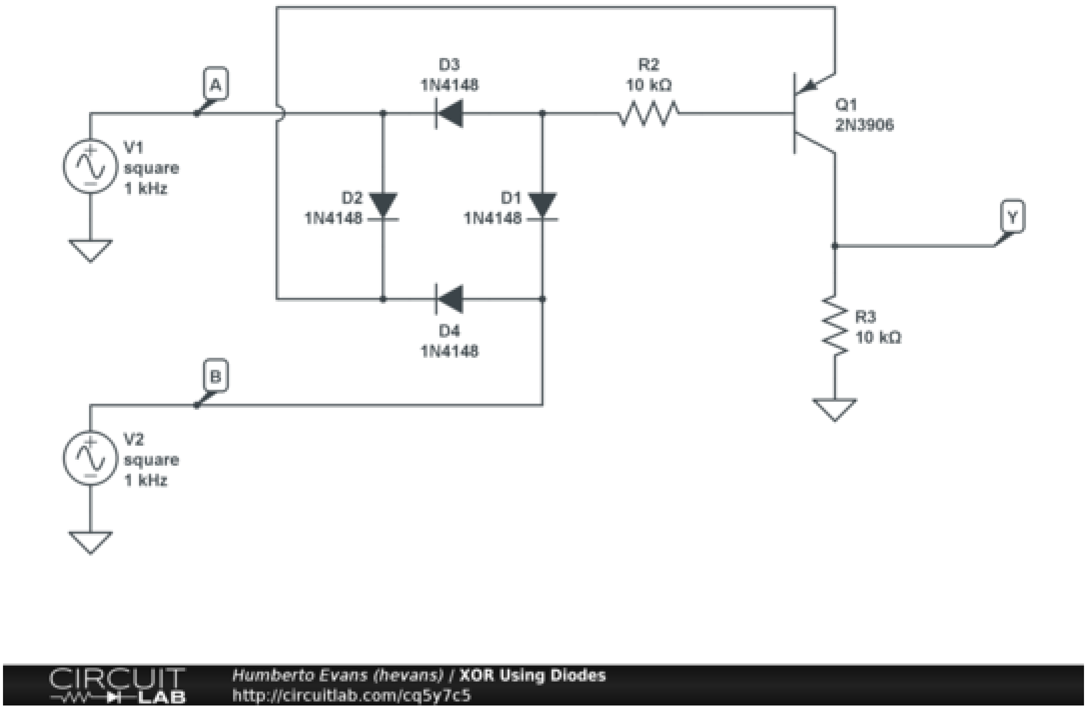
Truth table:

Input A	Input B	Output Q
0	0	1
0	1	1
1	0	1
1	1	0

Q-6: Define leakage current and Knee voltage. Implement Exclusive OR gate by diode.

- Leakage current is the current that flows through a diode or transistor even when there is no applied voltage. It is caused by the movement of minority carriers in the semiconductor material.
- Knee voltage is the voltage at which the leakage current of a diode or transistor increases significantly. It is caused by the breakdown of the depletion region in the semiconductor material.
- Exclusive OR gate (XOR gate) is a logic gate that produces a high output if and only if one of its inputs is high and the other input is low.

The following diagram shows the implementation of an XOR gate using a diode:



Truth Table:

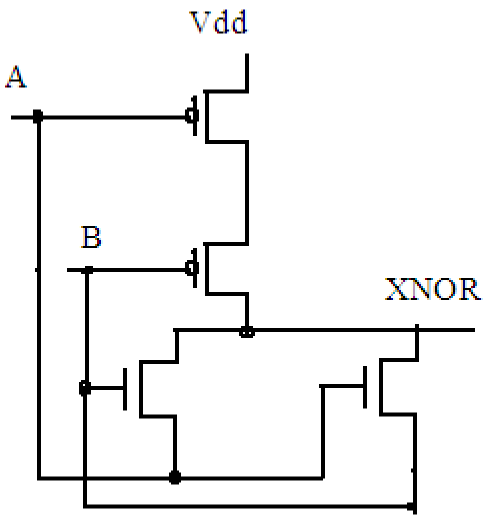
Input 1	Input 2	Output
0	0	0
0	1	1
1	0	1
1	1	0

Q-7: Implement XNOR gate by Transistor.

Answer:

XNOR gate (XNOR gate) is a logic gate that produces a high output if and only if both of its inputs are the same.

The following diagram shows the implementation of an XNOR gate using a transistor:



The transistor is configured as an inverter. When one of the inputs is high, the transistor turns on and the output of the gate is low. When the other input is high, the transistor turns off and the output of the gate is high.

Truth Table:

```
Input 1 | Input 2 | Output
------- | -------- | --------
0       | 0       | 1
0       | 1       | 0
1       | 0       | 0
1       | 1       | 1
```

Q-8: Differentiate between unipolar and bipolar logic family. Explain CMOS acts as inverter.

Answer:

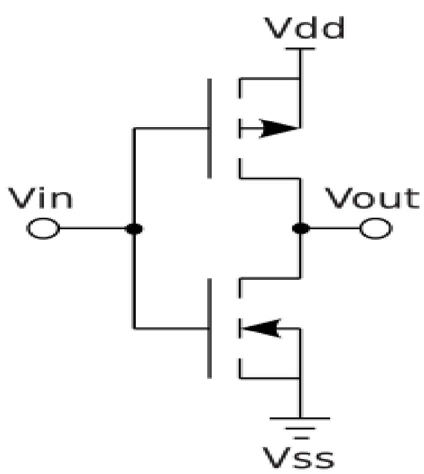
Here is the difference between unipolar and bipolar logic families:

Unipolar logic family	Bipolar logic family
• Uses only one type of charge carrier (either electrons or holes) to conduct current. • Examples: PMOS, NMOS, and CMOS. • Advantages: Low power consumption, high speed. • Disadvantages: More complex to design, lower noise immunity.	• Uses both electrons and holes to conduct current. • Examples: TTL, ECL, and I2L. • Advantages: Simpler to design, higher noise immunity. • Disadvantages: Higher power consumption, lower speed.

CMOS acts as inverter:

CMOS is a unipolar logic family because it uses only MOSFETs (metal-oxide-semiconductor field-effect transistors) to conduct current. MOSFETs are unipolar devices because they only conduct current when there is a voltage applied to their gate.

CMOS inverters work by using the complementary nature of PMOS and NMOS transistors. When the input to the inverter is 0, the PMOS transistor is turned on and the NMOS transistor is turned off. This results in a high output voltage. When the input to the inverter is 1, the PMOS transistor is turned off and the NMOS transistor is turned on. This results in a low output voltage.




```
Input | Output
------- | --------
0       | 1
1       | 0
```

Q- 9: Write the applications of S/H circuit and Multivibrator circuit.
Answer:

Applications of Sample and Hold Circuit:

I. Analog to Digital Converter Circuits (ADC):

Sample and Hold circuits are a crucial component in ADCs. They are used to sample and hold the analog input signal at a specific instant, ensuring that the voltage remains constant during the conversion process.

