Now, A angle b/w I_{RY} and I_{BR} is 120° the angle b/w I_{RY} and $-I_{BY}$ is 180° − 120° = 60°

$$I_R = |I_L| = \sqrt{I_{RY}^2 + I_{YB}^2 + 2 I_{RY} I_{YB} \cos 60°}$$

$$I_L = \sqrt{I_{ph}^2 + I_{ph}^2 + 2 I_{ph} I_{ph} \frac{1}{2}}$$

$$I_L = \sqrt{3}\, I_{ph}$$

Similarly

$$I_R = \sqrt{3}\, I_{ph}$$

$$I_B = \sqrt{3}\, I_{ph}$$

Hence, in delta connection line current is root three times of phase current.

Line current = $\sqrt{3}$ × Phase current

This is all about Delta connection In a 3-Phase System.

Chapter: 3

1. What are the difference between common base, common emitter and common collector configuration?

Ans: Common base (CB)

This configuration provides voltage gain but no current gain. The base of the transistor is common to both the input and output circuits.

Common collector (CC)

This configuration provides current gain but no voltage gain. It also known as the emitter follower. The collector is common between the emitter and base.

Common emitter (CE)

This configuration provides both current gain and voltage gain. The emitter is connected between the collector and base. It's the most commonly used configuration and provides the highest voltage gain

2. Explain the following terms.

i) Semiconductor material

A semiconductor is a material that has an electrical conductivity between that of a conductor and an insulator.

- These materials are used extensively in electronic devices such as transistors, diodes and integrated circuits (ICs).

Eg: Silicon and Germanium

(ii) P-Type material

A semiconductor that has a higher hole density than electron density. The majority carriers in a p-type semiconductor are holes, and minority carriers are electrons.

- In the p-type trivalent impurities such as Aluminium, Gallium and Indium.

(iii) Doping

The process of adding impurities to an intrinsic semiconductor to modify its electrical properties.

- This is done to control the type (P-type or N-type) and concentration of charge carriers in the material.

iv. Ripple Factor

The ripple factor is a measure of the AC (alternating current) component present in the output of a rectifier circuit.

v. N-Type Material

When the small amount of pentavalent elements impurities (P, As, Sb, Bi) is doped in pure semiconductor ~~soit is called~~ than it results N-type semiconductor

- N-type semiconductor the electron becomes the majority charge carrier and hole become minority charge carrier

3. Explain about unbaired and biased conditions of PN junction diode with its V-I characteristics.

Ans: Unbaired: A p-n junction is said to be in the unbaired state when not external voltage is supplied to the junction.

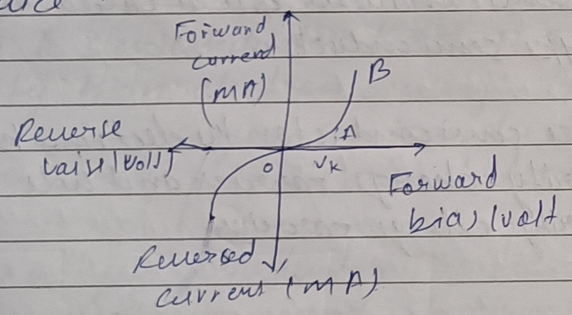
- When in an unbaised position there is always a barrier present in the p-n junction.

baised condition

When an external voltage is applied the diode is in a baised condition.

- There are two types of biasing:
Forward Bias and Reverse Biase

V-I characteristics stand for voltage - current characteristic stand of an electrical component or device.

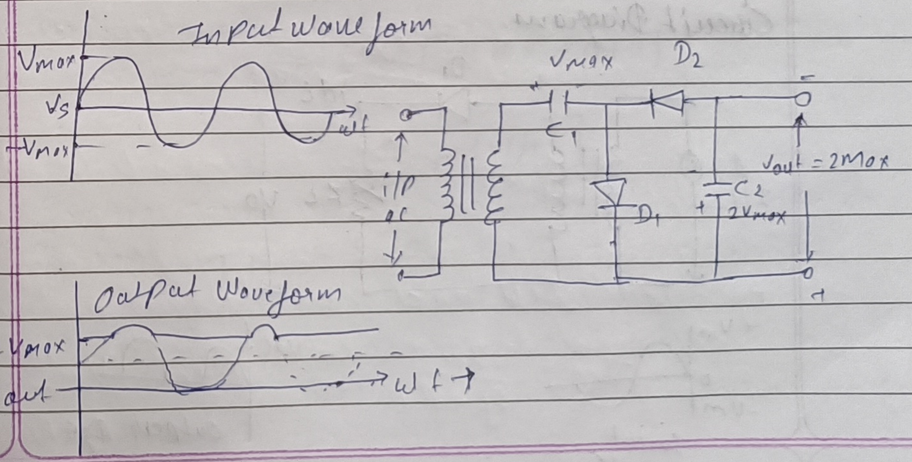


4. What is the use of voltage multiplier? Explain about half wave voltage doubler with it input & output wave form

Ans: Voltage multipliers can be used to generate a few volts for electronic appliances, to millions of volts for purposes such as high-energy physic experiment and lightning safety testing.

