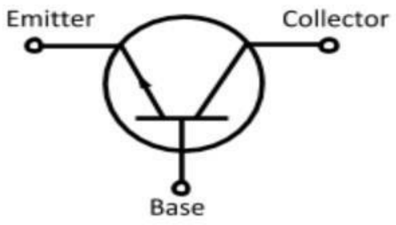
Basic Electrical and Electronic Circuits (BEC)
Course Code: (23EC1203)

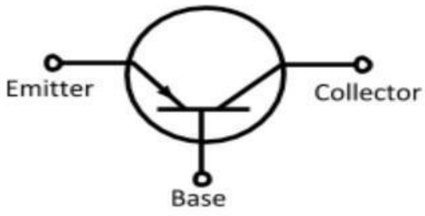
CO-3, CO-4 SHORT & LONG Q&A:

1. Draw the symbols for PNP and NPN transistor

ANS)



n-p-n transistor



p-n-p transistor

2. Mention the applications of PN diode

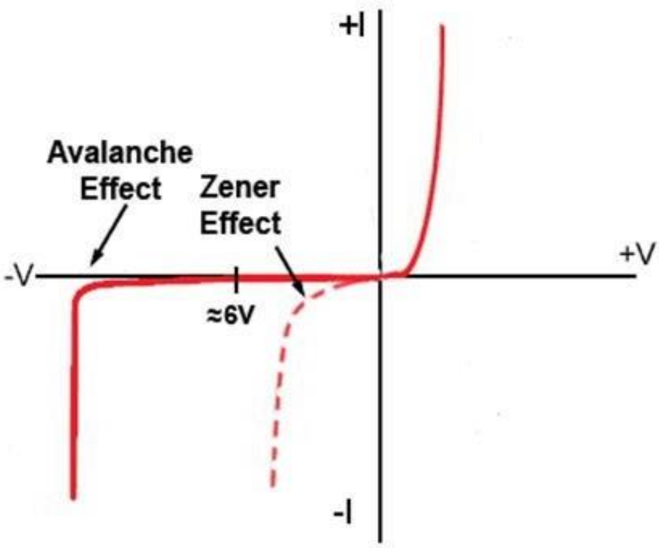
A) Diodes are used in a wide variety of applications such as a switch in rectifiers, current limiters, voltage snubbers or in wave-shaping circuits.

(Or)

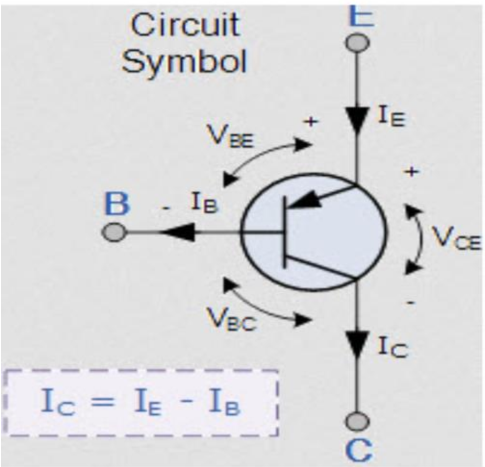
- PN diode can be used as a switch
- PN junction diode can be used in rectifiers
- PN junction diode can be used in clipper
- PN junction diode can be used in clampers

3. Draw the VI characteristics of Zener DIODE

A)

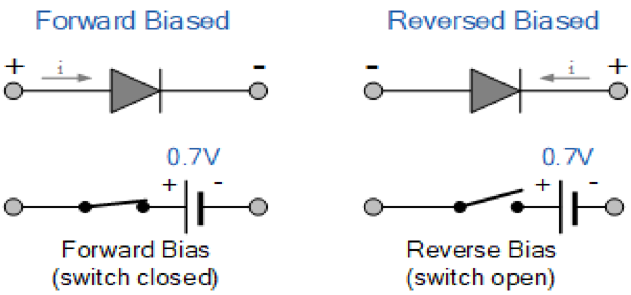


4. Draw the PNP Transistor mention voltages and currents

A) 

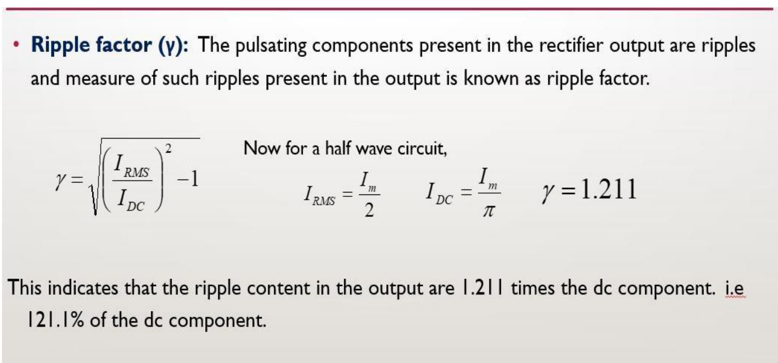
5. Explain how diode acts as switch with its equivalent circuit ?

A) Diode conducts current in one direction (forward biasing mode (conducting) and blocks current in the other direction (reverse biasing mode –blocking).



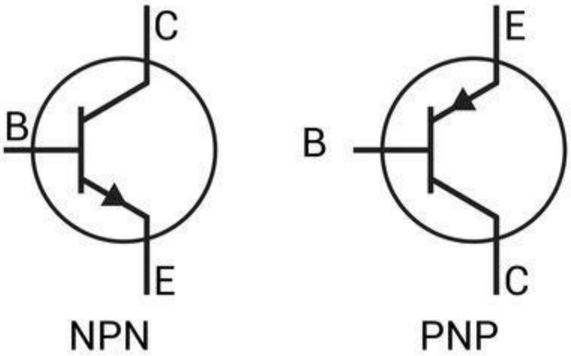
6. Define Rectification and ripple factor

A) Rectification is a process of converting AC in to DC .
The measure of the unwanted pulsating components present in the rectified output is called ripple factor.



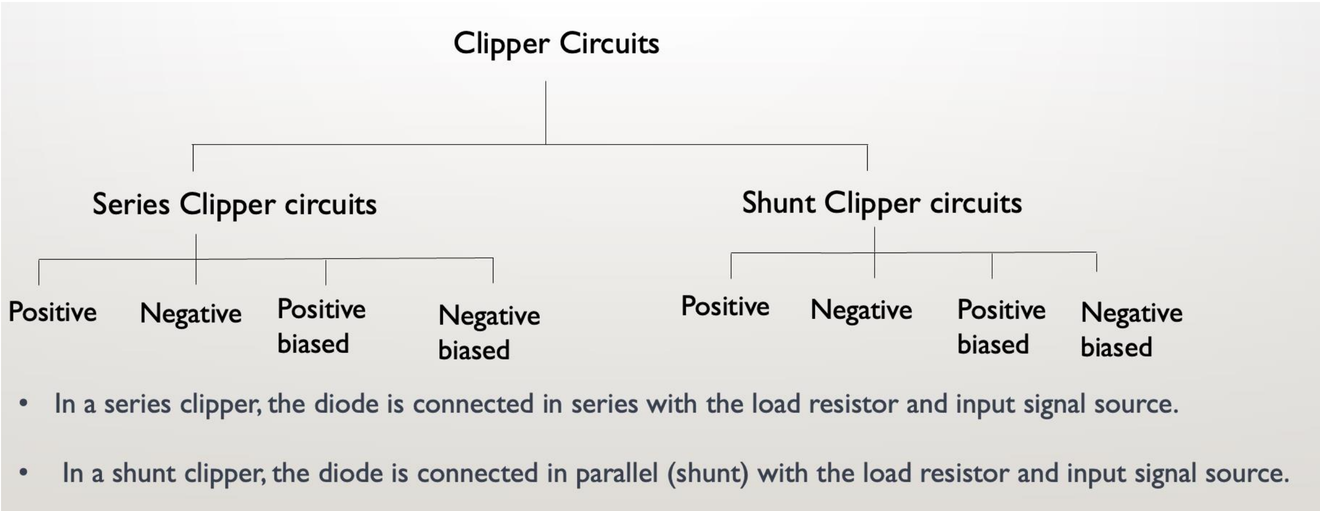
7. Draw the circuit symbol for PNP & NPN Transistor

