SNS COLLEGE OF ENGINEERING
Coimbatore-35
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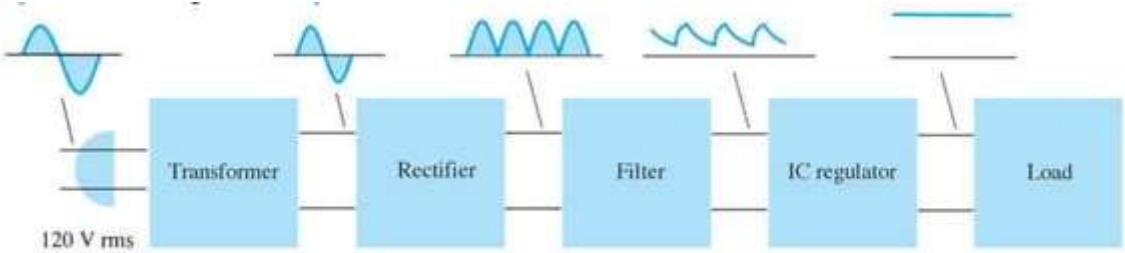
DEPARTMENT OF CSE (IoT)

23ECT102- ELECTRONIC DEVICES AND CIRCUITS

I YEAR/ II SEMESTER

UNIT 5 – **Rectifier & Filters**

voltage regulator

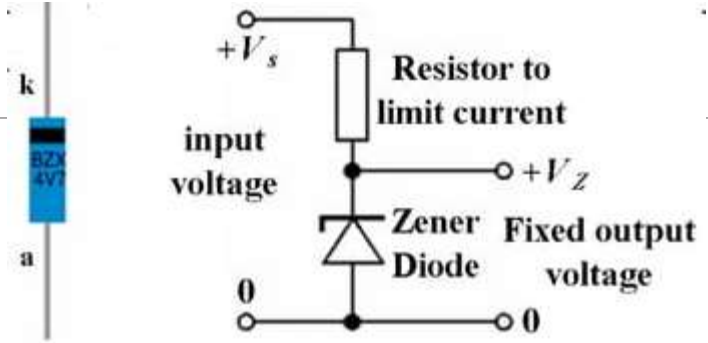


- ***Filter***: a circuit used to reduce the fluctuation in the rectified output voltage or ripple. This provides a ***steadier*** dc voltage.
- ***Regulator***: a circuit used to produces a ***constant*** dc output voltage by reducing the ripple to negligible amount. One part of power supply.

Introduction

Regulator - Zener diode regulator

- For low current power supplies - a simple voltage regulator can be made with a resistor and a zener diode connected in reverse.

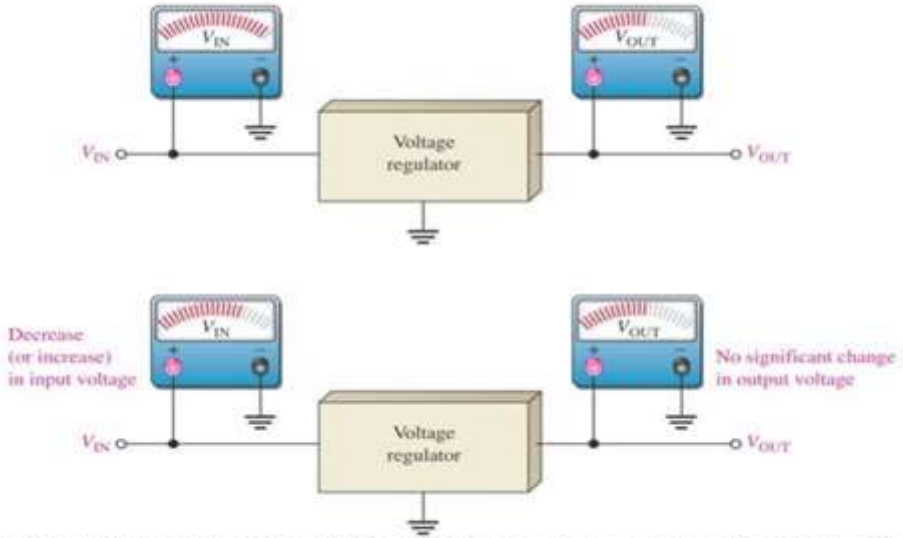


Voltage Regulation

- Two basic categories of voltage regulation are:
  - line regulation
  - load regulation