- A multiplier circuit that generates a DC output voltage having amplitude twice the maximum amplitude of the AC input voltage is known as voltage double

In a half-wave voltage doubler, a capacitor is charged on one half-cycle of the input AC wave form and discharges through a diode during the other half-cycle. This process effectively doubles the voltage across the load.



5. What is rectifier? Explain about half wave rectifier and derive the equation for Idc, Vdc and Irms.

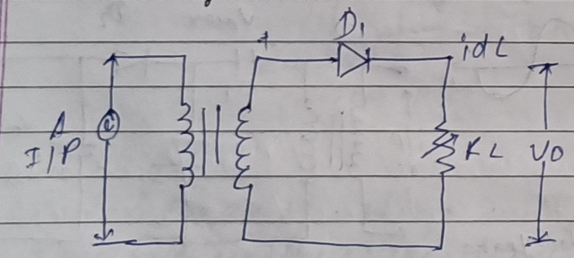
Ans:

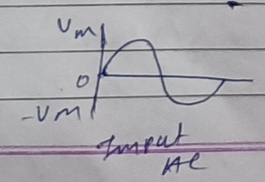
A rectifier is an electrical device used to convert alternating current (AC) into direct current (DC) by allowing to flow through the device in one direction only.

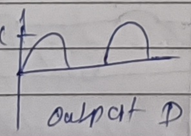
Half Wave Rectifier:

The half wave rectifier utilizes alternating half cycles of the input sinusoid. Half-wave rectifiers can be easily constructed using only one diode, but less efficient than full wave rectifiers.

Circuit Diagram







(A) Main Part of Circuit

(1) Transformer
(2) A Resistive load
(3) A Diode

$i = I_m \sin \omega t$ for, $0 \le \omega t \le \pi$

$i = 0$ for, $\pi \le \omega t \le 2\pi$

To find the rms value of half wave rectifier, we need to calculate the current across the load.

$I_{dc} = I_d = I_m \sin \omega t$

$$I_{dc} = \frac{1}{2\pi} \int_0^{\pi} I_m \sin \omega t \, d\omega t$$

$$= \frac{1}{2\pi} I_m \left[-\cos \omega t \right]_0^{\pi}$$

$$= \frac{I_m}{2\pi} \left[-\cos \pi + \cos 0 \right]$$

$$= \frac{I_m}{2\pi} \left[-(-1) + 1 \right]$$

$$I_{dc} = \frac{I_m}{\pi}$$

o RMS Value of Current

$$I = \sqrt{\frac{1}{2\pi}\int_0^{\pi} i^2\, d\omega t}$$

$$I_{rms} = \sqrt{\frac{1}{2\pi}\int_0^{\pi} I_m^2 \sin^2 \omega t\, d\omega t}$$

$$= \sqrt{\frac{I_m^2}{2\pi}\int_0^{\pi} \sin^2 \omega t\, d\omega t}$$

$$= \sqrt{\frac{I_m^2}{2\pi}\int_0^{\pi} \frac{1-\cos 2\omega t}{2}}$$

$$= \frac{I_m}{2}\sqrt{\frac{1}{\pi}\left[\omega t - \frac{\sin 2\omega t}{2}\right]_0^{\pi}}$$

$$= \frac{I_m}{2}\sqrt{\frac{1}{\pi}\left(\pi - \frac{\sin 2\pi}{2}\right) - 0}$$

$$= \frac{I_m}{2}\sqrt{\frac{\pi}{\pi}}$$

$$I_{rms} = \frac{I_m}{2}$$

* R_f = Diode Resistance in on State

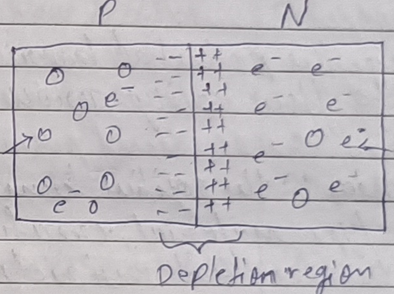
$$I_m = \frac{V_m}{R_f + R_L} \rightarrow I_{dc} = \frac{V_m}{(R_f + R_L)\pi}$$

$$V_{dc} = I_{dc} \cdot R_L = \frac{I_m}{\pi} \cdot R_L$$

$$V_{dc} = \frac{V_m}{(R_f + R_L)\pi} \cdot R_L$$

6. Explain formation depletion region in PN junction diode.

Ans



The depletion layer of a P-N junction diod is due to doping of two materials and diffusion of charge carriers.