II. Digital Interface Circuits:

Sample and Hold circuits are used in digital interface circuits to maintain the integrity of analog signals during their conversion into digital format.

III. Operational Amplifiers:

Sample and Hold circuits can be implemented using operational amplifiers (op-amps). Op-amps are used to sample and hold the input voltage, providing a stable and accurate output.

IV. Analog De-multiplexers:

Sample and Hold circuits are employed in analog de-multiplexers, which are used to select and distribute analog signals to different channels.

V. Storage of Outputs of Multiplexers:
Multiplexers are used to select one input from multiple sources and route it to a single output.

VI. Data Distribution Systems:

In data distribution systems, Sample and Hold circuits can be utilized to store and distribute analog signals to multiple destinations.

VII. Pulse Modulation Systems:

Sample and Hold circuits play a vital role in pulse modulation systems such as pulse amplitude modulation (PAM) and pulse width modulation (PWM).

Q-10: What is Virtual Memory? Differentiate between volatile and non-volatile memory.

Answer:

Virtual memory is a memory management technique that allows a computer to use more memory than is physically available. This is done by dividing the physical memory into smaller units called pages, and then storing the pages that are not currently being used on a disk. When a page is needed, it is brought back into memory from the disk.

Volatile memory is memory that loses its contents when the power is turned off. This type of memory is typically used to store data that is being actively used by the computer, such as the operating system, programs, and data. Examples of volatile memory include Random Access Memory (RAM) and Cache memory.

Non-volatile memory is memory that retains its contents when the power is turned off. This type of memory is typically used to store data that needs to be preserved even when the computer is turned off, such as program instructions, data files, and settings. Examples of non-volatile memory include Read-Only Memory (ROM), Flash memory, and Hard Disk Drives (HDDs).

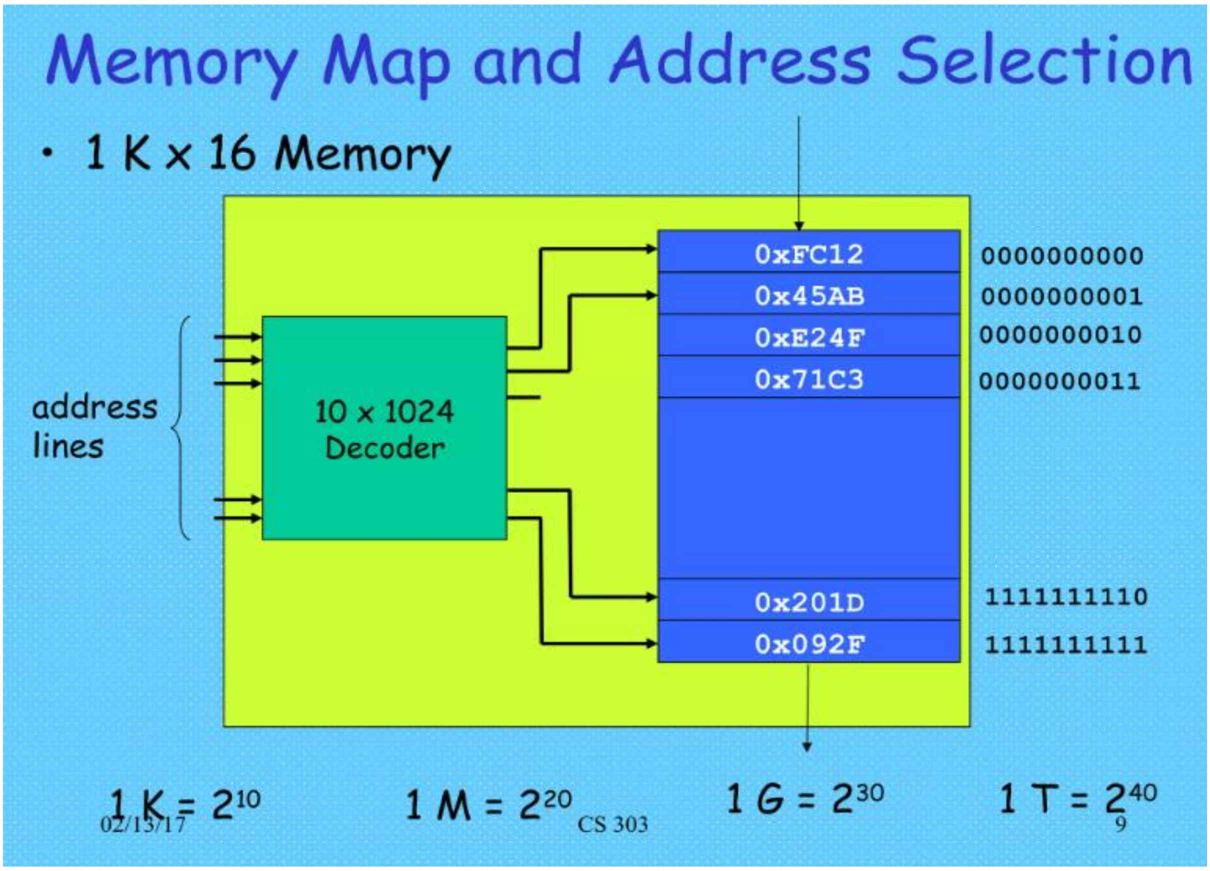
Here is a table that summarizes the differences between volatile and non-volatile memory:

Feature	Volatile Memory	Non-volatile Memory
Data retention	Contents are lost when power is turned off	Contents are retained when power is turned off
Typical use	Stores data that is being actively used by the computer	Stores data that needs to be preserved even when the computer is turned off
Examples	RAM, Cache memory	ROM, Flash memory, HDDs

Q-11: Show the 1Kx16 memory block diagram or contents. Explain the memory Read and Write operation.

Answer:

Here is a block diagram of a 1Kx16 memory:



The memory is organized as a 1024-word by 16-bit array. This means that the memory can store 1024 words, each of which is 16 bits long. The address bus is 10 bits wide, and the data bus is 16 bits wide.

The memory read operation is as follows:

1. The address of the word to be read is placed on the address bus.
2. The read control signal is asserted.
3. The data from the memory location is placed on the data bus.

The memory write operation is as follows:

1. The address of the word to be written is placed on the address bus.
2. The data to be written is placed on the data bus.
3. The write control signal is asserted.
4. The data from the data bus is written to the memory location.

Q-12: What is PLA? Implement the circuit with PLA having the following function.