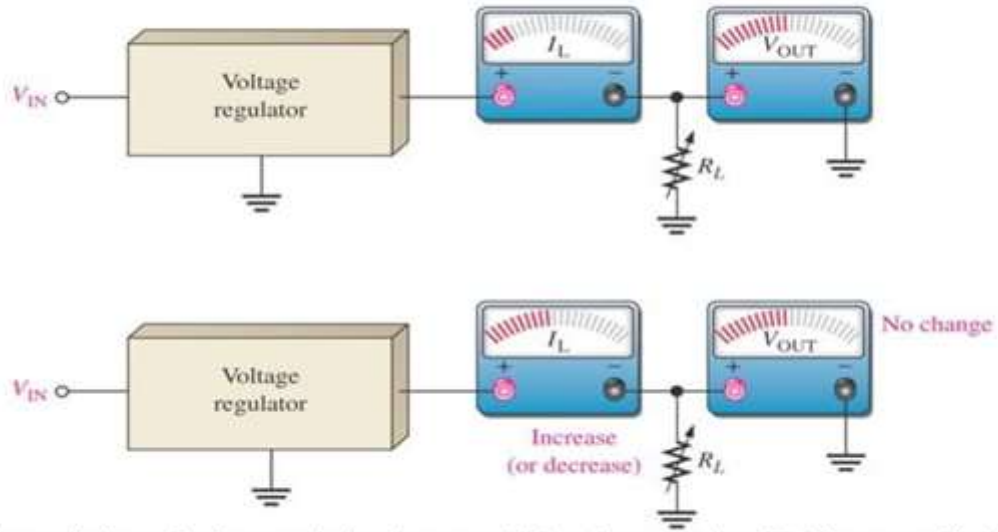
- The purpose of **line regulation** is to maintain a nearly constant output voltage when the **input voltage** varies.
- The purpose of **load regulation** is to maintain a nearly constant output voltage when the **load** varies

Line Regulation



Line regulation: A change in input (line) voltage does not significantly affect the output voltage of a regulator (within certain limits)

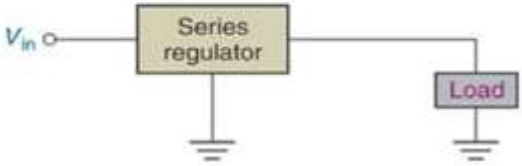
Load Regulation



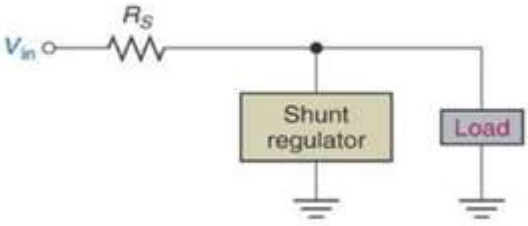
Load regulation: A change in load current (due to a varying R_L) has practically no effect on the output voltage of a regulator (within certain limits)

Types of Regulator

- Fundamental classes of voltage regulators are **linear regulators** and **switching regulators**.
- Two basic types of linear regulator are the **series regulator** and the **shunt regulator** .
- The series regulator is connected in **series** with the load and the shunt regulator is connected in **parallel** with the load.



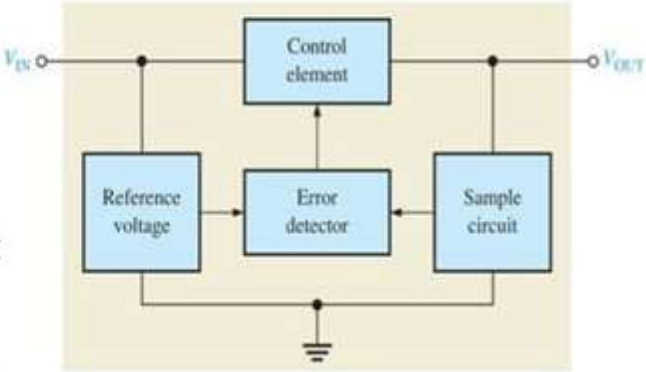
(a)