This space near the junction carrying fixed positive and negative charges is known as depletion region or depletion layer. Hence, the diffusion of holes and electrons in N-type region and P-type region to neutralize the both regions of the PN junction is the cause of depletion region formation

7. Write a short note on forward bias and reverse bias in PN junction.

Ans: Forward bias: The positive terminal of the voltage potential is connected to the p-type while the negative terminal is connected to the n-type material.

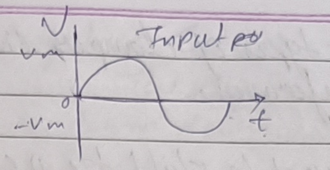
This reduce the potential barrier, allowing current to flow easily across the junction

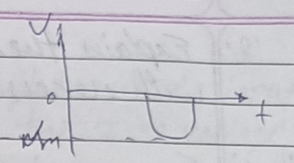
Reversed bias: The positive terminal is connected to the N-type material, creating a large potential barrier that restricts current flow.

8. Explain the unbiased series clipper circuit with necessary waveforms.

Ans: Unbiased series clipper acts as a half wave rectifier.

In this case input is a sine wave and diode is considered to be an ideal diode.





9. Compare the Half-Wave rectifier and full wave rectifier.

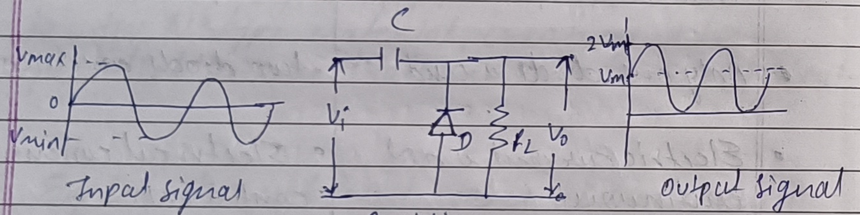
Ans:	Half Wave Rectifier	Full-Wave Rectifier
•	Converts only one-half of the AC input cycle into DC output.	• Converts both halves of the AC input cycle into DC output
•	Only one diode is used	• two diode are used
•	Electric current is not continuous	• Electrical current is continuous.
•	In the negative half cycle of a.c rectification will not take place	• In the negative half cycle of a.c also rectification will take place.
•	Efficiency is less	• Efficiency is high.
•	Ripples is less	• Ripple is high

10. Explain the different types of clamper circuit with necessary waveforms.

Ans: Camper circuits are used to shift the DC level of a waveform. There are two main types of clamper circuits:-

1. Positive Camper Circuit

In positive clamper circuit, the input wave form is shifted upward above the 0V referenced line, making the DC level positive



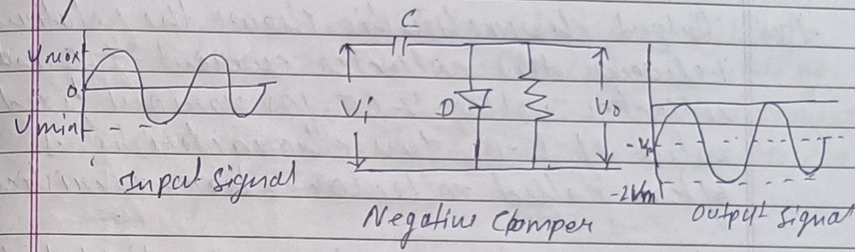
Positive Clamper

- During the negative half cycle of the input waveform, the diode is forward biased, and the capacitor charges to the peak value of the input singnal through the diode.

2. The output wave form is shifted upward, making the DC level positive.

2. Negative Camper

The negative clamper shift the whole input waveform downward below the zero voltage reference.



- During the positive half cycle of the input waveform, the diode is forward-biased, allowing the capacitor to the charg to the peak value of the input signal through the diode.

- When the input wave form becomes negative, the diode becomes reversed biased, and the capacitor holds the charge.

- The output wave form is shifted downward, making the DC level negative.

11. Draw the output characteristics of BJT. Explain the different operating regions in the output characteristic.

Ans: Output characteristic shows the relation between the collector current I_C and collector voltage V_CE, for various fixed value of I_B. This characteristic is often called collector characteristics.

The output characteristic can be divided into three region

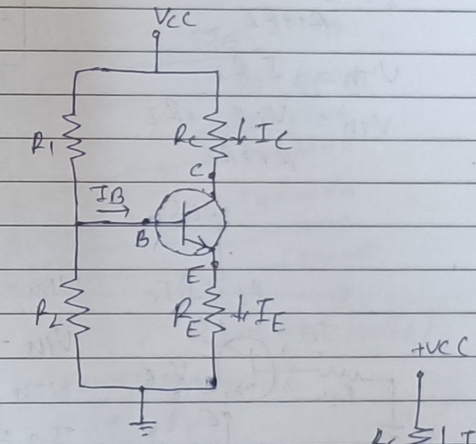
1. Active Region: The transistor is said to be in active region when both input as well as output voltage are varying.