- F1 (A, B, C) = (3,5,6,7)
- F2 (A, B, C) = (0,2,4,7)

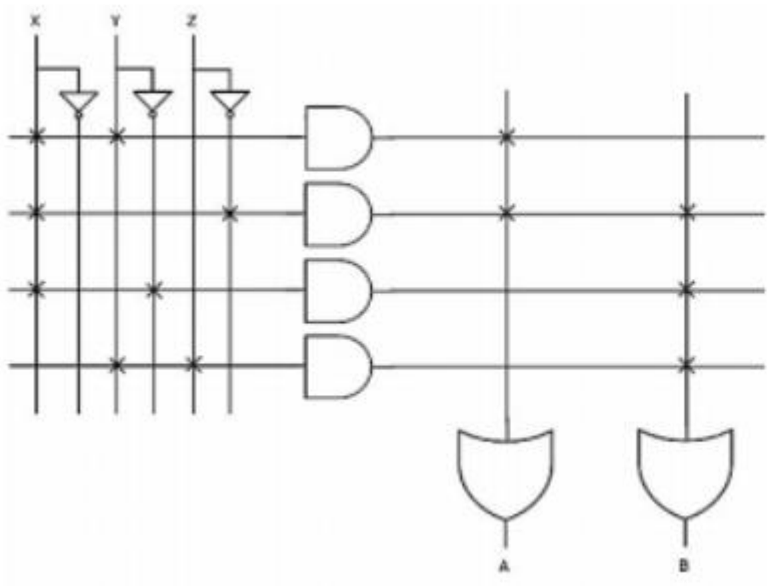
Answer:

PLA stands for Programmable Logic Array. It is a type of digital circuit that can be programmed to implement a variety of Boolean functions. PLAs are made up of an AND array and an OR array. The AND array produces a set of product terms, and the OR array produces the output of the PLA.

Implement the circuit with PLA having the following function.

- F1 (A, B, C) = (3,5,6,7)
- F2 (A, B, C) = (0,2,4,7)

The following diagram shows the implementation of a PLA with the given functions:



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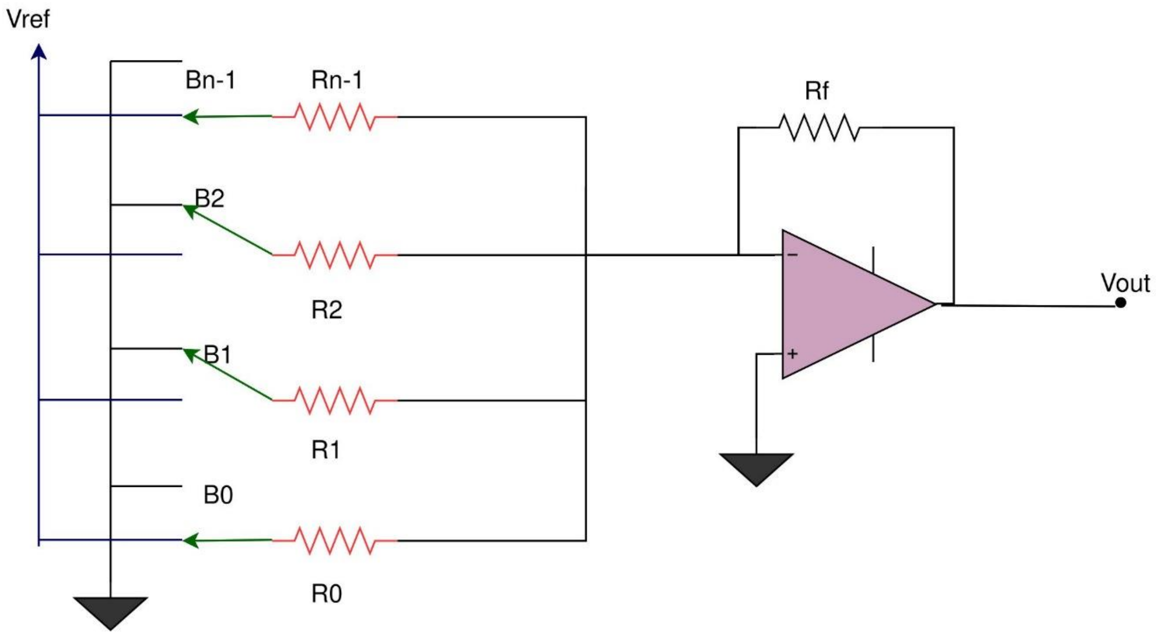
Q-13: Describe binary weighted resistor Digital to Analog Converter circuit.
Answer:
A binary weighted resistor DAC is a type of DAC that uses a network of resistors to convert a digital input into an analog output. The resistors are arranged in a binary weighted fashion, meaning that the value of each resistor is proportional to its binary weight.

The following diagram shows a 4-bit binary weighted resistor DAC circuit:



The resistors are arranged in a binary weighted fashion, with the largest resistor having a weight of 2^3 = 8 and the smallest resistor having a weight of 2^0 = 1.

The digital input to the DAC is a 4-bit binary number. The value of the digital input determines which resistors are connected to the output. For example, if the digital input is 0100, then the resistors with weights of 2^2 and 2^0 will be connected to the output.

The output voltage of the DAC is calculated as follows:

output voltage = reference voltage * (sum of the binary weighted resistors) / (sum of all the resistors)

TOPIC-3: LINEAR WAVE SHAPING

Q-1: What do you mean by clippers & clampers circuit?

Answer:

Clippers and clampers are two types of electronic circuits that are used to modify AC signals. Clippers are used to clip off a portion of the AC waveform, while clampers are used to shift the DC level of the AC signal.

Clippers

A clipper circuit is a simple circuit that uses a diode to clip off a portion of the input waveform. The diode is connected in series with the input signal, and it is biased so that it only conducts current in one direction. When the input signal is above a certain voltage, the diode conducts current and the output signal is equal to the input signal. When the input signal is below the certain voltage, the diode does not conduct current and the output signal is zero.

There are two main types of clippers: series clippers and shunt clippers. Series clippers clip off the top of the input waveform, while shunt clippers clip off the bottom of the input waveform.

Clampers

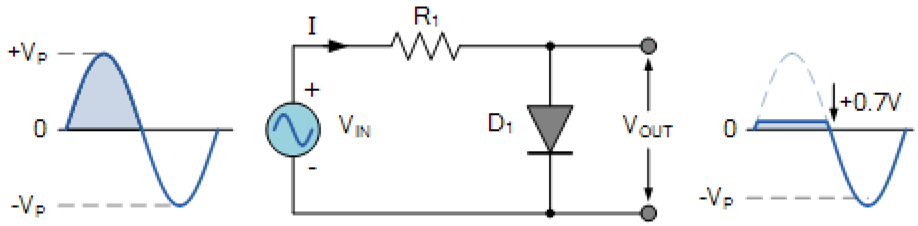
A clamper circuit is a slightly more complex circuit that uses a capacitor and a diode to shift the DC level of the input waveform. The capacitor is connected in parallel with the input signal, and the diode is connected across the capacitor. When the input signal is positive, the diode conducts current and charges the capacitor. When the input signal is negative, the diode does not conduct current and the capacitor discharges. The capacitor will charge to the same voltage as the input signal, but with the opposite polarity. This means that the output signal will be shifted up or down by the same amount as the voltage on the capacitor. Clampers are often used to restore the DC level of a signal that has been clipped by a clipper circuit.

Q-2: What is Clipping? Draw the output waveform of positive and Negative Clipping. Or, Describe Negative clipping circuit with output waveforms.