A)



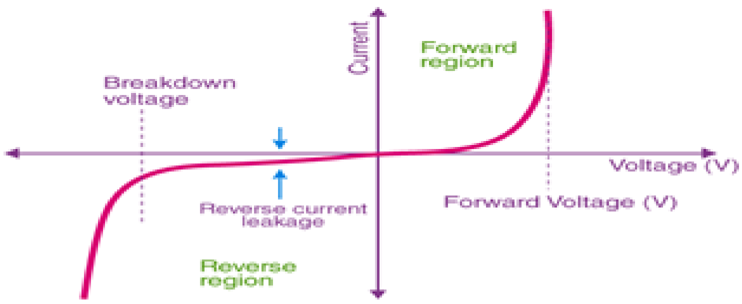
8.Mention different types of clippers and clamper circuits

A)

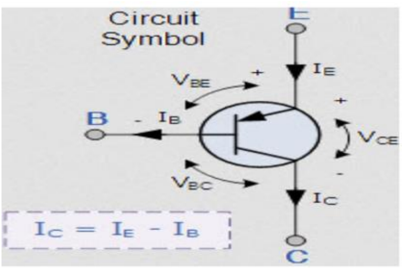


9.Draw the VI characteristics of PN junction DIODE

A)



10. Draw the PNP Transistor mention voltages and currents



CO-4 short answers:

1. Enumerate the features of 3 terminal IC regulator?

Characteristic Features

Output Voltage: The LM7805 is designed to provide a fixed positive output voltage of +5V

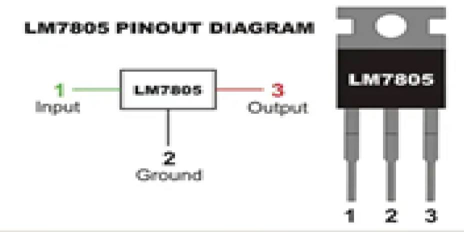
Input Voltage Range: It can accept an input voltage ranging from 7 volts to 35 volts, making it suitable for regulating higher voltage sources down to +5V.

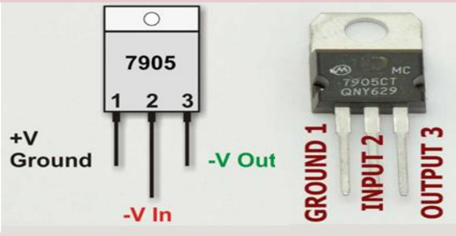
Output Current Capacity: The LM7805 is available in different variants with varying current capacities. Common variants include LM7805, LM7805C, and LM7805CT, which can handle currents up to 1A.

Linear Regulation: It employs linear regulation to maintain a stable output voltage. Linear regulators dissipate excess voltage as heat, so they may require a heat sink in high-power applications.

2.Compare 7805 and 7905 A)

LM 7805	LM 7905
1. Positive Voltage Regulator	1. Negative Voltage Regulator
2. Provides a regulated positive output voltage of +5 volts	2. Provides a regulated negative output voltage of -5 volts
3. Used to regulate and provide a stable +5V supply in electronic circuits, often used to power microcontrollers, digital ICs, and other components.	3. LM7905 is used in applications where a stable negative voltage supply is required, in analog circuitry or situations where a dual power supply (both positive and negative) is necessary





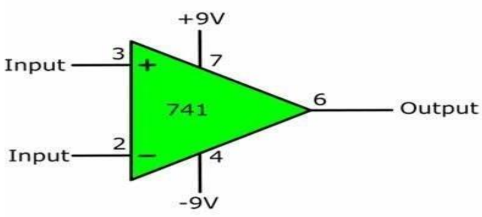
3.Mention the applications of LM723

A)

- ❑ The unnecessary o/p current will be 150mA without using an exterior pass transistor.
- ❑ The maximum input supply voltage will be 40V.
- ❑ It offers modifiable o/p from 3volts to 37volts.
- ❑ These ICs are used to make switching & linear regulator.
- ❑ It supplies 10A o/p current with the help of an external pass transistor.
- ❑ These ICs are used for different operations such as positive, negative, series, floating, and shunt.

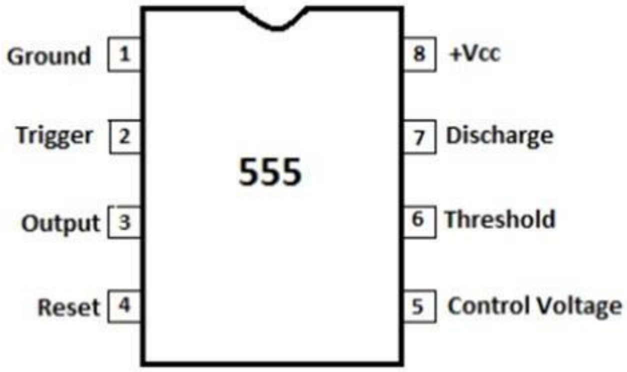
4. Draw the symbol of OP- AMP IC 741 with input and output pins

A)



741 Op-amp Symbol

5. Mention the significance of IC 555 with PIN configuration



A)

Pin no	pin description	Purpose
1	Ground	Ground reference voltage, low level (0 V)
2	Trigger	This output is driven to approximately 1.7 V below +Vcc, or GND
3	output	This output is driven to approximately 1.7 V below +Vcc or GND.
4	Reset	A timing interval may be reset by driving this input to GND, but the timing does not begin again until RESET rises above approximately 0.7 volts. Overrides TRIG which overrides threshold.
5	Control voltage	Provides "control" access to the internal voltage divider (by default, 2/3 Vcc).
6	Threshold	The timing (OUT high) interval ends when the voltage at the threshold is greater than that at CTRL (2/3 Vcc if CTRL is open).
7	Discharge	Open collector output which may discharge a capacitor between intervals. In phase with output.
8	VCC	Positive supply voltage, which is usually between 3 and 15 V depending on the variation.

6.Mention few applications of IC 555

A)

1) 555 timer is used in almost every electronic circuit,
2) A 555 timer works as a flip-flop or as a multi-vibrator, it has a particular set of configurations.
3) It operates from a wide range of power ranging from +5 Volts to +18 Volts supply voltage.
4) Sinking or sourcing 200 mA of load current.
5) The duty cycle of the timer is adjustable.
6) Maximum power dissipation per package is 600 mW,
7) Trigger pulse and reset inputs have logic compatibility.

7.Define slew rate and CMRR

A)

Slew Rate: slew rate is by dividing the change in output voltage by the change in time, illustrating how quickly the output voltage can change.