2. Saturation region: When the output voltage is constant and the only input voltage is varying.

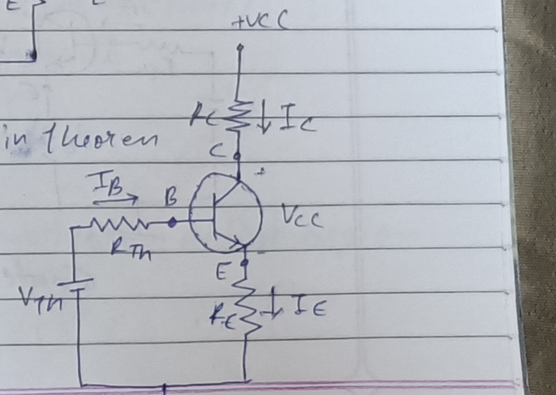
3. Cut-off region: When both input, as well as output voltage are zero.

12. Explain Voltage divider bias circuit and also explain about DC load line & Q-point.

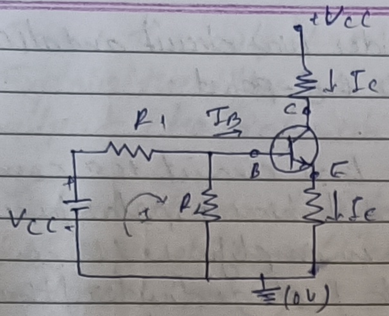
Ans:- The voltage divider bias circuit is a common configuration used to bias bipolar junction transistors (BJTs) in amplifiers. It consists of a resistor network (voltage divider) that provides the necessary bais bias for the transistor. Here is brief explanation:

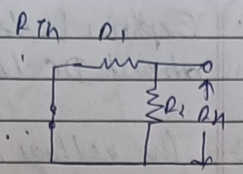


Using thevinin theorem



Emitter bias





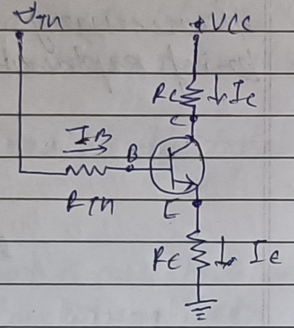
$$R_{th} = \frac{R_1 R_2}{R_1 + R_2}$$

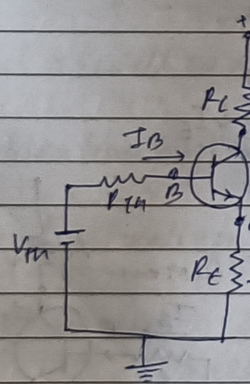
V_{th}

$$I = \frac{V_{CC}}{R_1 + R_2}$$

$$V_{th} = I R_2$$

$$V_{th} = \frac{V_{CC}}{R_1 + R_2} \cdot R_2$$





$$V_{th} - I_B R_{th} - V_{BE} - I_E R_E = 0$$

$$V_{th} - I_B R_{th} - V_{BE} - (\beta+1) I_B R_E = 0$$

$$V_{th} - I_B [R_{th} + (\beta+1) R_E] - V_{BE} = 0$$

$$I_B = \frac{V_{th} - V_{BE}}{R_{th} + (\beta+1) R_E}$$

$$I_C = \beta I_B$$

Emitter Bias

$$I_C = \frac{\beta (V_{th} - V_{BE})}{R_{th} + (\beta+1) R_E}$$

$R_{th} \ll (\beta+1) R_E$

By KCL

$$V_{CC} - I_C R_C - V_{CE} - I_E R_E = 0$$

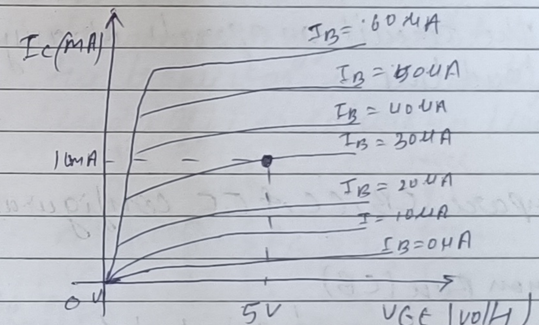
$$I_E \simeq I_C$$

$$V_{CC} - I_C (R_C + R_E) - V_{CE} = 0$$

$$V_{CE} = V_{CC} - I_C (R_C + R_E)$$

Common Emitter (CE) Configuration

Output characteristics



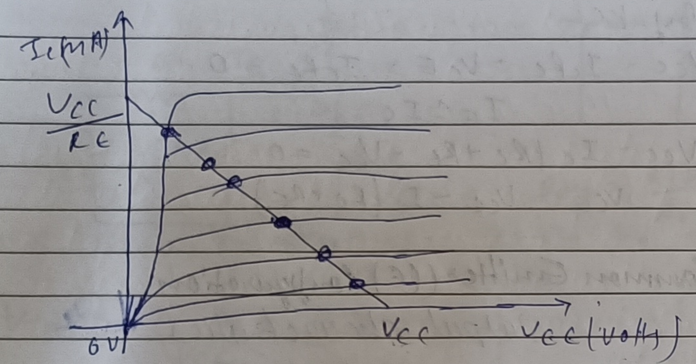
Operating point

or

Q point

Q point can be anywhere in active region.