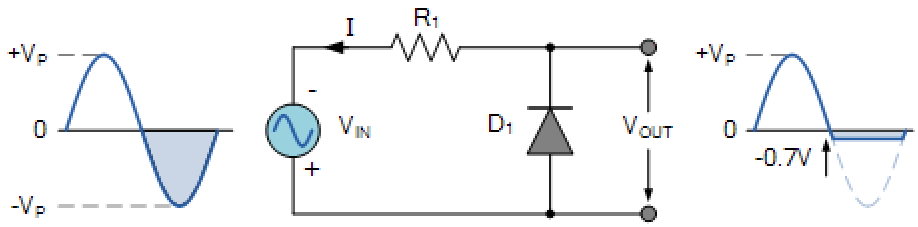
Answer:

A clipping circuit consists of linear elements like resistors and non-linear elements like diodes or transistors, but it does not contain energy-storage elements like capacitors. Clipping circuits are also called slicers or amplitude selectors.

Positive Clipping/Clipper:



Negative Clipping/Clipper:

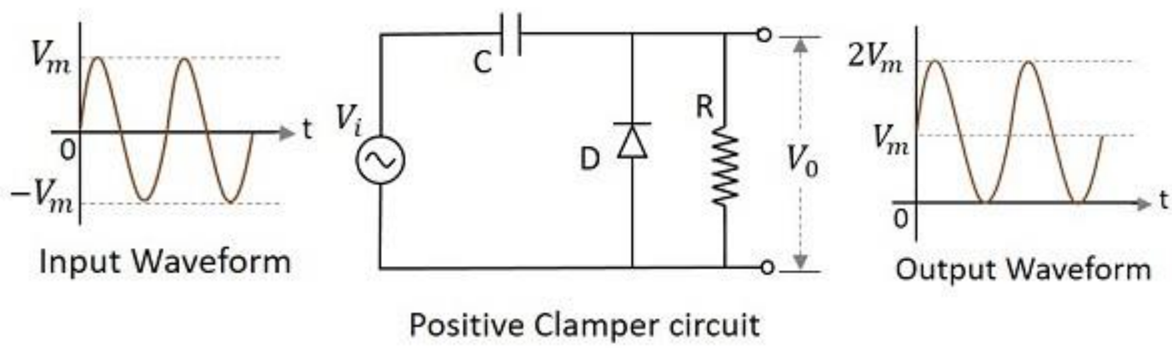


Q-2: What is Clamping? Draw the output waveform of positive and Negative Clamping.

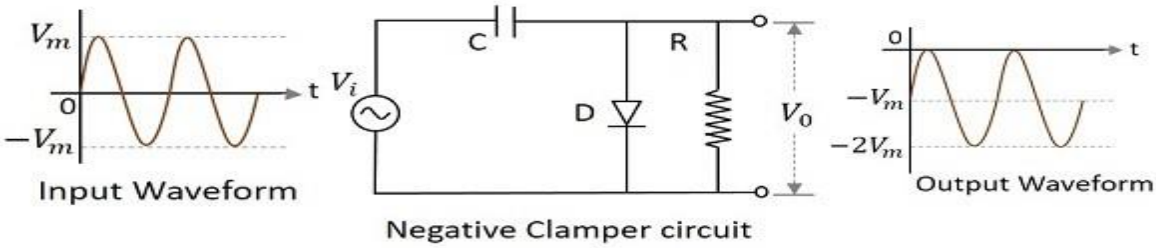
Answer:

A clamper (or clamping circuit or clamp) is an electronic circuit that fixes either the positive or the negative peak excursions of a signal to a defined voltage by adding a variable positive or negative DC voltage to it.

Positive Clamper/Clamping:



Negative Clamper/Clamping:



Q-3: What is Schmitt trigger circuit? Explain operating principle of Schmitt trigger circuit.

Answer:

A Schmitt trigger circuit is an electronic circuit that converts an analog input signal into a clean and well-defined digital output signal using positive feedback with hysteresis. It is commonly used in applications where a clean and well-defined digital signal is required from an analog input signal, such as in signal conditioning, digital logic, and power supply circuits.

Operating principal of Schmitt Circuit:

- A Schmitt trigger circuit is a type of electronic circuit that converts an analog input signal into a well-defined digital output signal with positive feedback and hysteresis. The circuit is designed using an operational amplifier with a feedback network that consists of two voltage dividers, one positive and one negative.
- The Schmitt trigger circuit has two threshold voltages, one for switching the output from low to high and another for switching the output from high to low. When the input voltage exceeds the upper threshold voltage, the output of the circuit switches from low to high. The output remains high until the input voltage falls below the lower threshold voltage, at which point the output switches back to low.
- The positive feedback provided by the voltage dividers ensures that the output of the circuit remains stable and well-defined, even in the presence of noise or other disturbances in the input signal. The hysteresis in the Schmitt trigger circuit provides a well-defined and stable output signal by maintaining a margin between the upper and lower threshold voltages.
- The Schmitt trigger circuit is widely used in various applications such as signal conditioning, digital logic, and power supply circuits. In particular, it is used to clean up noisy or distorted input signals and generate clean and well-defined digital output signals.

Q-4: "Write down application of clippers circuit. Or, clampers circuit
Answer:
Clippers circuits are electronic circuits used to clip off a portion of the input signal, limiting its amplitude or voltage level. This type of circuit has several applications, such as:

- Signal rectification: Clippers circuits can be used to rectify AC signals by removing one half of the wave cycle. This is useful in power supply systems, where DC voltage is required to power electronic devices.
- Voltage regulation: Clippers circuits can be used to limit the voltage level of an input signal. This is useful to protect sensitive electronic components from overvoltage, which can cause damage or even failure.
- Audio processing: Clippers circuits can be used in audio processing applications to remove unwanted portions of an audio signal, such as noise or distortion.
- Signal shaping: Clippers circuits can be used to shape the waveform of an input signal. For example, a diode clipper circuit can be used to produce a square wave output from a sine wave input.
- Overload protection: Clippers circuits can be used as overload protection devices in electronic circuits. If an input signal exceeds a certain threshold, the clipper circuit will clip off the excess voltage, protecting downstream electronic components.

<u>Application of clampers circuit:</u>

Clamper circuits, also known as DC restorer circuits, are electronic circuits used to add a DC offset to an AC signal. This type of circuit has several applications, such as:

- Waveform shifting: Clamper circuits can be used to shift the waveform of an AC signal up or down by adding a DC offset. This is useful in audio processing applications where waveform shifting is required.
- Signal rectification: Clamper circuits can be used to rectify AC signals by adding a
- DC offset to the negative half-cycle of the waveform. This is useful in power supply systems, where DC voltage is required to power electronic devices.
- Data transmission: Clamper circuits are used in data transmission systems to ensure that the transmitted data signal starts at 0 volts. This is done by clamping the input signal with a DC level before it is transmitted.

- Voltage regulation: Clamper circuits can be used to regulate the output voltage of a power supply. By adding a DC offset to the input signal, the output voltage can be adjusted to a desired level.
- Biasing: Clamper circuits can be used in electronic circuits to provide a biasing voltage to active components such as transistors and operational amplifiers. This helps to ensure that these components operate within their linear range and produce accurate output signals.