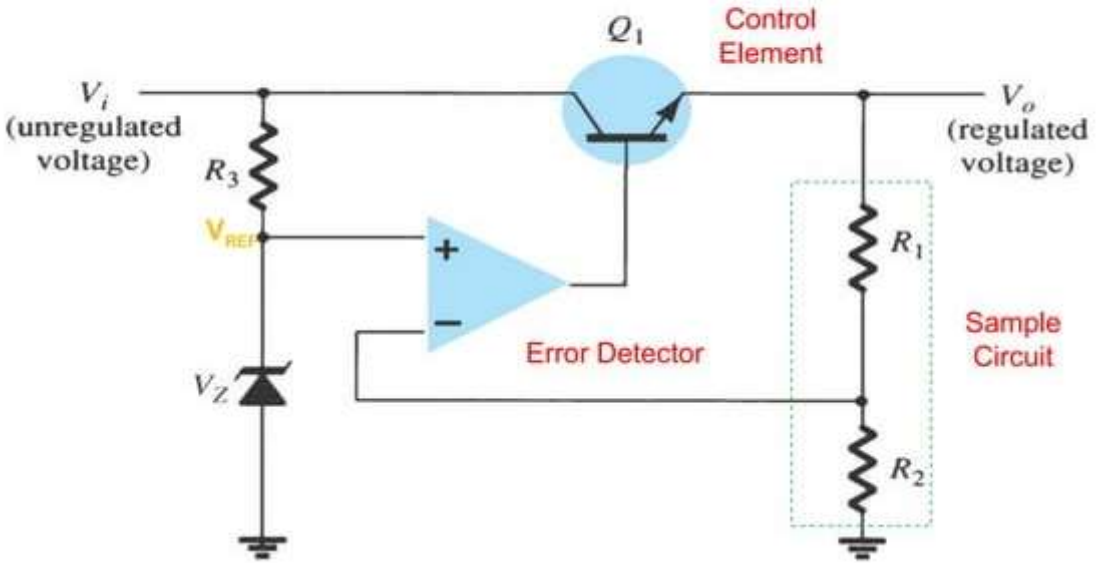
(b)

Series Regulator Circuit

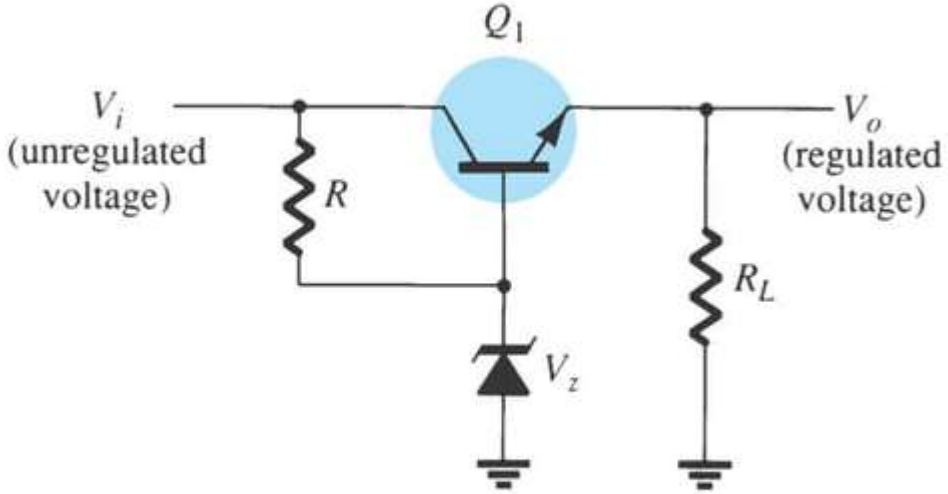
- **Control element** in series with load between input and output.
- Output **sample circuit** senses a change in output voltage.
- **Error detector** compares sample voltage with reference voltage → causes control element to compensate in order to maintain a constant output voltage.