Load line



The circuit can operate at any point on the load line

13. Compare CB, CC, & CE configuration

Ans: Common Base (CB)

Has no current gain but has voltage gain. It has a high voltage gain. It's commonly used for amplifiers that require low input impedance, such as microphones.

Common Collector (CC)

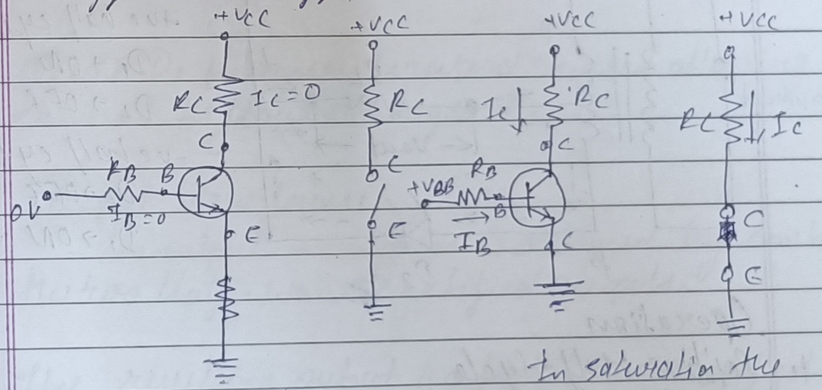
Has current gain ~~but~~ and voltage gain. It's ~~now~~ has a very high current gain, ~~but~~ the lowest voltage gain.

Common Emitter (CE)

Has current gain and voltage gain. It's popular in amplifier circuits because it provides the voltage gain required for most applications.

14. Explain transistor as a switch along with its operating regions.

Ans: A BJT can be used as a switching device in logic circuits to turn on or off current to a load. As a switch, the transistor is normally in either cutoff (load is off) or saturation (load is ON).

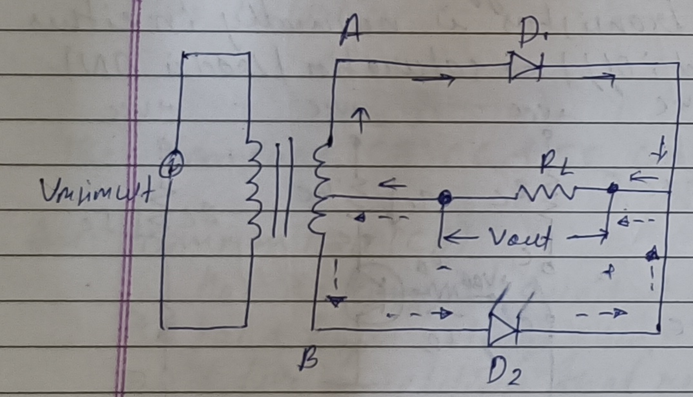


In cutoff the transistor look like an open switch

In saturation the transistor looks like a closed switch

15. Draw Full wave rectifier circuit for center tapped transformer. Explain the operation with input and output wave form.

Ans: The center Tapped Fullwave Rectifier employs a transformer with the secondary winding AB tapped at the centre point C. It converts the AC input voltage into DC voltage. The two diode D_1 and D_2 are connected in the circuit as shown in the circuit diagram.



+ve half cycle
$D_1 \rightarrow$ ON
$D_2 \rightarrow$ OFF
-ve half cycle
$D_2 \rightarrow$ OFF
$D_1 \rightarrow$ ON

Operation

1. Positive Half-Cycle

- During the +ve half cycle of the AC input, the upper end of the secondary winding becomes positive and the lower end negitive.
- Diode D_1 becomes forward biased, allowing current to flow through it.
- Diode D_2 become reverse-biased and blocks current flow.

2. Negative Half-Cycle

During the negative half-cycle, the upper end of the secondary winding becomes negative, and the lower end becomes positive.

