

Electrical Engineering Cheat Sheet

1. Basic Concepts

Potential Difference (Voltage, V)

- The work done per unit charge to move a charge between two points.
- Measured in volts (V).

Current (I)

- The rate of flow of electric charge.
- Measured in amperes (A).

Resistance (R)

- Opposition to the flow of current.
- Measured in ohms (Ω).

Inductance (L)

- The ability of a coil to store energy in a magnetic field.
- Measured in henrys (H).

Capacitance (C)

- The ability of a system to store charge per unit voltage.
- Measured in farads (F).

Work, Power, and Energy

- **Work (W):** Energy transferred by electrical means.
- **Power (P):** Rate of energy transfer ($P = VI$).
- **Energy (E):** The capacity to do work ($E = Pt$).

2. Current and Voltage Sources

Ideal vs Practical Sources

- **Ideal Source:** Provides constant voltage or current regardless of load.
- **Practical Source:** Includes internal resistance causing voltage drop.

Independent and Dependent Sources

- **Independent Source:** Voltage or current is constant.
- **Dependent Source:** Voltage or current depends on another circuit parameter.

3. Circuit Laws and Theorems

Ohm's Law

- $V = IR$

Kirchhoff's Laws

- **KCL (Kirchhoff's Current Law):** The sum of currents entering a node equals the sum of currents leaving.
- **KVL (Kirchhoff's Voltage Law):** The sum of voltages around a closed loop is zero.

4. Series and Parallel Combinations

- **Resistors in Series:** $R_{eq} = R1 + R2 + \dots$
- **Resistors in Parallel:** $1/R_{eq} = 1/R1 + 1/R2 + \dots$
- **Inductors and Capacitors:** Similar formulas apply with adjustments for AC circuits.

5. Voltage Divider and Current Divider Rules

- **Voltage Divider:** $V_{out} = V_{in} * (R2 / (R1 + R2))$
- **Current Divider:** $I_x = I_{total} * (R_{total} / R_x)$

6. Circuit Analysis Techniques

Mesh Analysis

- Applies KVL to independent loops to solve for unknowns.

Nodal Analysis

- Applies KCL at nodes to find node voltages.

7. Star-Delta (Y-Δ) Transformations

- **Star (Y) to Delta (Δ):** $R_{AB} = (R1 * R2 + R2 * R3 + R3 * R1) / R1$
- **Delta (Δ) to Star (Y):** $R1 = (R_{AB} * R_{AC}) / (R_{AB} + R_{BC} + R_{CA})$

8. Network Theorems

Superposition Theorem

- In a linear circuit with multiple sources, the response is the sum of responses from each source acting alone.

Thevenin's Theorem

- Any linear circuit can be replaced by an equivalent voltage source (V_{th}) and series resistance (R_{th}).

Norton's Theorem

- Any linear circuit can be replaced by an equivalent current source (I_n) in parallel with a resistance (R_n).

Maximum Power Transfer Theorem

- Maximum power is transferred when the load resistance equals the Thevenin resistance: $R_L = R_{th}$.

This cheat sheet provides a quick reference for fundamental electrical engineering concepts.