Q-5: What do you mean by multivibrators?

Answer:

A multivibrator is an electronic circuit that produces a continuous oscillation between two states, high and low. It is a two-stage amplifier with positive feedback from the output of one stage to the input of the other. The ON and OFF states of the whole circuit, and the time periods for which the transistors are driven into saturation or cut off, are controlled by the conditions of the circuit.

There are three main types of multivibrators:

- Astable multivibrators: These are free-running oscillators that produce a continuous square wave output.
- Monostable multivibrators: These are single-shot devices that produce a single pulse of a predetermined width when triggered.
- Bistable multivibrators: These are latches that can be switched between two stable states by applying a trigger signal.

Q-6: Explain operating principle of astable multivibrators.

Answer:

An astable multivibrator is a type of electronic circuit that produces a continuous, repeating square wave output. The frequency of the square wave is determined by the values of the resistors and capacitors in the circuit. Astable multivibrators are often used as timing circuits, pulse generators, and signal generators.

The basic operating principle of an astable multivibrator is as follows:

- Two transistors are connected in a cross-coupled configuration.
- A capacitor is connected between the bases of the two transistors.
- A resistor is connected between the collector of each transistor and the power supply.
- When the circuit is first turned on, one of the transistors will start to conduct current. This will cause the voltage on the capacitor to start to rise. As the voltage on the capacitor rises, it will eventually reach a point where it turns on the other transistor.

- When the other transistor turns on, it will stop the first transistor from conducting current. This will cause the voltage on the capacitor to start to fall. As the voltage on the capacitor falls, it will eventually reach a point where it turns off the second transistor.

- This process will continue indefinitely, with the two transistors alternately turning on and off. The frequency of the square wave output will be determined by the values of the capacitor and the resistors.

- Astable multivibrators can be configured in a variety of ways to produce different waveforms. For example, by adding an additional resistor to the circuit, it is possible to produce a triangular wave output. By adding an additional capacitor to the circuit, it is possible to produce a sawtooth wave output.

Applications: Astable multivibrators are used in a variety of applications, including:

- ✓ Timing circuits
- ✓ Pulse generators
- ✓ Signal generators
- ✓ Oscillators
- ✓ Data acquisition systems
- ✓ Telecommunications systems
- ✓ Biomedical engineering
- ✓ Industrial control systems

Astable multivibrators are versatile and useful circuits that can be used in a variety of applications.

Q-7: Write down application of monostable multivibrators & Bistable multivibrators.

Answer:

Monostable multivibrators and bistable multivibrators are types of electronic circuits that are commonly used in a variety of applications. Here are some examples:

Application of Monostable Multivibrators:

- Pulse shaping: Monostable multivibrators can be used to reshape or "clean up" input signals by producing a stable output pulse of a specific duration.

- Timing: The timing function of monostable multivibrators can also be useful in applications such as delay circuits and triggering other circuit elements.
- Audio and video circuits: In audio and video circuits, monostable multivibrators are often used to generate pulses for synchronizing different parts of the circuitry.
- Security systems: Monostable multivibrators can also be used in security systems as a way to signal an alarm or trigger other actions in response to an event.

Application of Bistable Multivibrators:

- Memory devices: Bistable multivibrators are commonly used in digital memory devices, such as flip-flops and latches, which store binary information.
- Counters: In electronic counters, bistable multivibrators are used to divide the frequency of an input signal by two.
- Switching circuits: Bistable multivibrators can also be used as simple switching circuits, where they serve as on/off switches for other circuit components.
- Oscillators: Bistable multivibrators can be used as the basis for oscillator circuits that generate repetitive waveforms at a specific frequency.

Q-8: Briefly explain various methods of generating a time-base waveform.

Answer:

There are several methods for generating a time-base waveform, which is a basic building block of many electronic systems. Here are some commonly used methods:

i. RC circuits: A simple method for generating a time-base waveform is to use an RC circuit. This involves charging and discharging a capacitor through a resistor to generate a signal with a characteristic exponential decay.

ii. Astable multivibrator: An astable multivibrator is an oscillator circuit that generates a continuous rectangular waveform with a frequency determined by the values of its resistors and capacitors.

iii. Monostable multivibrator: A monostable multivibrator can also be used to generate a time-base waveform. When triggered, it produces a pulse of fixed duration that can be used to control other parts of the circuitry.

iv. Voltage-controlled oscillators (VCOs): VCOs generate a time-base waveform whose frequency can be varied over a range by applying a voltage to a control terminal.
v. Crystal oscillators: Crystal oscillators are used in many electronic systems because of their high stability and accuracy. They use a quartz crystal to provide a reference frequency that is used to generate a time-base waveform.
vi. Digital clock generators: In digital systems, clock generators are used to produce a periodic signal that controls the timing of data transfers and other system events. These clocks can be generated using digital counters or phase-locked loops (PLLs).

Q-9: Write short Note on- i) Propagation delay ii) Noise margin

Answer:

i) Propagation delay: In digital electronics, propagation delay refers to the time taken for a signal to travel through a circuit from an input to an output. It is the total time required for a change in the input signal to be reflected in the output signal. Propagation delay is an important characteristic of digital circuits because it can affect the timing and accuracy of signals in a system.

Propagation delay can be influenced by several factors, such as the type of logic gates used, the length and impedance of the connecting wires, and the capacitance of the circuit elements. Generally, shorter propagation delays are desirable in digital circuits, as they result in faster operation and improved system performance.

ii) Noise margin: Noise margin is the difference between the minimum voltage level required to represent a logical "1" or high signal, and the maximum voltage level that can be present on the input without causing an incorrect output. It represents the tolerance of a digital circuit to noise and other interference.

There are two types of noise margins - high noise margin (NMH) and low noise margin (NML). The high noise margin is the difference between the minimum input voltage required to produce a logical "1" and the maximum input voltage that can be present on the input without causing an incorrect output. The low noise margin is the difference between the maximum input voltage required to produce a logical "0" and the minimum input voltage that can be present on the input without causing an incorrect output.

A high noise margin is preferred because it provides greater immunity to noise and interference, while a low noise margin can lead to errors in the output data. Therefore, digital circuits should be designed with appropriate noise margins to ensure reliable operation.

Q-10: Define filtering. Why filtering needed in linear wave shaping?
Answer:
Filtering refers to the process of removing unwanted frequencies or components from a signal, while passing through or retaining the desired frequencies. In other words, filtering is a type of linear wave shaping that modifies the amplitude and/or phase of different frequency components of a signal.

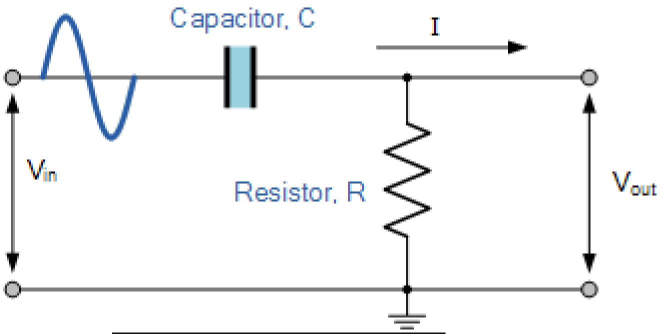
Filtering is often necessary in linear wave shaping to remove noise or unwanted signals that can interfere with the desired signal. For example, in audio applications, filtering can be used to remove low-frequency noise or "hum" caused by power lines or other sources. Similarly, in radio communications, filtering can be used to remove interference from adjacent channels.