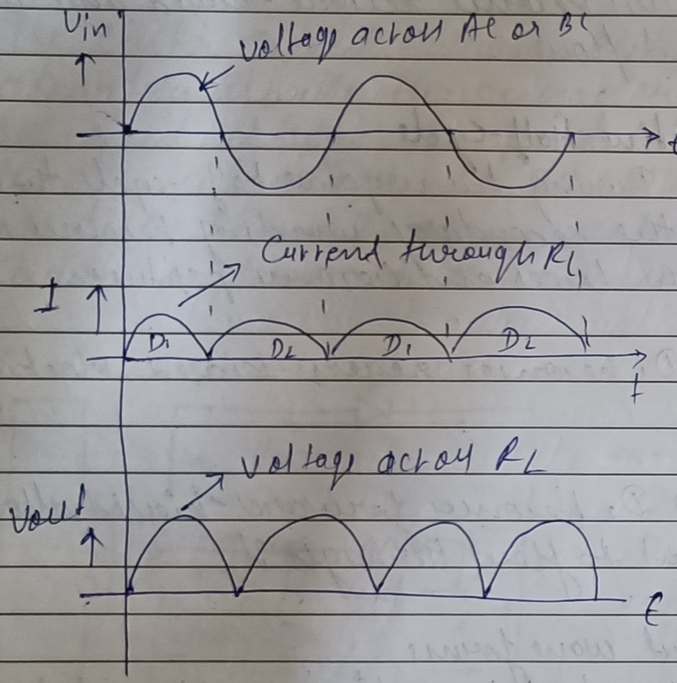
- Now D_1 becomes reverse-biased, blocking current flow
- Diode D_2 becomes forward-biased allowing current to flow through it.

3. Output wave form

The output waveform is obtained by combining the two half-wave rectified outputs.

- The resulting output is a full-wave rectified waveform with both positive and negative halves converted into a unidirectional flow.

The wave diagram of the input voltage, the current flowing through the load, and the output voltage developed across the load.

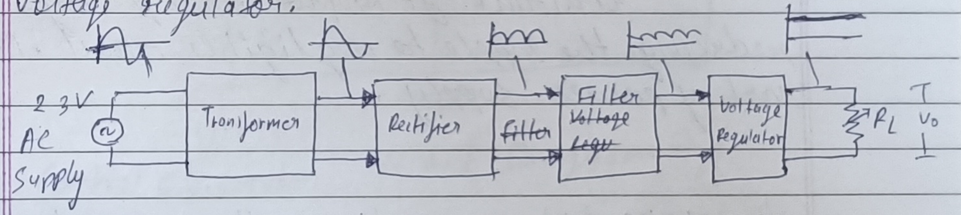


Chapter :-4

16. Briefly explain all the blocks for DC regulated power supply. Which IC we use to generate +9V at the output side?

Ans: A regulated power supply is an electronic device that maintain constant output voltage against the variation in input voltage, load current and temperature.

- It provides the constant output voltage.
- Regulated power supply consist of four basic element namely a transformer, a rectifier, a filter and a voltage regulator.



- Power Supply: A group of circuits that convert the standard ac voltage (220 V, 60 Hz) provided by the wall outlet to constant dc voltage

- Transformer: A device that step up or step down the AC voltage provided by the wall outlet to a desired amplitude through the action of a magnitude field.

- Rectifier: A diode circuit that converts the AC input voltage to a pulsating dc voltage.

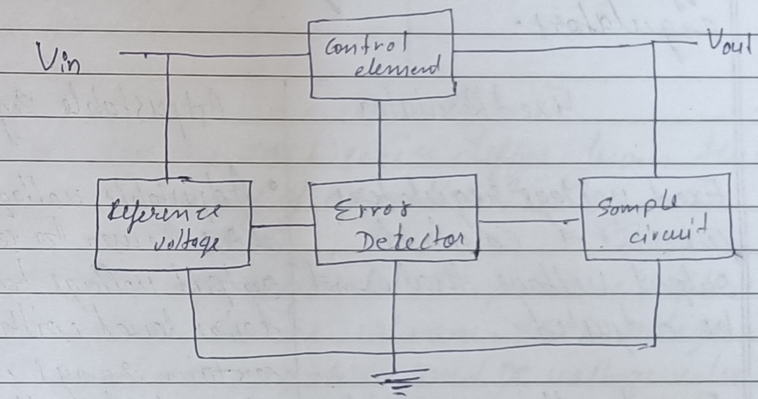
- Filter: A circuit used to reduce the fluctuation in the rectified output voltage or ripple. This provides a steadier dc voltage.

- Regulator: A circuit used to produces a constant dc output voltage by reducing the ripple to negligible amount. One part of power supply.

The 7809 IC is a positive voltage regulator that can provide a stable +9V output with a 12V input supply. The LM7809 is a 9V voltage regulator that limits the voltage output to 9V and draws a 9V regulated power supply.

17. Explain the fundamental principle behind a series voltage regulator.

Ans: A series regulator is placed between a power supply and a load. It regulates the output voltage by adjusting the value of a variable resistor according to changes in input voltage or output current.



