SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

COURSE NAME : 19AUB204 – AUTOMOTIVE ELECTRICAL AND ELECTRONICS ENGINEERING

II YEAR / IV SEMESTER

Unit 3 – Charging System

Topic : Bridge Rectifier

BRIDGE RECTIFIER

- A bridge rectifier is an electronic circuit used to convert alternating current (AC) to direct current (DC).
- It's commonly used in power supplies and devices that require a steady DC voltage for operation

COMPONENTS

- **Diodes**: A bridge rectifier typically employs four diodes arranged in a specific configuration known as a bridge. These diodes allow the flow of current in only one direction, effectively converting the AC input into a pulsating DC output.
- **Transformer**: While not a direct component of the bridge rectifier circuit itself, a transformer is often used in conjunction with the bridge rectifier. The transformer steps down the voltage from the mains supply to a suitable level for rectification.

COMPONENTS

- **Load**: The load is the device or circuitry that consumes the rectified DC output. This can be anything from a light bulb to electronic components in a power supply.
- **Filter Capacitor (optional)**: In some applications, a filter capacitor is added across the load to smooth out the pulsating DC output and reduce ripple. This capacitor stores charge during periods of high voltage and releases it during periods of low voltage, effectively filtering out fluctuations in the output voltage.

WORKING

- The bridge rectifier circuit is connected to an AC power source, typically the output of a transformer.
- The AC voltage has a sinusoidal waveform, alternating between positive and negative cycles.
- The bridge rectifier consists of four diodes arranged in a specific configuration known as a bridge.
- The four diodes are connected in a diamond shape, forming two pairs of diodes with a common connection point between them.

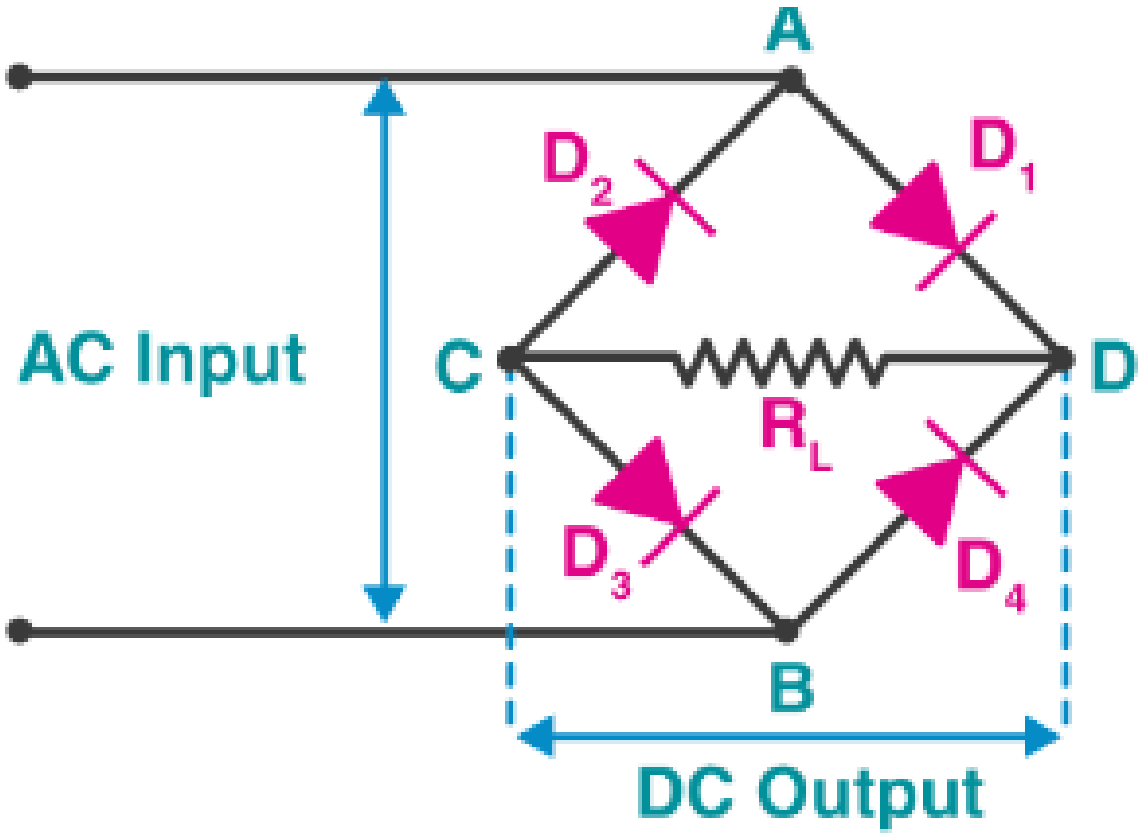
WORKING

- During the positive half-cycle of the input AC voltage, two diodes conduct current, allowing it to flow through the load in one direction.
- Simultaneously, the other two diodes are reverse-biased and do not conduct.
- The output voltage across the load during the positive half-cycle is nearly equal to the peak value of the input AC voltage minus the voltage drop across the conducting diodes.
- During the negative half-cycle of the input AC voltage, the roles of the diodes reverse.
- The previously conducting diodes become reverse-biased, and the other two diodes start conducting, allowing current to flow through the load in the same direction.

WORKING

- While bridge rectifiers provide DC voltage, it may not be perfectly smooth.
- Capacitors can be added across the load to filter out any remaining AC ripple, resulting in a smoother DC voltage output.

WORKING



RECENT DEVELOPMENT

- **High-Frequency Bridge Rectifiers**: With the increasing demand for compact and energy-efficient electronic devices, there's been a push towards high-frequency operation in power supplies. High-frequency bridge rectifiers can handle higher switching frequencies, leading to smaller transformers and capacitors, as well as reduced power losses.
- **Wide-Temperature Range Operation**: Bridge rectifiers designed for harsh environments, such as automotive or industrial applications, are being developed to operate over a wider temperature range. This involves using robust materials and construction techniques to ensure reliable performance under extreme temperature conditions.

RECENT DEVELOPMENT

- **Silicon Carbide (SiC) and Gallium Nitride (GaN) Diodes**: Traditional silicon diodes used in bridge rectifiers have limitations in terms of switching speed and power handling capability. Silicon carbide (SiC) and gallium nitride (GaN) diodes offer superior performance with lower forward voltage drop, higher breakdown voltage, and faster switching speeds. These advanced diodes result in higher efficiency and lower losses in bridge rectifier circuits.
- **Advanced Packaging Technologies**: Advances in packaging technologies, such as surface-mount technology (SMT) and flip-chip packaging, enable smaller and more robus bridge rectifiers. These packaging techniques improve thermal performance, increase power density, and enhance reliability.

RECENT DEVELOPMENT

- **Integrated Solutions**: Integrated bridge rectifier modules are becoming more prevalent, especially in consumer electronics and automotive applications. These modules combine the bridge rectifier circuitry with other essential components such as input protection, filtering capacitors, and voltage regulation, all housed in a single package. Integrated solutions simplify design, reduce component count, and save board space.
- **Efficiency Optimization**: Research continues into optimizing bridge rectifier circuits for maximum efficiency. This includes improving the design of diode bridges, reducing switching losses, and minimizing voltage drops across components to achieve higher overall efficiency in power conversion.

THANK YOU !!!