СӘТБАЕВ УНИВЕРСИТЕТІ SATBAYEV UNIVERSITY

Equivalent transformations of electrical circuits. Power balance. Operating modes of power sources

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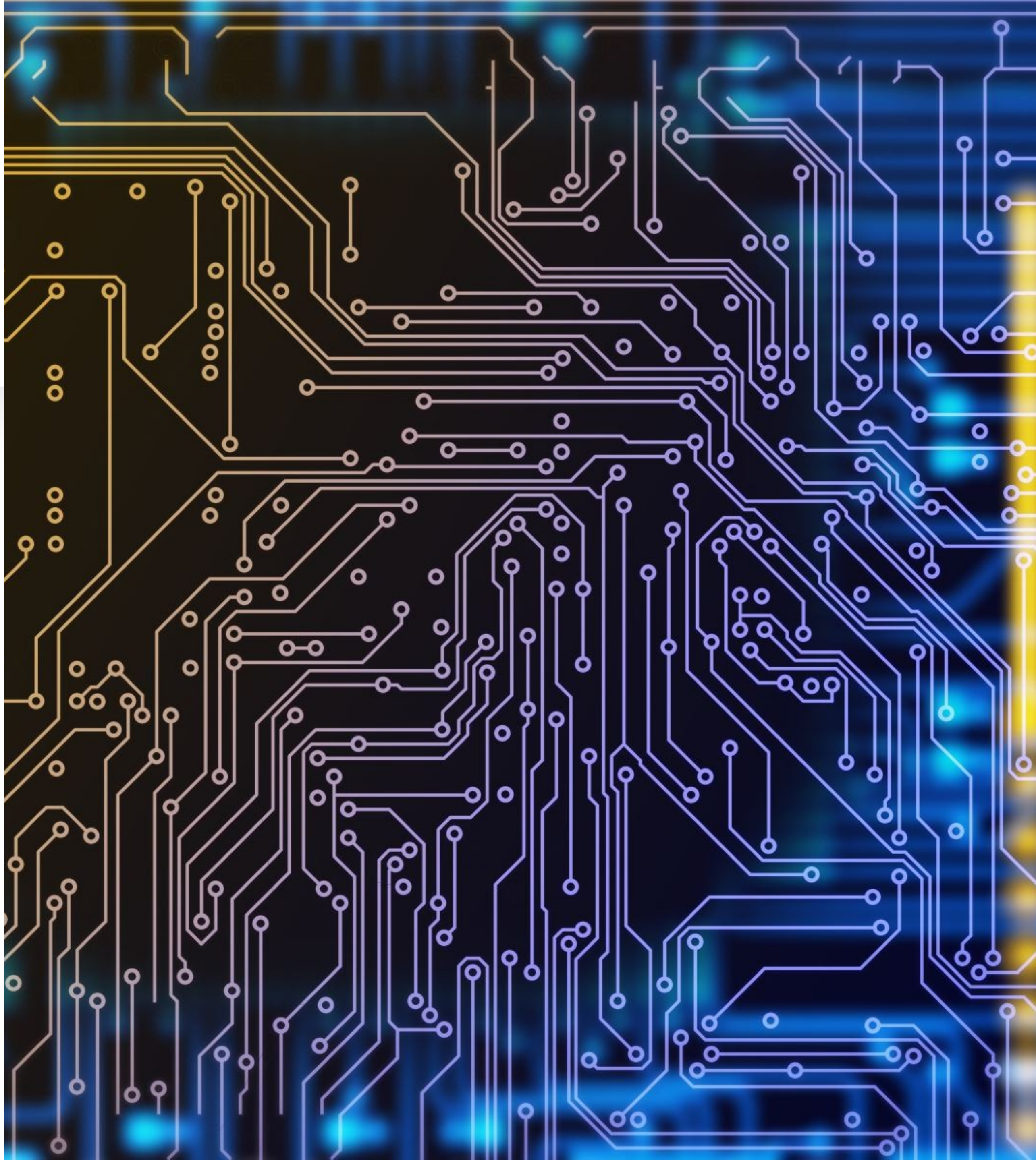
Contents