In linear wave shaping, filters are typically classified into two types: passive and active. Passive filters use only passive components, such as resistors, capacitors, and inductors, to modify the frequency response of a circuit. Active filters incorporate active components, such as operational amplifiers (op-amps), to achieve higher levels of performance and flexibility.

Filters can also be classified based on their frequency response characteristics, such as low-pass, high-pass, band-pass, and band-stop filters. Each of these filter types has a specific range of frequencies that it allows to pass through, while attenuating or blocking other frequencies.

Overall, filtering is an essential aspect of linear wave shaping, as it enables the extraction or removal of specific frequency components of a signal, allowing for better signal quality and improved system performance.

Q-11: Explain high pass filter circuit with proper diagrams.
Answer:



high pass filter circuit

- The high pass filter circuit consists of a capacitor and a resistor connected in series. The capacitor blocks low frequencies, while the resistor allows high frequencies to pass through. The cutoff frequency of the filter is determined by the value of the capacitor and the resistor. The higher the value of the capacitor, the lower the cutoff frequency. The higher the value of the resistor, the higher the cutoff frequency.

- The high pass filter circuit can be used to remove low-frequency noise from a signal. For example, if you have a signal that contains both high and low frequencies, but you only want to keep the high frequencies, you can use a high pass filter to remove the low frequencies.

- The high pass filter circuit can also be used to create a timing circuit. For example, if you want to create a circuit that turns on a LED every time a high frequency signal is received, you can use a high pass filter to detect the high frequency signal and then use that signal to turn on the LED.

- High pass filters are a versatile type of filter that can be used in a wide variety of applications. They are often used in audio, video, and telecommunications applications.

Here are some additional details about the high pass filter circuit:

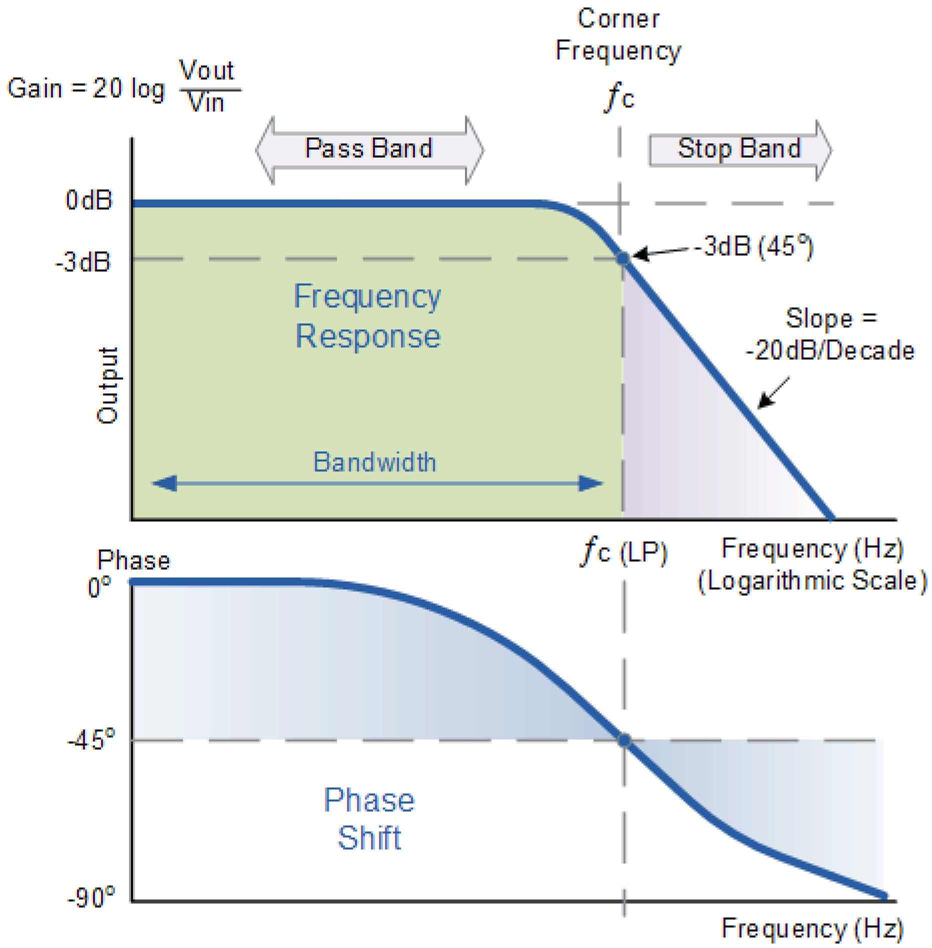
- Capacitor: The capacitor blocks low frequencies by creating a high impedance at low frequencies. The higher the value of the capacitor, the lower the cutoff frequency.
- Resistor: The resistor allows high frequencies to pass through by creating a low impedance at high frequencies. The higher the value of the resistor, the higher the cutoff frequency.

- Cutoff frequency: The cutoff frequency is the frequency at which the filter attenuates the signal by 3dB. The cutoff frequency is determined by the values of the capacitor and the resistor.

By understanding how a high pass filter circuit works, you can use it to improve the quality of signals and create a variety of useful circuits

Q-12: Sketch the frequency response of low pass filter.

Answer:



- The frequency response of a low pass filter is a graph of the output signal's amplitude as a function of frequency. The graph is typically in decibels (dB), with the frequency axis in hertz (Hz).

- The frequency response of a low pass filter is characterized by a cutoff frequency. The cutoff frequency is the frequency at which the output signal's amplitude drops by 3dB.

- Below the cutoff frequency, the output signal's amplitude is essentially unchanged. Above the cutoff frequency, the output signal's amplitude decreases as the frequency increases.

- The rate at which the output signal's amplitude decreases above the cutoff frequency is determined by the order of the filter. The order of a filter is the number of poles in the filter's transfer function.

- A first-order filter has one pole, a second-order filter has two poles, and so on. Higher-order filters have steeper roll-offs, which means that they attenuate higher frequencies more quickly.
- Low pass filters are used in a wide variety of applications, including audio, video, and telecommunications. They are often used to remove noise from signals or to smooth out the edges of signals.