Op-Amp Series Regulator



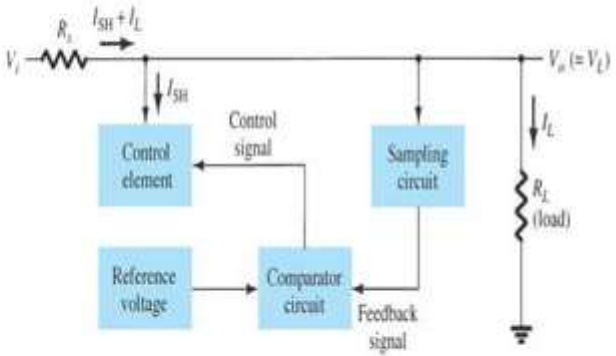
Transistor Series Regulator



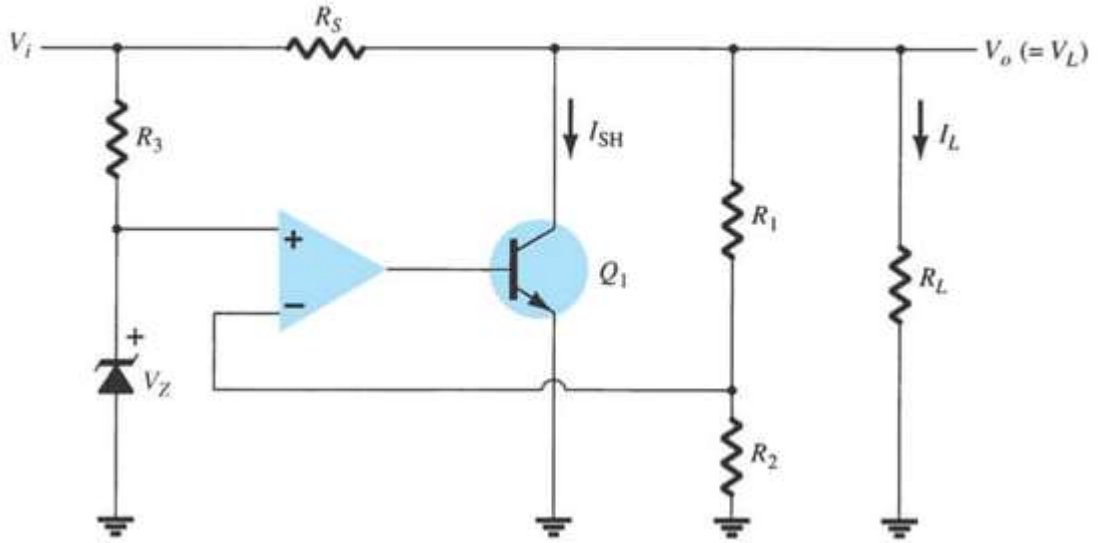
- The transistor Q_1 is the series control element.
- Zener diode provides the reference voltage.

Shunt Regulator Circuit

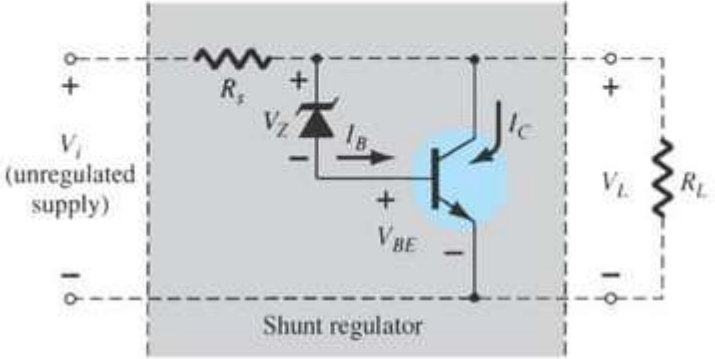
- The unregulated input voltage provides current to the load.
- Some of the current is pulled away by the **control element**.
- If the load voltage tries to change due to a change in the load resistance, the **sampling circuit** provides a feedback signal to a **comparator**.
- The resulting difference voltage then provides a control vary the amount of the current signal to shunted away from the load to maintain the regulated output voltage across the load.



Op-Amp Shunt Regulator



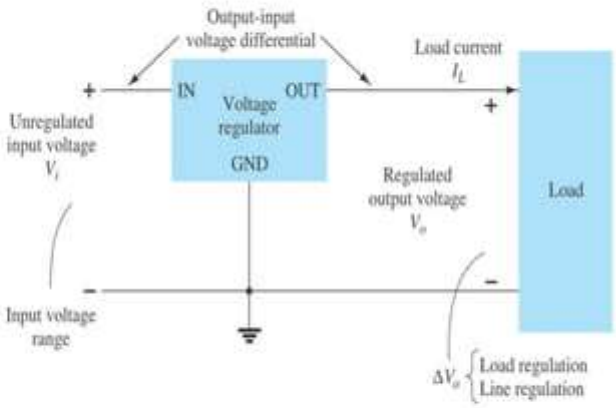
Transistor Shunt Regulator



- The control element is a transistor, in parallel with the load. While, the resistor, R_S, is in series with the load.
- The operation of the transistor shunt regulator is **similar** to that of the transistor series regulator, except that regulation is achieved by **controlling the current through the parallel transistor**

Switching Regulator

- The switching regulator is a type of regulator circuit which its efficient transfer of power to the load is greater than series and shunt regulators because the transistor is not always conducting.
- The switching regulator passes voltage to the load in pulses, which then filtered to provide a smooth dc voltage.