Block Diagram

1. Control Element:
Control element is a part of series regulator circuit which is control the required voltage or reference voltage.

2. Sample Circuit
It will take a sample change in a output voltage

2- Error Detector

Error Detector will compair Sample circuit value and reference value. and it will geberate the signal if any change will be reference value and output value.

18. Differentiate between fixed and ajustable voltage regulators.

Ans:

Fixed Regulator	Adjustable Regulator
• Fixed voltage regulators provide a constand output voltage that cannot be adjusted.	• Adjustable voltage regulato allow the user to set the output voltage to a desire level within a certain range.
• Fixed voltage regulator can be positive or negative	• Adjustable voltage regulator can also be positive or negative
• Simpler and easier to use	• Typically more complex than fixed regulators due to the added circuitry for adjustability.
• Adjustable voltage regulator requires a ~~few~~ few external components to ~~operate~~ operate	• Fixed voltage regulators requires almost no external components
• Examples include 7805(5V) 7812(12V) and 7905(-5V) fixed voltage regulator	• Examples include LM317 and LM338 adjustable voltage regulator

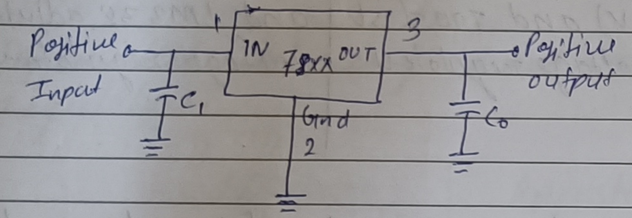
19. How does the 79XX series differ from the 78XX series in terms of operation?

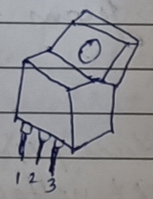
Ans: 78XX voltage regulator ICs produce positive fixed DC voltages values, whereas, 79XX voltage regulator ICs produce negative fixed DC voltage values.

- Both 78XX and 79XX voltages regulator ICs have 3 pins each and the third pin is used for collecting the olitput from them.
- 7805 voltage regulator IC produces a DC voltage of +5 volts
- 7905 voltage regulator IC produces a DC voltage of -5 volts.

* Fixed Positive Voltage Regulator

- The series 78xx regulators are the three-terminal devices that provide a fixed positive output voltage.

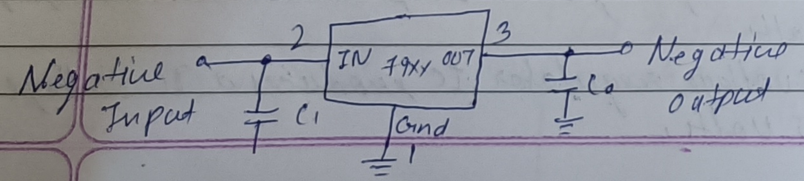




Pin 1. Input
2. ~~output~~ Ground
3. Output

* Fixed - Negative Voltage Regulators

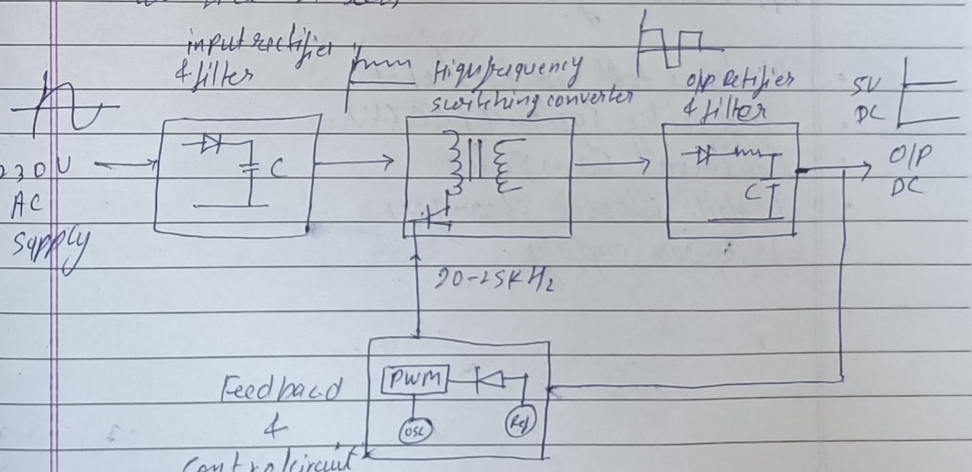
- The series 79xx regulators are the three-terminal IC regulators that provide a fixed features and characteristics are different.



20. Provide an overview of the operation principle of switched-mode power supply (SMPS).

Ans: SMPS means Switch Mode Power Supply. This is used for AC to DC conversion. This works on the principle of switching regulation.

- The SMPS system is highly reliable, efficient and
- noiseless and compact because the switching ~~regulation~~ is done at very high rate in the order of several KHz to MHz.
- It handle large amount of current without taking lot of space.
- Work on very High Frequency.
- Overall size is less.