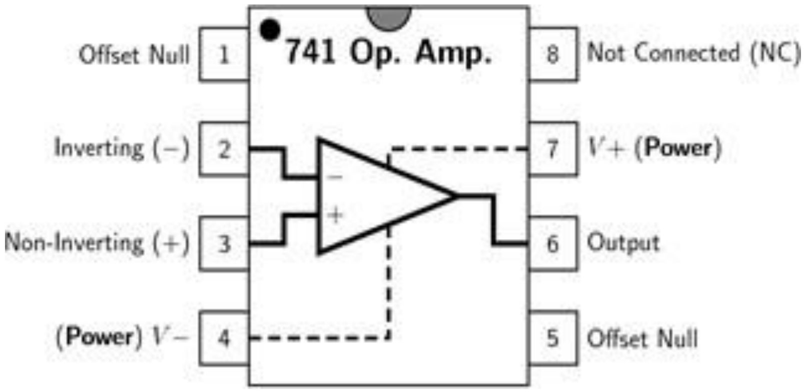
$$S = \frac{dV_0}{dt}\Big|_{maximum} = \omega V_m$$

CMRR: (Common Mode Rejection Ratio):
It's a measure of how well an amplifier can ignore OR Rejects the same signal that appears on both inputs.

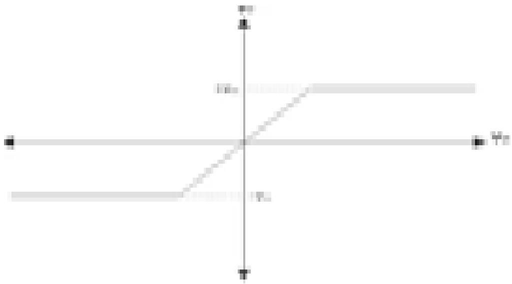
CMRR can be defined as the ratio of the differential gain (A_D) to the common-mode gain (Acm)

8.Draw the pin configuration of IC 741 OPAMP

A)



9Draw the transfer characteristics of OPAMP

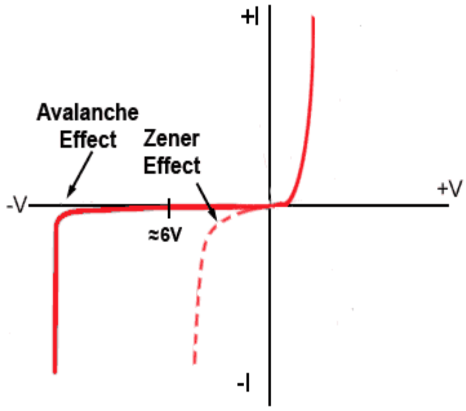


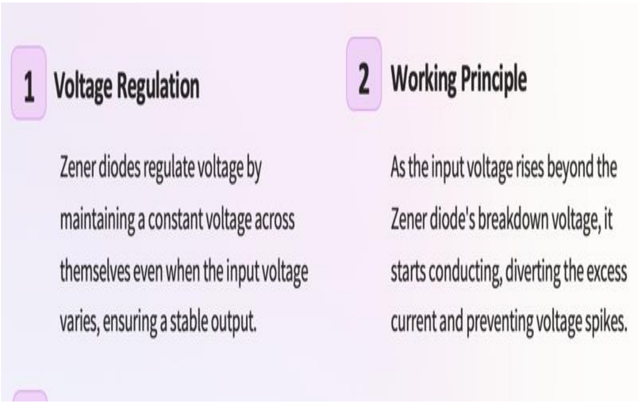
A.

Op-Amp characteristics.

Revision Questions CO-3   Long Answers

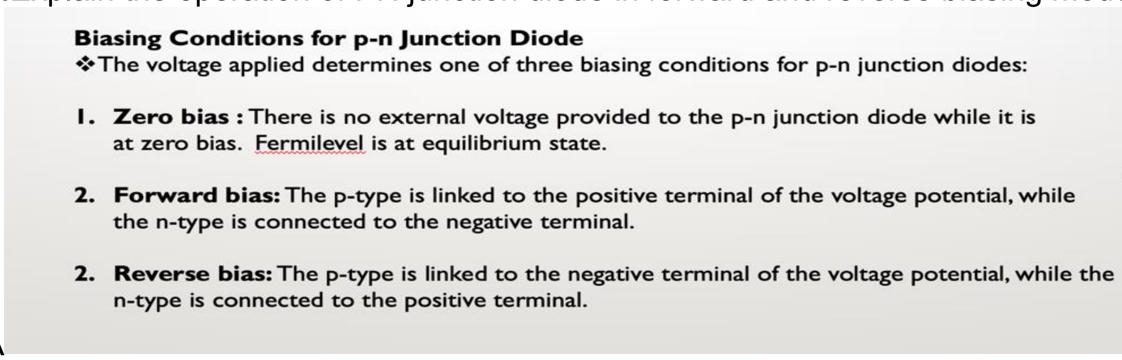
1.Explain the operation of Zener as voltage regulator with VI characteristics?





2.Explain the operation of PN junction diode in forward and reverse biasing modes?

A



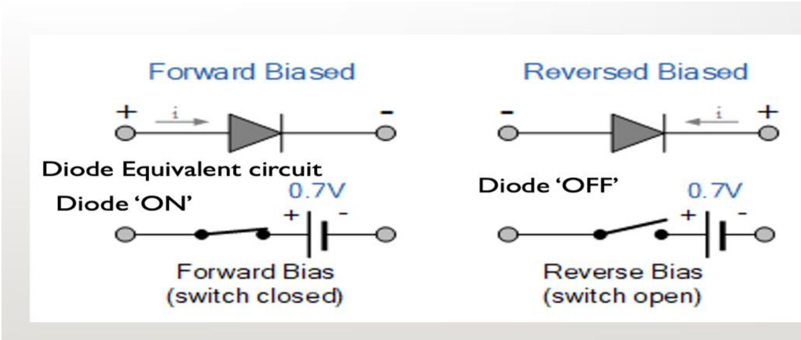
Biasing Conditions for p-n Junction Diode

❖The voltage applied determines one of three biasing conditions for p-n junction diodes:

1. **Zero bias :** There is no external voltage provided to the p-n junction diode while it is at zero bias. Fermilevel is at equilibrium state.

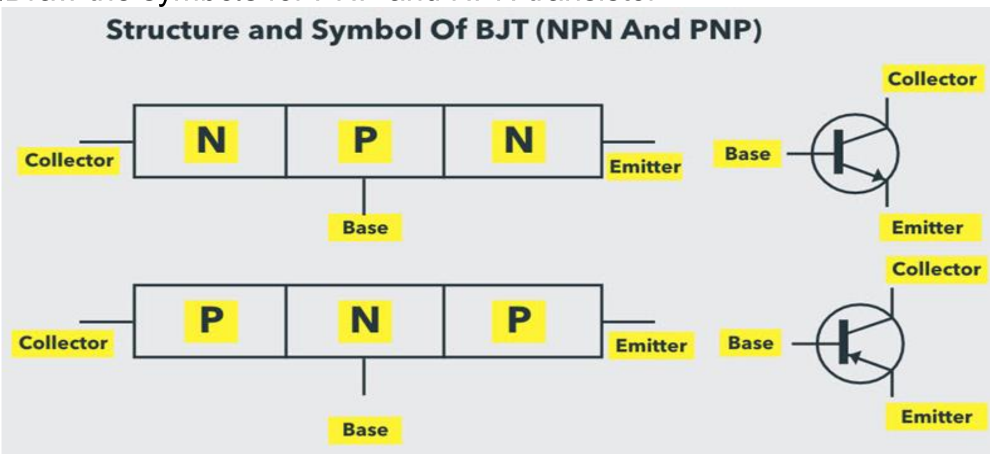
2. **Forward bias:** The p-type is linked to the positive terminal of the voltage potential, while the n-type is connected to the negative terminal.