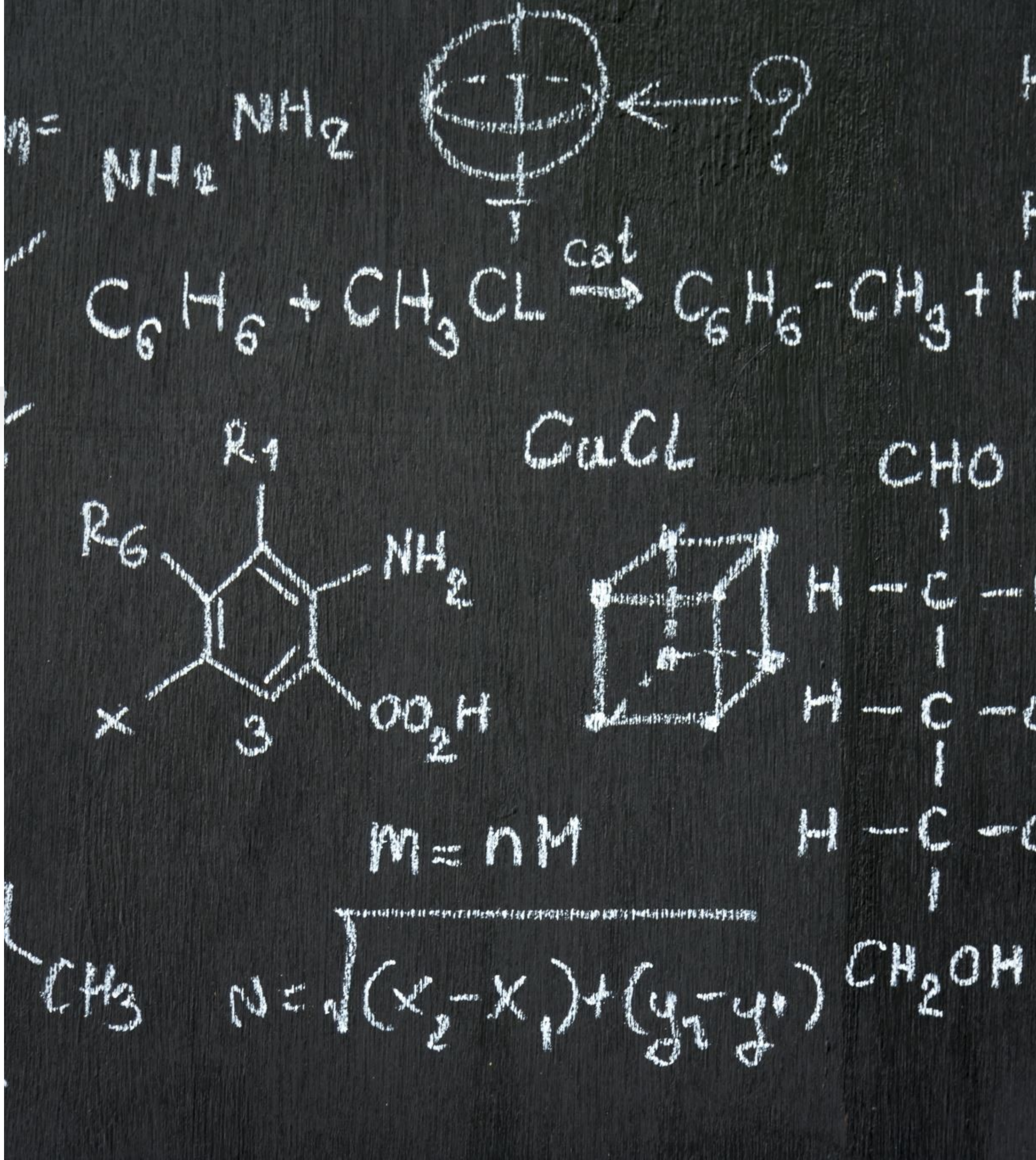
Abstract

- This presentation covers key concepts in circuit transformations, power balance, and the operating modes of power sources. Equivalent transformations simplify complex circuits, making analysis and calculations easier. Power balance ensures energy conservation, showing how energy is distributed across elements. Finally, we look at the operating modes of power sources, focusing on their characteristics in delivering maximum efficiency.



Equivalent Transformations of Electrical Circuits

- **Series and Parallel Transformations**:
  - **Series**: Resistors, inductors, and capacitors in series have cumulative resistances, inductances, and reciprocal capacitances.
  - **Parallel**: Components in parallel reduce to equivalent resistances and inductances, making calculations simpler.
- **Delta-Wye (Δ-Y) Transformations**:
  - Converting a delta (Δ) network to a wye (Y) network (or vice versa) simplifies certain complex circuits.
  - Useful in analyzing three-phase networks and circuits with symmetric configurations.
- **Application Example**: A combination of resistors can be reduced using series-parallel simplifications and Δ-Y transformations to find total resistance or impedance.