* Advantage of SMPS

- Lower Weight
- Smaller size
- High efficiency
- Lower Power ~~Dissipation~~ Dissipation
- Wide AC input voltage Range
- Reduce the cost

* DisAdvantage SMPS

- Complexity of the Circuit

- Application of SMPS

- Medical industries
- Security System (CCTV)
- Personal Computer
- Mobile Phone chargers
- EV Power supply.

21. What are the advantages and challenges associated with using SMPS in electronic devices?

Ans:- Advantage of SMPS

- Lower Weight
- Smaller size
- High efficiency
- Lower Power Dissipation
- Wide AC input voltage Range
- Reduce the cost

- SMPS can have some challenges, including.

- Complexity of the circuit
- High Frequency energy
- Random crash, hang, reboot
- Transformer saturation
- Overloading
- Electromagnetic Interference (EMI)
- Radio frequency noise

Chapter :- 5

22. Explain the difference b/w sensors and transducers.

Ans:-

Sensor	Transducer
• A sensor is a device that detects a change in a physical environment.	• A transducer is a device that converts one form of energy into another.
• A sensor is not necessarily a transducer.	• Each transducer includes a sensor as a component.
• A sensor is itself a component	• The transducer converts physical quantity or energy into an electrical signal.
• Sensor converts physical quantities or energy into non-electrical signal.	• Transducer is made of a sensor and a signal conditioning circuit.
• A sensor does not require external power to operate.	• A passive transducer requires an external power source to operate.
• A sensor is a simple device	• A transducer has a complicated electrical circuit used for energy conversion.
• Eg: thermometer, pressure sensor, ultrasonic sensor, light sensor, etc	Eg: thermistor, potentiometer, piezoelectric transducer, Hall Effect transducer etc.

23. Define what a sensor is and how it functions in the context of electronic systems.

Ans:- Sensor is a electrical device that produced an output signal for the purpose of sensing a physical phenomena. The input can be light, heat, motion, moisture, pressure or any numbers of other environmental phenomena

- Based on the measurement their are different types of sensor
  - Temperature Sensors
  - Pressure Sensors
  - Position sensors
  - Fluid Property Sensors
  - Humidity Sensors.
  - Moisture Sensors
- Sensors can output whether an objects is present or not present (binary) or what measurement value has been reached (analog or digital).
- In electronic systems, sensors play a crucial role by providing input data for control, monitoring or feedback purposes.

24. Classify transducers based on their primary function in the context of electronic systems. (Eg. input, output, control)

Ans: Transducers are devices that convert one form of energy into another. They can be classified based on their primary function as following:

1. Primary or Secondary transducers

Primary transducers are directly exposed to the physical stimulus and convert it into an electrical signal. Secondary transducers are indirectly involved in the conversion process.

2. Analog and digital transducers

Analog transducers converts input signals into output signals that are a continuous function of time. Digital transducers convert input signal into output signals that are in the form of pulses.

3. Active and Passive transducers

Active transducers are self-generating devices that draw power from the input applied. Passive transducers require power from an external source for transduction.

25. Categorize electronic sensors based on their sensing principles (e.g. optical, thermal, pressure).

Ans: Sensors can be categorized by the signals they create and obtain. These categories include:

1. Temperature sensors: Measure heat or temperature on a machine part.

2. Ultrasonic sensors: Detect the presence of an object.

3. Thermistors: Made of semiconductors, these thermally sensitive resistors are commonly used to detect small temperature change.

4. Proximity Sensors: A proximity sensor is a non-contact type sensor that detects the presence of an object.

5. Infrared Sensor (IR Sensor)
IR sensors or Infrared sensor are light based sensors that are used in various application like proximity and Object Detection.

6. Alcohol sensor: An Alcohol sensor detects alcohol.

7. Smoke and Gas Sensors: One of the very useful sensors in safety related application are Smoke and Gas sensor.

26. Explain the working principles of at least three different types of sensors.

Ans. Here are the working principles of three different types of sensors:

1. Temperature Sensors

One of the most common and most popular sensors is the Temperature sensor. A temperature sensor, as the name suggests senses the temperature i.e. it measures the change in the temperature.

There are different types of Temperature sensors like temperature sensor IC's, Thermistors, Thermocouples, RTD (Resistive Temperature Devices) etc.

2. Ultrasonic Sensor

An Ultrasonic sensors is a non-contact type device that can be used to measure distance as well as velocity of an object. An Ultrasonic sensor works based on the properties of the soundwaves with frequency greater than that of the human audible range.

3. Smoke and Gas Sensors.

One of the very useful sensors in safety related applications are Smoke and Gas sensors. Almost all offices and industries are equipped with several smoke detectors which detect any smoke due to fire and sound an alarm.