2. **Reverse bias:** The p-type is linked to the negative terminal of the voltage potential, while the n-type is connected to the positive terminal.



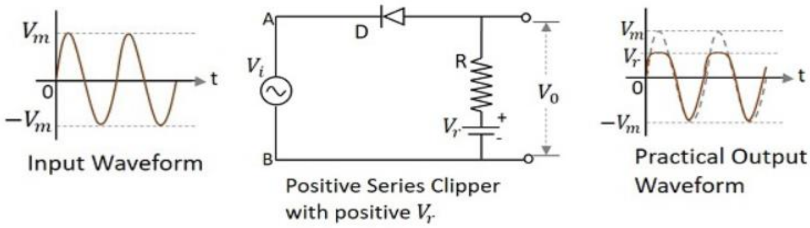
3 .Draw the symbols for PNP and NPN transistor

A.)

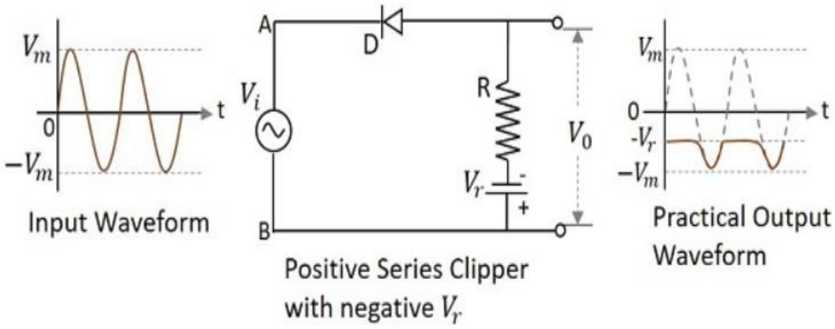


4. Explain the operation of positive and negative Biased clippers with circuit diagram

A.) Positive Series Clipper with Positive Biased (Vr)

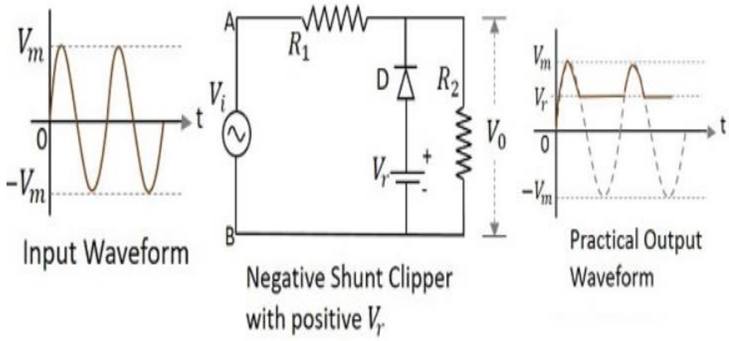


ii) Positive Series Clipper with Negative Biased (Vr)

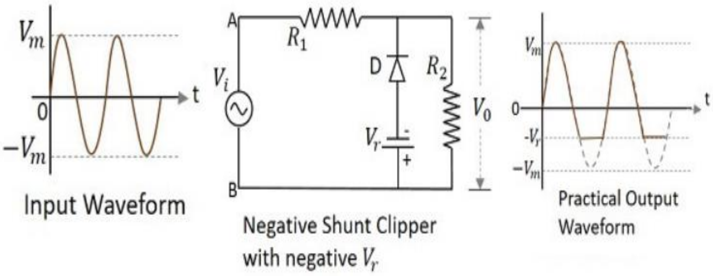


5. Explain the operation of negative biased clippers

a) Negative Shunt Clipper with Positive biased or reference voltage (Vr) and



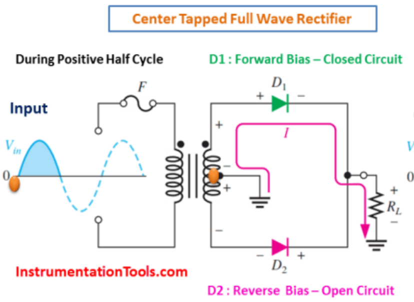
b) Negative Shunt Clipper Negative Biased (Vr)

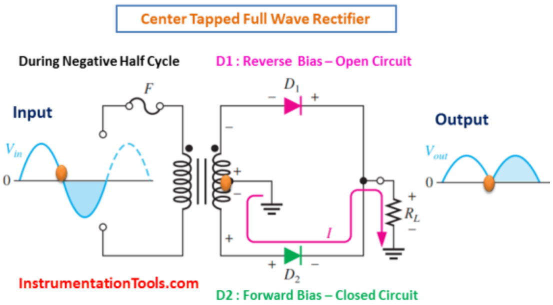


6. Explain the operation of full wave rectifier with neat circuit and output wave form

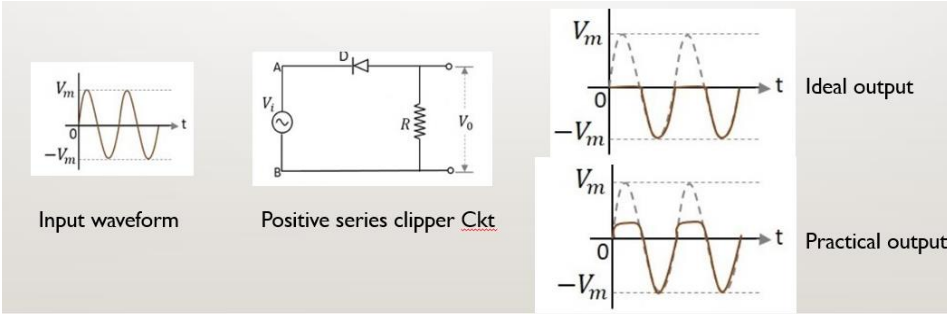
7. Explain the operation of full wave center tapped rectifier with neat circuit and output wave form

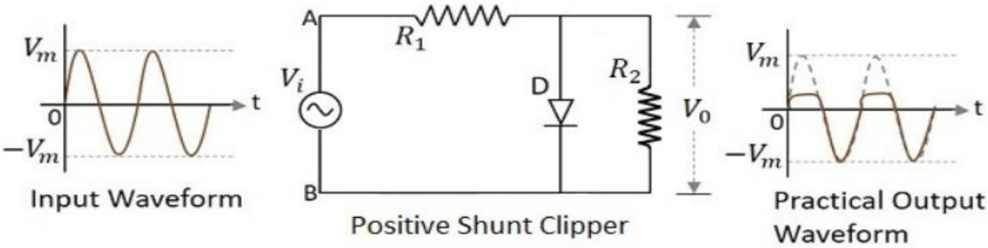
A.) **Full Wave Center-tapped Rectifier (Operation + Circuit diagram)**