Power Balance in Electrical Circuits

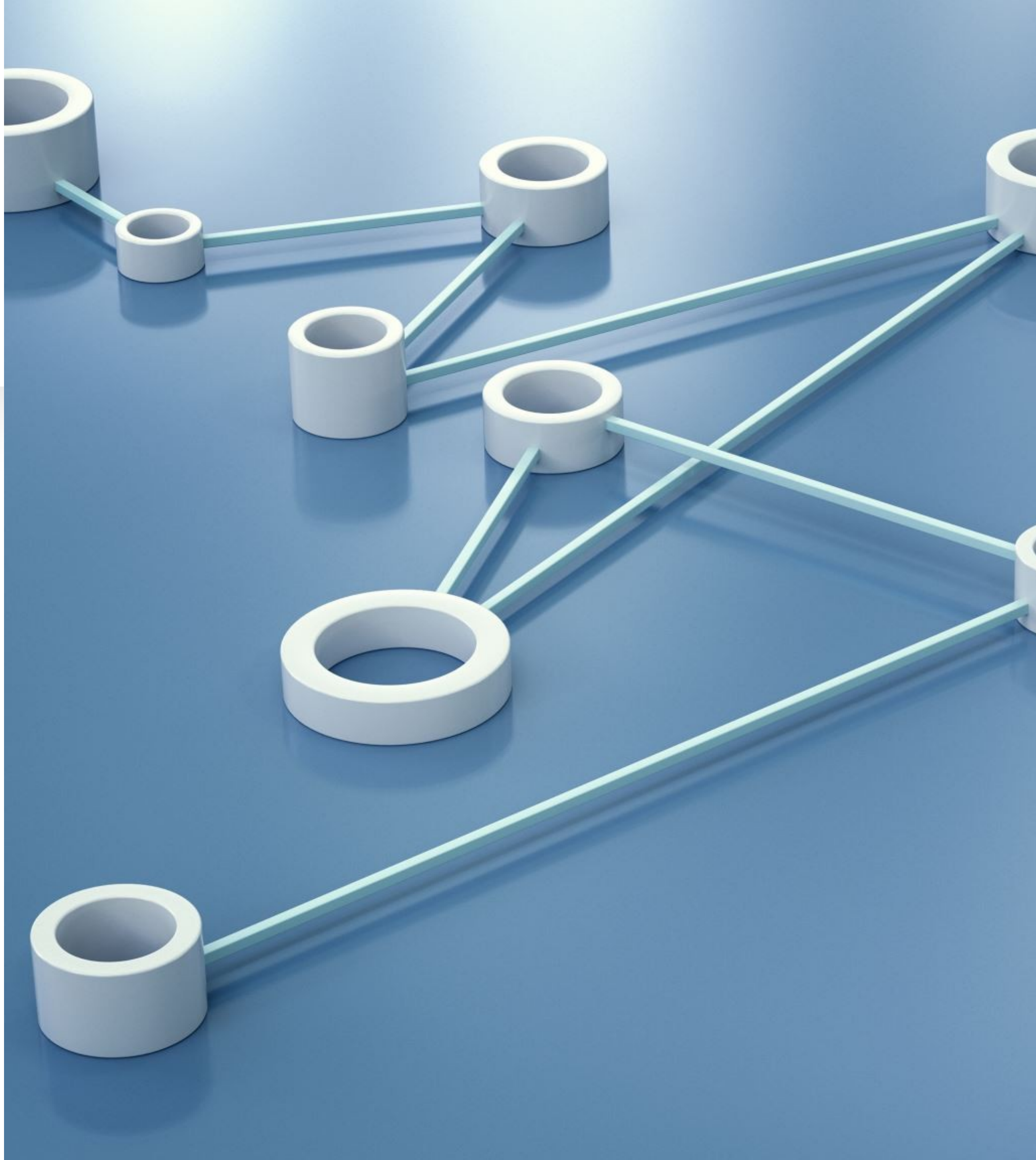
- **Types of Power**:
  - **Active Power (P)**: Real power consumed by resistive elements, measured in Watts (W).
  - **Reactive Power (Q)**: Power stored and released by inductors and capacitors, measured in Volt-Amperes Reactive (VAR).
  - **Apparent Power (S)**: The combined power, both active and reactive, measured in Volt-Amperes (VA).
- **Power Conservation**:
  - In a closed system, the total power supplied by sources is equal to the power dissipated or consumed by loads and losses.
- **Dissipative Elements**: Power dissipated across resistors and other load elements is calculated as or .
- **Example**: Analyzing a circuit with a power source and resistors, apply power balance by calculating the total power output and equating it to the power absorbed by each component.

Operating Modes of Power Sources

- **Ideal vs. Real Power Sources**:
  - **Ideal Sources**: Provide constant voltage or current with zero internal resistance.
  - **Real Sources**: Have internal resistance, affecting voltage and current output.
- **Constant Current and Constant Voltage Modes**:
  - **Constant Voltage**: Source maintains voltage output despite load changes, ideal for voltage-sensitive loads.
  - **Constant Current**: Source maintains current output for current-driven applications, like LED circuits.
- **Maximum Power Transfer**:
  - The load should match the internal resistance of the source for maximum power transfer. Achieved when .
- **Example**: Calculate the maximum power delivered to a load connected to a source with known internal resistance by matching the load resistance to the source resistance.

Conclusion

- Understanding equivalent transformations, power balance, and power source modes is essential for efficient circuit design. By transforming circuits and ensuring power balance, we can accurately design and analyze complex systems. Operating modes of power sources also dictate optimal configurations for energy-efficient and reliable operation in various applications.



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