

Circuit Analysis

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1. Introduction

- Circuit analysis is the process of determining voltages, currents, and power in an electrical circuit.
- It allows engineers to predict behaviour before building hardware.

2. Fundamental Laws

- **Ohm's Law:** voltage equals current multiplied by resistance ($V = IR$).
- **Kirchhoff's Current Law:** the sum of currents entering a node equals the sum leaving.
- **Kirchhoff's Voltage Law:** the sum of voltages around any closed loop is zero.

3. Series and Parallel Circuits

- In series, current is the same through all components and resistances add.
- In parallel, voltage is the same across components and conductances add.

4. Analysis Techniques

- **Node voltage method:** solves for unknown voltages at circuit nodes.
- **Mesh analysis:** uses loop currents to apply Kirchhoff's voltage law.
- Thevenin and Norton equivalents simplify complex networks.

5. Power Considerations

- Power dissipated equals voltage times current ($P = VI$).
- Calculating power helps select components rated to handle heat safely.

6. Summary

- Circuit analysis rests on Ohm's and Kirchhoff's laws.
- Systematic methods make even complex circuits solvable.