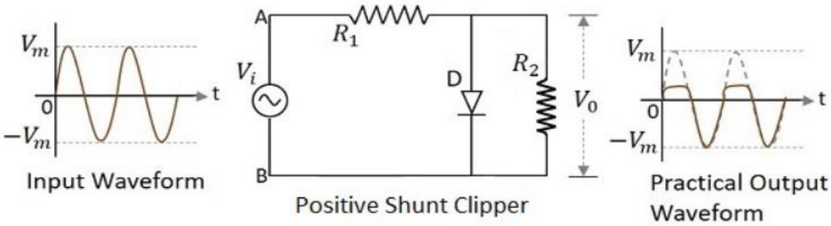


8. Explain the operation of positive series and shunt clipper with circuit diagram

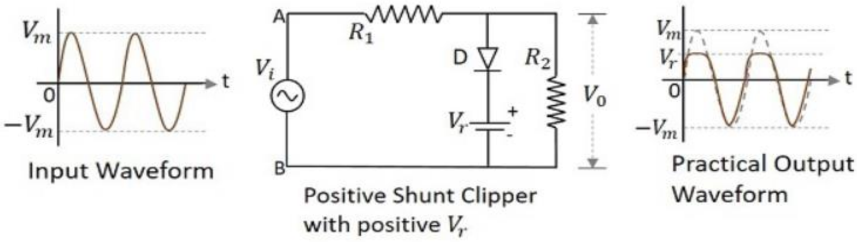




9. Explain the operation of shunt clippers with waveforms

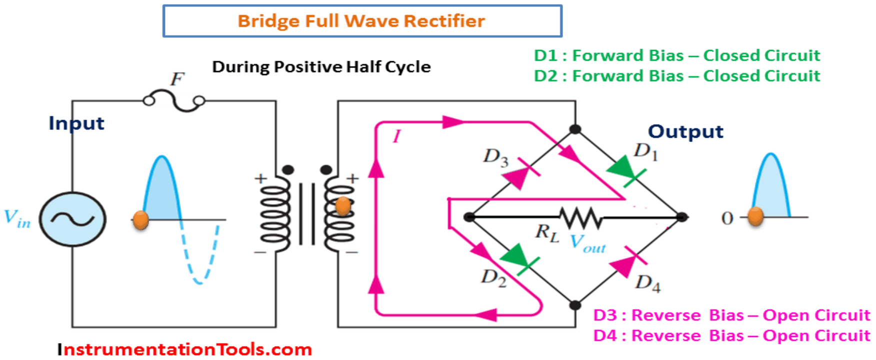


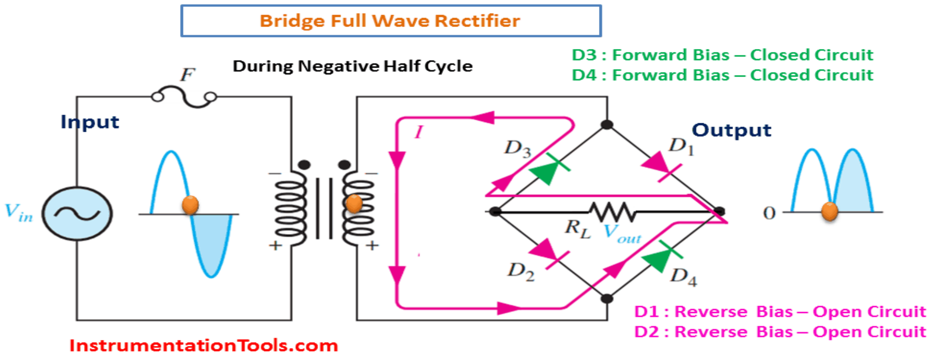
Positive Shunt Clipper with Positive Biased (Vr)



10. Explain the operation of full wave bridge rectifier with neat circuit and output wavform

A)

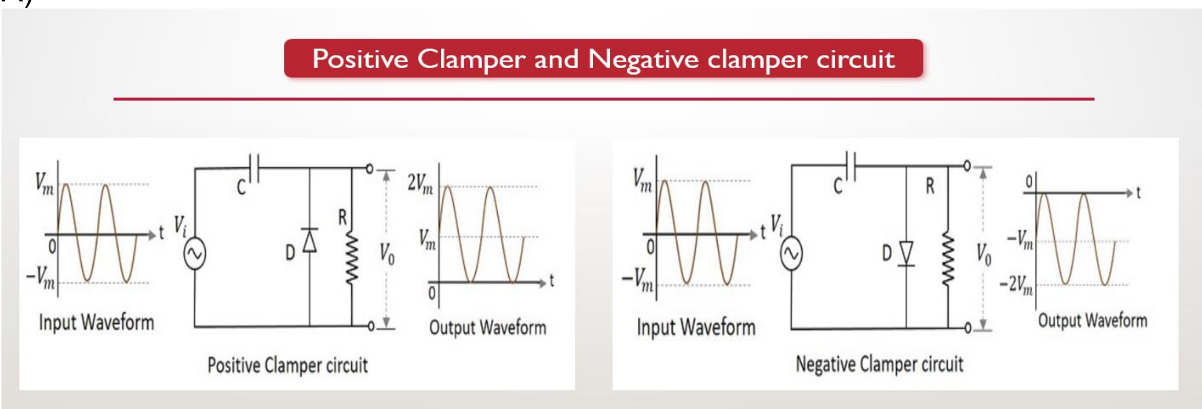




11. Explain about positive and negative clampers with input and output waveforms

12. Explain about clamper circuit ?

A)



13 Compare all rectifiers with respect to ripple factor, efficiency, TUF , PIV values.

14 Describe the following ripple factor, efficiency, TUF, PIV values for HALF & FULLWAVE rectifiers.

Ans : from this TABLE specific parameters ..

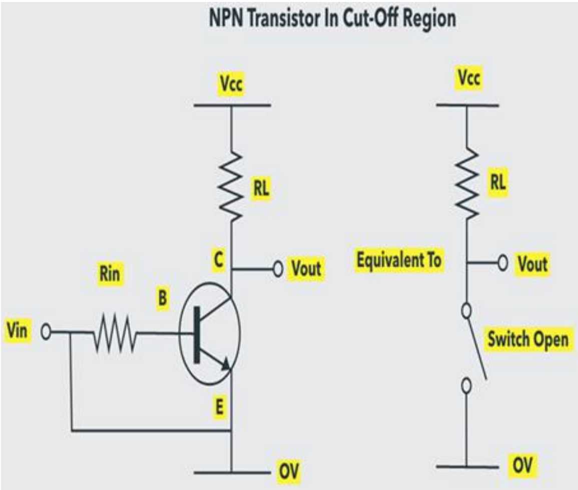
Parameter	HWR	FWR(CT)	FWR(Bridge)
I_{dc}	I_m/π	$2I_m/\pi$	$2I_m/\pi$
V_{dc}	V_m/π	$2V_m/\pi$	$2V_m/\pi$
I_{rms}	$I_m/2$	$I_m/\sqrt{2}$	$I_m/\sqrt{2}$
V_{rms}	$V_m/2$	$V_m / \sqrt{2}$	$V_m / \sqrt{2}$
f=Form factor	1.57	1.11	1.11
r = Ripple factor	1.21	0.48	0.48
P_{dc}	$(I_m / \pi)^2 R_L$	$(2I_m / \pi)^2 R_L$	$(2I_m / \pi)^2 R_L$
P_{ac}	$I_m^2 (R_s+R_f+R_L)/4$	$I_m^2 (R_s+R_f+R_L)/2$	$I_m^2(R_s+R_f+R_L)/2$
Efficiency	$4 /\pi^2 = 40.6\%$	$8 /\pi^2 = 81.2\%$	$8 /\pi^2 = 81.2\%$
PIV	$2V_m$	V_m	V_m
TUF	0.287	(0.574+0.812)/2	0.812
%Reg	$(R_s +R_f)/R_L$	$(R_s/2 +R_f)/R_L$	$(R_s +2R_f)/R_L$
No. of Diodes	1	2	4
frequency	f	2f	2f

15. Draw the configuration of NPN transistor and explain its operation

A.) Depending on the biasing conditions like forward or reverse, transistors have three major modes of operation namely cutoff, active and saturation regions.

