



# **SNS COLLEGE OF TECHNOLOGY**

**(An Autonomous Institution)**

**COIMBATORE-35.**



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Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai.

## **DEPARTMENT OF AUTOMOBILE ENGINEERING**

**COURSE NAME : 19AUB204 – AUTOMOTIVE ELECTRICAL AND ELECTRONICS ENGINEERING**

**II YEAR / IV SEMESTER**

**Unit 3 – Charging System**

**Topic : Compensated Voltage Regulator**



# COMPENSATED VOLTAGE REGULATOR



- ❖ A compensated voltage regulator is a type of voltage regulator that includes compensation circuitry to improve its stability and transient response.
- ❖ The compensation is designed to mitigate the effects of changes in load current, input voltage, temperature variations, and other factors that can affect the performance of the regulator



# COMPONENTS



- ❖ **Error Amplifier:** Like in basic voltage regulators, a compensated voltage regulator typically includes an error amplifier. This amplifier compares the output voltage to a reference voltage and generates an error signal based on the difference between the two.
- ❖ **Compensation Network:** The compensation network consists of passive components such as resistors, capacitors, and sometimes inductors. These components are strategically placed in the feedback loop of the error amplifier to shape the frequency response of the regulator and improve its stability.



# COMPONENTS



- ❖ **Frequency Compensation:** Compensation techniques are employed to stabilize the feedback loop of the voltage regulator over a range of frequencies. This is particularly important in switching voltage regulators, where fast transients and high-frequency oscillations can occur.
- ❖ **Feedback Network:** The feedback network provides a path for the output voltage to be compared to the reference voltage and fed back to the error amplifier. The compensation network may interact with this feedback network to adjust the loop gain and phase margin of the regulator.



# COMPONENTS



- ❖ **Transient Response Improvement:** Compensation techniques aim to improve the transient response of the regulator, ensuring that it can quickly recover from sudden changes in load current or input voltage without significant overshoot or undershoot.
- ❖ **Temperature Compensation:** Some compensated voltage regulators include temperature compensation circuitry to maintain stable operation over a wide temperature range. This may involve using temperature-sensitive components or incorporating temperature-dependent feedback mechanisms.



