Formula Sheet

Electric current: $I = \frac{dQ}{dt}$

Ohm's law $R = \frac{V}{I}$

Resistance and resistivity: $R = \rho \frac{L}{A}$

Electric power: $P = I \cdot V$

N resistors in series: $R_{eq} = R_1 + R_2 + \cdots + R_N$

N resistors in parallel: $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_N}$

Kirchhoff's current law (KCL): $\sum I_{in} = \sum I_{out}$ at a junction

Kirchhoff's voltage law (KVL): $\sum \Delta V = 0$ around a closed loop

Capacitance: $C = \varepsilon_0 \frac{A}{d}$; $C = \frac{Q}{V}$

Capacitor and inductor $i - v$ relationship: $i_C = C\frac{dv_C}{dt}$; $v_L = L\frac{di_L}{dt}$

Capacitor energy $E_c = \frac{Q^2}{2C}$

Inductor energy $E_L = \frac{1}{2}Li^2$

Capacitor in parallel: $C_{eq} = C_1 + C_2 + \cdots$

Capacitor in series: $\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \cdots$

Impedance: $Z_R = R$; $Z_C = \frac{1}{j\omega C}$; $Z_L = j\omega L$.

Capacitor charging by an emf through a resistor: $V_C = \varepsilon(1 - e^{-\frac{t}{RC}})$

Capacitor discharging through a resistor: $V_C = \varepsilon e^{-\frac{t}{RC}}$

Inductor charging by an emf through a resistor: $i_L = \frac{\varepsilon}{R}(1 - e^{-\frac{t}{L/R}})$

Inductor discharging through a resistor: $i_L = \frac{\varepsilon}{R} e^{-\frac{t}{L/R}}$

General formula for transient variables $x(t) = x(\infty) + (x(0^+) - x(\infty))e^{-\frac{t}{\tau}}$