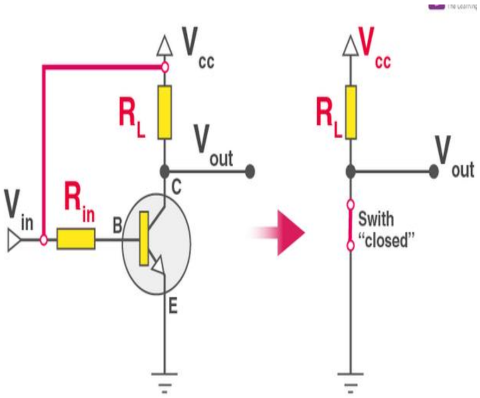
Cutoff Mode

- In this mode, both collector base junction and emitter base junction are reverse biased. As both the PN Junctions are reverse biased,
- there is almost no current flow except small leakage currents BJT in this mode is switched OFF and is essentially an open circuit.
- Cutoff Region is primarily used in switching and digital logic circuits.

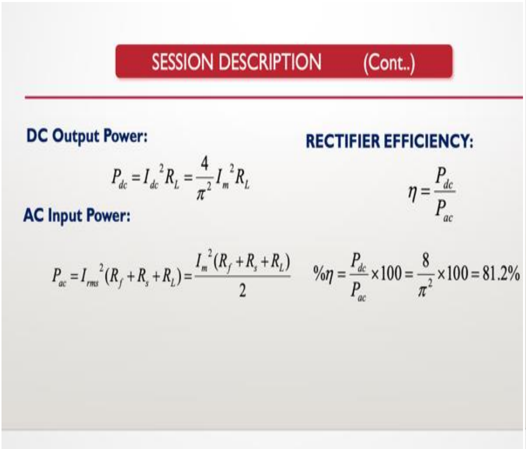


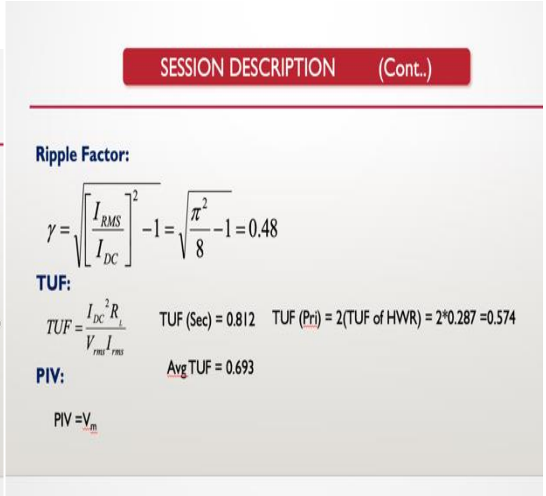
If TRANSISTOR IN SATURATION mode

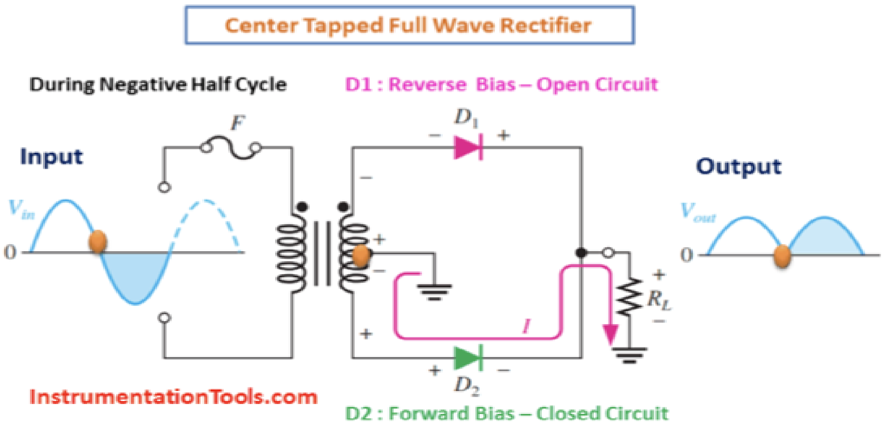
- The highest base current is applied, leading to the overall collector current.
- causes the average collector-emitter voltage to fall and the leakage surface as small as possible
- the maximum current that flows across this transistor.
- Thus "Fully ON" transistor is triggered.



16. Derive the expression for ripple factor, % efficiency , for fullwave rectifier and draw the output waveforms

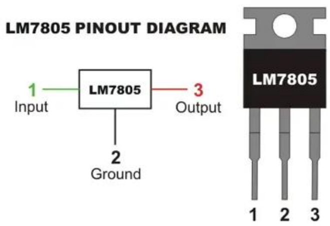


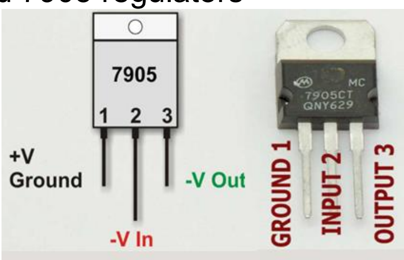




LONG Answers CO-4 Questions:

1. Distinguish 7805 and 7905 regulators





LM 7805	LM 7905
1. Positive Voltage Regulator	1. Negative Voltage Regulator
2. Provides a regulated positive output voltage of +5 volts	2. Provides a regulated negative output voltage of -5 volts
3. Used to regulate and provide a stable +5V supply in electronic circuits, often used to power microcontrollers, digital ICs, and other components.	3. LM7905 is used in applications where a stable negative voltage supply is required, in analog circuitry or situations where a dual power supply (both positive and negative) is necessary

PIN Description

PIN 1 (INPUT)

Input pin gives the input voltage, within the range of 7V to 35V. An unregulated voltage is applied to the input pin for regulation. The maximum efficiency is achieved for an input of 7.2V

PIN 2 (GROUND)

This pin is connected to ground. For the input and output, this pin is equal to neutral voltage (0V)

PIN 3 (OUTPUT)

Output pin is used to receive the regulated output.
Characteristic Features
Output Voltage: The LM7805 is designed to provide a fixed positive output voltage of +5V
Input Voltage Range: It can accept an input voltage ranging from 7 volts to 35 volts, making it suitable for regulating higher voltage sources down to +5V.
Output Current Capacity: The LM7805 is available in different variants with varying current capacities. Common variants include LM7805, LM7805C, and LM7805CT, which can handle currents up to 1A.
Linear Regulation: It employs linear regulation to maintain a stable output voltage. Linear regulators dissipate excess voltage as heat, so they may require a heat sink in high-power applications
Applications of LM 7805 Voltage Regulator

- Current regulator
- Regulated dual supply
- Building circuits for Phone charger, UPS power supply circuits, portable CD player etc
- Fixed output regulator
- Adjustable output regulator