IC Voltage Regulators

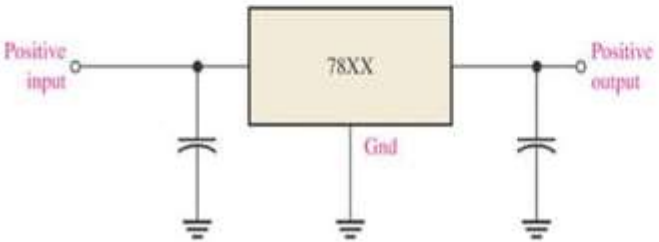
- Several types of both linear (series and shunt) and switching regulators are available in integrated circuit (IC) form.
- Single IC regulators contain the circuitry for:
  (1) reference source
  (2) comparator amplifier
  (3) control device
  (4) overload protection
- Generally, the linear regulators are three-terminal devices that provides either positive or negative output voltages that can be either fixed or adjustable.

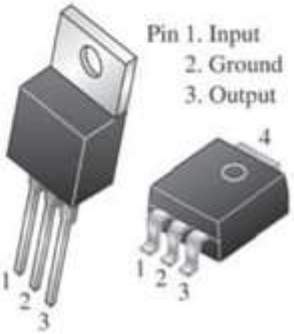
Fixed Voltage Regulator

- The fixed voltage regulator has an unregulated dc input voltage V_i applied to one input terminal, a regulated output dc voltage V_0 from a second terminal, and the third terminal connected to ground.

Fixed-Positive Voltage Regulator

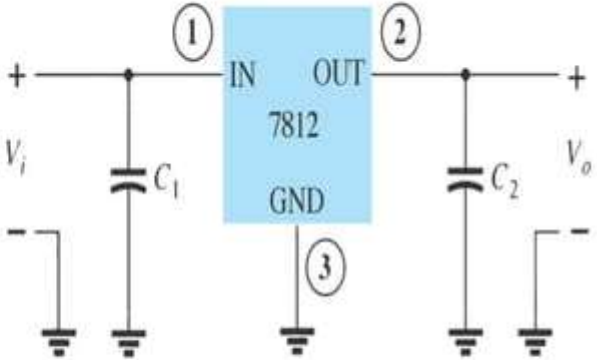
- The series 78XX regulators are the three-terminal devices that provide a fixed positive output voltage.





Fixed Voltage Regulator

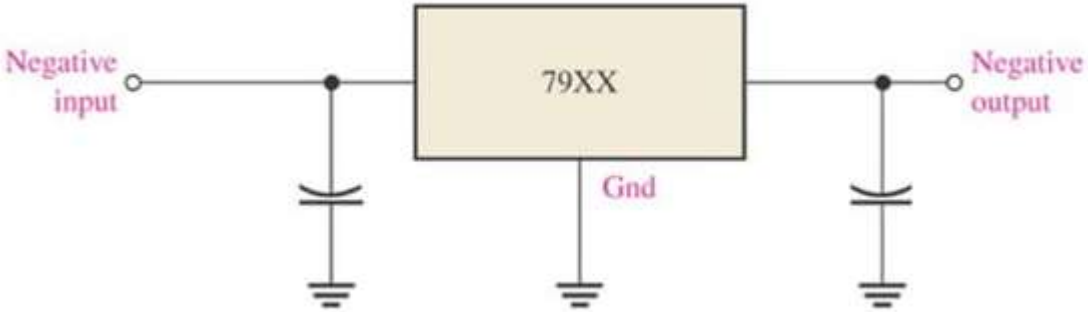
- An unregulated input voltage V_i is filtered by a capacitor C_1 and connected to the IC's IN terminal.
- The IC's OUT terminal provides a regulated +12 V, which is filtered by capacitor C_2.
- The third IC terminal is connected to ground (GND)



Fixed Voltage Regulator

Fixed-Negative Voltage Regulator

- The series 79XX regulators are the three-terminal IC regulators that provide a fixed negative output voltage.
- This series has the same features and characteristics as the series 78XX regulators except the pin numbers are different.



Fixed Voltage Regulator

Adjustable-Voltage Regulator

- Voltage regulators are also available in circuit configurations that allow to set the output voltage to a desired regulated value.
- The LM317 is an example of an adjustable-voltage regulator, can be operated over the range of voltage from 1.2 to 37 V