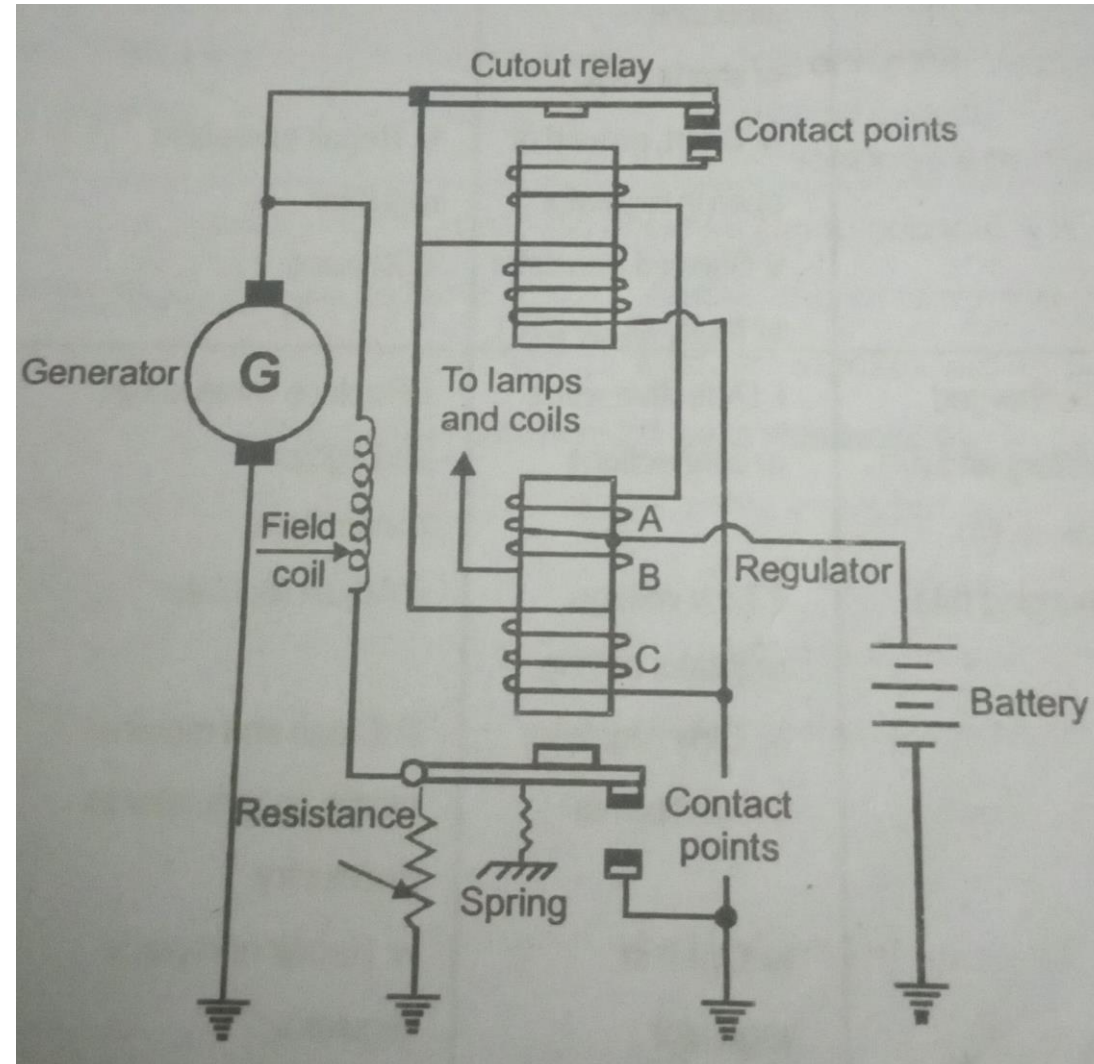
# COMPONENTS



- ❖ **Voltage Reference:** A stable voltage reference is essential for accurate regulation. Compensated voltage regulators often use precision voltage references to set the desired output voltage level.
- ❖ **Output Capacitor:** An output capacitor is often included to filter out any residual ripple or noise in the output voltage, contributing to overall stability and transient response.



# COMPENSATED VOLTAGE REGULATOR





# WORKING



- ❖ The regulator begins by comparing the output voltage with a reference voltage using an error amplifier.
- ❖ The error amplifier generates an error signal proportional to the difference between the reference voltage and the actual output voltage.
- ❖ The error signal is then fed back into the regulator circuitry through a feedback loop.
- ❖ This feedback loop adjusts the operation of the regulator to minimize the error signal, aiming to keep the output voltage at the desired level.





# WORKING



- ❖ A compensated voltage regulator includes a compensation network, which consists of passive components like resistors, capacitors, and sometimes inductors.
- ❖ These components are strategically placed within the feedback loop to shape the frequency response of the regulator.
- ❖ The compensation network is designed to stabilize the feedback loop over a range of frequencies.
- ❖ This ensures that the regulator remains stable and maintains its desired performance characteristics, even in the presence of fast-changing load conditions or input voltage variations.



# WORKING



- ❖ The compensation network also improves the transient response of the regulator.
- ❖ This means that the regulator can quickly respond to sudden changes in load current or input voltage without causing significant overshoot or undershoot in the output voltage.
- ❖ Some compensated voltage regulators include temperature compensation circuitry to ensure stable operation over a wide temperature range.
- ❖ This may involve using temperature-sensitive components or incorporating temperature-dependent feedback mechanisms.



# WORKING



- ❖ Based on the error signal and the compensation provided by the compensation network, the regulator adjusts its control elements.
- ❖ This could involve modulating the duty cycle of a switching regulator, adjusting the bias of a linear regulator, or controlling the conduction of active components like transistors.
- ❖ Through continuous adjustment of its control elements, the regulator maintains a stable output voltage that closely matches the reference voltage, compensating for variations in input voltage, load current, temperature, and other factors.



THANK YOU !!!