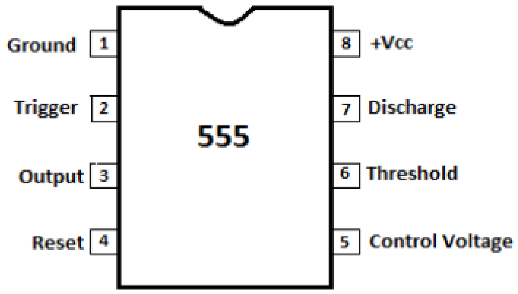
<u>PIN Description</u>
PIN 1 (GROUND)
This pin is an unregulated input voltage
PIN 2 (INPUT)
This pin is connected to ground.
PIN 3 (OUTPUT)
Output pin is used to receive the regulated output of -5V.
Characteristic Features

- **Output Voltage:** The LM7905 is designed to provide a fixed negative output voltage of -5 volts.
- **Input Voltage Range:** It can accept an input voltage ranging from -7 volts to -25 volts, making it suitable for regulating higher negative voltage sources down to -5V.
- **Output Current Capacity:** Similar to the LM7805, the LM7905 is available in different variants with varying current capacities. Common variants include LM7905, LM7905C, and LM7905CT, which can handle currents up to 1A.
- **Linear Regulation:** Like other regulators in the LM78xx series, the LM7905 uses linear regulation to maintain a stable output voltage. Heat dissipation may be a consideration, especially in high-power applications.

Applications of LM 7905 Voltage Regulator

- Constant -5V output regulator to for op-amp signals
- Adjustable Output Regulator
- Current Limiter for certain applications
- Regulated Dual Supply

2.Draw the IC 555 timer pin configuration and mention its applications?
3. Explain the pin configuration of IC 555
4. Explain about IC 555 TIMER pin configuration



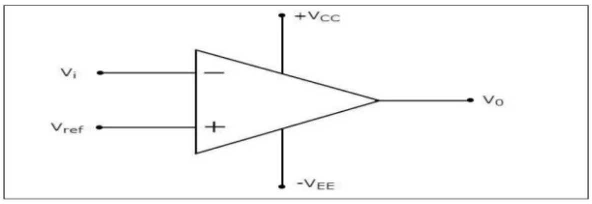
Pin no	pin description	Purpose
1	Ground	Ground reference voltage, low level (0 V)
2	Trigger	This output is driven to approximately 1.7 V below +Vcc, or GND
3	output	This output is driven to approximately 1.7 V below +Vcc or GND.
4	Reset	A timing interval may be reset by driving this input to GND, but the timing does not begin again until RESET rises above approximately 0.7 volts. Overrides TRIG which overrides threshold.
5	Control voltage	Provides “control” access to the internal voltage divider (by default, 2/3 Vcc).
6	Threshold	The timing (OUT high) interval ends when the voltage at the threshold is greater than that at CTRL (2/3 Vcc if CTRL is open).
7	Discharge	Open collector output which may discharge a capacitor between intervals. In phase with output.
8	VCC	Positive supply voltage, which is usually between 3 and 15 V depending on the variation.

1 Dimmer circuits
2 TIMERS
3 PULSE GENERATOR CIRCUITS
4 ALARMING CIRCUITS
5 DUTY CYCLE Adjuster
SQUARE WAVE GENETATOR

5.Explain the operation of IC comparators.

Inverting Comparator:

An inverting comparator is an op-amp based comparator for which a reference voltage is applied to its non-inverting terminal and the input voltage is applied to its inverting terminal. This comparator is called as inverting comparator because the input voltage, which has to be compared is applied to the inverting terminal of op-amp.

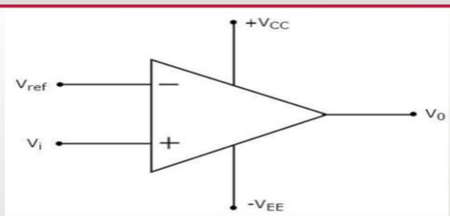


The operation of an inverting comparator is very simple. It produces one of the two values +Vsat and –Vsat at the output based on the values of its input voltage Vi and the reference voltage Vref.

- The output value of an inverting comparator will be –Vsat , for which the input Vi voltage is greater than the reference voltage Vref .
- The output value of an inverting comparator will be +Vsat , for which the input Vi voltage is less than the reference voltage Vref .

Non-Inverting Comparator:

- A non-inverting comparator is an op-amp based comparator for which a reference voltage is applied to its inverting terminal and the input voltage is applied to its non-inverting terminal.
- This op-amp based comparator is called as non-inverting comparator because the input voltage, which has to be compared is applied to the non-inverting terminal of the op-amp.



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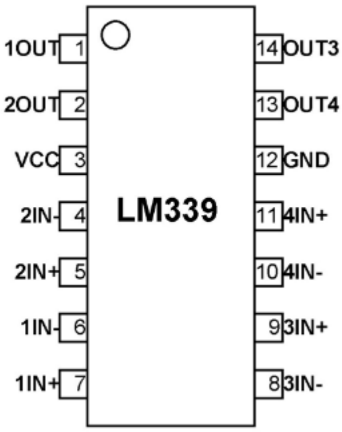
6 Write a short note on LM 339

7 .Explain the operation of LM339



pin	Name	Description
1	1OUT	Output pin of the comparator 1
2	2OUT	Output pin of the comparator 2
3	VCC	Power supply
4	2IN-	Negative input pin of the comparator 2
5	2IN+	Positive input pin of the comparator 2
6	1IN-	Negative input pin of the comparator 1
7	1IN+	Positive input pin of the comparator 1
8	3IN-	Negative input pin of the comparator 3
9	3IN+	Positive input pin of the comparator 3
10	4IN-	Negative input pin of the comparator 4
11	4IN+	Positive input pin of the comparator 4
12	GND	Ground
13	4OUT	Output pin of the comparator 4
14	3OUT	Output pin of the comparator 3

- Comparators are electronic circuits designed to compare two voltage inputs and produce a digital output based on their relationship

8. Mention the features of op-amp Ic 741 , explain with its pin configuration

Characteristics of Op-Amp

- **Open-loop gain:** This is the gain of the op-amp without any feedback. It is typically very high, ranging from 105 to 108.
- **Input impedance:** This is the resistance that the op-amp presents to the input signal. It is typically very high, ranging from 105 to 1013 ohms.
- **Output impedance:** This is the resistance that the op-amp presents to the output load. It is typically very low, ranging from 10 to 100 ohms.
- Offset voltage: This is the voltage difference between the inverting and non-inverting inputs when the output voltage is zero.
- **Slew rate:** This is the maximum rate of change of the output voltage per unit time. It is usually expressed in volts per microsecond (V/μs). $SR = \frac{dv}{dt} = \frac{i}{C}$
- **Bandwidth:** This is the range of frequencies that the op-amp can amplify without significant attenuation or distortion $f_{max} = \frac{Slew\ Rate}{2\pi V_p}$
- **Common-mode rejection ratio (CMRR):** This is a measure of how well the op-amp can reject signals that are common to both inputs

A.)

9. Describe OFFSET VOLTAGE open loop gain, input ,output impdence,CMRR, SLEW RATE

Characteristics of Op-Amp

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A.

10. Explain the comparator circuit using OPAMP

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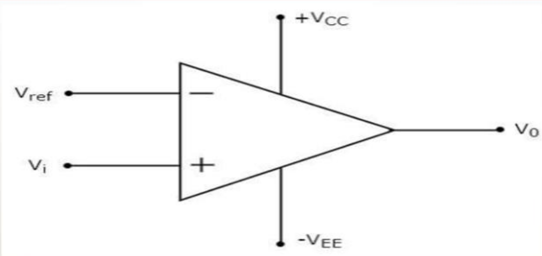

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11.Describe the characteristics of ideal OPAMP?