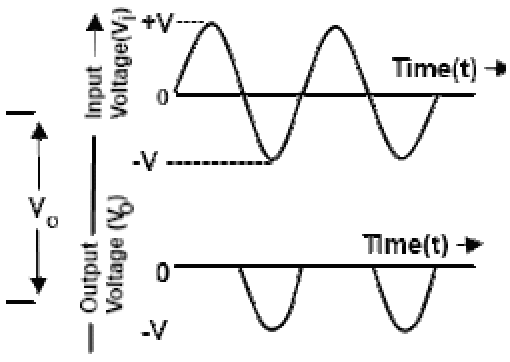
Here are some additional details about the frequency response of a low pass filter:

- Cutoff frequency: The cutoff frequency is the frequency at which the output signal's amplitude drops by 3dB.
- Order: The order of a filter is the number of poles in the filter's transfer function.
- Roll-off: The roll-off is the rate at which the output signal's amplitude decreases above the cutoff frequency.
- Applications: Low pass filters are used in a wide variety of applications, including audio, video, and telecommunications.

Q-14: Define free running multivibrator. Describe the working principles of positive clipping circuit with proper diagrams.

Answer:

A free running multivibrator, also known as an astable multivibrator, is an electronic circuit that produces a continuous series of pulses without any external trigger or input signal. It consists of two cross-coupled amplifiers, each with a positive feedback loop and a time delay element such as a capacitor or resistor.

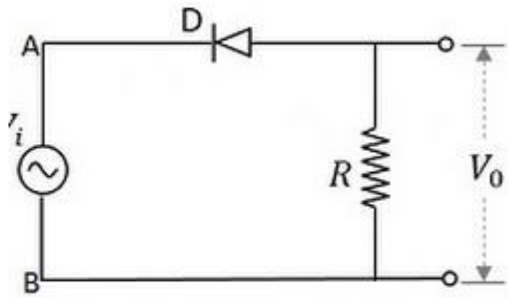


(b) Output Waveform

The positive clipping circuit consists of a diode and a resistor. The diode is connected in series with the input signal, and the resistor is connected to ground. When the input signal is positive, the diode is forward biased and allows the signal to pass through. When the input signal is negative, the diode is reverse biased and shunts the signal to ground.

The positive clipping circuit is a simple and effective way to protect sensitive circuitry from negative voltages. It is a commonly used circuit in many electronic applications.

The following image shows the circuit diagram of a positive clipping circuit:



Positive Series Clipper

In this circuit, the diode is connected in series with the input signal and the resistor is connected to ground. When the input signal is positive, the diode is forward biased and allows the signal to pass through. When the input signal is negative, the diode is reverse biased and shunts the signal to ground.

The positive clipping circuit can be used to protect a variety of sensitive circuitry from negative voltages. For example, it can be used to protect an amplifier from clipping, or it can be used to protect a microcontroller from damage

Q-15: Differentiate between negative diode clipping and negative biased diode clipping circuits with figures.
Answer:

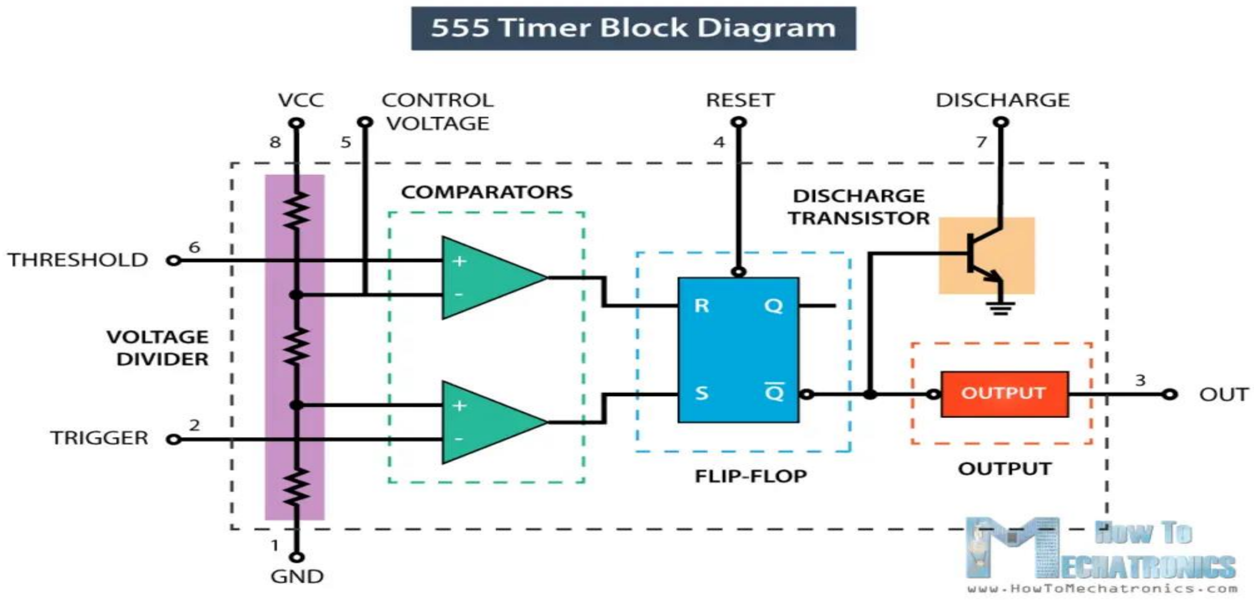
Feature	Negative Diode Clipping	Negative Biased Diode Clipping
Working principle	Uses a diode to shunt negative voltages to ground.	Uses a diode that is biased with a negative voltage to shunt negative voltages to ground.
Output	The output signal is a positive signal with the negative voltages removed.	The output signal is a positive signal with the negative voltages clipped to a specific level.
Applications	Protecting sensitive circuitry from negative voltages, creating a symmetrical signal, adding a DC offset to a signal.	Protecting sensitive circuitry from negative voltages, creating a symmetrical signal, limiting the amplitude of a signal.
Circuit diagram	[Diagram of a negative diode clipping circuit]	[Diagram of a negative biased diode clipping circuit]

Feature	Negative Diode Clipping	Negative Biased Diode Clipping
Diode	Unbiased	Biased with a negative voltage
Output	Positive signal with negative voltages removed	Positive signal with negative voltages clipped to a specific level
Applications	Protecting sensitive circuitry from negative voltages, creating a symmetrical signal, adding a DC offset to a signal	Protecting sensitive circuitry from negative voltages, creating a symmetrical signal, limiting the amplitude of a signal

Q-1: Draw the internal circuit diagram of 555 timer circuit and describe the functionality of each pin.
Answer:
Answer:

The 555 timer is an electronic component that can be used to create timing signals, oscillators, or flip-flops. It is a low-cost and easy-to-use integrated circuit that has been widely used in various electronic applications since its introduction in 1971. The 555 timer consists of comparators, a flip-flop, a discharge transistor, and other components that allow it to be configured in different modes depending on the specific application. It is commonly used in electronic timing circuits, LED flashers, and other applications where a precise and stable signal is required.

Draw the block/circuit Diagram:



explain the operation procedure of 555 timer:

The 555 timer IC can be operated in three different modes: astable, monostable, and bistable.

Astable mode: In astable mode, the 555 timer produces a continuous square wave with a specific frequency and duty cycle. To operate the 555 timer in astable mode, a resistor and capacitor are connected to the timing pins (pins 2 and 6), and the output is taken from pin 3. The capacitor charges and discharges through the resistor, producing the square wave output.

Monostable mode: In monostable mode, the 555 timer produces a single pulse with a specific duration in response to a trigger input. To operate the 555 timer in monostable mode, a trigger input is applied to pin 2, and a timing resistor and capacitor are connected to pins 6 and 2. When the trigger input is applied, the capacitor charges through the timing resistor, and the output goes high. The capacitor discharges through the discharge transistor and the timing resistor, and the output goes low after a specific time period.

Bistable mode: In bistable mode, the 555 timer acts as a flip-flop, maintaining a stable output state until a trigger input is received. To operate the 555 timer in bistable mode, two external resistors are connected to pins 2 and 6, and the output is taken from pin 3. A trigger input applied to pin 2 sets the output high, and a reset input applied to pin 4 sets the output low. The output remains in its current state until a trigger or reset input is received.

In all three modes, the timing and frequency of the output signal can be controlled by adjusting the values of the external components connected to the timing pins. The 555 timer is widely used in various electronic applications due to its simplicity, versatility, and ease of use.

Q-2: Mention the difference between Clipping and Clamping circuit.

Answer:

Here are the differences between clipping and clamping circuits:

- Clipping circuit limits the output signal to a specified range. It is used to remove unwanted portions of a signal, such as noise or harmonics.
- Clamping circuit fixes the DC level of an AC signal. It is used to maintain a constant DC level for an AC signal, even if the amplitude of the signal varies.

Feature	Clipping Circuit	Clamping Circuit
Purpose	Limits the output signal to a specified range	Fixes the DC level of an AC signal
Output	Truncated signal	DC-shifted signal
Applications	Removing noise, harmonics	Maintaining a constant DC level
Implementation	Diodes	Diodes and capacitors

Q-3: Mention the usages of different types of multivibrators.

Answer:

- Astable multivibrator is a type of multivibrator that produces a square wave output. It is used in a variety of applications, such as timers, pulse generators, and frequency dividers.
- Monostable multivibrator is a type of multivibrator that produces a single pulse output. It is used in a variety of applications, such as pulse width modulation (PWM) controllers, digital counters, and edge detectors.
- Bistable multivibrator is a type of multivibrator that has two stable states. It is used in a variety of applications, such as flip-flops, latches, and memory cells.

Here is a table that summarizes the usages of different types of multivibrators:

Type	Usage
Astable multivibrator	Timers, pulse generators, frequency dividers
Monostable multivibrator	PWM controllers, digital counters, edge detectors
Bistable multivibrator	Flip-flops, latches, memory cells

Q-4: Describe negative clipping circuit.

Answer:

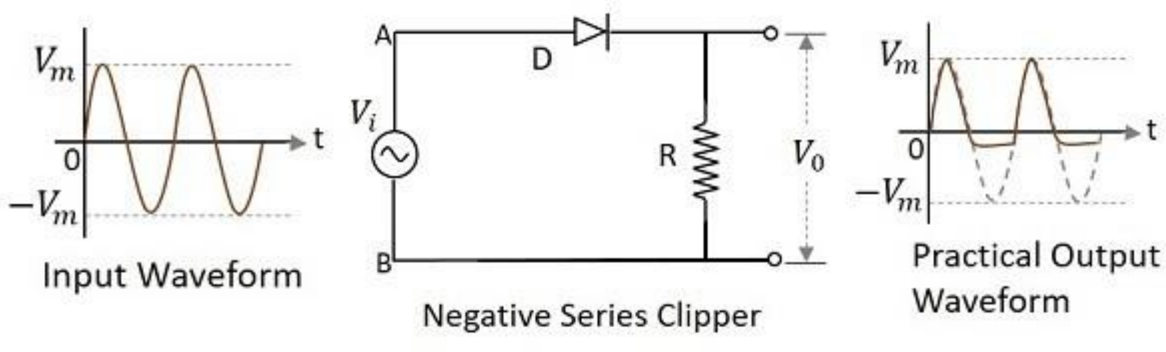
A negative clipping circuit is a type of circuit that limits the output signal to a specified range. The output signal is truncated, or cut off, if it falls below the specified range.

The negative clipping circuit is typically implemented using a diode. The diode is connected in series with the input signal, and the cathode of the diode is connected to ground. The anode of the diode is connected to the output of the circuit.

When the input signal is above the specified range, the diode is reverse biased and the output of the circuit is equal to the input signal. When the input signal is below the specified range, the diode is forward biased and the output of the circuit is zero.

The negative clipping circuit can be used to remove unwanted portions of a signal, such as noise or harmonics. It can also be used to create a square wave signal from a sine wave signal.

Here is a diagram of a negative clipping circuit:



Q-1: Implement Bi-stable Multivibrator circuit with working procedure.
Answer:

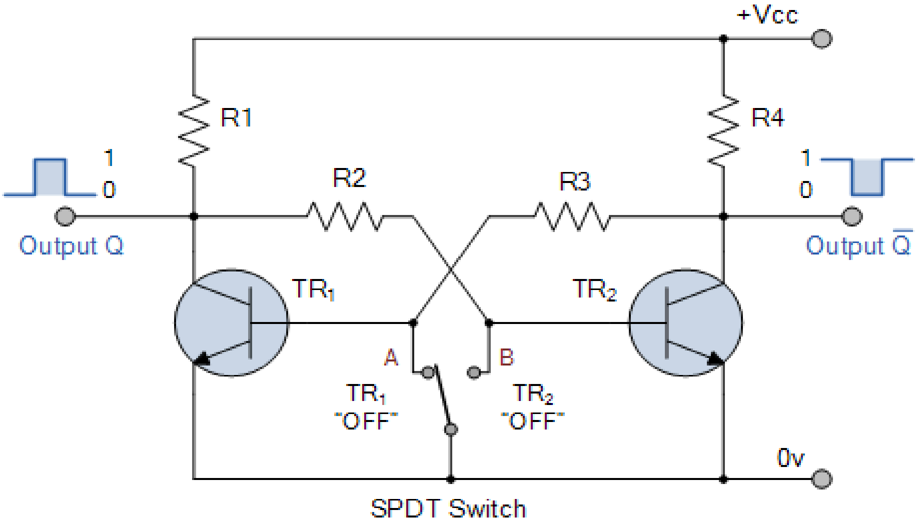
A bistable multivibrator, also known as a flip-flop, is a circuit that has two stable states. The state of a bistable multivibrator can be changed by applying an external input signal.

The bistable multivibrator can be implemented using two cross-coupled transistors. The transistors are connected in such a way that they form a feedback loop. When one transistor is turned on, the other transistor is turned off.

The bistable multivibrator can be triggered by applying a pulse to one of the transistors. The pulse will cause the transistor to turn on, and the other transistor to turn off. The bistable multivibrator will then remain in the new state until it is triggered again.

The bistable multivibrator is used in a variety of applications, such as digital counters, registers, and memories.

Here is a diagram of a bistable multivibrator circuit:



The following table shows the operation of the bistable multivibrator for different input signals:

Input Signal	State of T1	State of T2
Low	Off	On
High	On	Off

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