Characteristics of Op-Amp

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12. Classify Analog and Digital ICs

Integrated circuits are of two types:

1.Analog Integrated Circuits (Analog ICs)
2. Digital Integrated Circuits (Digital ICs).

Analog Integrated Circuits	Digital Integrated Circuits
operate over an entire range of continuous values of the signal amplitude	are electronic circuits that process discrete signals or information represented as a sequence of numbers They operate with distinct states, typically represented as 0s and 1s (binary).
Examples of analog ICs operational amplifiers (op-amps), voltage regulators, and audio amplifiers.	Examples of digital ICs include microprocessors, memory chips (like RAM and ROM), and logic gates (such as AND, OR, and NOT gates).

	Analog IC	Digital IC
size	Analog chips tend to be relatively bigger and bulky.	Small in size (miniaturized chips)
Design	Analog chips tend to feature more complex designs than the digital ICs..	Most digital chips are simple and can be easily integrated into circuits
Noise levels	Analog chips tend to be more susceptible to the electrical noise than the digital chips. This is mainly due to the nature signals that they work on.	Analog ICs are designed to work on continuous signals which have more noise levels than for signals with defined state(High or Low).
Cost N Component density	Moderate N More	Lesser cost .. Moderate density
Examples	Operational Amplifiers (Op-Amps),LM741, LM324, LM358,Voltage Regulators: LM78XX series (Positive voltage regulators),LM79XX series (Negative voltage regulators)	Logic Gates:74LSXX series (Low-power Schottky TTL),74HCXX series (High-speed CMOS), Flip-Flops and Latches:74LS74 (D-type flip-flop)74HC373 (Octal D-type transparent latch)

13. Classify IC voltage regulators explain the operation of IC 723.

Types of Voltage Regulators

Types of Voltage Regulators *according to their working principle*

Linear Voltage Regulators

→ These regulators use a series pass transistor to adjust the output voltage.

→ Simple, easy to design, and are suitable for low to moderate power applications

→ Limited efficiency and may often generate heat

Switching Voltage Regulators

→ These regulators switch the input voltage ON and OFF rapidly and use inductors and capacitors to filter the output

→ More complex, and are suitable for high power applications

→ Offer higher efficiency

A.

Types of Voltage Regulators *according to the type of voltage generated*

Positive Voltage Regulators

Provides regulated positive voltage

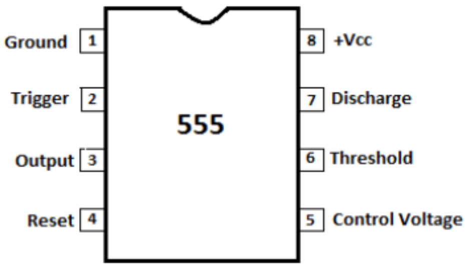
LM78XX series (e.g., LM7805 for +5V)

Negative Voltage Regulators

Provides regulated negative voltage

LM79XX series (e.g., LM7905 for -5V)

14. Explain the operation of timer circuit with its PIN diagram of IC 555



MODES OF OPERATION OF IC555:-
The NE555 timer IC generally operates in 3 modes:
1) Astable Mode 2) Monostable Mode 3) Bi-stable modes

Astable Mode

This means there will be no stable level of output. So the output will be swinging between high and low. This character of unstable output is used as a clock or square wave output for many applications.

Monostable Mode

This configuration consists of one stable and one unstable state. The stable state can be chosen as either high or low by the user. If the stable output is set at high (1), the output of the timer is high (1).

At the application of an interrupt, the timer output turns low (0). Since the low state is unstable it goes to high (1) automatically after the interrupt passes. Similar is the case for a low stable monostable mode.

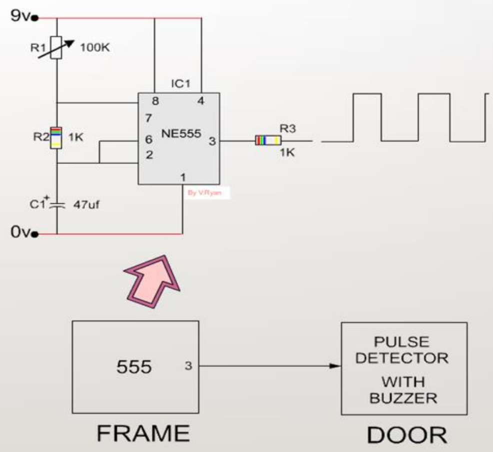
Bi-stable Mode

In bistable mode, both the output states are stable. At each interrupt, the output changes from low (0) to high (1) and vice versa, and stays there. For example, if we have a high (1) output, it will go low(0) once it receives an interrupt and stays low (0) till the next interrupt changes the status.

30. Mention the applications of 555 IC explain with one example

1. TIMERS
2. Dimmer circuits
3. PULSE GENERATOR CIRCUITS
4. ALARMING CIRCUITS
5. DUTY CYCLE Adjuster
6. SQUARE WAVE GENERATORS

- The first 555 circuit generates a pulse (positioned on the doorframe) and the second circuit detects the pulse and is positioned on the door
- If the door is opened the connection between the two circuits is broken. The second circuit can not detect a pulse and so the buzzer sounds.



15. Mention the applications of OP AMP

Important Applications of Op-Amp

- **Voltage follower:** This is a circuit that produces an output voltage that is equal to the input voltage. It is also known as a buffer or an isolation amplifier.
- **Inverting amplifier:** This is a circuit that produces an output voltage that is proportional and opposite to the input voltage.
- **Non-inverting amplifier**: This is a circuit that produces an output voltage that is proportional and the same as the input voltage.
- **Summing amplifier:** This is a circuit that produces an output voltage that is proportional to the sum of two or more input voltages.
- **Differential amplifier:** This is a circuit that produces an output voltage that is proportional to the difference between two input voltages.
- **Integrator:** This is a circuit that produces an output voltage that is proportional to the integral of the input voltage with respect to time.
- **Differentiator:** This is a circuit that produces an output voltage that is proportional to the derivative of the input voltage with respect to time.

16 Mention the applications of TIMERS

1. TIMERS
2. Dimmer circuits
3. PULSE GENERATOR CIRCUITS
4. ALARMING CIRCUITS
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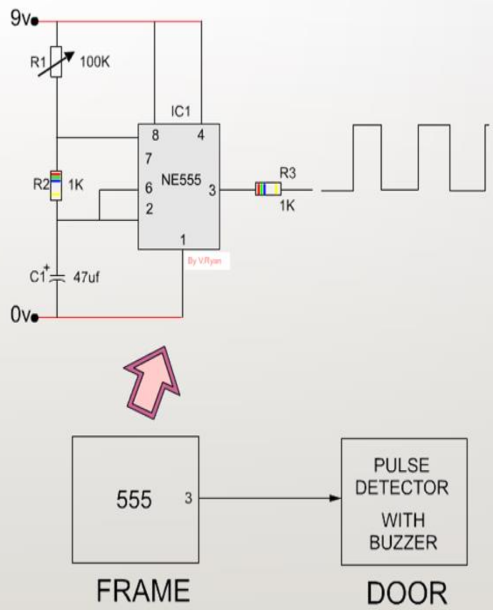

17. Draw the block diagram of op- amp explain its features

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